TITLE: Influence of Patient Beliefs about Recovery and Rehabilitation on Functional Outcomes

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ABSTRACT BODY:
Background & Purpose: Research suggests that a patient’s capacity to participate and benefit from rehabilitation is influenced by both their level of self-efficacy (situation-specific belief in one’s capability to act in order to succeed) and perceived locus of control (belief in whether one’s actions vs. forces outside of oneself will determine the outcome achieved). High self-efficacy builds belief in one’s own actions. While different health related self-efficacy and locus of control measures exist, no single tool assesses a patient’s beliefs about their potential for recovery (Self Efficacy) and whether improvement is due to the actions they make (Internal Locus of Control) or to the actions of the PT and others in their lives (External Locus of Control). Thus, the Recovery and Rehabilitation Questionnaire (RQQ) was created to assess a patient’s beliefs about self-efficacy for recovery and locus of control for rehabilitation. The purpose of this case report is to describe the RRQ scores reported by stroke survivors and their relationship to the functional outcomes achieved after a 5-day intervention.

Case Description: 7 stroke survivors (3 women, 4 men; ages 60.29±7.2; 60.7±88.8 months post CVA) with varying severity of hemiplegia and aphasia who attended an intensive 5-day physical therapy clinic at Northern Arizona University completed a pilot study of the RRQ. The pilot RRQ contains 18 items rated on a 7-point Likert scale (Strongly Disagree to Strongly Agree) divided into 3 subscales: Self Efficacy (SEff) “I am confident I will improve,” Internal Locus of Control (IntLOC) “How much I practice will determine how much I will improve,” and External Locus of Control (ExtLOC) “Only the amount of time with a PT determines how much I improve.” Subjects completed the RRQ, 6-Minute Walk Test (6MWT), 10-Meter Walk Test (10mWT), 5 times Sit-to-Stand (5xSTS) and Timed Up and Go (TUG).

Outcomes: At baseline, 5 subjects had high levels of SEff and IntLOC with low levels of ExtLOC. 2 subjects had low levels of SEff and IntLOC with high levels of ExtLOC. After the 5-day intervention, all subjects improved endurance (6MWT: 26-140%), 4 improved gait speed (10mWT: 9-86%), and 6 improved functional mobility (5xSTS: 20-44%; TUG: 10-37%). All subjects reduced their levels of ExtLOC by 3-42% and chose Strongly Disagree to “Only time will determine how much I improve.” 2 subjects with low initial SEff and IntLOC increased both by 18-400%. All subjects chose Strongly Agree to “How much I practice at home determines how much I improve.” Subjects with a low initial RRQ had lower mean functional outcome %changes than subjects with high baseline RRQ (22% vs. 35%).

Discussion: The results illustrate that the RRQ provides valuable insight to a patient’s beliefs about recovery, to the source of actions needed for rehabilitation, and that beliefs can shift after rehabilitation. Additional research is needed to validate the RRQ as a tool to help PTs understand a patient’s mindset and how that may influence their capacity to participate in and benefit from rehabilitation.

Background & Purpose: Efficacy of interventions for balance and gait dysfunction in cerebellar ataxia is unclear. This may be due to the generalized nature of treatment approaches used thus far. Persons with cerebellar dysfunction often exhibit difficulty with event timing and have greater temporal variability during non-continuous rhythmic tasks. Thus incorporation of event-related postural and locomotor tasks in the treatment plan of persons with cerebellar ataxia would appear to be prudent. The purpose of this case report was to examine the influence of metronome-paced unipedal stepping practice and physical therapy on balance and gait in a participant with left cerebellar ataxia.

Case Description:
The participant was a 45-year old female one-year post left acoustic neuroma resection who presented with left cerebellar ataxia. The participant performed five, seventy-second metronome-paced trials of rhythmic unipedal stepping daily. The subject stood at a countertop, one hand lightly on the surface, and was instructed to “tap your foot on the ground to the beat of the metronome”. Rhythmic unipedal stepping was performed starting with unaffected and then affected side. The participant performed 3 continuous trials of rhythmic stepping laterally to side and returned medially, 45° diagonally (forward and laterally) and returned to initial position, and then forward and returned back to initial position. Metronome pacing consisted of frequency plateaus increasing from 1.0 to 2.8 Hz then decreasing to 1.0 Hz in 0.6 Hz steps (1.0-1.6-2.2-2.8-2.2-1.6-1.0 Hz) during 1 trial. Pacing frequencies allowed for both discontinuous and continuous rhythmic task practice. In addition, the patient performed flexibility, strength, and plyometric exercises; walking and marching-walking hybrid paced with a metronome; and jogging. The patient was treated for 7 sessions over 4 months.

Outcomes:
Initially, the participant could not step with the involved lower extremity to the frequencies. After 4 months of practice, the participant was able to step to all frequencies with the involved leg laterally and diagonally. When stepping forward, the participant could perform at all frequencies except 2.8. Initially, the participant ambulated with a straight cane. By the 3rd month, the participant stopped using a cane. Over 4 months, the participant’s average number of steps per day increased from 2,000 to 3,000 and sense of energy increased. The participant continued to have difficulty initiating walking, but once in rhythm, could execute the movement and change direction without loss of balance.

Discussion:
This is the first study to incorporate a postural-locomotor therapeutic task that addresses a specific timing-related problem associated with cerebellar dysfunction. Significant gains were made in the distance that she ambulated per day due to improved postural stability during stance and lower limb coordination. Further investigation of this approach is warranted.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.:  
TITLE: Is Mirror Therapy more effective at reducing Phantom Limb Pain compared to other interventions?: A Systematic Review

AUTHORS/INSTITUTIONS: D. Chamberlain, H. Hollinger, A. Lovell, R. Mueller, H. Reid, DPT, Franklin Pierce University, Hesperus, Colorado, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Currently, there is no gold standard of care to reduce phantom limb pain (PLP) for individuals with limb loss. Interventions used are varied including, but not limited to: mirror therapy, biofeedback, soft tissue mobilization/massage, TENS, pharmacological intervention, and therapeutic exercise. Research does not report which intervention is most effective. Mirror therapy has the potential to be a low cost and effective means in treating this condition. It may potentially save patients and health care systems money by reducing pharmaceutical needs and therapy visits and thus making it an optimal choice.

The purpose of this systematic review therefore was to determine the effectiveness of mirror therapy versus other interventions in improving pain and functional outcomes for patients with PLP.

Number of Subjects: N/A

Materials/Methods: A comprehensive electronic search was conducted using the following databases: PubMed, The Cochrane Library, Cumulative Index to Nursing and Allied Health Literature (CINAHL), ProQuest, and Hooked on Evidence. Search key words included: Amputees or amputation, mirror therapy, phantom limb pain, TENS, soft tissue mobilization or STM or massage, biofeedback, therapeutic exercise, medication. References in articles were manually searched for any eligible articles.

Inclusion criteria: Subjects must have PLP, studies include utilizing interventions for PLP including, but not limited to mirror therapy, TENS, soft tissue mobilization, biofeedback, and/or pharmacological and studies must be a randomized controlled trial (RCT).

Exclusion criteria: Mirror therapy for treating other pathologies, studies that did not focus on reducing PLP, case studies, case reports, pilot studies, systematic reviews, and incomplete studies.

The Physiotherapy Evidence Database (PEDro) scale was used to assess the quality of the articles.

Results: Ten studies met the criteria and were chosen for this review. The average PEDro score was 6.5/10 indicating good quality. Variability of study design and outcome measures made comparison across studies difficult. Some component of pain or discomfort was analyzed in each study. However, few of them examined function. Most studies reported a reduction in symptoms.

Conclusions: Although most of the studies reported a reduction in symptoms, there is no conclusive evidence to support mirror therapy as a superior intervention for the treatment of PLP over other interventions. Soft tissue mobilization/massage and biofeedback cannot be advocated based on lack of high quality evidence. The results of this systematic review imply that pharmacological interventions alone are not an effective treatment for PLP. Mirror therapy for the treatment of phantom limb pain is still relatively new. Few studies on mirror therapy make it difficult to have a conclusive statement on its effectiveness.

Clinical Relevance: Mirror therapy should be considered as part of the plan of care for individuals with PLP. Physical therapists and physicians are recommended to work together as a team to determine the most effective treatment.
TITLE: Cortical reactivity and plasticity measured via Transcranial Magnetic Stimulation in individuals post subacute stroke after exercise and cognitive training- a case series.

AUTHORS/INSTITUTIONS: N.A. Ziemba, S. Saenz, N. Ciparelli, Y. Hera, A. Andrews, S.P. Halperin, A. Gerasimovich, M. Yoshimura-Rank, S. Beckel, E.N. Chambers, I. Acevedo, J. Gomes-Osman, Physical Therapy, University of Miami Miller School of Medicine, Coral Gables, Florida, UNITED STATES.

ABSTRACT BODY:

Background & Purpose: There is evidence to support physical exercise and cognitive training as potential strategies to improve cognitive function after a chronic stroke, but there is less data regarding the implementation of such strategies in the subacute stage. In addition, exercise-mediated improvements are at least partly attributed to an effect on neuroplasticity. Transcranial magnetic stimulation (TMS) interleaved with intermittent theta-burst stimulation (TMS-iTBS), enables a non-invasive assessment of cortical reactivity and plasticity, which resembles long-term potentiation, the most well known mechanism used to explain learning and memory. Our objective was to assess plasticity via TMS-TBS in 3 individuals with subacute stroke who were participated in a 12 week protocol of one of the following: exercise; exercise+cognitive training; stretching.

Case Description: All 3 participants fulfilled the following criteria: diagnosis of ischemic stroke within 6 months from study enrollment, Modified Rankin Score of <4 at hospital discharge, ‘less than ideal physical activity’ prior to stroke onset (defined by the current American Heart Association guidelines), ability to walk ≥10 meters with or without assistance. All interventions were delivered 3x/week for 12 weeks. Exercise (45-60 min) consisted of combined aerobic and resistance training (60% age-predicted maximum heart rate [HRMax] on weeks 1-2, 60-70%HRMax on week 3-4 and 70-85%HRMax on weeks 5-12). Cognitive training (30 min sessions) was a computer-based paradigm that targeted auditory visual attention and memory, working memory, processing speed, and executive function. Stretching exercises were performed in 30 min sessions.

Outcomes: Prior to and following the interventions described above, participants performed assessments with TMS and surface recordings of motor evoked potentials (MEPs) from the first dorsal interosseous. Participants underwent an assessment of cortical reactivity utilizing single TMS pulses (resting motor threshold) and plasticity utilizing TMS-TBS. Plasticity was measured based on an analysis of MEPs from single TMS pulses prior to and following iTBS. The participant who engaged in exercise+cognitive training demonstrated an increase in 12% in cortical reactivity pre-post intervention, and there were no changes in the other 2 participants. There was variability in the response to the plasticity assessment, and the participant who engaged in exercise in isolation demonstrated an 80% increase in the amount of TMS-TBS-mediated facilitation of single-pulse responses.

Discussion: Participants tolerated the study procedures and there were no adverse effects, suggesting that the implementation of a 12-week program of exercise, exercise+cognitive training is feasible for individuals post subacute stroke with similar functional ability as the participants of this study. This preliminary data suggests that TMS and iTBS may be useful tools in studies of exercise and plasticity.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: Freitas, C., Perez, J., Knobel, M., Tormos, J. M., Oberman, L., Eldaief, M., ... Pascual-Leone, A. (2011). Changes in cortical plasticity across the lifespan. Frontiers in Aging Neuroscience, 3, 5. doi:10.3389/fnagi.2011.00005 [doi]
The Effects of Physical Therapy and Transcranial Low-Level Laser Therapy in Post-Concussion Syndrome: A Case Study

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Background & Purpose: The application of transcranial low-level laser therapy (LLLT) has recently shown positive outcomes in the reduction of post-concussion syndrome (PCS) symptoms. The purpose of this case study was to describe the effects of incorporating a physical therapy (PT) program consisting of progressive sub-symptom exercise in conjunction with transcranial-LLLT in a patient with PCS.

Case Description: The subject of this case study was a 54-year-old male diagnosed with PCS following a biking accident. As a result of the injury, the participant experienced concentration difficulties and headaches, subsequently preventing him from fulfilling work-related duties and recreational activities. In-clinic interventions involved a sub-symptom physical therapy program, in which intensity progressions were made for aerobic and resistance exercise. The investigational transcranial-LLLT was administered once per week for six weeks at an off-site research facility.

Outcomes: After 29 total PT encounters and six treatments with transcranial-LLLT, the participant demonstrated decreased headache intensity, an 18° increase in right cervical side-bending range of motion, and a 26% reduction in the Neck Disability Index signifying a marked decrease in self-perceived disability. Subjective reports consisted of an 80-85% improvement in overall condition, an 8 hour increase in work tolerance, and the ability to return to his exercise program at pre-concussion intensity levels.

Discussion: The outcomes from this case study suggest that a multimodal PT rehabilitation program consisting of a gradual sub-symptom exercise protocol in conjunction with transcranial-LLLT may be a viable treatment option for patients experiencing prolonged concussion symptoms. Follow-up research on the sequencing and parameters of transcranial-LLLT application within the PT plan of care will be needed to ascertain optimal dosage recommendations in the management of PCS symptoms.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.:


Purpose/Hypothesis: Physical therapy (PT) has emerged as a potential intervention for youth with concussion. Evidence regarding when PT can and should be initiated is lacking. The purpose of this study was to describe the safety and tolerability of PT initiated at varying time-since-injury blocks.

Number of Subjects: 175 patients (108 females, 67 males; mean age 14.2 years; range, 6-21 years)

Materials/Methods: Data were extracted from a PT registry for patients with concussion at a metropolitan pediatric medical center. Multimodal PT interventions were used to address patients' individual needs. Patients were categorized into cohorts based on timing of PT initiation: 0-2.99 weeks post-injury (early), 3-5.99 weeks post-injury (middle), and 6 or more weeks post-injury (late). Records for each patient's course of care were reviewed for indicators of poor safety and tolerability by two independent reviewers. Poor safety was defined as a need for emergent care in the form of an emergency department, urgent care, or unplanned pediatrician office visit during or immediately following an in-clinic PT visit or while performing home exercises. Tolerability was measured in two ways: 1) symptom changes between the beginning and end of initial evaluation session measured by the Post-Concussion Symptom Inventory (PCSI) and 2) an unplanned visit to an emergency department, urgent care, or pediatrician's office for symptom exacerbation any time during the PT episode of care. Initial exam session PCSI changes were categorized into: improved/no symptom changes, mild increase (1-10 points), or large increase (11 or more). Chi-square tests for independence were utilized to determine if safety and tolerability were associated with timing of intervention.

Results: Fifty-two (29.7%), 56 (32.0%), and 67 (38.3%) of patients were identified in the early, middle, and late cohorts, respectively. No patients needed emergent care during or immediately following an in-clinic PT visit or while performing home exercises. Tolerability was measured in two ways: 1) symptom changes between the beginning and end of initial evaluation session measured by the Post-Concussion Symptom Inventory (PCSI) and 2) an unplanned visit to an emergency department, urgent care, or pediatrician's office for symptom exacerbation any time during the PT episode of care. Initial exam session PCSI changes were categorized into: improved/no symptom changes, mild increase (1-10 points), or large increase (11 or more). Chi-square tests for independence were utilized to determine if safety and tolerability were associated with timing of intervention.

Conclusions: Early introduction of PT has similar safety and tolerability profiles to later introduction. A mild symptom exacerbation during evaluation may occur, regardless if PT initiation is early or late. Future studies should compare outcomes between patients who receive PT and those who do not to establish the efficacy of utilizing PT to facilitate recovery. Additional research is also needed to evaluate the tolerability and outcomes for specific PT interventions.

Clinical Relevance: Safety and feasibility of early PT is similar to later introduction, indicating early PT after concussion may be safe and feasible.
TITLE: Quality of life measures that detect clinically important decline in Parkinson’s disease

AUTHORS/INSTITUTIONS: R.A. Martin, G. Fulk, Physical Therapy, Clarkson University, Potsdam, New York, UNITED STATES|R. Duncan, G. Earhart, Washington University in St. Louis School of Medicine, St. Louis, Missouri, UNITED STATES|J.T. Cavanaugh, University of New England, Portland, Maine, UNITED STATES|T. Ellis, Boston University, Boston, Massachusetts, UNITED STATES|M. Ford, Samford University, Birmingham, Alabama, UNITED STATES|K.B. Foreman, L. Dibble, University of Utah, Salt Lake City, Utah, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: The impact of both motor and non-motor symptoms on quality of life (QoL) for individuals with Parkinson’s disease (PD) has been well documented. Because of the degenerative nature of PD, it is important to be able to identify when a meaningful decline has occurred. While some data exists regarding the ability of tests and measures commonly used in PD to detect a clinically important change, there is a void of information available on the ability of these tests to identify a clinically important decline in QoL. The purpose of this study was to determine which commonly used tests and measures were able to detect a meaningful decline in QoL for individuals with PD.

Number of Subjects: 208 participants with idiopathic PD, with a mean age of 67.2 years, mean years with symptoms of 8.3, and mean modified Hoehn Yahr of 2.3.

Materials/Methods: All participants completed the Parkinson’s Disease Questionnaire (PDQ-39), the Unified Parkinson Disease Rating Scale (UPDRS), the Freezing of Gait Questionnaire (FOG-Q), the 10 Meter Walk Test to determine gait speed (GS), the Timed Up and Go Test (TUG), the Functional Gait Assessment (FGA), the Berg Balance Scale (BBS), and the Functional Reach Test (FRT) at baseline and again at 6 months. At 6 months, participants also completed a global rating of change (GROC) questionnaire regarding their quality of life, (possible range of 0-14, with a score of 7 indicating the individual perceives no change had occurred) which served as the anchor for their perceived change in QoL. A receiver operating characteristic curve (ROC) was used to estimate the clinically important decline for each measure utilizing the GROC score as an anchor.

Results: At 6 months, the mean GROC score was 7.07. The estimated clinically important decline in QoL on the PDQ was -1.8 (AUC 0.75, Sn=0.96, Sp=0.45). The estimated clinically important decline in QoL on the UPDRS was indicated by an increase of 11.5 (AUC 0.65, Sn=0.46, Sp=0.89). The estimated clinically important decline in QoL on GS was indicated by a decrease of -0.01 m/s (AUC 0.61, Sn=0.82, Sp=0.51). The estimated clinically important decline in QoL on the FOG-Q was an increase in 0.5 points (AUC 0.74, Sn=0.73, Sp=0.65). There was no change in the TUG, FGA, BBS, or FRT that was identified as meaningful decline in QoL (AUC 95% CI <0.5).

Conclusions: For individuals with PD, a 1.8 point decrease in the PDQ-39, an 11.5 point increase in the UPDRS, a -0.01 m/s loss in GS, or an increase of 0.5 points on the FOG-Q may indicate a clinically important decline in their perceived QoL.

Clinical Relevance: While four of the studied tests and measures were able to detect meaningful decline in QoL, physical therapists and researchers may want to utilize a combination of tests and measures in order to best identify those patients with PD who perceive that a meaningful decline in their QoL has occurred. Combining the UPDRS and the PDQ-39 provides the greatest likelihood of correctly identifying those with a meaningful decline and correctly ruling out those without a meaningful decline in QoL.
TITLE: Child with traumatic brain injury improved gait abilities following intervention with pediatric motor-assisted elliptical training: A case report

AUTHORS/INSTITUTIONS: G.M. Cesar, S.L. Irons, A. Garbin, E. Eckels, T.W. Buster, J.M. Burnfield, Institute for Rehabilitation Science and Engineering, Madonna Rehabilitation Hospital, Lincoln, Nebraska, UNITED STATES

ABSTRACT BODY:

Background & Purpose: Children with physical disabilities sometimes experience challenges with walking and exercising. A motor-assisted elliptical training device (ICARE) is being used in rehabilitation and medical fitness settings to address these concerns in adults.[1,2] A motor helps users advance their limbs at speeds up to 65 RPM. As strength increases, users can over-ride the motor-assistance.[3] Recent modifications now enable mass repetition of the gait-like activity in smaller children.[4] This study evaluated the impact of an ICARE training intervention on walking of a child with traumatic brain injury (TBI).

Case Description: A 9-year old child with TBI participated in a 24-session ICARE training intervention (3 days/week) as training parameters (speed, motor-assistance, total training time, and time without motor-assistance) were manipulated to progressively challenge walking and fitness.

Outcomes: Training capacity improved across sessions as evidenced by increases from pre- to post-intervention in exercise time (21 vs. 50 min), speed (25 vs. 42 RPM), and amount of times the child overrode ICARE’s motor (0 vs. 11 one-minute intervals). Overground walking measures (GAITRite®) improved from pre- to post-intervention including velocity (70.9 vs. 89.3 m/min), cadence (118.3 vs. 138.8 steps/min), left step length (35.8 to 38.9 cm), right step length (36 to 38.8 cm), and functional ambulation performance scale (80.3 vs. 86.7). From pre- to post-intervention, the child’s height increased from 132 to 135 cm with no changes in trochanteric height.

Discussion: Intensive, task-specific training is encouraged for improving walking and fitness following neurologic injury. ICARE promotes movements (joint motions and muscle demands) similar to gait[5,6] and can be used by children as young as three years. Our participant improved spatiotemporal gait characteristics and function after engaging in ICARE training. While not quantified, the parents also reported the child was able to engage in more community activities including family outings to places that required walking longer distances. Collectively, these data suggest ICARE is a promising therapeutic technology. Future clinical studies are required to elucidate the impact of ICARE training on function, fitness and community participation for children with neurologic disorders including TBI.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: [1] Burnfield JM, Shu Y, Buster TW, Taylor AP, Nelson CA (2011). Impact of elliptical trainer ergonomic modifications on perceptions of safety, comfort, workout, and usability for people with physical disabilities and chronic conditions. Phys Ther 91(11):1604-1617.
TITLE: Do isolated sensory diagnostic tests predict sway while standing on foam with eyes closed?

AUTHORS/INSTITUTIONS: E.R. Anson, R.T. Bigelow, Y. Agrawal, Otolaryngology Head & Neck Surgery, Johns Hopkins School of Medicine, Baltimore, Maryland, UNITED STATES|S. Studenski, Longitudinal Studies Section, National Institute on Aging, Baltimore, Maryland, UNITED STATES

ABSTRACT BODY:

**Purpose/Hypothesis:** Standing on foam with eyes closed (FEC) has been characterized as a measure of vestibular function. Peripheral sensory signals are integrated in the central nervous system for optimal control of upright posture. It is unclear whether isolated tests of peripheral sensory function are related to postural sway in healthy adults. Here we investigated the relationship between tests of vestibular and proprioceptive function and postural sway on FEC in healthy adults.

**Number of Subjects:** 301 community dwelling healthy adults (mean age 72.7 (12.6) years, range 27-93 years) participating in the Baltimore Longitudinal Study of Aging were tested.

**Materials/Methods:** Proprioceptive threshold (PROP) was evaluated with passive motion detection at the right ankle. Bilateral hypofunction was defined when vestibulo-ocular reflex gain was < 0.8 using video head impulses (VestHypo). Otolith function was measured with cervical and ocular vestibular evoked myogenic potentials. Otolith function was dichotomized as present and absent (OrdinalVemp). Participants stood on FEC for 40 seconds while wearing BalanSens (BioSensics, LLC) to quantify center of mass sway area (COM). Multiple linear regressions were used to examine the association between COM and PROP, VestHypo, and OrdinalVemp separately and combined in a multi-sensory model while controlling for age and gender.

**Results:** Bilateral vestibular hypofunction (BVH) was significantly related to increased COM sway area in the simple model ($\beta = 2.0, p = 0.028$) controlling for age and gender. BVH remained significantly related to increased COM sway area in the multisensory model ($\beta = 2.1, p = 0.021$) controlling for age and gender. COM sway also increased with age across all models [ranging from ($\beta = 0.03, p = 0.052$) to ($\beta = 0.04, p = 0.022$)].

**Conclusions:** COM sway on FEC significantly increased with bilateral *angular* vestibular hypofunction, but was not associated with otolith hypofunction. COM sway area also increased with increasing age in healthy adults.

**Clinical Relevance:** Sway area while standing on FEC may be a proxy for rotational vestibular contributions to postural control in healthy adults. These results may differ in populations with greater balance impairments.
Acute intermittent hypoxia: Effects on diaphragm activation and respiratory function in an individual with spinal cord injury

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Background & Purpose: Individuals with cervical spinal cord injuries (SCIs) often have severe respiratory impairments and require ventilator support. Rhythmic diaphragm activation via intramuscularly placed wires (i.e. "pacing") is a relatively new approach for sustaining ventilation after acute SCI, and the intramuscular wires also enable recording of diaphragm electrical activity. Acute, intermittent exposure to moderate (and safe) levels of hypoxia (IH) is a therapeutic approach that can trigger spinal neuroplasticity and increases in respiratory and somatic motor output in both animals and humans with SCI. However, the direct impact of acute IH on diaphragm activation has never been examined in a person with SCI. In addition, the potential for IH to modulate respiratory function has not been explored in individuals with severe respiratory impairments after SCI. Accordingly, the purpose of this case report is to describe the effects of IH on respiratory function and diaphragm activation in an adult with SCI and dependence on diaphragm pacing.

Case Description: A 46 year-old male with complete C5 SCI (AIS A) completed eight, 1-minute bouts of IH. Each bout consisted of breathing a mildly hypoxic gas mixture (10-15% oxygen) through a face mask, interspersed with 1-minute periods of room air breathing. Blood oxygen saturation was monitored. Maximal expiratory and inspiratory pressures as well as diaphragm electromyograms were recorded prior to and 45-minutes after completion of IH. Diaphragm muscle activation was quantified based on the peak amplitudes of activation recorded during a maximal inspiratory effort.

Outcomes: During the bouts of IH, blood oxygen saturation decreased from 96 to 86% for brief intervals and then rebounded. This response is consistent with prior reports of IH in adults with SCIs. Following eight bouts of IH, maximal expiratory pressure increased 45% from 11.5 to 16.7 cmH2O, while maximal inspiratory pressure increased 18% from 22.3 to 26.3 cmH2O. Peak amplitude of diaphragm electromyograms recorded from intramuscular wires increased 6%.

Discussion: The outcomes demonstrate that acute IH is feasible and potentially beneficial in individuals with severe SCIs and dependence on diaphragm pacing. The increased respiratory pressures and diaphragm activation following IH are consistent with facilitation of respiratory synaptic pathways, as demonstrated in numerous animal studies. To our knowledge this is the first time IH has been applied to an individual with a diaphragm pacer and severe respiratory impairment. The outcomes suggest great therapeutic potential of IH to trigger plasticity and motor recovery in severe cases of SCI.

TITLE: Estimated clinically meaningful decline in Freezing of Gait Questionnaire and self-selected gait speed for individuals with Parkinson’s disease

AUTHORS/INSTITUTIONS: R.A. Martin, G. Fulk, Physical Therapy, Clarkson University, Potsdam, New York, UNITED STATES| R. Duncan, G. Earhart, Washington University in St. Louis School of Medicine, St. Louis, Missouri, UNITED STATES| J.T. Cavanaugh, University of New England, Portland, Maine, UNITED STATES| T. Ellis, Boston University, Boston, Massachusetts, UNITED STATES| M. Ford, Samford University, Birmingham, Alabama, UNITED STATES| K.B. Foreman, L. Dibble, University of Utah, Salt Lake City, Utah, UNITED STATES

ABSTRACT BODY:
Purpose/Hypothesis: For individuals with Parkinson's disease (PD), changes in gait are common. It is estimated that 32.8% of all people with PD experience freezing of gait, which has been well documented to negatively affect quality of life. However, the minimal clinically important difference (MCID) for the commonly used Freezing of Gait Questionnaire (FOG-Q) has yet to be determined. Furthermore, for individuals with PD, a range of MCIDs for gait speed have been suggested (0.2-0.18m/s). Prior studies have not separated clinically important decline from clinically important improvements when determining levels of clinically important differences. The purpose of this study was to determine the change in the FOG-Q and self-selected gait speed (GS) that is indicative of self-reported meaningful decline in balance and walking ability of individuals with PD.

Number of Subjects: 208 participants with idiopathic PD, with a mean age of 67.2 years, mean years with symptoms of 8.3, and mean modified Hoehn Yahr of 2.3.

Materials/Methods: All participants completed the FOG-Q and the 10 Meter Walk Test for GS speed at baseline and at 6 months. Participants completed 2 global rating of change (GROC) questionnaires, which served as the anchors for their perceived change in balance and walking, at 6 months. Receiver operating characteristic curve (ROC) was used to estimate the clinically important decline of the FOG-Q and GS for the 2 different anchors.

Results: During the 6 month period, the mean change in the FOG-Q was an increase of 0.26 points and the mean decline in GS was -0.02 m/s, for all participants. The estimated clinically important decline in the FOG-Q was an increase of 0.5 based on the walking GROC (AUC 0.62) and an increase of 1.5 based on the balance GROC (AUC 0.66). The estimated clinically important decline in GS was -0.01 m/s (AUC 0.62) based on the walking ability GROC (AUC 0.62). Based on the balance GROC, there was no significant decline in GS that was identified as meaningful (AUC <0.5).

Conclusions: For people with PD, a change in the FOG-Q by -0.5 may indicate a clinically important decline in perceived ability to walk and perceived ability to maintain balance. A change in GS of -0.03 m/s may indicate a clinically important decline in their perceived ability to walk.

Clinical Relevance: Physical therapists and researchers can utilize the FOG-Q and GS as measures to identify a meaningful decline in walking and balance for individuals with PD. Evidence of a clinically important decline may help to substantiate need for community based wellness programs or skilled rehabilitation intervention.
TITLE: A combined cognitive and virtual-reality training program for reducing for cognitive-motor interference under dual-task conditions for intentional balance control

AUTHORS/INSTITUTIONS: T. Bhatt, L. Kannan, J. Vora, Physical Therapy, University of Illinois at Chicago, Chicago, Illinois, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: To examine efficacy of a novel dual-task intervention paradigm that combined virtual reality for balance training along with cognitive training compared to a conventional exercise paradigm, for reducing cognitive-motor interference under dual-task conditions. We hypothesized that the cognitive-motor training paradigm would perform better under dual-task conditions than the conventional group while performing volitional balance control task. They would also show significant improvements in their cognitive performance.

Number of Subjects: Twenty-three

Materials/Methods: After being screened for exclusionary factors subjects were allocated to either the cognitive motor (CMT) group (n = 11) or the conventional training group (n=12). Both groups received baseline testing at week 0 that measured their intentional balance quantitatively using the limits of stability test (Neurocom Inc.) under single talks and dual task conditions (that is with a cognitive task). We also measured their balance as evaluated routinely vial performance-based balance scales (TUG, BERG and four square step test) and cognitives tests of visual stroop and working memory. Both groups then received their respective interventions for 6 weeks followed by a post-test at week 7. The cognitive motor intervention consisted of the subjects playing on 6 different Nintendo Wii fit games while simultaneously performing higher level cognitive tasks. The conventional exercise consisted of stretching, strengthening, stance balance and aerobic activities.

Results: In the single task condition both gorups showed improvements in outcome measures with increased number of stands in the chair stand test, reduced time to complete the four square step test and the timed up and go test and improved limits of stability. However, under dual-task conditions, the CMT group demonstrated significantly greater improvements than the conventional group on the limits of stability test (movement velocity and maximum center of pressure excursion). The CMT group also demonstrated significantly improved cognitive performance, with the number of errors made on the visual stroop and letter number sequencing tasks on the post-training test being significantly lower in this group than the conventional group (p < 0.05).

Conclusions: The proposed novel training paradigm resulted in positive effects on postural stability and balance control for both groups, suggesting efficacy of the high-intensity tapering protocol for post-stroke rehabilitation. As hypothesized, the CMT group had significantly better balance performance under dual-task conditions and also greater cognitive gains.

Clinical Relevance: The application of combined cognitive and motor training during post-stroke rehabilitation could significantly reduce fall-risk and should be implemented as part of fall-prevention programs. Such training might also improve subclinical cognitive impairments which are not that apparent, however do influence their everyday function, physical activity and fall-risk.
TITLE: Plasticity of Human Cortical Neuronal Circuits after Transspinal Direct Current Stimulation: A Single-Blind, Sham-Controlled, Randomized Crossover Study

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ABSTRACT BODY:

Purpose/Hypothesis: The spinal cord has remarkable potential for neuroplasticity that can be induced by many different interventions including motor activity and stimulation. A form of stimulation that induces neuronal changes is direct current stimulation delivered at constant low intensity. Animal and human studies have shown that transspinal direct current stimulation (tsDCS) causes short-term and long-term changes on spinal reflex excitability, spinal anatomy, excitability of the cortico-phrenic, lemniscal and corticospinal pathways, spinal processing of nociceptive inputs, and muscle tone. However, the effects of tsDCS on the excitability of cortical neuronal circuits in humans have not been examined. Thus, the objective of this study was to establish whether noninvasive tsDCS induces persistent changes on the excitability of cortical neuronal circuits in healthy humans.

Number of Subjects: Seven subjects without any history of neurological or musculoskeletal disorder or contraindication to transcranial magnetic stimulation (TMS) participated in the study after giving written informed consent in accordance with the Declaration of Helsinki.

Materials/Methods: Cathodal, anodal, and sham tsDCS over the Thoracic 10 vertebra was delivered randomly for 30 min on different days. Before, immediately after (0-min), and 30-min after cathodal and anodal tsDCS, the amount of intracortical inhibition and intracortical facilitation, based on the amplitude of the conditioned tibialis anterior (TA) motor evoked potentials (MEPs), was established upon paired TMS pulses. Paired TMS pulses were delivered over the left primary motor cortex at the interstimulus intervals of 1, 2, 3, 15, 20, and 30 ms. Conditioned TA MEPs were normalized to the mean size of the homonymous control MEP.

Results: Before tsDCS was delivered, we successfully probed and recorded short-latency TA MEP inhibition and medium-latency TA MEP facilitation upon paired TMS pulses. A repeated measures analysis of variance showed a significant effect of polarity and interstimulus interval but not between time of testing.

Conclusions: This study is ongoing, but the preliminary findings suggest that cathodal and anodal tsDCS do not affect the amount of intracortical inhibition or intracortical facilitation. Based on these findings, we suggest that tsDCS may act on neuronal circuits close to the stimulation site. Further research is currently being conducted in our laboratory to delineate further the effects of tsDCS on corticospinal and spinal reflex excitability in humans.

Clinical Relevance: Understanding better the neurophysiological changes associated with tsDCS will enable the clinical and scientific community to develop tsDCS protocols suited for neurological disorders.
TITLE: Yoga for Individuals with Essential Tremor

AUTHORS/INSTITUTIONS: N.A. Elliott, Physical Therapy, Cressman Rehab Center for Movement Disorders, Louisville, Kentucky, UNITED STATES|M. Danzl, E. Ulanowski, Bellarmine University, Louisville, Kentucky, UNITED STATES

ABSTRACT BODY:

Purpose: The purpose of this special interest report is to describe the design and outcomes of an innovative community-based group yoga program for individuals with Essential Tremor (ET), led by a physical therapist. Potential key components for a specific guideline for exercise through yoga for individuals with ET that warrant future investigation are identified. Lastly, reflections about facilitators, barriers, and strategies for establishing similar programs in other local communities are provided.

Description: Essential Tremor is the most common movement disorder. Symptoms include tremor of the hands most commonly and the potential to progress to the jaw, trunk and lower extremities. Other symptoms include decreased balance, diminished quality of life, and anxiety. Research has demonstrated that yoga has been beneficial in improving core strength, postural stability and balance and decreasing anxiety in other populations. Some including Parkinson’s Disease, Multiple Sclerosis, Diabetes, and chronic low back pain, among several others. Previous research has not yet examined the role of yoga for individuals with ET.

Summary of Use: The effects of yoga on symptoms associated with ET were investigated using a pre-test post-test outcomes study design. Nine subjects with a medical diagnosis of ET were recruited from local ET support groups and the rehab services department of a large urban hospital. The intervention consisted of a one-hour guided yoga class, once a week, over an 8-week period. The program was provided by a licensed physical therapist who was also a neurological resident and 200-hour registered yoga teacher. A local yoga studio donated space for the program. Data collected included measures associated with symptoms of ET, including the Tremor Rating Scale, Fullerton Advanced Balance scale, Beck Anxiety Inventory, and McGill QoL Questionnaire. Each participant demonstrated an improvement in tremor and balance. Regarding quality of life, two participants rated an improvement in physical well-being and two reported improvement in emotional well-being.

Importance to Members: This special interest report provides a description of yoga as an intervention for individuals with ET through a community-based group format design. Individuals in the sample presented with balance impairments, highlighting the need for assessments of fall risk and subsequent balance training in this patient population. Given that ET is the most common movement disorder and the difficulty of management with medications as the disorder progresses, there is an evident need for a program like this in the ET community. Preliminary outcomes suggest that regular participation in a yoga class, led by a physical therapist, can lead to improvements in tremor reduction, balance with functional activities, and QoL. This work provides a springboard for future research to further examine the effects of yoga for individuals with ET. For example, the effects of introducing yoga within traditional physical therapy individual sessions and the value of yoga for individuals with other movement disorders are yet to be explored.
TITLE: Effects of LSVT BIG therapy on balance and postural control: preliminary results

AUTHORS/INSTITUTIONS: L. Inglis, P.J. Berg-Poppe, Physical Therapy, University of South Dakota, Vermillion, South Dakota, UNITED STATES|M.B. Powell, Physical Therapy, Sanford Health Systems, Sioux Falls, South Dakota, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis: Lee Silverman Voice Treatment (LSVT) BIG therapy retrains movement amplitude in individuals with Parkinson’s disease (PD). Evidence supports improved gait parameters with this intervention, but little is known about the effects of the treatment approach on balance and postural control. The purpose of this research was to examine changes in measures of balance following (LSVT) BIG training in individuals with PD.

Number of Subjects: Participants comprised 5 subjects with a diagnosis of Parkinson’s disease (PD) (3 male; age = 61.20±10.803 years; Hoehn & Yahr [HY] Stage 1 = 1 subject, HY2.5 = 2 subjects, HY3 = 1 subject, HY4 = 1 subject).

Materials/Methods: Participants were tested using the Fullerton Advanced Balance Scale (FAB), the Mini BESTest, and the Functional and Multidirectional Reach tests before, immediately after, and 3-months post LSVT BIG training. Center of pressure measurements were also collected using a digitized walkway to evaluate changes in limits of stability.

Results: One-way repeated measures analysis of variance (ANOVA) revealed changes in composite MiniBESTest score alone (Wilks’ Lambda = 0.98, F(1,4) = 13.841, P = 0.031, eta² = 0.902). Results indicated improvements between pre- and post-intervention (P = 0.030) that persisted at follow-up (P = 0.035) for the composite score. The only MiniBESTest subtest to show statistically significant improvements over time was the Dynamic Gait subtest (Wilks’ Lambda = 0.034, F(1,4) = 42.290, P = 0.006, eta² = 0.966). No significant differences over time were observed for the FAB total score the reach tests, or measures of limits of stability.

Conclusions: Improvements in dynamic gait found in this study agree with current studies finding changes in gait parameters following LSVT BIG. However, the preliminary results of the current study suggest that LSVT BIG treatment alone is inadequate when treatment goals include improvements in anticipatory and reactive postural control mechanisms and strategies.

Clinical Relevance: Functional gains in balance and postural control are a product of training specificity. The current study suggests that activities specifically designed to enhance anticipatory and reactive postural control should be used in conjunction with LSVT BIG therapy to address balance and postural control deficits that contribute to the risk of falls for those with PD.
ABSTRACT BODY:

Purpose/Hypothesis: The use of backward walking (BW) as an intervention to improve forward walking (FW) in individuals with stroke has clinical support but minimal research support. Rationale behind the use of BW to improve FW is the increased muscle activation during BW in key groups that tend to be weaker following neurologic injury or disease. There is evidence that backward walking kinematics are similar to that when walking forward, however, there is no research investigating EMG activity for backward walking in individuals with stroke. The purpose of this study was to compare lower extremity EMG and kinematics between backward and forward walking in non-mobility impaired individuals and individuals with stroke.

Number of Subjects: 5

Materials/Methods: Three individuals with stroke and two age matched non-mobility impaired participants ambulated on a 30’ walkway forward and backward while recording surface EMG from 14 lower extremity muscles (Delsys Trigno, sampled at 1200 Hz) and 3D kinematic data from the pelvis and lower extremities bilaterally (8 camera Qualisys, sampled at 120Hz, data processed with Visual3D). Temporal activity patterns relative to gait cycle events were analyzed and compared between walking directions.

Results: Kinematic data for forward and backward walking in the non-mobility impaired and stroke participants were consistent with data previously reported. Sagittal joint angle patterns in BW were essentially a mirror image of those seen in FW. In contrast, EMG activity in BW bore a poor relationship to that of FW and indicated that there was little correspondence in time of muscle activation between the two walking directions. E.g. at initial contact in FW there is a coactivation of knee flexors and extensors whereas in BW there is a reciprocal activation pattern of the same muscles. Results were consistent with what has been previously described in the literature and now can be extended to individuals with stroke.

Conclusions: These results verify that kinematic and muscle activation patterns in individuals with stroke are similar to previous findings for non-mobility impaired individuals during backward walking.

Clinical Relevance: Results provide support that use of BW in individuals with stroke has the potential to re-educate muscles not heavily active during forward gait and that this re-education will translate into more adaptable muscle activation during FW. The nature of BW requires that muscles at the hip, knee, and ankle work differently for propulsion and shock absorption. Training muscle adaptability through a relevant functional task is desirable for normal synergy development.
TITLE: Relationship between gait and reactive postural control in fallers and non-fallers with Parkinson disease

AUTHORS/INSTITUTIONS: M.E. McNeely, R. Duncan, Program in Physical Therapy, Department of Neurology, Washington University in St. Louis School of Medicine, St Louis, Missouri, UNITED STATES|K.J. Seidler, Program in Physical Therapy, Washington University in St. Louis School of Medicine, St Louis, Missouri, UNITED STATES|G. Earhart, Program in Physical Therapy, Departments of Neurology and Neuroscience, Washington University in St. Louis School of Medicine, St Louis, Missouri, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis: Parkinson disease (PD) is a common neurodegenerative disorder, causing deficits in balance and gait. While slowness of movement and short step length are observed during both responses to balance perturbations and during ambulation, the connection between these gait and balance impairments is unclear. The goals of this study were to examine parameters of gait and compensatory stepping responses in both forward and backward directions, in individuals with and without recurrent falls, and to describe the relationships between these metrics.

Number of Subjects: 111 people with mild to moderate PD (mean age: 66.5 ± 9.2, median MDS-UPDRS III: 37.0, 46 women, 31 fallers)

Materials/Methods: A cross-sectional analysis was performed on baseline data from a large clinical trial that assessed participants in the “off” anti-Parkinson medication state. Gait velocity and step length in forward and backward directions were evaluated with a GAITRite computerized walkway. Postural responses were evaluated with the forward compensatory stepping test (item 4) and the backward compensatory stepping test (item 5) on the Mini-BESTest. Gait parameters and postural response scores were compared between fallers and non-fallers with Mann Whitney U tests. Relationships between gait and postural response performance were examined with Spearman correlation coefficients.

Results: Forward and backward gait was significantly worse in fallers as compared to non-fallers (all p<0.05). Forward stepping postural response on Mini-BESTest item 4 did not differ between fallers and non-fallers (p=0.359). Fallers demonstrated worse backward stepping postural response than non-fallers on Mini-BESTest item 5 (p=0.009). All relationships between gait parameters and postural responses were significant (p<0.05) and of weak to moderate strength in both fallers and non-fallers, except for the relationship between forward step length and forward stepping response on Mini-BESTest item 5, which was significant in non-fallers (p<0.001), but not in fallers (p=0.076).

Conclusions: Spatiotemporal parameters of gait are related to postural response in both fallers and non-fallers, but the relationships are weak suggesting that there are additional key contributors other than postural control that determine walking performance. Furthermore, relationships between backward gait and postural responses in both directions are similar to relationships between forward gait and postural responses in both directions, suggesting that direction-specific postural control tests are not uniquely predictive of gait in a specific direction.

Clinical Relevance: People with PD are more likely to fall than healthy individuals of comparable age, leading to increased morbidity and mortality. It is vital that we continue to develop our understanding of this phenomenon, including the contributions of gait and postural control deficits. The present data support a complex view of gait and balance impairment, as well as the need for a detailed, multidimensional approach to preventing falls in people with PD.
TITLE:
Utilization of an Instrumented Cane in a Neurological Physical Therapy Clinic

AUTHORS/INSTITUTIONS: P.J. Flemming, Pi Beta Phi Rehabilitation Institute, Vanderbilt Medical Center, Brentwood, Tennessee, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: The purpose of the study is to evaluate the use of an instrumented cane (IC) in a neurologic physical therapy (PT) out-patient clinic. A primary hypothesis is that a sensor-bearing cane can identify differences in cane usage between neurologically impaired older adults and controls. A secondary hypothesis is that PTs may utilize an IC to more objectively assess a patient's weight bearing on the assistive device, cane placement angle, frequency and timing of cane placement, and usage of the device.

Number of Subjects: 14 subjects were recruited and provided consent to participate in an ongoing, preliminary, Institutional Review Board (IRB)-approved study aimed at assessing use of a novel device in a patient population (n=9) and controls (n=5). The patient group was 77.8% female with a mean age of 74.1 years (SD 13.5), and the control group was 40% female with a mean age of 72.6 years (SD 8.9). All participants from the patient group were actively participating in a skilled PT program at a neurological out-patient center. Controls were adults over 65 who did not use an assistive gait device and were not actively participating in a rehabilitation program.

Materials/Methods: The IC was developed by the university-affiliated Dept. of Mechanical Engineering. Measurement parameters of the IC include: linear acceleration, rotational velocity, orientation with respect to gravity, axial load, grip pressure, and distance between device and potential environmental barriers. Software was developed to log and display data and to provide real time prediction for activity. With use of the IC, subjects were asked to complete all of the task items of either the Dynamic Gait Index (DGI) or Functional Gait Assessment (FGA), both of which contain seven similar task items that can be compared across all subjects. The functional balance measure (FGA or DGI) utilized in the study was the primary outcome measure utilized by the PT in the initial evaluation of participating patients. In addition, subjects were asked to walk on surfaces including turf, gravel, and a semi-compliant rubberized surface with the IC.

Results: All subjects in the patient group scored in the high fall risk range with their respective measures (DGI 14.7±3.1; FGA 18±1.63), while 2 of the 5 controls scored in the high fall risk range (DGI 18; FGA 23.5±0.9). The patient group demonstrated lower acceleration than control subjects for all observed activities. With respect to IC mean applied load, patients and controls demonstrated similar behavior on all items except stair ascension and descension. The best classifier, artificial neural network, demonstrated 91% accuracy in distinguishing walking with the IC and stair climbing with the IC.

Conclusions: The IC demonstrates sensitivity to different users and can isolate specific parameters of cane usage.

Clinical Relevance: PTs increasingly rely on objective measures in clinical practice. Use of a novel IC in the clinic could assist in selection of the most appropriate assistive device for patients and could potentially be utilized to monitor cane usage in patients outside the clinic.
TITLE: Efficacy of LSVT BIG, Rock Steady Boxing and traditional exercise on gait and functional mobility in patients with Parkinson's disease: A systematic review


ABSTRACT BODY:

Purpose/Hypothesis: Parkinson’s disease is a progressive neurodegenerative disease that can result in motor and non-motor symptoms that vary by individual. The disease results in decreased production of dopamine, with motor symptoms of bradykinesia, tremor, and postural instability. Emerging treatments to target deficits in gait and mobility in Parkinson’s disease are LSVT BIG and Rock Steady Boxing, which are becoming increasingly more common instead of or in conjunction with traditional physical therapy. The purpose of this systematic review was to evaluate the effects of LSVT BIG, or Rock Steady Boxing, compared to traditional therapy on gait and mobility in individuals with Parkinson’s disease rated as Hoehn & Yahr stages 1-3.

Number of Subjects: For the five studies included in this systematic review there were a total of 209 subjects.

Materials/Methods: Two reviewers searched electronic databases (PubMed, CINAHL, EBSCOHost, and Google Scholar) for literature investigating the effects of the LSVT BIG, Rock Steady Boxing or traditional physical therapy exercises for Parkinson’s disease, resulting in 66 articles. After applying the exclusion criteria, five articles were appraised in this systematic review.

Results: The five articles were assessed for methodological quality with the PEDro scale by two separate reviewers, scoring all five articles as moderate to high quality. Community-based group exercise for persons with Parkinson disease, a randomized controlled trial, and Effects of Exercise on Motor and Non-motor Symptoms of Parkinson’s Disease both received a PEDro score of 8/10. Randomized Clinical Trial of 3 Types of Physical Exercise for Patients with Parkinson’s Disease, and Comparing Exercise in Parkinson’s Disease - The Berlin LSVT ® BIG Study both received PEDro scores of 7/10. Amplitude-oriented exercise in Parkinson’s disease, a randomized study comparing LSVT BIG and a short training protocol received a PEDro score of 5/10. Outcome measures related to gait and mobility included: 6MWT, TUG, UPDRS-III, BBS, and 10 MWT. Significant improvements were seen between all interventions that utilized UPDRS-III, BBS, and TUG with the greatest improvements seen in LSVT BIG intervention study.

Conclusions: LSVT BIG, Rock Steady Boxing, and traditional PT exercises all had significant positive effects on gait and mobility in persons with Parkinson’s disease in Hoehn & Yahr stages 1-3. The most significant improvements made were in the UPDRS-III, TUG, and 10 MWT while following the LSVT BIG protocol compared to a Nordic Walking program and an unsupervised home exercise program. Participants treated with boxing therapy exhibited significantly better outcomes in gait velocity when compared to traditional exercise. Further research evidence for both LSVT BIG and Rock Steady Boxing is warranted to determine the efficacy of the treatment of individuals with Parkinson’s disease.

Clinical Relevance: LSVT BIG and Rock Steady Boxing both show promise as effective PT treatment for patients with Parkinson's disease.
TITLE: Lifespan Normative Data for the BTrackS™ Balance Test

AUTHORS/INSTITUTIONS: H.S. Baweja, M.E. Romero, E.J. Castagner, A.J. Kress, B.A. Vasko, M.M. Rabanal, M.J. Rauh, Physical Therapy, San Diego State University, San Diego, California, UNITED STATES|D.J. Goble, Exercise and Nutritional Sciences, San Diego State University, San Diego, California, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: The BTrackS Balance Test (BBT) is a brief, easily administered test of static balance using a low-cost and highly portable force plate. The purpose of this study was to develop the first normative database for this test.

Number of Subjects: 7276

Materials/Methods: The sample was drawn from a population of over 200 client sites across the United States taking part in a comprehensive data contribution program for Balance Tracking Systems (San Diego, CA). Community dwelling volunteers aged 5-100 y were administered the BBT within the context of a balance screening/fitness evaluation. The subjects did not have any significant medical, neurological, or lower extremity problems that might have an adverse effect on their balance. The BBT consisted of three trials of quiet unperturbed standing with eyes closed; feet shoulder width apart and hands on the hips. Each trial lasted 20s during which center of pressure (COP) was recorded. From these data the total COP sway, COP antero-posterior (AP), and COP medio-lateral (ML) sway excursion were calculated. In addition, a principle component analysis was used to calculate the 95% confidence interval (CI) area of the ellipse within which the COP would lie. The BBT normative data were then stratified by age and gender.

Results: BBT results improved steadily from childhood through adolescence and then remained similar from age 15 to 40 y. A slow decline in performance was observed in ages 4 to-59 y. A greater decline was found between ages 60 to 100 y. On average, females performed better than males on the BBT. For gender, a more prominent bimodal age distribution was observed with females up to age 15 y, or over the age of 50 y, performed better than males in corresponding age groups.

Conclusions: These normative data provide a frame of reference for interpreting BBT performance across the lifespan in both men and women.

Clinical Relevance: From a clinical standpoint, these data provide important reference values to compare the balance performance of individuals with athletic, orthopedic or traumatic brain injuries and in persons with diverse neurological or vestibular issues.
Use of mobile technology to study physical activity levels and its diurnal variation in an individual with Parkinson disease – a case report

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Background & Purpose: People with PD experience diurnal fluctuations in motor and non-motor symptoms. Motor fluctuations experienced by individuals with PD have been shown to have an impact on the quality of life and may affect the quantity and quality of physical activity (PA) levels throughout the day. Data on PA levels in this population is limited. This study objectively determined the feasibility of using mobile technology to determine (a) quantity, intensity and nature of PA throughout the day during home and community ambulation and (b) fluctuations in PA levels by collecting granular data by the minute for PA as well as for several factors (e.g. sleep, medication cycle) that may have an impact on PA in an individual with PD.

Case Description: PB is a 76 year old male who has had PD for 10 years. The participant came in for one in-person functional assessment consisting of the 10 meter walk test, miniBESTest, Unified Parkinson disease rating scale, functional reach test, Activities Specific balance confidence scale, falls efficacy scale, Environmental Analysis of Mobility Questionnaire and the Parkinson disease questionnaire – 39. The participant was then sent home with a Fitbit HR Charge activity monitor and a pair of instrumented socks (Sensoria inc.) with textile sensors embedded on the sole, for 15 days. Data from both devices was uploaded remotely for analysis. Additionally, the participant kept a log of his medication times, an activity log and filled out a usability questionnaire about the devices.

Outcomes: PB was able to wear both devices for 15 days without any reported adverse events. There were 2 occasions when he had technical difficulty with the instrumented sock which were both resolved over the phone. He was able to upload the data to the server for analysis. At the end of the study, he reported no additional burden of wearing the devices or filling out the logs and that the devices were easy to use (don/doff, charge, data upload). The Fitbit activity monitor provided us with minute by minute data about the no of steps taken during each day, calories burnt, number of sedentary, light, fair and very active minutes, heart rate and sleep data. The instrumented socks provided us with cadence, left and right foot % instances of heel contact vs not, left and right foot contact times. We also examined the influence of factors such as time since last medication dose, sleep, gait impairments(from the socks) and physical function on PA levels.

Discussion: Understanding the nature of PA fluctuations throughout the day, is crucial especially in the light of the factors that may be associated with the fluctuations in order to enhance PA in this population. We were able to demonstrate feasibility of our protocol to assess PA levels in an individual with PD. The long term goal of this research is to collect data from 30 individuals with PD and 30 age-matched controls to determine PA levels as well as factors that influence physical activity levels in this population.

Purpose/Hypothesis: Alternative forms of intervention, such as “dance therapy” is being increasingly used in rehabilitation settings for improving function post-stroke. Previous findings have shown improvements in postural stability among chronic stroke survivors after a 6-week virtual-reality dance intervention. However, its effect on improving movement control and translation to improved function is yet to be evaluated. Purpose: This study, thus evaluated the whole body kinematics of a custom-designed dance-based virtual reality (VR) protocol.

Number of Subjects: Individuals with chronic stroke (n=15).

Materials/Methods: Participants received a VR based dance training for 6 weeks using Kinect dance gaming “Just Dance 2014” for one hour thirty minutes. To quantify changes in full-body kinematics and compute the center of mass (COM) participants (n=8) were exposed to dance movements to VR dance movements. An 8-camera motion capture system recording at 120 Hz was used to record full-body kinematics and compute the COM. Postural stability was examined via COM position excursions in the anterior-posterior (AP) and medio-lateral (ML) directions for each dance. Hip. Knee and ankle joint angle excursions were measured. Gait speed and cadence were recorded using an electronic walkway. Functional measures were used to assess balance control (BERG), fear of falling (Fall efficacy scale [FES]). Changes in physical activity during community ambulation (one week before and after intervention start) were assessed using Omran HJ-321 Tri-Axis Pedometer. Adherence to exercise was assessed by change on the Intrinsic Motivation Inventory (IMI) scores.

Results: The anteroposterior (AP), mediolateral (ML) COM excursion, along with hip and ankle angle excursions significantly increased on the paretic side (pre-vs post, p<0.05); with no change on the non-paretic side. The knee angle excursion displayed trend to increase as well. Gait outcomes of speed and cadence and functional measures BERG and FES increased significantly (pre vs. post, p < 0.05). Community physical activity showed a mean of 2898.1 ± 1312.3 steps per day pre intervention and 3876 ± 171 post intervention.(p = .24). There was a significant increase in motivation, [IMI scores] (pre-vs post, p<0.05). A correlation analysis indicated that participants’ post-training ML COM excursion correlated with BERG [R2 of 0.415 (p<0.05)] and FES [R2 of 0.8213 (p<0.05)].

Conclusions: Results validate the effect of this short duration high-intensity training protocol for improving weight shifting ability in AP and ML directions and movement kinematics on the paretic side. Such improvements resulted in a change in falls efficacy and community ambulation in stroke.

Clinical Relevance: Given the results of this study, virtual reality-based dance gaming using an off-the shelf gaming console could be incorporated as a clinical intervention to address fall risk and community mobility limitations in chronic stroke survivors.
TITLE: The NExT Step in Promoting Physical Activity After Stroke: A Community-Based Gym for Survivors of Stroke.

AUTHORS/INSTITUTIONS: R. Handlery, B.S. Miller, A. McManus, G. Hainline, D.M. Liuzzo, J.C. Stewart, S.L. Fritz, University of South Carolina, Columbia, South Carolina, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Regular physical activity (PA) post-stroke can improve walking efficiency, balance, aerobic endurance and quality of life and protects against subsequent stroke. Unfortunately, survivors of stroke are not meeting PA recommendations and are significantly less active than other older adults with chronic disease. This is partly due to the barriers to exercise post-stroke. The NExT Gym is a community-based program designed to remove many barriers and help survivors of stroke meet PA guidelines. The purpose of this study was to determine the feasibility and efficacy of a community-based PA program. While we know that controlled exercise programs work, it is unknown whether a less structured program can demonstrate similar positive effects regarding health and mobility.

Number of Subjects: Seven individuals (mean age 67.29 yrs) with chronic stroke (>1 yr). Average Berg Balance Scale was 48.7 (6) and average walking speed of 0.9 m/s (.3).

Materials/Methods: We addressed external barriers to PA by providing a no-cost gym designed specifically for survivors of stroke, with accessible parking, facilities, and restrooms. To address internal barriers (e.g. balance and walking impairments, fear of falling) we provided trainers who were educated in post-stroke PA. While participants were encouraged to exercise, they were not required to attend. The NExT Gym was open 6 hours/week for a total of 10 weeks. Participants exercised under the guidance of senior-level DPT students and a licensed PT, with examples of exercises given alongside post-stroke education. Exercises were performed with minimal equipment to promote the continuation of activity at home. Feasibility measures included occurrence of adverse events, attendance, retention and Global Rating of Change (GRC). Efficacy measures collected prior to and after 10 weeks included: Timed Up and Go (TUG), Berg Balance Scale (BBS), Ten Meter Walk Test, Five Times Sit to Stand (5xSS), Six Minute Walk Test (6MWT), Four Square Step Test, Stroke Impact Scale (SIS-16), Activities-specific Balance Confidence Scale and Fatigue Severity Scale (FSS).

Results: Participants attended an average of 71.45% (13.3%) of possible sessions. No adverse events occurred during the program. The TUG, BBS, 5xSS, FSS and SIS-16 demonstrated a medium effect size (0.3-0.7), suggesting improvements in mobility, balance, strength, fatigue and psychological changes.

Conclusions: The NExT Gym had high levels of attendance and retention, along with no reported adverse events. All participants regarded the gym as valuable in addition to a positive change in balance, mobility, strength and quality of life.

Clinical Relevance: These findings implicate the need for safe, accessible, and affordable exercise facilities in the community for those affected by stroke. This study may serve as a model for future programs to promote voluntary participation in PA and improve the lives of survivors of stroke.
TITLE: The use of vibration therapy for increasing bone architecture in patients with spinal cord injury: a systematic review and meta-analysis.

AUTHORS/INSTITUTIONS: A.K. Lorio, B. Yisrael, J. Connelly, E. Jackson, Department of Physical Therapy, Georgia State University, Atlanta, Georgia, UNITED STATES

ABSTRACT BODY:

Purpose: To determine by systematic review and meta-analysis whether vibration therapy increases bone architecture in patients that have sustained spinal cord injury (complete and/or incomplete).

Description: A systematic review on seven databases (PubMed, Cochrane Library, Web of Science, SportDiscus, REHABdata, TRIP, and EMBASE) found 132 potentially relevant studies that were further analyzed by two authors via title and abstract for the following inclusion criteria: 1) spinal cord injury (complete and/or incomplete) 2) intervention included vibration therapy, 3) published within the last five years, 4) peer-reviewed, 5) human and animal subjects, and 6) randomized control trial. Six articles met these criteria and were included in the meta-analysis. The primary outcome measures used were multiple measurable determinations including bone mineral content, bone mineral density, volume bone density, trabecular integrity, surface area, microstructure, microarchitecture, and associated structural components as measured in the upper and lower extremities. All data were standardized by conversion to standardized mean differences or effect sizes (ES). A random-effects model was used in conjunction with Comprehensive Meta-analysis software (version 3).

Summary of Use: Currently, there is not enough evidence to support vibration therapy alone as an intervention for increasing bone architecture of patients with spinal cord injury after an average 3 months of intervention. Following the average intervention period of 20 minutes/day, 5 days per week, for 3 months, there was no significant overall effect of vibration therapy with all measures combined (ES =-.055, p = .81).

Importance to Members: Spinal cord injury causes rapid and marked bone loss most rapidly in the initial post-SCI phase, with initial rates as high as 4.7% per month. More specifically, bone mineral density loss can exceed 34% by the first year post-injury and 52 % by 4 years (Dudley-Javorski et al., 2015). Collective attributes show increased resorption after injury resulting in an accelerated loss of bone structure of the paralyzed limbs. Individuals with spinal cord injury (complete and/or incomplete) show altered viability more specifically related to a decrease in bone mineral density, bone mineral content, bone volume (totals), and trabecular microstructure which directly impact the chance and risk of fracture, joint stiffness, loss of range of motion, pressure ulcers, pain, and increased spasticity (Bloomfield et al. 1996). Therefore, interventions that may reduce the percentage and/or amount of bone loss are vital for this patient population. Currently, this systematic review and meta-analysis is limited in scope due to the small number of articles available. Further research needs to be conducted in order to evaluate the use of vibration therapy, in combination with other interventions (e.g. weight bearing activities) as well as other possible interventions, which could impact bone loss in this population.
TITLE: Effects of a week-long intense rehabilitation camp on walking outcomes in stroke- individual differences related to baseline walking performance


ABSTRACT BODY:

Purpose/Hypothesis: The purpose of this retrospective analysis was to investigate the effects of a week-long, intense and structured rehabilitation camp on gait speed in patients with stroke. We further investigated if baseline walking performance, categorized by pre-intervention gait speed (household ambulators (<0.4 m/s); limited community ambulators (0.4-0.8 m/s); community ambulators (>0.8 m/s)) determined the amount of improvement in gait speed post-intervention.

Number of Subjects: 60 patients with subacute stroke

Materials/Methods: Patients participated in intense circuit training program that involved upper and lower extremity functional activities including gait training for 7 hours/day for a week. Gait speed was measured before and after the program.

Results: As a group, participants improved their walking speed with an average increase of 0.18 m/s., an improvement greater than the MCID (0.16 m/s). However, the changes in gait speed were not equal across the functional groups (ANOVA: F=6.715, p=.0024). Post hoc pairwise t-tests revealed significant improvements only for the household ambulators and community ambulators (t=-3.58, p < 0.001). Further, the number of participants passing the MCID differed between household and community ambulators (χ²=4.737; p=0.0295).

Conclusions: An intense week-long therapeutic camp can provide clinically-important improvements in gait speed in patients post-stroke, Greater improvements are seen in patients with an initial gait speed greater than 0.8 m/s than those with gait speed less than 0.4 m/s.

Clinical Relevance: Group therapy in a stroke camp may be delivered as a valuable mode to improve gait outcomes in patients with stroke. Maximal benefits are evident in patients who are community ambulators.
TITLE: Post-Concussion: Is Convergence Insufficiency Related to Balance Impairments?

AUTHORS/INSTITUTIONS: D. Gobert, S.A. Buchner, J. Kerby, D. Rouse, S. Nelson, Physical Therapy, Texas State University, Austin, Texas, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: To characterize the relationship between oculomotor convergence insufficiency (CI) during long term recovery from mild head injury (mTBI) as measured by the near-point convergence test (NPCT) and other symptomatology including balance deficits common to chronic post-concussion syndrome (CPCS).

Number of Subjects: 23 individuals with/without mTBI in past 12 months (n = 21/2).

Materials/Methods: Participants received a simple medical screening including the standardized NPCT (> 6.0 cm clinically significant) and computerized static visual acuity (InVision®) and neurocognitive testing (ImPACT®) which included report of Total Symptoms (TSYMP) and balance deficits (BAL). Participants were tested twice over a 3-week period to confirm stability of test results.

Results: Of the 23 patients recruited, most participants exhibited mild to moderate CI according to NPCT scores (avg. 6.72 +/- 5.22cm). The TSYMP score was found to be significantly related to the Concussion Score as well as a significant predictor of the NPCT. Average CON_Score = 2.57 +/- 1.472 concussions. NPCT was significantly related to TSYMP (r = 0.397), Static Visual Acuity (r = .251), and VM_Speed (r = -0.257). A regression model indicated that TSYMP, BAL, CON_Score and STATIC_Acuity were able to explain 70.2% of the variance in NPCT. Alpha level = 0.05.

Conclusions: Preliminary results indicate that the NPCT is a valid clinical assessment of CPCS during long-term recovery from mTBI. Number of concussions, visual memory processing, and the total symptom scores including balance deficits were significant predictors of NPCT values.

Clinical Relevance: Results suggest that CI can continue during the chronic phases of recovery from head injury especially if symptoms imbalance persist. Recommend that rehabilitation specialists continue use of the NPCT to manage symptoms along with neuromuscular balance retraining. Further study is warranted.
TITLE: Effect of Unilateral Step Training on Walking Ability in an Individual with Spinal Cord Injury and Hemiparesis: A Case Study

AUTHORS/INSTITUTIONS: E. Anderl, Physical Therapy, TIRR Memorial Hermann, Houston, Texas, UNITED STATES

ABSTRACT BODY:

Background & Purpose: Intensive, task-specific therapies for walking recovery have emerged from the recent paradigm shift from compensation to activity-dependent plasticity post-spinal cord injury (SCI). Unilateral step training (UST) has been shown to improve gait symmetry and walking speed in individuals with unilateral hemiparesis post-stroke, but no literature to date has investigated the effect of UST on walking in people with damage to spinal pathways. The purpose of this study was to investigate the feasibility and potential value of a UST program for a patient experiencing hemiparesis post-SCI.

Case Description: This was a single case study ABC design. The patient was a 50 year old male who presented to outpatient rehabilitation following an incomplete SCI resulting in left-sided hemiparesis. After achieving modified independent ambulation with a rolling walker (RW), the patient had reached a "plateau" in walking capacity as measured by the 6 Minute Walk Test (6MWT). The patient participated in 7 sessions of traditional UST and 6 sessions of alternating unilateral and bilateral step training (UST-MOD). Stepping was performed for 20 minutes, 1-2 times weekly for 8 weeks. Starting treadmill speed was equivalent to the patient's initial self-selected overground gait speed, and speed was increased incrementally during and between sessions.

Outcomes: Gait velocity was measured with the 10 Meter Walk Test (10MWT) and walking capacity was measured with the 6MWT. Outcome measures were collected at baseline, session 6 of UST, session 4 of UST-MOD, and 5 days post-intervention. Fast gait speed increased from 0.22m/s to 0.25m/s with UST and increased further to 0.35m/s (MDC = 0.13m/s, MCID=0.06m/s) with UST-MOD. Walking capacity increased from 211' to 225' with UST and further to 335' (MDC=22% change) with UST MOD. During the intervention period, the patient progressed from using a manual wheelchair to utilizing a RW for community mobility. Subjectively, the patient reported increased balance confidence. At follow-up, the patient retained a clinically significant improvement in his 6MWT (65'=31% change) versus his pre-test measure; however, significant changes in gait velocity were not retained.

Discussion: This case study provides evidence that UST, when used as part of a comprehensive plan of care, can contribute to improved overall walking ability in patients presenting with hemiparesis post-SCI. It is well documented that high-repetition treadmill training produces improvements in functional ambulation following incomplete SCI; however, its efficacy has been examined predominantly at high frequencies. The positive adaptations observed in this case are noteworthy considering the low dose of UST prescribed. Discerning the mechanism of its effectiveness will require further exploration. This case study is consistent with previous research on various types of treadmill training post-SCI and indicates that improvements in walking ability are possible in individuals with damage to spinal pathways.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: Behrman AL, Bowden MG, Nair PM. Neuroplasticity after spinal cord injury and training: An emerging paradigm shift in rehabilitation and walking recovery. Phys Ther. 2006;86(10):1406-1425.


AUTHORS/INSTITUTIONS: V. Eberly, S.J. Mulroy, Pathokinesiology Laboratory, Rancho Los Amigos National Rehabilitation Center, Downey, California, UNITED STATES|K.L. Kubota, Physical Therapy Department, Rancho Los Amigos National Rehabilitation Center, Downey, California, UNITED STATES|P. Requejo, Rehabilitation Engineering, Rancho Los Amigos National Rehabilitation Center, Downey, California, UNITED STATES

ABSTRACT BODY:

Purpose: The Rancho Observational Gait Analysis (OGA) System is a well-known method to analyze gait. Teaching materials evolve with advances in technology. Our NIDDR Field-Initiated Development Grant (#H133G100268) was designed to develop an interactive program to teach clinicians how to utilize a decision-making algorithm (the Rancho R.O.A.D.M.A.P.) for lower extremity orthotic prescription. A foundation for learning Rancho normal and pathologic gait was the first step in utilizing the R.O.A.D.M.A.P. End-user feedback from prior educational sessions requested mobile multimedia resources resulting in our current app-based program. This special interest report will describe the ongoing evolution of our project.

Description: The Normal Gait module was completed in 2013. The Pathologic Gait module, with videotaped clips and voiceover of each gait deviation on the Rancho Full Body OGA Form, was completed in 2016. A Use Case document describing the interaction between user and app was used to guide app programming. The Rancho R.O.A.D.M.A.P. and MOPS Brace (adjustable trial orthosis developed as part of the project) modules are currently in progress.

Summary of Use: The Normal Gait module is the first in a series to help a clinician evaluate normal and pathologic gait; with the final module to aid in lower extremity orthotic selection. The RanchoGait app allows the user to actively participate in learning essential elements of normal and pathologic gait utilizing critical thinking. In the Pathologic Gait module the user selects buttons for deviations of interest on the device. An interactive player allows the user to view a video clip describing each gait deviation on the Rancho Gait Form. The aim of the R.O.A.D.M.A.P. module is to interactively guide the clinician through the algorithm in selection of an appropriate orthosis given a patient’s gait deviations. The MOPS Brace module describes how to adjust the modular trial orthosis as well as how to set a stop (dorsiflexion or plantar flexion) and/or dorsiflexion assist on the orthosis. The full series of components of the RanchoGait app can be used as a stand-alone learning tool or in conjunction with an in-person course to supplement principles presented in a lecture/lab-based design.

Importance to Members: The RanchoGait app is a unique, significant advancement to learn gait analysis and guide orthosis selection and modification with end-user accessibility in the digital age. The gait sections of the app facilitate identification of the most significant gait deviations in persons with neurological disorders. The R.O.A.D.M.A.P. portion assists with orthotic prescription, and the MOPS Brace component assists with orthotic adjustment. This app can help a clinician target interventions to improve the walking ability of patients with neurologic disorders. The app’s ease of use, portability, and utility will be demonstrated during the presentation.
ABSTRACT BODY:

Background & Purpose: Although the application of virtual reality (VR) in health care arose nearly 3 decades ago, the expectation of a vast transformation regarding patient care was underwhelming. However, with a shift from computer to mobile device, the renewal of VR technology created the possibility for use in rehabilitation. With a goal of desensitization by graded exposure to stimulating environments, patients using VR transitioned from observing an image to becoming an active participant in their own 3D virtual environment. Research suggested that exercises involving visuo-vestibular conflict are beneficial in the treatment of visual vertigo (VV), defined as “dizziness provoked by full field repetitive or moving visual environments of visual patterns.” VR technologies, such as the CAREN were studied in the treatment of VV. Unfortunately, these large-scale systems may be too costly and require more space than available. The purpose of this case study was to determine the effectiveness of 3D VR training using Google Cardboard headsets to address VV unresolved by 2D training.

Case Description: A 35-year-old female diagnosed with post-concussion syndrome was seen for a second course of vestibular therapy in February 2016 with exacerbation of symptoms following pregnancy. Her chief complaints included dizziness, vertigo, and imbalance worsening in busy environments and when tracking a moving target. The patient was seen once per week for 45-minute sessions and her initial program consisted of turning, gait with head turns, vestibular-ocular reflex training, and 2D video/optokinetic exercises. The patient’s progress plateaued with 2D training, though she continued to report VV. Thus, 3D VR training using Google Cardboard was initiated. To improve carryover of VR training, the patient performed Google Cardboard at home for 1 set of 5 repetitions, 15-30 seconds each, one time per day, at least 5 days/week. Week-to-week progressions were implemented in both duration and difficulty of video.

Outcomes: At reassessment 6-weeks after the initiation of Google Cardboard VR, patient demonstrated improvements in the Sensory Organization Test from a composite score of 72 to 85, Dizziness Handicap Inventory from 12 to 6/100, and on several conditions depicted in the Visual Vertigo Analog Scale. More specifically, she improved her scores of “walking through a supermarket aisle” from 6.5 to 3/10 and “walking through a shopping mall” from 8 to 3.5/10. In addition to the above objective measures, patient subjectively reported that she “felt a true turning point when VR was added to (her) program”.

Discussion: The favorable results suggest that Google Cardboard VR may help bridge the gap between 2D training and real life scenarios. Google Cardboard VR offers a feasible option for both clinical and home use, including reduced cost and size, as compared to other VR systems. Further research is warranted to determine the effectiveness of VR headsets versus larger-scale VR systems.


High Intensity Interval Training in a Young Adult Male with Chronic Traumatic Brain Injury and Impact on Functional Recovery

K. Russett, Physical Therapy, Rusk Rehabilitation at NYU Langone Medical Center, Astoria, New York, United States

Background & Purpose: High intensity training (HIT) is beneficial in patients with cardiopulmonary disease. There is also a developing body of research that indicates that patients who suffered a stroke also benefit from HIT both from an aerobic training and neuroplasticity perspective. The purpose of this case study is to illustrate the benefits of HIT in a young adult in the chronic phase of a traumatic brain injury (TBI) with no compounding cardiac impairments.

Case Description: A 29 year old male with a TBI in 2013 presented to outpatient physical therapy (PT) to address deficits in high level mobility skills to enable him to meet the physical demands of his work as a painter. Patient was able to walk without an assistive device using a toe off brace with significant gait deviations related to right hemiparesis. During his biweekly, hour long sessions patient was prescribed high level mobility exercise, including plyometrics, and HIT with a body weight supported system. Intensity was measured based on Rate of Perceived Exertion (RPE) scale, where patient was to walk at his fastest tolerated speed for 30 second intervals. Fast tolerated speed is defined as 0.1 miles per hour (MPH) below the speed at which the patient demonstrates a mechanical fault (e.g. drifted backwards, marked instability in gait). Following each successful trial, speed was increased by 0.1 MPH.

Outcomes: Initially, patient tolerated HIT parameters of 30 s on/off period, 3.3 MPH, 10 minute total duration, and RPE 16/20. He progressed to 30 s on/off period, 4.0 MPH, 20 minutes total duration and 14/20 RPE. This patient demonstrated significant improvement on all outcome measures within 7 sessions. He improved HiMat score from 20/56 to 25/56. His gait speed improved from 1.1 m/s to 1.8 m/s and 6 minute walk test improved from 419 m to 457 m. Patient progressed from catching his right foot within 50 ft to running in 200 ft without loss of balance, demonstrating carry over into over ground running. Patient has returned to work part time as a painter with accommodations.

Discussion: Often patients with TBI remain limited in return to high level mobility. Based on current research, when compared to moderate intensity aerobic exercise, patients with chronic stroke utilizing HIT protocols experienced greater improvement in fast over ground gait speed. This case study demonstrates that HIT principles studied in the stroke population are applicable to an individual with a TBI. HIT requires increased neuromuscular demand, potentially fostering increased neuroplasticity and producing concurrent motor recovery. This patient case highlights the feasibility and benefits of HIT as a promising intervention in the chronic TBI population to improve functional outcomes. Further research is required to confirm the safety and efficacy of HIT as an intervention in the rehabilitation of the TBI population.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: 1: Damiano DL, Zampieri C, Ge J, Acevedo A, Dsurney J. Effects of a rapid-resisted elliptical training program on motor, cognitive and neurobehavioral functioning in adults with chronic traumatic brain injury. Exp Brain Res. 2016 Mar 30.


TITLE: A comparison of the Developmental Eye Movement Test to the King-Devick Test in 14 to 35 year olds.

AUTHORS/INSTITUTIONS: J. Heick, C. Bay, T. Valovich McLeod, A.T. Still University, Mesa, Arizona, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Concussions are one of the most prevalently acquired neurologic conditions in young adults. The King-Devick test (K-D) captures oculomotor function while incorporating attention and language which may be compromised by a concussion. The K-D has been validated as an assessment of oculomotor function using horizontal saccades. The Developmental Eye Movement (DEM) test is similar to the K-D test but uses horizontal saccades and a subtest of vertical saccades to evaluate oculomotor function. There is no known study investigating the use of the DEM test as a concussion assessment tool. The purpose of this study is to determine the association between the K-D test and DEM test in healthy 14 to 35 year olds. Additionally, the K-D and DEM tests were evaluated for practice effects to determine the appropriate number of trials needed.

Number of Subjects: 42

Materials/Methods: Forty two healthy adults (22 males, 20 females; mean age, 24.3 ± 2.91 years) performed 6 trials of the K-D and DEM test in one session. A factorial model was used for all possible interactions to determine if a practice effect was present. Composite and trial scores of the K-D and DEM test were evaluated using an Intraclass correlation coefficients (ICC 2, 1) using consistency and a 95% confidence interval to determine agreement between the two tests. An additional analysis was conducted to assess possible differences in practice effect across the 3 cards and 6 trials for both tests.

Results: K-D and DEM composite scores revealed main effects for trial order and cards. Post hoc comparisons showed faster times until trial 4 for the K-D and DEM tests. All pairwise differences for the K-D and DEM composite scores were significant. Test-retest reliability for both tests were excellent.

Conclusions: Both the K-D and DEM tests were developed to assess oculomotor dysfunction but only the K-D test has been used as a concussion assessment tool. We found a strong correlation between the K-D and the DEM test on repeated testing in healthy adults. We also observed a practice effect for the K-D and the DEM test with a performance plateau occurring after four trials.

Clinical Relevance: Accurate assessment of concussion is crucial. Practitioners should consider using the DEM test as a concussion screening tool as it uses vertical and horizontal saccades that correspond to separate distinct areas of the brain. We suggest additional practice trials should be completed before recording baseline K-D or DEM scores to minimize the impact of practice effect on test interpretation.
Purpose/Hypothesis: Post-stroke paretic arm impairment has been associated with multiple neurobiological factors including lesion location and volumes, cortical excitability, and hemispheric lateralization. However, associations between these factors and persistent paretic arm impairment have not been consistently observed and the clinical significance remains unclear. Investigating the relationships between lesion characteristics and levels of arm impairment may help guide development of improved treatment options for stroke survivors. The primary purpose of this study was to study relationships between lesion characteristics and paretic arm impairment in participants with chronic stroke. A secondary aim was to examine if relationships were influenced by lesion location subtype.

Number of Subjects: 12 individuals with chronic (>6 months), first diagnosed ischemic stroke and residual paretic arm impairment.

Materials/Methods: High-resolution T1-weighted anatomical magnetic resonance imaging (MRI) data were acquired and reviewed to determine lesion location subtype, primary anatomical structures involved, and lesion hemisphere (right hemisphere lesion[RHL]: 6, left hemisphere lesion [LHL]: 6). Lesion locations were divided into one of four subtypes: brainstem, cortical, subcortical, or mixed cortical/subcortical. Basal cortical excitability was assessed by resting motor threshold (RMT) determined bilaterally using standard transcranial magnetic stimulation (TMS) procedures. An independent t-test was performed to evaluate the effect of lesion hemisphere on level of paretic arm impairment quantified by upper extremity (UE) Fugl-Meyer Assessment (FM) scores. Pearson correlation coefficients were calculated to investigate relationships between FM scores and ipsilesional RMT, contralesional RMT, lesion location, and lesion volume. A post-hoc qualitative assessment of the influence of lesion subtype on the primary analyses was conducted.

Results: Significantly lower FM scores were observed in individuals with a RHL (mean=41.2, SD=19.8) vs. a LHL (mean=61.5, SD=2.6) (p =0.032). There were no significant relationships between FM scores and other lesion characteristics or RMT values (p>0.05), nor did lesion subtype appear to influence these relationships.

Conclusions: Findings suggest that the degree of post-stroke arm motor impairment was greater with right hemisphere involvement when evaluated in the chronic stage of recovery. Additional lesion characteristics and basal cortical excitability were not significantly related to the degree of persistent arm motor impairment.

Clinical Relevance: Previous research suggests that individuals with a RHL demonstrate difficulty in end point control for UE tasks while individuals with a LHL show difficulty with stabilization and movement trajectory. Taken together, future investigations into the relationships between lesion characteristics, in particular lesion hemisphere, and arm impairment in larger sample sizes using advanced lesion mapping approaches may contribute to novel personalized therapies to improve stroke outcomes.
Neurologic Music Therapy for Gait Training Following Stroke: A Case Study

A.B. Spaulding, B. Harris, Brain Injury Program, Spaulding Rehabilitation Hospital, Charlestown, Massachusetts, UNITED STATES

Abstract Body:
Background & Purpose: Advances in neuroscience research and neuro-imaging have shown the ability of the auditory system to communicate with motor structures in the brain to create an entrainment between a rhythmic signal and a motor response. Audio-motor pathways have rich connectivity at the level of the brain stem and the cerebellum. Changes in motor output have even been noted immediately following the presentation of rhythmic stimuli in individuals who cannot consciously detect rhythmic changes. This entrainment has been translated into a gait training intervention termed Rhythmic Auditory Stimulation (RAS). Clinical trials have shown that RAS can produce significant functional gains of desired gait parameters in persons with neurologic injury including stroke. Initial trials of RAS for individuals following stroke produced improvements in stride length, symmetry, and vertical center of mass translation, while reducing lateral center of mass displacement. More recently, several small studies have shown similar changes in gait kinematics with the use of RAS. The use of RAS in the clinical setting can be practical and cost effective. The purpose of this case study is to examine the use of neurologic music therapy (NMT) in addition to standard practice of care in the inpatient rehabilitation setting following stroke.

Case Description: Mr. A is a 41 year old admitted to the acute hospital due to endocarditis. He then suffered a right middle cerebral artery stroke, rupture of aneurysm caused by an infected thrombus, and uncal herniation. Mr. A was stabilized and transferred to an inpatient rehabilitation facility (IRF) 18 days after admission. While at the IRF treatment focused on neuro re-education, progression of functional mobility, and gait. NMT was initiated during the first week of physical therapy treatment as an adjunct to standard care.

Outcomes: On admission, Mr. A required maximal assistance of two people for all mobility and was unable to stand or ambulate. He scored 33 on the Functional Independence Measure (FIM), 0/56 on the Berg Balance Scale, and was unable to complete any gait measures. Once gait was initiated, Mr. A progressed from ambulating with a four beat gait pattern at 45 beats per minutes to a two beat gait pattern at 70 beats per minute. At discharge, Mr. A was modified independent with bed mobility, close guard with transfers, contact guard for ambulation with a small base quad cane (SBQC), and minimal assistance for stairs. He scored 92 on the FIM, 10/56 on the Berg Balance Scale, and was able to ambulate at cadence of 70 steps per minute. At a five month follow up Mr. A had transitioned home successfully and was walking independently with a SBQC.

Discussion: Mr. A demonstrated improvements in both quantitative mobility measures and qualitative gait parameters during the course of his stay. NMT was an integral part of gait training with this patient. NMT as an adjunct to standard practice in the inpatient setting may promote more normal gait. Further research into the effects of NMT on gait training after stroke is merited.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.:
ABSTRACT BODY:

**Background & Purpose:** Poor balance and poor balance confidence are common post-stroke impairments that contribute to slow gait speed and more significantly to an increased fall risk. Gait and static and dynamic balance training are standard interventions to address these impairments. Given the unique postural and lower extremity motor control demands required to walk backwards, Backward Walking (BW) is a novel training approach that may provide benefit for individuals post-stroke. In community-dwelling elderly, BW speed is inversely related to fall incidence, such that a greater BW speed is associated with fewer falls. Increasing BW speed may serve as a fall-prevention strategy post-stroke. The purpose of this case report is to examine the effects of a BW training program in a patient with chronic stroke.

**Case Description:** Patient is a 64 year old male, 19 months post-right ischemic stroke. Relevant medical history includes Patent Foramen Ovale and intermittent right osteoarthritic knee pain. Following acute management, patient participated in 21 days of inpatient physical therapy for gait, balance and bed mobility training and lower extremity strengthening. Patient was discharged home with spouse, able to ambulate 150 feet with a rolling walker. He experienced a fall 1-month post-discharge. Due to persistent gait impairments he was eligible for a BW rehabilitation study consisting of 18 sessions of gait training both on a treadmill with body-weight support and over ground. The goal for each treadmill session was 20 minutes of BW. Participant was assisted at the lower extremities and pelvis as needed to ensure appropriate kinematics and weight shift. Limb loading, speed and bout duration were consistently progressed. Following each treadmill session, the patient was assisted as needed in 20 minutes of BW over ground. Over the course of the intervention body-weight support decreased 20% to 8%, treadmill speed increased 0.6 mph to 1.0 mph, bout duration increased one minute to four minutes and total BW time on the treadmill increased from 6 to 20 minutes. Assistance at the paretic limb was also decreased.

**Outcomes:** Patient's forward gait speed increased greater than the minimally clinical important difference from 0.43 m/s to 0.71 m/s accompanied by a 10 cm increase in paretic limb step length. BW speed increased 0.25 m/s to 0.40 m/s, and the Activity-Specific Balance Confidence Scale improved by 10 points. At a 1-month retention assessment, in the absence of BW training, these gains were maintained with BW speed increasing to 0.49 m/s.

**Discussion:** This case study explored the use of a novel BW intervention to improve gait in a patient discharged from formal rehabilitation. This was the patient’s first exposure to a BW intervention yet he quickly accommodated with no complaints. The outcomes from this case study suggest that BW training can not only improve forward gait speed to promote community participation, but can also increase BW walking speed and balance confidence, two factors known to reduce fall risk.

**References:** Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old:

- Salbach NM, Mayo NE, Robichaud-Ekstrand S, Hanley JA, Richards CL, Wood-Dauphinee S. Balance self-efficacy and its relevance to physical function and perceived health status after stroke. *Archives of physical medicine and
TITLE: Effects of Excitatory and Inhibitory rTMS on Neurophysiological and Neuromotor Outcomes

AUTHORS/INSTITUTIONS: E.C. Wonsetler, S.A. Kautz, M.G. Bowden, Health Sciences and Research, Medical University of South Carolina, Charleston, South Carolina, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Repetitive transcranial magnetic stimulation (rTMS) has successfully altered upper extremity motor control after stroke, and preliminary findings demonstrate promise in rehabilitation of the lower extremity (LE). However, we lack the foundational work necessary to utilize rTMS as an adjunctive therapy for post-stroke walking rehabilitation. The purpose of this proposal is to investigate the effects of high frequency (excitatory) rTMS, low frequency (inhibitory) rTMS, and sham rTMS on neurophysiological, neuromuscular, and neuromechanical outcomes in individuals post-stroke.

Number of Subjects: To date, 8 participants (4 male, 2 with left hemiparesis, mean age 65.4±14.8 yrs) with chronic hemiparesis (>6 months post-stroke) completed the study.

Materials/Methods: Individuals received a random sequence of rTMS, ipsilesional 10 Hz (excitatory), contralesional 1 Hz (inhibitory), and sham (randomized to excitatory or inhibitory), each on a separate day, over the LE motor cortex (M1) using neuro-navigation (Brainsight). Each rTMS treatment session was preceded and followed by assessments of biomechanical gait, TMS-based neurophysiology (using a Magstim double cone coil), and isometric plantarflexion (PF) and dorsiflexion (DF) strength of the paretic tibialis anterior (TA) and soleus (SOL).

Results: After excitatory rTMS, resting motor threshold (rMT) decreased in TA (6.1%) and SOL (7.9%), paretic propulsion (Pp, a walking-specific measure of coordinated force output) improved by 9.8%, and strength decreased by 11.4% (PF). Following inhibitory rTMS, rMT decreased in the TA (4.6%) and increased in the SOL (5.4%), Pp decreased by 9.7%, and DF strength increased by 16.1%. Lastly, after sham rTMS, rMT decreased in TA (4.9%) and strength decreased by 8.1% (PF) and 6.7% (DF).

Conclusions: Results are preliminary, as only 8 participants out of 20 have completed testing. Following excitatory rTMS, rMT and Pp results are consistent with the hemispheric imbalance model for cortical excitability, as were the SOL rMT and DF strength increases after inhibitory rTMS. However, this model does not predict the decreases in strength after excitation, or Pp decreases and SOL rMT increases following inhibition. Coil placement may be a contributing factor to the variability of results due to decreased localization of M1 specific to the LE (deep within the interhemispheric fissure). Variability may also be due to the heterogeneity of individual lesion location, altered brain activity, and impaired corticospinal tract integrity. The robust nature of the sham response is likely due to outlying responses from participants. Future work plans to assess neuroimaging results as well as different stimulation frequencies in combination with a locomotor rehabilitation protocol.

Clinical Relevance: Non-invasive brain stimulation to alter LE motor control post-stroke continues to demonstrate great potential, but remains in the pre-clinical, exploration phase. Further investigation into the neurophysiological and neuromotor mechanisms of rTMS will be necessary prior to direct clinical translation.
Purpose/Hypothesis: Purpose: Multiple sclerosis (MS) manifests in a variety of symptoms depending on location and prevalence of neuronal scarring. Other factors, such as age, gender, race, onset of disease, and economic resources may impact disease progression and function. This study was designed to identify the most prevalent symptoms and impairments seen in adults with MS, who attended a free community-based clinic.

Number of Subjects: Participants: 25

Materials/Methods: Methods: 25 participants were assessed by physical therapy students and faculty advisors. Data collection included demographics, participant goals, impairments, and individualized tests based on clinical presentation and chief complaints. Data was recorded for 9 African American (AA) females and 2 AA males, and 14 Caucasian females (mean age 52 years; mean period since diagnosis of 13 years).

Results: Results: Trends in symptomology included lower extremity (LE) weakness (84%), balance deficits (76%), fatigue (68%), gait deviations (60%), vestibular deficits (48%), and dizziness with changes in head position (32%). Fatigue was associated with balance impairment, LE weakness, and gait deviations. Relationships were noted between LE weakness and gait deviations, dizziness with change in head position, and vestibular deficits (p < .05). Age, race, and years with MS did not impact presence of balance deficits, fatigue, or LE weakness.

Conclusions: Conclusions: Findings suggest that there is a prevalence of LE weakness, balance deficits, and fatigue in this population of adults with MS seen in a free clinic. These results differed from the recent clinical summaries on MS, which did not specifically report LE weakness or balance impairments. Fatigue may influence the severity and presence of additional symptoms.

Clinical Relevance: Clinical Relevance: Adults with MS may benefit from more detailed assessments in the areas of LE weakness, balance, and fatigue. Clinicians should keep in mind that fatigue may influence the severity and presence of additional symptoms.
Purpose/Hypothesis: Previous research by this team in a group of young adults (22-35 years) suggested that the effect of a cognitive task on static balance changes with age, even in a relatively young cohort. In an extension of this work, the purpose of this study was to test dual task static balance in a group of adults age 22-65 to determine differences between young (YA), middle age (MA) and older adults (OA).

Number of Subjects: Subjects were 55 healthy adults with an average age of 31.2 years, 55% female.

Materials/Methods: Subjects performed the Sensory Organization Test (SOT) with the Natus SMART Equitest system under single task (ST) and dual task (DT) conditions on separate days within the same week. A coin flip determined which condition would be performed first. In the ST condition, the subject stood barefoot on dual-force plates in 3-sided surround. Sway was recorded under 6 sensory conditions: 1. Eyes open (EO), firm surface (FS), 2. Eyes closed (EC), FS, 3. FS, sway referenced visual surround (SRVS), 4. EO, sway-referenced support (SRS), 5. EC, SRS, 6. SRS, SRVS. Each condition consisted of three, 20-second trials where the subject was instructed to stand quietly with hands to their sides. In the DT condition the subject performed the ST condition while simultaneously performing a cognitive task, recalling digits in backwards order. An average equilibrium score for each sensory condition and composite score was calculated for each subject per established protocol. Dual task cost (DTC) was calculated as 

\[ \frac{(ST-DT)}{ST} \times 100 \]

ANOVA statistics were calculated to compare ST, DT and DTC SOT scores among three age groups, 22-29, 30-49, and 50-65 years.

Results: The three groups showed significant differences in SOT composite scores in the DT tests, but not in the ST tests. The OA group had significantly lower scores on the DT SOT for conditions 4, 5, and 6. For the ST SOT, only condition 5 showed a significant difference among the three groups. The OA group showed a DTC suggesting poorer performance on the DT than the ST tests while the YA groups showed no difference between DT and ST tests, or a better performance in the DT vs ST tests (dual task benefit). Age was moderately correlated with DT conditions 4-6 and composite scores, but was only correlated with ST condition 5 scores. Age is moderately correlated to DTC composite score and conditions 4 and 6.

Conclusions: The results of this study demonstrated that ST balance performance was the same across the age groups, whereas DT static balance performance declined with increasing age. The YA group showed a DT benefit, whereas the OA group showed a DT cost. The MA group showed no difference between ST and DT tests. During DT test of condition 5 of the SOT, all subjects performed better than during ST test, and this finding needs further investigation.

Clinical Relevance: DT performance appears to decline at younger ages than previously suggested. Performance of a DT may result in balance deficits that can increase risk of falls, even in middle-aged adults. DT balance screening and interventions may be warranted in younger adult populations.
Purpose/Hypothesis: Technology has advanced rehabilitation interventions, particularly with patients with neurologic dysfunction such as traumatic brain injury (TBI). Objective: The purpose of this systematic review was to examine the effect of body weight supported treadmill training (BWSTT) and lower extremity robotic interventions on gait and locomotion ability among individuals with TBI.

Number of Subjects: Eleven studies met the requisite inclusion criteria.

Materials/Methods: A comprehensive literature search was conducted using the following data bases: Pubmed, PEDro, the Cochrane Library, CINAHL, and the Ovid portal. Inclusion criteria mandated that gait and locomotion performance be primary dependent variables in studies which included randomized control trials, cohort, and case study designs. RCT quality was assessed using Sackett’s Level of Evidence and the PEDro scale for randomized control trials (RCT).

Results: Twenty studies were initially retrieved. Six studies (2 RCT’s) and five studies (1 RCT) met the requisite inclusion criteria for BWSTT and robotic interventions, respectively. The two RCT’s employing BWSTT received PEDro grades of 5/10 and 7/10; in addition, the robotic RCT was rated as a 4/10. Overall, studies incorporating both interventions varied in terms of treatment frequency, duration, and intensity. BWSTT and robotic interventions were not superior to control or usual care treatment. Discordant outcomes measures used in clinical trials made comparisons between studies difficult.

Conclusions: Interventions with both BWSTT and lower extremity robotics in patients with TBI lack sufficient evidence to draw definitive conclusions about their superior efficacy in comparison to other gait and locomotor interventions. More high quality studies with standardized assessment tools are needed to effectively compare these interventions to alternative rehabilitation procedures.

Clinical Relevance: Results of the systematic review will assist physical therapists in designing an effective plan of care for patients recovering from a traumatic brain injury. Results contribute to establishing best practice strategies for gait and locomotion interventions in this population given the availability of technology resources.
TITLE: Multimodal treatment for an adolescent female with concussion using cervical, vestibular-ocular, balance and progressive aerobic exercises: A case report.

AUTHORS/INSTITUTIONS: C.D. DiSanto, Rehabilitation and sports medicine, Cleveland Clinic, Vermilion, Ohio, UNITED STATES

ABSTRACT BODY:

Background & Purpose: Concussion may present with a constellation of physical, somatic, cognitive and emotional impairments, that are lasting and severe at times. Adolescent females in particular may be vulnerable to greater severity and persistent symptoms. Concussion injuries may cause functional disabilities, such as diminished performance with scholastic responsibilities and recreational interests. The purpose of this case study is to describe the current evidence based treatments for an adolescent female with post-concussion syndrome.

Case Description: This case involved a 14 year old color guard in the marching band who sustained a concussion from being hit in the head by her flag 14 days prior to initial physical therapy evaluation. She presented with headache, dizziness, fatigue and cognitive difficulties. Her balance was impaired and she was unable to participate with school or color guard. The patient performed 4 sessions of physical therapy over 4 weeks. Intervention included a combination of manual therapy and exercise for the neck, balance, vestibular-ocular and progressive aerobic exercise.

Outcomes: At the end of 4 weeks the patient reported resolution of symptoms on a concussion graded symptom scale. She had near resolution as measured on the Dizziness Handicap Inventory, the Headache Disability Index, and the Neck Disability Index. Both static and dynamic balance returned to normal: a score of 30/30 was achieved on the Functional Gait Assessment, and the Balance Error Scoring System was within normal standard deviation of error. Neck motion returned to pain-free baseline. Oculomotor impairments were abolished.

Discussion: This case demonstrates the simple and practical use of self-administered questionnaires and objective testing to demonstrate functional improvement for an adolescent female recovering from concussion. Evidence based treatment guided therapy of 5 areas including: the cervical spine neuromuscular system, balance, vestibular-ocular system, graded and progressive aerobic exercise, and self-care education. These combined treatments facilitated near resolution of symptoms and impairments for this individual. At the time of discharge she demonstrated the ability to attend school at her prior level of function and to return to her position in the marching band. Therefore, a combination of evidence based treatments may facilitate quicker and more complete return to function in an adolescent female with post-concussion syndrome.


Feasibility of peer coaching to increase physical activity in people with Parkinson disease

Purpose/Hypothesis: The great majority of individuals with Parkinson disease (PD) are sedentary (1). Long-term engagement in physical activity (PA) increases quality of life and function and may mitigate the progression of the disease (2). Prior research reveals that common barriers to regular exercise and physical activity are primarily psychosocial factors (ie: self-efficacy, outcome expectations) as opposed to physical factors (ie: motor impairments) (3,4). Peer support may positively affect the behavioral factors that are crucial for the adoption of PA (5). There is a critical need for effective methods to assist those with PD to consistently participate in active lifestyles. The purpose of this study was to determine the safety, feasibility, acceptability and initial efficacy of a peer coaching model to increase PA (ie: walking activity) in people with PD. We hypothesized that a peer coaching model would be safe, feasible and acceptable to those with PD. In addition, we hypothesized that individuals would have higher levels of PA with peer support compared to baseline levels of PA without peer support.

Number of Subjects: 10 individuals with PD (5 peer coaches, 5 peer mentees)

Materials/Methods: A peer coaching training program was developed and pilot tested with individuals with PD. The peer coaches were trained in basic knowledge of PD and exercise, active listening and motivational interviewing during online and in-person training. All participants were given FitBit Zip activity monitors. Peer pairs interacted via the FitBit application and via weekly telephone calls for a period of 8 weeks.

Results: There were no adverse events over the course of the study. All participants would recommend this program to others with PD. All peer coaches and mentees were satisfied/very satisfied with the peer coaching experience. Four of the five peer pairs completed all eight recommended phone conversations and the remaining pair completed six of the eight phone conversations. The peer mentees increased their average steps/day by 31% from 5428 steps (SD 2440) to 7115 steps/day (SD 1291). Four of the five peer mentees increased their average steps/day above the minimally clinically important difference.

Conclusions: Peer coaching is safe, feasible and acceptable in people with PD. Peer coaching may be an effective method to increase PA in people with PD. Further research is needed to understand the factors that mediate this relationship.

Clinical Relevance: Peer coaching may be an effective adjunctive intervention to physical therapy in order to sustain and support active lifestyles in people with PD.
Purpose/Hypothesis: Stroke is a leading cause of long-term disability in adults often resulting in functional limitations of the upper extremities (UE). Although several strategies have been utilized during rehabilitation of the hemiparetic arm following stroke, there are limits and challenges of known intervention approaches. Therefore, the purpose of this study was to determine whether application of vibration on spastic hand muscles can improve upper extremity functions. It was hypothesized that application of vibratory stimulus on spastic hand muscles would improve hand functions by reducing muscle tone of wrist flexor and finger flexor muscles.

Number of Subjects: Eleven individual with chronic hemiplegia following a stroke (ages 55-71 years old; time since stroke from 1-11 years) who had >10 degrees of passive wrist extension, >5 degrees of passive finger extension in the affected arm were recruited.

Materials/Methods: Participants were divided into two groups with six individuals in the treatment group and five individuals in the control group. Each individual in the treatment group received vibration treatment twice daily followed by 15 minutes of functional activities for five days a week for six weeks while control group received 15 minutes of functional activities twice daily and five days a week for six weeks. Measurements were taken at 0 and 6 weeks of treatment. Functions of the UE were assessed using Wolf Motor Function Test (WMFT) and Nine Hole Peg Test (NHPT), spasticity of wrist wrist and finger flexor muscles was assessed using Modified Ashworth Scale (MAS), and grip strength was determined using Microfet 2 dynamometry. Percentage of changes in WMFT, NHPT and grip strength from 0 week were calculated. Statistical analyses were performed using the Wilcoxon test for MAS scores and the paired t-test for the percentage of changes of other measurements between control and experimental group after 6 weeks of treatment. P<0.05 was considered statistically significant.

Results: Grip strength and WMFT Functional Ability Scale appeared to show significant improvement in the experimental group after 6 weeks of treatment when compared to the control group. Both NHPT scores and WMFT time scores showed significant reduction in experimental group compared to the control group. Individuals in experimental group showed significant improvement in the MAS scores of wrist flexor and finger flexor muscles when compared to individuals in the control group.

Conclusions: It appeared that application of vibratory stimuli on spastic hand preceding functional use improved arm and hand functions, in hemiparetic individuals following stroke. Based on our study, we may conclude that vibratory therapy has some benefits in reducing muscles tone and improving motor functions of UE. Further research with a larger sample size is required to generalize the effects of vibration on arm functions.

Clinical Relevance: Vibratory stimulation could be advantageous for improvement of UE functions in individual with stroke and may be used as adjunct during stroke rehabilitation.
TITLE: Vibration tilt-table improves training performance in a wearable robotic exoskeleton: Two case observations for individuals with severe lower limb spasticity.

AUTHORS/INSTITUTIONS: C.J. Newsam, Doctor of Physical Therapy Program, Mount Saint Mary's University, Los Angeles, California, UNITED STATES| D.L. Weidemann, M.S. Grufstedt, T.J. Cassetty, Able Bionics USA, Inc, Aspen, Colorado, UNITED STATES|

ABSTRACT BODY:

Background & Purpose: Technology designed to augment mobility and recovery for individuals with neurologic dysfunction are becoming more prevalent. Unfortunately, research and clinical expertise of these devices may be limited when they are first introduced into market. A unique challenge is how multiple technologies can be combined to improve patient care. The purpose of this case study report is to describe an application of a whole-body vibration tilt table (WBVTT)\(^1,3,4\) for the purpose of improving performance in and outcome from a wearable robotic exoskeleton (WRE)\(^2,4\).

Case Description: Two individuals were treated using the WBVTT prior to WRE training sessions. Client 1 was 16 months post incomplete spinal cord injury and was ambulating with a walker and one KAFO. Client 2 was a 28-year-old with a diagnosis of cerebral palsy (spastic quadriplegia) and was walking with a walker and two AFOs. Both clients had hypertonicity/spasticity measuring 3-4 on the Modified Ashworth Test in several lower limb (LL) muscles. Client 2 also had bilateral hip and knee contractures that initially excluded her from WRE use. After 10 sessions of WBVTT and passive stretching, this individual was able to increase LL ROM such that she was able to meet the inclusion criteria for the WRE. WBVTT sessions included 2 to 4, 3-minute bouts at 50 to 70 degrees of tilt (18-24 hz vibration).

Outcomes: Clinical observation identified that LL tone/spasticity was reduced following WBVTT sessions. This allowed for improved quality of gait training in the WRE. Sit-to-stand and walking function in the WRE improved which decreased motor demands of the WRE and increased battery life allowing for longer training session. Clients quickly progressed to the adaptive mode of the WRE (vs. maximum assistance) which allowed for active participation from the client. Client 1 reported subjective benefits of the combined sessions including: greater walking confidence and distance; improved bowel sensation, LL circulation and sleep; reduction in use Gabapentin use for nerve pain; as well as improved strength and decrease tone. Client 2 reported similar benefits of the combined sessions including: increased walking confidence and speed; improved bowel and bladder function; increased circulation in her feet; decrease of nerve and muscle pain; and improved strength and decreased tone.

Discussion: Clinical observations suggest that WBVTT use prior to WRE walking can improve session performance and potentially improve clinical outcome. Collection of additional objective data on future clients is needed to determine if combining these 2 technologies is beneficial for a larger group of individuals with a variety of neurological conditions.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old: 1. Dickin DC, et al., The acute effects of whole-body vibration on gait parameters in adults with cerebral palsy. J Musculoskeletal Neuronal Interact 2013; 13:19-26.


TITLE: Incremental vestibulo-ocular reflex gain adaptation: Effects of background light and intensity

AUTHORS/INSTITUTIONS: M. Schubert, Johns Hopkins, Baltimore, Maryland, UNITED STATES|M.M. Mahfuz, A.A. Migliaccio, Neuroscience Research Australia, Randwick, New South Wales, AUSTRALIA|

ABSTRACT BODY:

Purpose/Hypothesis: Tradition has taught that vestibulo-ocular reflex (VOR) gain adaptation occurs:
1. In complete dark
2. Using large error signals (i.e. wearing strong magnifying/minimizing lenses)
3. Using whole body (head) rotation
4. Using slow head velocities and/or low frequencies
We have developed a method to increase the VOR gain (eye-velocity/head-velocity) on one side (or both) using an error signal that gradual increases over a 15 min interval (incremental velocity error, IVE) while making fast head rotations (Schubert et al 2008a; Migliaccio and Schubert MC 2013; Migliaccio and Schubert 2014; Fadaee and Migliaccio 2015). We sought to determine the effect of background light level (lux) and laser target intensity on VOR gain adaptation.

Number of Subjects: We tested 12 normal subjects over 10 separate sessions.

Materials/Methods: For sessions 1-8, the background light level (lux) during adaptation training was: dark, 0.1, 0.2, 0.3, 0.5, 0.7, 1 and 475 lux. For sessions 9-10 the laser target intensity was halved with a background of 0 and 0.1 lux. The adaptation training lasted 15 minutes and consisted of left/right active head impulses. The VOR gain was challenged to increment, starting at unity, by 0.1 every 90 seconds for rotations to one side (adapting) and fixed at unity towards the non-adapting side. We measured active and passive VOR gains before and after training.

Results: We found a significant VOR gain increase dependent on lux intensity and side of the adaptation (p ≤ 0.0001), however the type of impulse (active vs passive) and brightness intensity did not affect the VOR gain change. The greatest increase in VOR gain occurred on the adapting side in complete dark (13 ± 3.8%, 0 lux), however even at 1 lux the VOR gain change was still increased by 9 ± 4.6%. At 0.1, 0.2, 0.3, 0.5, 0.7 and 1 lux the significant gain increase was 9 ± 2%, 7 ± 3%, 6 ± 2.8%, 9 ± 4.7%, 6 ± 1.8% and 9 ± 4.6%, respectively. At 475 lux (office lighting), the VOR gain increase towards the adapting side was no different than the roughly 4% increase towards the non-adapting side at all light levels.

Conclusions: Our data suggest IVE VOR adaptation training occurs in light levels that are low but not completely dark. IVE training appears robust to enable adaption in test conditions different to training, i.e., both the active and passive VOR adapted even though the training consisted of active head rotations only.

Clinical Relevance: VOR gain adaptation is possible in clinical and home environments where it would be difficult to ensure complete darkness. Prior data has shown VOR gain increases from 7% to 28% (Schubert et al 2008b) are enough to improve the ability to see clearly during head rotation (as measured by dynamic visual acuity), within the ranges our IVE method provides.
Background & Purpose: Background & Purpose: Stiff-Person Syndrome (SPS) is a rare, progressive central nervous system disorder. SPS commonly presents with rigidity and severe, painful spasms of the truncal and proximal limb muscles. Individuals with SPS commonly demonstrate anxiety related to mobility, which can increase frequency and severity of spasms, and slow progression during rehabilitation. Effective approaches to mitigate the effects of anxiety on mobility remain unknown. Although rehabilitation outcomes often focus on mobility recovery, compensatory strategies may be necessary for individuals with SPS to decrease mobility-related anxiety. Therefore, the purpose of this case is to describe the use of compensatory treatment strategies to decrease anxiety and progress functional mobility in a patient with SPS.

Case Description: Case Description: The patient was a 79-year-old male diagnosed with SPS 30 years ago. He had recently experienced an increase in falls and a subsequent decline in functional mobility. He was seen by physical therapy (PT) for 90 minutes a day, 5 days a week, for 15 days. Due to the severity of his extensor spasms during transfers, he initially required total assistance of two people to transfer. Initial interventions were focused on recovery of mobility, specifically transfers, in order to improve his level of independence. However, the patient’s heightened anxiety and resultant extensor spasms limited progress and recovery, thereby leading to the practice of compensatory strategies to allow for success with functional tasks. The Functional Independence Measure (FIM) was used to evaluate progress.

Outcomes: Outcomes: Following 15 days of inpatient PT, with a shifted treatment focus from recovery to compensation, the patient improved his FIM transfer score from total assistance (1) to supervision (5). The patient reported reduced anxiety when provided with a training environment that he perceived to be safe and secure. With reduced anxiety, he also had fewer spasms and performed the transfer more quickly and confidently. These compensatory, environmental modifications allowed the patient to discharge home safely with his wife.

Discussion: Discussion: There is little research evaluating the effect of PT on functional mobility in patients with SPS. In this case, the patient’s increased level of mobility-related anxiety triggered severe and debilitating spasms that interfered with his ability to progress. Anxiety has been shown to lead to increased muscle tension and overactivity in both healthy individuals and those identified as having high levels of anxiety. The PT approach in this case was to modify the external environment in order to reduce anxiety and improve the patient’s level of independence with functional mobility tasks. Although the primary focus of rehabilitation is typically recovery-based, the patient in this case was able to achieve a greater level of independence and return home with the use of compensatory strategies to reduce spasms and anxiety.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: Sarva H, Deik A, Ullah A, Servert WL. Clinical Spectrum of Stiff Person Syndrome: A Review of Recent Reports. Tremor and Other Hyperkinet Mov. 2016;6. Doi 10.7916/D85M65GD.


Background & Purpose: This case study presents the complicated and complex therapy course of a patient who presented with one sided multiple canal Benign Paroxysmal Positional Vertigo (BPPV), complicated by a history of migraine and anxiety that transitioned to Persistent Postural Perceptual Dizziness (PPPD).

Case Description: Patient S presented to physical therapy with debilitating vertigo, a history of migraines, anxiety and posterior canal BPPV. She was treated in therapy for seven and a half months. She was found to have BPPV of the posterior, anterior, and horizontal canal through her course of care, and with the resolution of her BPPV was treated for vestibular migraine and PPPD.

Outcomes: On initial evaluation, Patient S scored 82/100 on the Dizziness Handicap Inventory (DHI) and 27% on the Activities Specific Balance Confidence Scale (ABC) She subjectively rated her dizziness 0-10/10 with getting in and out of bed, rolling in bed, bending over and looking up. With positional testing she was positive for left posterior canal BPPV, and one canalith repositioning maneuver (CRM) was performed. On her second visit she presented with left torsional upbeating nystagmus during the first CRM that transitioned to horizontal left beating nystagmus indicative of left horizontal canal BPPV. After 39 days the left posterior and horizontal canals were clear, treated with multiple CRMs, BBQ rolls, liberatory maneuvers and prolonged positioning. Her DHI improved to 48/100 and ABC to 86%. Five days after the resolution of her BPPV, she reported several episodes of spinning while getting out of bed and in the shower. Repeat testing was clearly positive for left anterior canal BPPV. Patient S was treated over the course of the next 56 days with the deep head hanging maneuver, CRM and the Forward Particle Repositioning Maneuver. With the resolution of the anterior canal BPPV, Patient S had asymptomatic persistent right beating nystagmus with all positional testing, as well as right beating nystagmus with Head Shake Test. Given her migraine history, her nystagmus was assumed to be migraine related. Her function and participation continued to improve with DHI: 32/100 and ABC: 91%. With the resolution of BPPV, intervention efforts shifted to postural control and habituation. She subsequently returned to, eye/head coordination, core stability and aerobic exercise training. Additional treatment was focused on the management of her PPPD with meditation and relaxation techniques, pharmaceutical management and counseling for her anxiety. At the end of her treatment her DHI was 30/100 and ABC was 91%. She rated her dizziness 0/10 and returned to working out at the gym.

Discussion: Through the course of therapy Patient S had a resolution of the BPPV in all canals and she benefited from treatment to address her dizziness and unsteadiness from PPPD. Patient S had a complicated trajectory secondary to her history of migraine and anxiety and multiple canal involvement. The complicated vestibular patient often needs an extended treatment period as well as a wide variety of progressive interventions for a full return to function.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: Agrawal, Yuri, John P. Carey, Charles C. Della Santina, Michael C. Schubert, and Lloyd B. Minor. "Disorders of Balance and Vestibular Function in US Adults." Arch Intern Med Archives of Internal Medicine 169.10 (2009): 938. Web.


Background & Purpose: Integration of technology in the clinic can play an integral role in patient care; especially when the technology can offer the patient and clinician real-time objective feedback. Examples of current technologies used in the clinic for improving patient learning and patient care, include virtual reality, simulated auditory feedback, and telerehabilitation. Since motor skill acquisition requires proper feedback, novel technologies which can aid the timing and amount of feedback provided may assist in improved skill acquisition for patients. A common clinical scenario of acquiring a skill occurs with weight shift during gait or a sit to stand task in patients with hemiparesis, such as stroke. The technology used in this case study was designed to provide real-time feedback, using bilateral shoe inserts with force plates and a tablet via Bluetooth about symmetry of weight shift during sit to stand training.

Feedback provided included overall force between feet via percentages. The purpose of this case study is to describe the use of this real-time feedback technology about force distribution (FD) in a patient with stroke during sit to stand training to improve weight shift symmetry.

Case Description: The subject is a 70-year-old female who suffered a right CVA 20 months prior to intervention. Patient presents with left hemiplegia, requires minimal assist for sit to stand, walks with a hemi-walker, a rigid AFO, and has a poor weight shift onto the left lower extremity during gait and functional tasks. Intervention focused on task-specific training for sit to stand, with FD feedback (12 trials performed). Initial two trials the subject was only given continuous verbal feedback by the therapist to shift her weight onto the left limb throughout the sit to stand. Visual feedback via device was provided during trials 3 – 12 showing the patient and therapist FD. Data is described for the initial 2 trials and final 2 trials using the device.

Outcomes: Initial, trial 1 FD: Right (R) = 82% / Left (L) = 18%. Trial 2 FD: R = 73% / L = 27%. Final trials trial 11: FD: R = 58% / L = 42%. Trial 12: R = 61% / L = 39%. The subject shows an average of 18% of her weight shifted to her paretic side during the last two trials versus the first two, which results in an overall 44% improvement in weight distribution.

Discussion: This case study shows the benefits of using real time visual feedback for a patient during sit to stand training. This device gave the patient and therapist real time feedback of FD and resulted in increased force symmetry between the limbs during the final 2 trials of sit to stands. This objective feedback allows for real change to be observed which may not be obtained as well when only verbal feedback by therapist is provided. This device has the potential for many applications inside and outside of the clinic to assist patients and clinicians to better assess and teach proper FD, including during gait training and provides anterior/posterior weight shift data as well as lateral weight shift.

ABSTRACT BODY:

Background & Purpose: Migraines are complex medical conditions influenced by a variety of factors. There is typically no cure, instead symptoms are managed. The purpose of this case study is to demonstrate effective management of migraines through education and intervention within the context of the individual as a whole. It is also to encourage therapists to develop treatment plans that go beyond treating initial impairments and incorporate improvement of functional limitations and disabilities.

Case Description: A 41 year old female presented with a 2 year history of dizziness, vertigo, and imbalance. Her roles included wife, mother and home maker. Her daily tasks included home care, meal preparation, family care and exercise. Her medical history included migraines and whiplash. Previously she received PT for neck pain and headaches.

Outcomes: Initial impairments included symptoms rated 5 on a 0-10 scale. Dix-Hallpikes were positive for left posterior canal canalithiasis. Functional Gait Assessment (FGA) was 13 out of 30. Dizziness Handicap Index (DHI) was 62 out of 100. Functional limitations included inability to do house work, inability to drive for 2 years, and inability to exercise. Disability was evident in her inability to fulfill responsibilities as wife and mother.

She was initially treated with Epley maneuvers. BPPV resolved in 3 sessions. She continued to have dizziness and balance concerns that limited her daily activities. Residual impairments, functional limitations and disabilities were addressed with vestibular rehabilitation, manual therapy, stretching, core stabilization, deep neck flexor training, education on body mechanics and sleep posture, and consultation with her neurologist on medication management.

At discharge, her symptom rating improved to 0, FGA to 26 and DHI to 0. Functional improvements included being able to drive for 30 minutes, being able to exercise on a treadmill and being able to meet her family and home responsibilities without symptom interference. She returned to successfully fulfilling her responsibilities as wife and mother.

Discussion: “Health-related quality of life (HRQL) can be said to represent the total effect of individual and environmental factors on function and health status.” (APTA, 2003, p.24). This case example demonstrates that although migraines are very complex and difficult to manage due to individual and environmental triggers, a physical therapist can successfully influence quality of life through direct intervention and education. It also demonstrates that once an initial impairment such as BPPV is eliminated, further intervention can restore a patient’s functional abilities to be successful in life roles.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: American Physical Therapy Association (2003). Guide to Physical Therapist Practice (2nd ed.). Alexandria, VA. 13-25.


TITLE: Does dual task treadmill walking activate spinal circuitry in people with Parkinson’s disease?

AUTHORS/INSTITUTIONS: M.B. Smith, C. Barnes, J.C. Wahab, G. Ames, P. Bailey, E. Blankespoor, T. Buessing, K. Miesbauer, C. Patis, C. Prewitt, C. Rauert, School of Physical Therapy, Regis University, Denver, Colorado, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Single tasks (ST) are rarely performed in everyday activities; instead, most people engage in motor and/or cognitive dual tasks (DT), resulting in decreased performance in either task. Treadmill walking (TM), a routine clinical intervention, has not been compared to overground (OG) to assess DT impact in Parkinson’s Disease (PD). The aim of this study was to compare effects of OG and TM gait while performing ST, and motor and cognitive DT activities.

Number of Subjects: Twenty-one community-dwelling adults, ages 53 to 73 and diagnosed with Parkinson’s Disease (Hoehn & Yahr Stages I - III) participated. Those with musculoskeletal, cardiovascular, and other neurological disorders that limited ambulatory ability were excluded.

Materials/Methods: Characteristics recorded included demographics, cognitive MMSE, and the Uniform Parkinson’s Disease Rating Scale scores. The Action Fluency cognitive test provided a ST cognitive score. Subjects were instructed to walk at their self-selected pace (OG) on an instrumented mat (GaitRite™) and independently on a TM at self-selected speed as a ST and during motor (walk and carry a glass of water) and cognitive DT (walk and recite words) activities. Gait parameters and cognitive performance were obtained for each task.

Results: For OG ambulation gait velocity was significantly slower (p<.008) for both motor and cognitive DT, with a clear effect of PD Stage on gait. Although TM speed was slower than OG, no subject required slowing of TM speed so TM velocity was unchanged for ST and DT. When cognitive tasks were examined for 60 second word production, there was no significant difference between ST and DT production for either OG or TM. Calculation of OG dual task interference rose significantly more with cognitive than motor DT.

Conclusions: When cognitive DT were undertaken, OG velocity significantly decreased while TM velocity was unchanged; thus OG gait was affected at the expense of the cognitive task. Absence of a significant decline in cognitive DT performance on the TM may indicate that little or no DT interference occurred. Use of TM appears to have activated two distinct neuronal pathways: one processing motor walking, the other, cognitive word production. We speculate that TM walking at a constant speed generates a nearly automatic process through central pattern generators in the spinal cord, freeing the cortex to address the control required for cognitive function. The use of TM reinforces the view of some that DT walking improvements may be due to enhancing gait automaticity.

Clinical Relevance: The literature is unclear whether DT activities can be improved with practice. While ST and DT OG gait in PD has been examined, use of TM and DT has not been addressed as an intervention to determine whether transfer of training can be expected when a patient moves from TM to OG. Additionally, physical therapists should calculate DT interference as a ‘cost’ for classifying DT impact to examine effects on rehabilitation.
Effectiveness of Exercise Program on Reducing Fatigue in Parkinson’s Disease: A Systematic Review

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Purpose/Hypothesis: Parkinson’s disease (PD) is characterized by cardinal motor symptoms, e.g., bradykinesia, rigidity and tremor, and also associated with non-motor symptoms such as constipation, fatigue, and olfactory deficits etc. [1-2]. Fatigue is frequently reported as one of the most debilitating symptoms and voted as the leading symptom in need of research by patients with PD [3-4]. Currently, no effective treatment is available for PD-related fatigue which has equivocal responses to anti-PD medication [5]. Accumulating evidence suggests that exercise training improves PD-related fatigue [6]. The purpose of this systematic review was to evaluate the effects of exercise programs on treating fatigue in patients with PD.

Materials/Methods: A systematic search of databases CINAHL Complete, PubMed, and PEDro was performed using search terms: “Parkinson’s disease” AND “fatigue” AND “exercise” OR “physical therapy.” In order to be included in this review, the studies had to be either randomized controlled trials or a quasi-experimental study, and to meet the following inclusion criteria: 1) patients with Parkinson’s disease; 2) using exercise training, such as treadmill training, LSVT BIG therapy, general exercise, and land-based aerobic walking; 3) fatigue as one of outcome measures; and 4) a score of at least 5 out of 10 on the PEDro scale that was used to assess the methodologic rigor of each individual study.

Results: Four randomized controlled trials [7-10] and two quasi experimental trials [11-12] published in and after 2012 were included in this systematic review. Five of the six studies consistently demonstrated statistically significant reductions in fatigue following exercise treatment programs [7,9-12]. Canning et al. [7] showed greater improvement in fatigue in the group receiving treadmill training at posttest (p < 0.05). A significant improvement upon exercise in the Fatigue Severity Scale (p < 0.01) was demonstrated by Uc et al. [9]. Dashtipour et al. [10] reported statistically significant improvement in the Modified Fatigue Impact Scale at 6-month posttests for both LSVT BIG and General Exercise groups (p < 0.05). Cugusi et al. [11] reported a significant decrease in the Parkinson’s Fatigue Scale (p < 0.005) due to the effects of the Adapted Physical Activity program. Kelly et al. [12] reported a significant improvement in fatigue assessed by the Fatigue Severity Scale (p < 0.05) following a resistance, endurance, and balance training. On the other hand, Winward et al. [8] found no significant change in fatigue in response to a therapist-supported and patient’s self-determined weekly exercise program (p > 0.05).

Conclusions: This review has shown that multiple modes of exercise treatment programs were effective in reducing fatigue levels in patients with PD.

Clinical Relevance: Physical therapy should be considered as an integral component of clinical management of PD-related fatigue and other symptoms, ultimately enhancing and maximizing the quality of life in patients with PD.
Purpose/Hypothesis: Mobility is central to activities of daily living, participation in societal roles, and quality of life. Life-Space Assessment (LSA) is a self-reported measure of mobility that reflects the values, preferences, needs, and outcomes that are most important to patients and/or caregivers. Difficulties with balance have been linked to poor mobility as measured by performance-based clinical measures. We investigated the hypothesis that subjects with a higher score on the Brief-BEST and the Short version of Activity-specific Balance Scale (ABC-6) would also have a higher score on the LSA.

Number of Subjects: 40

Materials/Methods: Community-dwelling adults aged >50 years participated (44% female). The inclusion criteria were: able to follow instructions in English, medically stable, no neurologic conditions, and no severe pain affecting standing/walking. Primary outcomes were LSA total score and sectional scores at 5 levels: (1) home, (2) outside of house, (3) neighborhood, (4) town, and (5) outside of town and unlimited. Independent variables were balance performance measured by Brief-BEST, and ABC-6. Covariate were age and functional comorbidity index (FCI). Forward stepwise linear regression was applied to determine the contribution of cognition to LSA. The significant level was p<0.05.

Results: Descriptive statistics (mean±SD) are as followed: age=66.4±9.29 years; FCI=4.9±2.94, Brief-BEST=13.4±5.81, ABC-6=54±27.7%, LSA Total=56.8±23.05, LSA Section-Home=7.5±0.97, Outside of House=12.9±3.49, Neighborhood=13.4±7.01, Town=15.6±8.70, and Outside of Town=7.5±8.68. Regression analyses showed that: (1) Better balance measured by Brief-BEST and lower comorbidity measured by FCI were significantly associated with higher LSA Total scores (p<0.001), indicating better overall mobility. These variables together explained 56% of variance in LSA Total scores, (2) Brief-BEST and FCI significantly contributed to scores of LSA Section-Home (p<0.01) and LSA Section-Outside of House (p<0.01), (3) Balance confidence measured by ABC-6 significantly contributed to scores of LSA Section-Neighborhood (p<0.01), (4) ABC-6 and FCI significantly contributed to LSA Section-Town (p<0.001), (5) Brief-BEST significantly contributed to LSA Section-Outside of Town (p<0.01).

Conclusions: Balance performance was an important factor determining overall self-reported mobility, particularly for mobility within one’s home, outside of house, and outside one’s town. Balance confidence influenced self-reported mobility in the neighborhood and community within one’s town. Mobility may be multifaceted in its construct. Balance performance and perceived competence in balance while carrying out daily activities may contribute to different levels of mobility in terms of life space.

Clinical Relevance: Clinicians need to assess balance using both self-reported and performance-based tools while addressing patient-reported limitations in mobility. Addressing patients’ balance performance as well as balance confidence and working to improve the two can have effects on mobility and overall quality of life.
Feasibility and Benefits of a Brief, Intense Exercise Program Targeting Balance, Gait, Endurance and Upper Extremity Function in Persons with Parkinson Disease: A Case Series


Background & Purpose: Parkinson Disease (PD), a progressive neurological disease, affecting about 1% of persons above the age 60 in the US, is associated with rigidity, bradykinesia, tremors and postural instability. Functional decline is typically seen as the disease progresses. Intensive exercise programs have been studied in persons with PD, but not week-long intensive models. The purpose of this case series was to describe the feasibility and benefits of a week-long intensive exercise program, Movement Camp (MC), for individuals with PD.

Case Description: Fifteen participants, Hoehn and Yahr stage 2-3, completed one of three annually scheduled MCs. Two participants completed three consecutive MCs. Only data from their first MC are included. The MC week consisted of 3.5 full days of exercise, 5.5 hours per day, (19 hours of exercise in one week), and two half days of testing. In pairs, participants rotated through four high-intensity, literature-based, one-hour intervention stations where they completed exercises targeting balance, gait quality, endurance and upper extremity function. Participants also completed three 30-minute group sessions: warm-up, cool-down and flexibility training. Testing was completed at the beginning of the week, immediately post intervention and at six-weeks post intervention. Participants (n=5) in the most recent MC have not completed the six-week post intervention testing. This testing is scheduled for July of 2016.

Outcomes: All participants completed the exercise program with no adverse events. At the immediate post intervention testing, all participants made gains in the 6-Minute Walk Test (6MWT) and the Mini-BESTest, and 11 of 15 on the United Parkinson Disease Rating Scale (UPDRS). Gains exceeded the minimal detectable change (MDC) for six of 15 participants for the Mini-BESTest and three of 15 for the UPDRS. Nine of 15 participants improved in the five times sit to stand (5xSTS) and fast gait speed. Gains exceeded the MDC for three of 15 participants for the 5xSTS and fast gait speed. At the six-week post testing, gains in the 6MWT and Mini-BESTest were maintained by the 10 participants who have so far completed the six-week post testing, and six of the 10 participants retained their gains in the UPDRS. Gains exceeded the MDC for two of 10 participants for the 6MWT and four of 10 for both the Mini-BESTest and the UPDRS. Nine of the 10 participants maintained their gains in the 5xSTS and fast gait speed. Gains exceeded the MDC for four of 10 participants for the 5xSTS and three of 10 for fast gait speed. The two participants who completed three consecutive MCs showed gains in most tests when comparing baseline scores from each year.

Discussion: An intensive 19-hour intervention appears to be safe and feasible for individuals with PD to improve and maintain function. A randomized trial is needed to validate this model.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: References:


Purpose/Hypothesis: Following a stroke, rehab interventions that target paretic propulsion for smooth forward progression during walking may improve energy consumption. The attentional resources needed during this walking relearning process, however, may be inadequate or unavailable in this population. Therefore, motor interventions may not be as effective if patients don’t have the cognitive resources to devote to relearning walking strategies. The purpose of this study was to determine the effect of an additional cognitive task applied during a novel walking retraining task on the energy cost of walking.

Number of Subjects: Six participants (4F/2M; 52±12 years) with chronic (>6 months) stroke and 8 unimpaired control subjects (5F/3M; 26±3 years) participated in this single session study.

Materials/Methods: Subjects completed three randomly ordered walking conditions on a dual-belt instrumented treadmill for up to 5 minutes, with 5 minutes rest between conditions: 1) propulsion assistance (Anterior); 2) propulsion assistance with concurrent cognitive task (Dual-task); and 3) control (usual) walking. Propulsion assistance was provided with an elastic band to facilitate anterior center of mass velocity during paretic propulsion only. During the Dual-task condition, accuracy and reaction time (button press) data were collected from a 2-back task, which were compared to single-task performance using a paired samples t-test. We also recorded gas exchange (VO\textsubscript{2} inspired/VCO\textsubscript{2} expired) on a breath-by-breath basis using a portable metabolic cart. The average VO\textsubscript{2} was normalized to walking speed (cost of transport [COT]) over the final minute of each condition and compared separately for each group between conditions using a repeated-measures ANOVA, with Bonferroni-corrected paired samples t-tests used for post-hoc analysis.

Results: Accuracy (p=0.659) and reaction time (p=0.734) of the cognitive task were not altered during the dual-task condition compared to a single-task cognitive condition in the Stroke group. The Control group had no dual-task effect on accuracy (p=0.717), but had slower reaction time during walking compared to sitting (p=0.011). The propulsion assistance provided significant reductions in COT (p<0.001; \eta^2_p=0.515), with no difference between the Anterior and Dual conditions in either group (p=0.140).

Conclusions: The addition of a cognitive component to a treadmill intervention did not increase energy expenditure. During the dual-task condition, individuals were able to maintain a lower COT with the propulsion assistance, while also maintaining accurate and rapid responses. It is possible that the propulsion assistance did not require additional cognitive resources, or that the additional cognitive task was not taxing enough for our subjects.

Clinical Relevance: A treadmill walking intervention that assists with smooth forward propulsion may be a feasible intervention to reduce the energy cost of walking while not requiring individuals to increase cognitive demands during the walking task.
The Impact of LSVT BIG Training on Balance and Dual-task Performance on Individuals with Parkinson Disease: A Case Series

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Background & Purpose: For individuals with Parkinson disease (PD), falls are a common and devastating clinical problem that may result in injury, loss of independence, and reduced quality of life (QOL). Increased risk of falls has been linked to multiple factors, including impaired dynamic balance and impaired dual task ability. Evidence supports high intensity, task specific, supervised exercise to improve postural control and reduce falls. One such program is the Lee Silverman Voice Treatment (LSVT) BIG training program, which focuses on large amplitude movements to reduce bradykinesia for individuals with PD. Evidence supports the use of LSVT BIG to improve motor and non-motor symptoms of PD, but the effect on dynamic balance, dual task performance and fall risk is not known. The purpose of this retrospective case series is to describe the impact of LSVT BIG training on the balance, gait, dual-task performance, balance confidence, and QOL of 4 individuals with PD.

Case Description: The LSVT BIG training program was delivered to 4 community-dwelling adults (ages 67-91) with moderate PD (Hoehn & Yahr stage 3). In the last 6 months 1 patient reported a fall and 1 patient reported daily near falls. Assistive devices were used by 2/4 patients. The following outcome measures were performed with all patients: Mini-BESTest, Timed “Up&Go,” (TUG), TUG cognitive, and 10 meter walk test (10MWT). In addition, 3/4 patients also completed the 6 minute walk test (6MWT), 5 time sit to stand (5TSTS), Activity Specific Balance Confidence Scale (ABC), and Parkinson Disease Questionnaire 39 (PDQ-39). Prior to intervention, 4/4 patients were classified as high fall risk by at least 1 outcome measure. Each patient received 4 weeks of LSVT BIG training (16-18 individual 1 hour sessions) and a daily home exercise program (HEP).

Outcomes: Gait and balance improved in all patients, with changes exceeding the MDC for the Mini BESTest (4/4), 6MWT (2/3), 10MWT (2/4), and 5TSTS (2/3). All patients were considered low fall risk at post-testing as determined by the TUG-C and 3/4 patients were low fall risk on the Mini-BESTest. Improved balance confidence was noted on ABC for 3/3 patients, with 1 patient’s score exceeding the MDC. Changes on the PDQ-39 did not exceed the MDC for any patient. No falls were reported during the intervention period. Prospective follow up testing is ongoing.

Discussion: This case series reinforces the impact of LSVT BIG training on the motor symptoms of PD and demonstrates improvements in dynamic balance and dual task performance that have not previously been reported. These were seen in all patients, despite differences in age, number of co-morbidities, and adherence to HEP. These changes did not translate to reported improvements in QOL. Based on these results, LSVT BIG training can improve gait speed, dynamic balance, walking endurance, and has the potential to prevent falls in community dwelling individuals with PD. Future studies are indicated to further investigate this relationship.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.:


TITLE: The Effect of Incline versus Decline Walking in Chronic Stroke

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ABSTRACT BODY:

Purpose/Hypothesis: Improved symmetrical force output is a primary goal of walking rehabilitation after stroke. Previous work demonstrated that incline walking improves ground reaction forces, but the effect of incline walking on the center of mass acceleration (COMa), a potential clinical surrogate to laboratory-based measures of kinetics, is unclear. In addition, little is known regarding the biomechanical effects of decline walking, in spite of associated improvements in walking function. The purpose of this study is to examine the biomechanical effects of incline and decline treadmill walking on kinetic outcomes in individuals > 6 months post-stroke.

Number of Subjects: 21 individuals post stroke, 12 male, 14 with left hemiparesis, mean age 53.6±15.3 years, mean time since stroke 55.2±36.6 months.

Materials/Methods: Participants walked on an instrumented split-belt treadmill with motion capture. Baseline assessments were followed by 10 minutes of either incline or decline walking on an 8 degree slope at the participants' self-selected speed (at least 50% of level treadmill walking speed). Re-assessment was completed after 5 minutes of level walking. Kinetic variables (propulsive impulse, peak COMa, positive area under COMa curves, and joint kinetics) were collected. The group was differentiated into two categories: those who produced a lower COMa in paretic late stance compared to the non-paretic (low COMa ratio), and those with higher relative stance COMa but prolonged negative COMa during stance to swing transitions and swing phase (high COMa ratio). Paired samples t-tests were used to compare changes for all kinetic measures (α=0.05) for the whole group and for sub-categories.

Results: As a group, individuals improved from incline training in paretic impulse (p=0.006), COMa positive area (p=0.031), COMa during paretic late stance and pre-swing (p=0.011) as well as peak ankle power (p=0.022). In the sub-category analysis, these gains were significant in the low, but not high COMa ratio categories. Similarly, decline training produced significant group changes in paretic knee power (p=0.004) and negative knee work (p=0.023). In addition, COMa increased during swing phase (p<0.001) implying improved stance to swing transition. This COMa change was only significant in those individuals with high COMa ratios.

Conclusions: Incline training selectively improves paretic impulse and stance phase COMa as well as peak ankle power in post-stroke patients with a low COMa ratio. Decline training improved positive COMa in the second half of the step cycle and increased eccentric knee power, but only in those with a high COMa ratio. Low and high COMa ratios appear to represent different motor control problems that may be addressed through different alterations of the treatment environment.

Clinical Relevance: Stroke survivors present with distinct gait patterns that should be best treated with individualized treatment, including uphill or downhill treadmill walking, in order to normalize biomechanical gait pattern based upon their underlying motor control deficits.
Use of an Evidence-Based Circuit Training Program for a Patient with Myasthenia Gravis: A Case Study

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Background & Purpose: Myasthenia gravis (MG) is a chronic autoimmune disease affecting the neuromuscular junction. Patients with this condition typically experience reduced muscular strength and endurance as well as fatigue. While adults with early onset MG may have increased reserve capacity to maintain function, older adults with MG are at higher risk for secondary geriatric syndromes such as falls, frailty, pressure ulcers and immobility. Balancing exercise dosing and intensity with fatigue reduction presents a unique challenge for the clinical management of this patient population. There is limited evidence exploring physical therapy interventions in older adults with MG. This case study will illustrate the use of an evidence-based circuit training program for a geriatric client with MG in the inpatient rehabilitation setting.

Case Description: An 83 year old male was admitted to the inpatient rehabilitation facility (IRF) for a decline in functional mobility secondary to MG with respiratory failure. The patient presented with strength and endurance deficits, balance impairments, and inspiratory muscle weakness. He also met classification for frailty including: unintentional weight loss, weakness, exhaustion, reduced gait speed, and reduced physical activity. An evidence-based circuit training program (EBCT) was developed to maximize the total volume of work performed in all domains while respecting the fatigue limitations associated with MG. During the 13 day length of stay, the patient completed a moderate intensity EBCT program for 10 days and a total of 760 minutes.

Outcomes: Berg Balance Scale score improved from 28/56 to 40/56. 5 Times Sit to Stand Test improved to 16 seconds from being unable to perform. 6 Minute Walk Test improved from 394 feet to 1152 feet. 10 Meter Walk Test improved from 12.9 seconds to 8.8 seconds. The Activities Specific Balance Confidence Scale improved from 0% to 57%. These outcome measures are reliable and valid for use in the geriatric population. Improvements in strength, balance, walking speed and gait endurance were greater than the established minimal detectable change scores for the geriatric population.

Discussion: These outcomes suggest a benefit for use of an EBCT program for a patient with MG in the IRF setting. At admission, this patient was at high risk for the negative consequences of the frailty cycle such as immobility, reduced activity and falls in addition to many disease specific complications. However, the intensity requirements of an IRF setting paired with the significant fatigue barrier in MG created a unique challenge for the physical therapy plan of care. The patient made significant functional gains with the prescription of an appropriately dosed circuit training program. Additionally, these improvements positively influenced multiple risk factors for frailty. Physical therapists in the IRF setting may consider the use of an EBCT program for patients with MG to maximize patient outcomes and optimize therapist efficiency.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old:
Purpose/Hypothesis: We investigated the contribution of auditory inputs to balance in healthy young and older adults by simulating hearing loss.

Number of Subjects: 10 healthy young adults 18-35 years old and 10 healthy older adults 50 to 75 adults without vestibular or other neurologic impairments participated.

Materials/Methods: Participants were tested for balance, gait and functional activities, under control and simulated hearing loss condition. Hearing loss was achieved using a pair of ‘Bose A20® Aviation Headset’ and Adobe Audition software that manipulated volume and frequencies to simulate mild to moderate hearing loss. Participants completed standing balance, walking and responding to perturbations while completing a standardized audiology test (BKB-SIN). Outcome measures included: standing center of pressure sway, Center of Pressure – Center of Mass (COP-COM), performance of dual-task, and self-selected gait speed on flat and uneven terrain. Clinical tests of 6-Minute Walk Test, Functional Gait Assessment, and Short Physical Performance Battery were also administered. ANOVA was conducted for each of the dependent variables with respect to group and condition of auditory task.

Results: Preliminary results showed that in response to perturbations simulating a fall, the COP-COM distance was an average of 25 cm and 15 cm in young and older adults, respectively. Center of pressure sway variability increased in participants under simulated hearing loss condition as compared to normal.

Conclusions: Simulated hearing loss negatively impacts postural control particularly in dual-task conditions when individuals simultaneously attend to auditory and postural tasks. The effect is stronger in older adults who have fewer resources to compensate for poor sensory input.

Clinical Relevance: Age-related hearing loss affects a large percentage of the older adult population. Individuals with hearing loss may be at greater risk of falling than individuals without hearing loss. One possible explanation includes reduced or conflicting auditory information increases the cognitive load and thus, attentional resources may be taxed particularly in older adults. Majority of current PT clinical outcome measures are not designed to evaluate the impact of hearing loss on measures of postural control, however most of the therapist – patient interaction is mediated through speech recognition, therefore further studies are necessary.
Balance Telerehabilitation Using Vibrotactile Sensory Augmentation for Treatment of Persons with Vestibulopathy: Two Cases

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Background & Purpose: Vestibular rehabilitation (VR) is effective in improving balance outcomes for persons with vestibular loss; however, full functional recovery is often incomplete. These case reports highlight the use of a smartphone-based vibrotactile sensory augmentation device in a telerehabilitation balance training program for two persons with vestibular hypofunction.

Case Description: Case 1 is a 57-year-old male with history of right vestibular neuritis who completed a course of vestibular rehabilitation four years prior who presented one year ago with onset of mild oscillopsia and imbalance when jogging. Vestibular testing revealed mild bilateral peripheral vestibular involvement with a 56% right caloric weakness. Case 2 is a 42-year-old female with complete bilateral vestibular paresis secondary to IV gentamicin ototoxicity 3 months ago. She had completed six visits of VR with ongoing deficits that limited her ability to participate in driving, community outings, and she experienced multiple falls. Both subjects participated in a telerehabilitation balance program three times per week for eight weeks using a smartphone-based vibrotactile sensory augmentation device that recorded sway and provided directional sway cues when pre-defined thresholds were exceeded. Subjects performed six repetitions of six different categories of balance exercises including standing on a firm surface, standing on foam, weight shifting, arm raises, gait and vestibulo-ocular exercises, while receiving vibrotactile feedback during 4 out of 6 trials. Subjects were remotely supported by a physical therapist who recommended the exercise progression weekly based on each subject's verbal analog score about the exercise difficulty.

Outcomes: Pre, mid (4 weeks), post (8 weeks, end of training), post 1 month and post 6 month training assessment scores were obtained for several outcome measures including the Activities-Specific Balance Scale (ABC), Dizziness Handicap Inventory (DHI), 10 meter gait speed, the Mini-BESTest, and the Sensory Organization Test (SOT) composite. Case 1 demonstrated the following improvement at the pre, post, 1 month post and at 6 month post: ABC = 73%; 90%; 93%; and 97%. DHI = 42/100; 16/100; 12/100; and 6/100. Gait speed = 1.02 m/s; 1.35 m/s; 1.39 m/s; and 1.33 m/s. Mini-BESTest = 24; 26; 27; and 25. SOT = 77; 85; 90; and 84. Case 2 outcome scores at the pre, post and 1 month post: ABC = 16%; 40%; and 33%. DHI = 80/100; 90/100; and 74/100. Gait speed =1.04 m/s; 1.16 m/s; and 1.19 m/s. Mini-BESTest = 20; 24; and 23. SOT = 51; 58; and 54.

Discussion: The two case reports demonstrate that persons with uncompensated unilateral vestibular or bilateral vestibular loss could benefit from a telerehabilitation program incorporating balance training with sensory augmentation to improve outcomes and facilitate additional functional improvements in persons who have plateaued. Future work will focus on controlled long-term studies and gait exercises.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.


6) Sienko KH, Balkwill MD, Oddsson LI, Wall C. Effects of multi-directional vibrotactile feedback on vestibular-deficient
ABSTRACT BODY:

Purpose/Hypothesis: Investigate perturbation-induced protective stepping response in people post-stroke and age-matched controls. We hypothesized there would be significant differences in step characteristics 1) between people post-stroke and controls and 2) between paretic (P) and non-paretic (NP) limbs within post-stroke subjects.

Number of Subjects: 21 stroke survivors (15 men, mean age 55.9±13.3 yrs) with unilateral hemiparesis (6 right side weakness, chronicity 9.3±6.6 yrs) and 17 controls (10 men, mean age 54.4±17.4 yrs).

Materials/Methods: Subjects were tested without AFO/AD. Recovery steps were induced by an anterior waist pull perturbation at 10% of body weight (BW). Ten trials at equal weight-bearing, and 6 catch trials at 2% BW were randomly applied. Subjects were instructed to stand with feet shoulder-width apart and respond naturally to the perturbation. A visual cue was used to achieve and maintain equal weight-bearing for 250-1000 ms to initiate the weight drop perturbation. Markers on lateral malleoli were used to track step characteristics. Kinematic data were collected using Qualysis motion analysis systems.

Results: STEP DURATION: Recovery step duration on the P limb for stroke subjects was longer than that for controls on the nondominant (ND) limb. Within stroke subjects, P limb step duration was significantly longer than NP limb step duration. STEP LENGTH: Control subjects had significantly longer step length than stroke subjects on the dominant (D)/NP limb. No significant differences were found between limbs within stroke subjects. STEP ONSET: No significant differences were found between groups or within stroke subjects. # OF STEPS: Stroke subjects took 2.94 (2-12) steps to recover balance after perturbation, while controls took 1.85 (1-5) steps to recover balance after perturbation (p=0.066), regardless of the limb used. Stroke subjects took significantly more steps to recover balance when leading with the P limb compared to when leading with the NP limb. ABC SCALE: On average, stroke subjects had diminished balance confidence (80%) compared to controls (92%).

Conclusions: These findings suggest execution rather than the initiation of protective steps after a perturbation are the primary differences between perturbation responses in stroke and controls. Differences between limbs in post-stroke may be related to asymmetrical motor control. Greater number of steps utilized by persons post-stroke with either limb compared to controls suggests there are impaired reactive stepping strategies even with the NP leg.

Clinical Relevance: Altered stepping after a perturbation in individuals post-stroke may be problematic for balance recovery. Balance training in individuals post-stroke should focus on the use of both lower extremities. P limb interventions should optimize force generation for faster swing phase and aim to improve weight acceptance during single limb stance. Reactive balance training with the NP limb is warranted as individuals post-stroke require a greater number of steps after perturbation compared to controls, regardless of which limb initiated the step.
TITLE: Effect of high intensity interval treadmill training on executive function of chronic stroke survivors

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ABSTRACT BODY:

Purpose/Hypothesis: After a stroke, many individuals (35-75%) experience some degree of cognitive or executive function impairment. Aerobic training has been shown to benefit cognitive function in the general population but less is known about its effects in people after stroke. We pilot-tested the effects of a 10-week treadmill interval training program on executive function in eight adults in the chronic (> 6 months) stages of stroke recovery.

Number of Subjects: Six males and two females with residual gait impairments due to stroke were recruited from outpatient rehabilitation units and stroke support groups (mean ± standard deviation: age = 60.0 ± 16.7, months post-stroke = 25.9 ± 14.8, body mass index = 27.3 ± 5.2).

Materials/Methods: Participants completed 2 treadmill walking sessions per week. Each 35-minute session consisted of a 5-minute warm-up, followed by four 4-minute walking bouts at supra-ventilatory threshold (avg. 88.5% of age-predicted maximum heart rate) interspersed with three 3-minute recovery bouts at ventilatory threshold (avg. 76.1% of age-predicted maximum heart rate), then a 5 minute cool-down. Participants also completed 30 minutes of walking per week at home. Outcome measures included the Trail Making Test A and B (set-shifting ability), the Stroop Test (inhibitory control), and the Flanker Task (selective attention). These tests were administered before and after the 10-week intervention and were completed with the non-paretic hand on an iPad.

Results: No change was found in the time it took to complete the Trail Making Test A (post – pre = 0.21; SE = 3.87; t(7) = -0.06; p = 0.96) or B (post – pre = 9.56; SE = 28.85; t(7) = -0.33; p = 0.75) or in the Stroop Test score (post – pre = 3.38; SE = 1.69; t(7) = 2.00; p = 0.09). The Flanker Task performance (time to completion) improved significantly (post – pre = 15.41; SE = 5.99; t(7) = 2.573; p = 0.04).

Conclusions: The effects of the treadmill intervention on executive function were mixed. While there was a significant improvement in selective attention, as measured by the Flanker Task, there was no improvement in set-shifting ability (Trail Making Test), and only a trend for an improvement in inhibitory control (Stroop Test). Our findings are consistent with the literature to date. Inclusion of a control group may shed light on the question of whether executive function deteriorates across a span of 10 weeks and whether the mere maintenance of executive function is a desirable goal for people after a stroke.

Clinical Relevance: The present findings suggest that high intensity interval treadmill training may help to maintain or improve executive function after a stroke. This could have a positive impact on activities of daily living, independence, and life satisfaction. Particularly, an improvement in selective attention may translate into an improvement in dual tasking and a reduced fall risk.
Effects of an Individualized Exercise Program on Psychosocial and Physical Factors in an Individual with Multiple Sclerosis: A Case Study

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Background & Purpose: Multiple sclerosis (MS) is an idiopathic inflammatory disease of the central nervous system that causes demyelination, axonal injury, and axonal loss. Previous research has demonstrated beneficial effects of physical therapy in individuals with MS, including improvements in fatigue, gait speed, quality of life (QOL), and balance. However, less is known regarding the benefits of individual exercise prescription, including the optimal mode, intensity, frequency, and duration of exercise in managing the progression of fatigue, QOL, and gait dysfunction. The purpose of this study was to determine the impact of an individualized treatment program on these factors in an individual with MS.

Case Description: The subject of this case study is a 69 year old woman with a 20 year history of relapsing remitting MS. Other conditions include scoliosis, osteoarthritis, total knee replacement, lower extremity edema, and malalignment of the lower extremity. The intervention included two 8-week treatment sessions with an 8-week intermission between treatment. Physical outcome measures collected at baseline and 8 week intervals include the Timed Up and Go (TUG), 6-Minute Walk Test, Berg Balance Scale, and 30-Second Chair Stand Test. Four surveys assessing psychosocial measures were completed at two-week intervals during each intervention period. Intervention focused on aerobic conditioning, lower extremity and trunk strengthening, functional training, and balance exercises. Specific intervention was determined on a daily basis based on patient presentation and needs.

Outcomes: Improvements were seen for the TUG and reported number of falls, but the Multiple Sclerosis Impact Scale-29 (MSIS-29), MS Self-Efficacy Scale, and 6 minute walk scores worsened. All other outcome measures were inconclusive due to fluctuating results. However, the patient consistently reported enjoying and benefitting from the intervention.

Discussion: Overall, this individual's condition was complex with many comorbidities that needed addressed, indicating the need for early and ongoing intervention in patients with MS. The improvements in TUG and decrease in falls suggest that the intervention did have positive effects on this patient. We speculate that the decrease in gait speed during the 6-minute walk test may be correlated with decreased falls and greater safety awareness. The results from MSIS-29 and MS Self-Efficacy suggest that this patient is consistently feeling more impacted in her daily life by her MS, although subject reports were not consistent with that. It should also be noted that TUG and MSIS-29 scores worsened during the 8 week intermission, which may indicate that this patient declined when not receiving direct intervention. Although the patient reported benefits from PT, the dosage utilized during this treatment was insufficient to effect significant change or to maintain previous improvements.


Background & Purpose: Polymyositis, an idiopathic inflammatory myopathy causing severe skeletal muscle weakness, impairs control of movement. Exercise is recommended for chronic polymyositis; little guidance exists for physical therapy (PT) in treatment of acute polymyositis. The purpose of this platform is to describe the clinical-decision making of a PT for a unique patient with muscle weakness and spasms, subsequently diagnosed with polymyositis.

Case Description: The patient, a 32 year-old male, underwent radiation ablation of his thyroid due to cancerous tumor September 2010. He was in good health until onset of leg and trunk weakness August 2011, progressing to significant weakness, severe muscle spasms and pain upon presentation to PT October 2011 resulting in inability to perform mobility or achieve comfortable resting position. Initial interventions included there, body-weight supported ambulation and stretching. December 2011: patient was diagnosed with polymyositis 2° radiation toxicity. PT then included strengthening, functional mobility training, reciprocal movement on a recumbent bike and deep tissue massage to leg muscles using a rolling stick.

Outcomes: Initial (October 2011) and retest (2 months after resuming PT) measures: spasm frequency (Penn Spasm Frequency Scale [PSFS]), strength (Manual Muscle Testing [MMT]), function (Berg Balance Scale [BBS]), and self-perceived quality-of-life (SF-36) PSFS: initial frequency of 4, severity of 3; retest: 3 & 2. MMT: initial Bilateral Hip Flexion, Extension and Abduction and Knee Flexion and Extension 3-/5, Ankle Dorsiflexion and Plantarflexion 3+/5. Retest: Hip Flexion, Extension, Abduction & Knee Flexion and Extension 3+/5, Ankle Dorsiflexion and Plantarflexion 5/5. BBS: initial 2/56, retest 4 /56. SF-36: initial 26/100, retest 48/100. Functional Index-2 (FI-2) was initially not tested; at retest patient did maximum reps for shoulder flexion/ abduction and neck flexion but unable to perform hip flexion, step test, heel lift, or toe lift. Improvements were eventually noted in all areas: strength and mobility as well as spasm and pain reduction including an immediate decrease in spasms upon introduction of deep tissue massage. Patient demonstrated a full recovery after 18 months.

Discussion: This case introduced two unique treatments for acute myositis: fast, reciprocal movement and deep tissue massage using a rolling stick. As active cycling resulted in significant spasm, we initiated reciprocal fast, passive cycling movements. The spasms diminished allowing the patient to actively bike for upto 2 minutes. Decreased spasm and pain frequency and severity was noted immediately after use of the rolling stick with carryover post session allowing for patient comfort and ability to sleep. This case supports use of passive reciprocal cycling and deep tissue massage in addition to strengthening exercises as well as aerobic and functional activities to address impairments related to polymyositis.

TITLE: Comparison of Cardiorespiratory Fitness between Regular Group Exercisers with and without Parkinson Disease

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ABSTRACT BODY:

Purpose/Hypothesis: The purpose of this study was to examine differences in cardiorespiratory fitness (CRF) between people with and without Parkinson disease (PD) after regular participation in community-based group exercise programs. Based on previous evidence that indicates similar maximal oxygen consumption, but less time to fatigue during exercise for people with PD, we hypothesized that regular participation of a group with PD in a high-intensity interval-based boxing program would result in similar CRF levels to that of healthy exercisers from other group programs.

Number of Subjects: Thirty participants who regularly participated (at least 120 minutes/week for 3 months) in group exercise were enrolled in this cross-sectional study (PD n=15, mean age 63.0±5.4, median months post diagnosis 53.0 IQR 45, Hoehn & Yahr 1-3; Healthy control n=15, mean age 62.4±5.6).

Materials/Methods: Each participant completed two study visits, one week apart. During the first visit, demographic, health and exercise (minutes of exercise/week, peak rate of perceived exertion RPE) characteristics were collected. Participants wore a step activity monitor for 5 consecutive days between visits. On the second visit, participants completed the comfortable 10-meter walk test (CWT), 6-minute walk-test (6MWT) and a graded exercise test (GXT). Treadmill speed during the GXT was held constant based on each participant’s mean CWT with treadmill grade increased over the course of the test. Peak oxygen consumption (PeakVO2), time to fatigue, respiratory exchange ratio (RER), final heart rate (HR) and final treadmill grade were recorded. Participants with PD were instructed to take their PD medications 1-hour before their testing session. Analysis of covariance was used to examine differences between groups and to control for differences in gender ($p<.05$).

Results: Groups did not differ in age, minutes of exercise ($p>.05$), but the boxers reported a significantly higher peak RPE during their exercise program than the healthy controls (PD 16.5±1.6 vs. controls 13.7±1.7, $p=.00$). There were no significant differences in 6MWT, stepping activity, PeakVO2, time to fatigue, final HR and final treadmill grade between the groups ($p>.05$). The boxers demonstrated a significantly higher RER at PeakVO2 than the controls (PD 1.11±0.04 vs. controls 1.0±0.10, $p=.01$).

Conclusions: Findings supported our hypothesis that regular participation in a high intensity, interval-based boxing program by persons with PD resulted in comparable levels of CRF to healthy exercisers. No significant differences between groups in PeakVO2 and time to fatigue indicate similar levels of CRF during exercise and equivalent exercise durations. Regular exercise at higher RPE may be important to achieving these outcomes in persons with PD. Significantly higher RER by the group with PD may have physiological or pharmacological implications related to PD.

Clinical Relevance: These results support the use of regular exercise, particularly at a higher intensity, for individuals with PD in order to optimize cardiorespiratory health and fitness.
TITLE: The Effect of Text Messaging on Postural Sway under Different Surface and Visual Conditions


ABSTRACT BODY:

Purpose/Hypothesis: To determine how texting influences postural sway and to determine how changing the postural demands affects the influence texting has on postural sway.

Number of Subjects: Thirty-three healthy adults aged 20-32 (mean = 23.2) familiar with texting were recruited.

Materials/Methods: Subjects performed balance tasks under 15 conditions: three positions (two feet on firm surface, two feet on foam, and single-limb on firm surface) under 5 sensory/task conditions (eyes open, eyes closed, while texting, wearing dome, wearing dome while texting). Ten second trials were completed in a standard order with a standard rest. While texting, subjects responded to an open-ended question. Subjects texted for the duration of the trial using their own phone. Total postural sway was measured during each trial using VirtuSense technology, an infrared motion-capturing device that can measure center of mass excursion. Repeated measures analyses were performed.

Results: As the sensory/surface challenge was progressed, postural sway increased in degrees comparable to normative data. While texting, postural sway was significantly less compared to the eyes closed condition on each surface (p ≤ .001) and no different than eyes open. However no statistical difference in postural sway was seen with the addition of texting to the dome condition (sway referenced) on any surface.

Conclusions: Unlike many previous dual-task balance/cognitive studies, our results showed decreased sway with the addition of texting. This may be due to an elevated autonomic or anticipatory stabilization to complete the task. When visual background information was referenced to the sway (dome condition) no difference occurred with texting, thus indicating background visual information may be important for balance while texting.

Clinical Relevance: Texting appears to reduce postural sway during standing balance, influencing postural stabilization. This adjustment in postural tone while texting may disrupt subsequent responses to perturbation or surface changes, as other research has shown, and produce inadequate reactive responses. Texting without accurate visual background information, such as at night or while walking, could also produce inadequate postural responses.
Purpose/Hypothesis: To investigate differences in vestibular measures (Vestibular Ocular Reflex, VOR, posturography testing including the Sensory Organization Test, SOT, and self-report measures) following blast vs. blunt head trauma in the military.

Number of Subjects: 504 active duty and veteran military personnel in 6 studies exposed to blast and/or blunt trauma in combat or training settings and subsequently diagnosed with mild traumatic brain injury.

Materials/Methods: A systematic review utilizing Embase, CINAHL, and PubMed. Inclusion criteria included military personnel, traumatic brain injury, blast injury and/or blunt injury, concussion, and vestibular symptoms. The exclusion criteria were: non-English articles, non-military, articles published more than 20 years ago, non-human participants, no access to the full-text article, unidentified mechanism of injury (MOI), and non-observational cohort study. The Newcastle-Ottawa Quality Assessment Scale for cohort studies was utilized for risk of bias. Data were tabulated in a PEO table.

Results: Six studies met the inclusion criteria, with 504 subjects ranging from 19-57 years old. Number of blast exposures ranged from 1-100 and time from injury ranged from 72 hours to 2 years. Five studies assessed combat exposure to blast, blunt, or mixed trauma and one assessed blast exposure in the training setting. Two papers described blast cohorts only, one paper compared blast vs. blunt cohorts, and three papers described mixed cohorts. The most commonly utilized clinical vestibular measures were the VOR and SOT. Findings across studies were mixed. Four of the 6 studies demonstrated abnormalities in VOR function, and 3 of the 5 studies that assessed the SOT found abnormalities.

Conclusions: While symptoms of dizziness are common following blast injuries, there are no clear patterns related to vestibular measures based on MOI. A more cohesive descriptive language and changes in study design will be necessary to better elucidate vestibular sequelae following blast injuries.

Clinical Relevance: Combat blast injuries are complex by nature with wide variation in the language used to describe the injuries, complicating interpretation of the research. Of the measures reviewed, VOR and SOT show some promise in differentiating between the effects of ballast vs. blunt trauma. In addition to standard rotational chair testing, we recommend use of the head thrust test to assess VOR function acutely following injury. We also suggest further investigation of individual SOT condition scores in addition to composite scores. Future studies may benefit from reporting both MOI and symptomology, and controlling for factors such as blast intensity, time from injury, and number of exposures. Such research will be critical for the effective and efficient treatment of those with vestibular impairments following blast trauma. This information will hopefully lead to improved clinical practice, having implications for return to duty decision-making, military readiness, and more efficient utilization of military medical resources.
Purpose/Hypothesis: The purpose of this study was to determine the effectiveness of an aquatic therapy program on improving the balance and quality of life (QOL) of individuals with Parkinson’s Disease (PD) when administered by an instructor who had been trained by a physical therapist.

Number of Subjects: Eight of the original 11 participants completed the 8-week aquatic therapy program.

Materials/Methods: Subjects were recruited by a sample of convenience from the community through local support and exercise groups. Eleven subjects between the ages of 50-80 with PD with a disease severity of Stage I to Stage III according to the Hoehn & Yahr scale were enrolled. The programs were held twice a week for one hour on non-consecutive days, for 8-weeks at 2 YMCAs. These YMCAs were chosen due to the success of their group wellness classes such as the LIVESTRONG program as well as the accessibility of the pool and locker rooms. Program instructors were either certified aquatic instructors or senior undergraduate kinesiology students. The instructors met with a qualified physical therapist twice prior to the start of the program to receive general education and guidelines for exercise for individuals with PD. The guidelines included focusing on flexibility, strength, and aerobic endurance at a moderately high level of intensity, in addition to gait and balance activities. The Mini-BESTest and Parkinson’s Disease Questionnaire-39 (PDQ-39) were administered as pre-/post-test measures to assess balance and QOL outcomes.

Results: Of the original 11 participants enrolled, 2 did not finish the aquatic program; of the remaining 9, only 8 completed the post-testing. A paired samples t-test was performed to determine whether aquatic therapy had an effect on balance and QOL. The Mini-BESTest scores significantly increased (p<0.001) while the PDQ-39 scores did not (p=0.2).

Conclusions: While physical therapy has been shown, in many earlier studies, to improve balance and QOL in individuals with PD, both on land and in water, there is little research that looks at exercise programs, not led by physical therapists. While this research had a small number of participants it did demonstrate that a community-based program, not led by a physical therapist, may be effective in improving balance for individuals with PD. Given that PD is a progressive disorder, offering community-based aquatic exercise programs may assist these individuals in managing their impairments. Future research should have larger sample sizes, increase compliance with program adherence and should examine long-term outcomes to conclusively determine if aquatic programs led by non-PT instructors could improve balance and QOL in individuals with PD.

Clinical Relevance: The increases in balance ability achieved by the participants of this study suggest that this approach may be a viable and effective adjunct to physical therapy. It is hoped that more community-focused organizations would be able to offer these programs to increase their accessibility and affordability to individuals living with progressive disorders like PD.
TITLE: A 4-week regular aerobic exercise regimen improves executive function and influences transcranial magnetic-based measures of intracortical inhibitory circuits—a preliminary and ongoing pilot study.

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ABSTRACT BODY:

Purpose/Hypothesis: There is evidence supporting improved cognitive performance following regular aerobic exercise (delivered usually over a period of 9-12 months), but it is not clear if shorter interventions would influence cognitive performance in sedentary adults. It has been proposed that the exercise-mediated cognitive improvements can be at least partly attributed to neuroplastic changes that occur at the cortical level. Transcranial magnetic stimulation (TMS) can be used to assess the excitability of the motor cortex and intracortical circuits in a non-invasive manner in humans. We hypothesized that regular aerobic exercise would be associated with improvement in cognitive performance measures, decreased intracortical inhibition, and increased intracortical facilitation and corticomotor excitability from baseline to post-test following 4 weeks of moderate intensity aerobic physical exercise.

Number of Subjects: Nine sedentary (less than one hour of physical exercise in the last month), healthy adults (7 females, mean age=30 years).

Materials/Methods: Participants engaged in an aerobic exercise intervention (30 min daily sessions, 4x/week for 4 weeks [i.e., 16 total] delivered at 55-64% age-predicted maximal heart rate). Prior to and following the exercise protocol, participants performed a battery of tests containing measures of: memory (Rey Auditory Verbal Fluency Test [RAVLT]); sustained attention (Conners’ Continuous Performance Test [CPT-2]) and executive control (Stroop Color Word Test); corticomotor excitability (amplitude of motor evoked potentials) and excitability of cortico-cortical connections (short-interval intracortical inhibition [SICI], intracortical facilitation [ICF] and long-interval intracortical inhibition [LICI]), measured with TMS. Paired t-tests were used to compare outcome measures prior to and following exercise.

Results: There was a significant pre-post improvement in the time to complete the Stroop color-word test (2.53±1.03 sec, p=0.03). In addition, there were trends toward significant increases in SICI (-193.7±92.5 mV, p=0.06), and LICI (-83.1±37.9mV, p=0.059). There were no significant pre-post changes in RAVLT, CPT-2, corticomotor excitability and ICF.

Conclusions: Four weeks of moderate intensity aerobic exercise is associated with an improvement in executive control. Contrary to our hypothesis, there was a trend for increased cortico-cortical inhibition, which may suggest increased activity in GABAergic circuits involved in attentional control.

Clinical Relevance: While most intervention studies to date have found value in longer exercise interventions in improving cognitive function, this pilot study suggests that improvements in executive control may be possible after 4 weeks of moderate-intensity aerobic exercise in healthy sedentary adults. These findings add to the understanding of the exercise-mediated effects on cognitive function, and are relevant for the use of exercise to maintain or improve cognition during aging.
TITLE: The Impact of Type 2 Diabetes on Symptom Presentation and Recovery after Repositioning Maneuvers in Individuals with Benign Paroxysmal Positional Vertigo.

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ABSTRACT BODY:

Purpose/Hypothesis: Type 2 diabetes affects the vestibular system and the prevalence of benign paroxysmal positional vertigo (BPPV) is higher in people with diabetes. The influence of diabetes on recovery in people with BPPV is unknown. In this prospective study, we compared symptom severity, mobility and postural sway before and after canalith repositioning maneuvers (CRM) in people with BPPV and people with BPPV and diabetes mellitus (BPPV+DM). Our hypotheses were that at baseline and after resolution of BPPV with treatment maneuvers, people with BPPV+DM would have higher symptom severity, lower functional mobility scores, higher postural sway and require more treatments with the CRM for symptom resolution compared to people with BPPV only.

Number of Subjects: Fifty participants, BPPV (n=34) and BPPV+DM (n=16) with unilateral posterior canal BPPV canalithiasis, completed the study. Patients with neurological diagnoses and any musculoskeletal problems that would affect mobility were excluded.

Materials/Methods: Symptom severity (Dizziness Handicap Inventory, DHI), mobility (Functional Gait Assessment, FGA), and postural sway (accelerometer in five different conditions) were examined before and after the CRM. Participants came for a follow-up visit after 7 to 10 days and the maneuver was repeated if patients were symptomatic with the Dix-Hallpike test, until complete resolution of symptoms. CRM was considered effective if there were no complaints of vertigo or signs of nystagmus with the Dix-Hallpike test, which was confirmed with videonystagmography. The number of maneuvers required for resolution of vertigo was recorded. Baseline DHI and FGA scores were compared using ANOVA, while sway was compared using a linear mixed model. Repeated measures ANOVA was used to examine change in DHI and FGA scores while change in sway measures was examined using a mixed model design.

Results: No baseline differences in DHI or FGA scores between the BPPV and BPPV+DM groups were noted. At baseline, higher range and peak velocity of sway were seen in tandem stance in the anteroposterior and mediolateral directions, in the BPPV+DM group (p<0.01). After treatment, the DHI and FGA scores improved showing a main effect of time (p<0.01), yet there was no difference between groups. After treatment, range of acceleration and sway velocity decreased significantly in the mediolateral direction (p=0.003) in both groups. There were no differences in the number of maneuvers needed between the two groups.

Conclusions: People with BPPV and BPPV+DM have similar mobility and functional deficits when symptomatic with vertigo, and they both respond well to treatment maneuvers.

Clinical Relevance: People with comorbidities like diabetes often have BPPV that goes undiagnosed, however, they respond well to treatment maneuvers.
The effect of fatigue on sensory impairment in Multiple Sclerosis: A randomized crossover study


ABSTRACT BODY:

Purpose/Hypothesis: Fatigue and sensory loss are common findings in persons with Multiple Sclerosis (pwMS). MS fatigue is known to worsen with exertion, and previous studies have shown that both increasing fatigue and sensory loss can worsen walking endurance in this population. Anecdotally, pwMS have noted that sensory impairment worsens with increasing fatigue, but this has not been studied. The purpose of this study was to examine whether worsening MS fatigue can effect sensation in pwMS. We hypothesized that as fatigue increased, sensation would worsen. If our hypothesis were correct, it would suggest that fatigue may play a role in sensory loss in pwMS.

Number of Subjects: 17 subjects with a definitive diagnosis of MS recruited from local area MS practices.

Materials/Methods: A randomized crossover design was used. Following obtaining consent and subject characteristics, subjects were randomized into walking (W) and resting (R) groups. All subjects received sensory testing using a biothesiometer on 5 key (B) lower extremity points. Subjects in the (W) group then performed a 6-minute walk (6MW) to induce fatigue, while subjects in the (R) group lie supine for 6 minutes to minimize fatigue. Fatigue was assessed using the Visual Analog Scale of Fatigue (VAS-F). Immediately following either 6-minute condition biothesiometer testing was repeated. This was repeated for three trials in one week, followed by a 2-week detraining period. Subjects then crossed over, performing whatever type of testing they did not participate in initially.

Results: 17 subjects (mean EDSS=3.45) completed the study. Mean biothesiometer readings increased significantly difference from pretest (mean =22.0 microns, SD=12.9) to posttest (mean =25.6 microns, SD=13.7) in the fatigued condition, p=.001. There was no significant pre- to post difference in sensation for the unfatigued state. VAS-F scores increased significantly in the fatigued condition by 35.2mm (p < .001) but remained unchanged for the unfatigued condition.

Conclusions: Results from this study suggest that increased fatigue in persons with MS can result in worsening sensation. The results of this study should be interpreted with caution due to 1) small sample size, and, 2) biothesiometry only measures dorsal column sensory function, and not anterolateral sensory structures.

Clinical Relevance: This study may provide insight into the mechanism behind how fatigue in pwMS can lead to impaired mobility. Sensation that worsens as a result of fatigue may be a contributing factor to the impaired balance and gait observed in this population. While this study only explores the relationship between fatigue and sensory impairment, it provides a platform for future research, which examines relationships between fatigue and the various factors associated with mobility loss. The results of this study also suggest that evaluation of sensation in pwMS should be performed in both a fatigued and unfatigued state.
ABSTRACT BODY:

**Purpose/Hypothesis**: Extra functional electrical stimulation (FES) cycling performed in addition to inpatient rehabilitation (IR) has recently shown promising results in stroke survivors. However, the feasibility of an extra FES cycling program has yet to be determined for IR. The purpose of this study was to design an extra FES cycling program to determine the feasibility of its implementation in patients with non-progressive upper motor neuron (UMN) disorders who were concurrently receiving IR. It was hypothesized that the extra cycling program would be feasible and that the enrolled patients would demonstrate positive outcomes in regards to balance and functional mobility.

**Number of Subjects**: 4

**Materials/Methods**: One non-traumatic spinal cord injury survivor and three acute stroke survivors were enrolled in the extra FES cycling cohort. Subjects completed no less than six extra FES cycling sessions for at least 15 minutes per session in addition to standard IR. Feasibility was assessed via two separate on-line surveys. One survey was administered to staff Physical Therapists (PT) at the participating location and a separate survey to the staff PTs with enrolled patients in the extra FES cycling program. Patient fall risk and functional mobility were assessed via the Berg Balance Scale (BBS), Dynamic Gait Index (DGI), Six Minute Walk Test (6 MWT), Timed Up and Go Test (TUG), and Ten Meter Walk Test (10 MWT).

**Results**: Four subjects received at least 6 extra FES cycling sessions. Three clinicians, author included, enrolled their patients in the program. Survey results of all staff PTs revealed a moderate to high confidence level in utilizing the extra FES cycling program. Among staff PTs, the greatest barrier to program use was insufficient staffing. Among the staff PTs whose patients participated in the program, the greatest barriers were adding extra time to the workday and confounding factors outside of the extra practice intervention. The average change scores of all outcomes between the four subjects were as follows: TUG=136.46 sec, 10 MWT=.41 m/s, 6 MWT=385 ft., BBS=31 points and DGI=4 points.

**Conclusions**: These findings suggest that an extra FES cycling program combined with IR was feasible, but costly of time, which may be attributed to confounding factors outside of the extra practice protocol. Increased therapy staffing may facilitate program use among PTs. The large change scores demonstrated by the extra FES cycle cohort are intriguing and need further investigation.

**Clinical Relevance**: A sustainable extra FES cycling program that allows for specificity, transference, intensity, and repetition to occur sooner in the patient’s recovery is optimal for restoration of function. An adjunct benefit to extra FES cycling may be shorter hospital length of stay, but this is yet to be determined using this extra practice model.
Purpose/Hypothesis: Adults and children with hemiplegia following a stroke often exhibit abnormal synergy patterns in and between their upper (UE) and lower extremities (LE). For example, when individuals post-stroke increase their gait speed and overall effort, involuntary UE movements are seen. This may limit their functional ability to simultaneously use their UEs and LEs, as well as impact gait and balance. Understanding these interactions, called associated reactions, will allow future research to develop interventions to maximize function. The objective of this study was to determine if different levels of force exerted by the paretic or nonparetic LEs influence involuntary UE movement. Adults and children post-stroke were both assessed to determine if timing of injury impacts associated reactions. We hypothesized there would be associated reactions between UE and LEs in individuals post-stroke, with greater LE effort causing greater UE reactions. Specifically, we expected knee flexion to be associated with UE flexion synergy and knee extension associated with UE extension synergy.

Number of Subjects: 12 adults and 5 children with chronic hemiplegia were compared to 2 adult and 3 pediatric control participants.

Materials/Methods: Participants were seated with their tested arm in a robotic device. Haptic springs were used to support the UE while allowing for movement. The tested LE was secured to a device with a load cell to measure isometric torque. Participants were instructed to relax their arm while they performed maximal knee flexion and extension torques followed by submaximal torques (25, 50, 75%) with visual feedback. Fingertip positions were recorded as a measure of involuntary UE movement.

Results: Control participants were able to perform the LE task with minimal UE movement (<2 cm in adults, <4 cm in children), while LE tasks caused >9 cm of involuntary arm movement in children and adults with hemiplegia. The amount of involuntary movement was dependent on effort level of the LE task. Movement directions were dependent on the LE task, with both children and adults with hemiplegia showing UE movement toward their body with knee flexion, and away from their body with knee extension. This directionality was not seen in control participants.

Conclusions: Associated reactions are dependent on effort, and occur in stereotyped patterns based on the lower extremity task. Based on the preliminary results, timing of injury (pediatric vs. adult onset stroke) does not appear to affect the associated reactions.

Clinical Relevance: Our findings indicate that associated reactions must be considered when treating an individual post-stroke, rather than treating upper and lower extremities in isolation. Specifically, with high intensity gait training frequently used in stroke rehabilitation, clinicians must be aware of the effects lower extremity training has on upper extremity, such as possibly reinforcing components of upper extremity synergies.
Background & Purpose: There are about 12,000 new cases of spinal cord injury (SCI) each year in the United States. Roughly 40% of those cases are diagnosed with incomplete tetraplegia (TP). Paresis is a severe limitation in people with SCI. Recovery of residual muscle strength is a determining factor for return of independence. The American Spinal Injury Association (ASIA) impairment scale classifies injury based on residual muscle strength below the level of insult. ASIA level D indicates that at least half of key muscles below the level of injury have a muscle grade $\geq 3/5$. Body-weight supported (BWS) gait training is widely used to retrain mobility post SCI. BWS allows gait training to be initiated despite paresis preventing the ability to fully support standing. This case study illustrates a progression of gait training in an individual with incomplete TP, C6 ASIA D, from wheelchair mobility to independent ambulation.

Case Description: 55y/o female presenting with incomplete TP, C6 ASIA D, to an outpatient neurological therapy clinic in a power wheelchair 2 months after initial injury with reports of no weight bearing (WB) since insult. Pt was seen for 25 visits over a 3 month plan of care, receiving skilled therapy geared toward early WB and gait training. BWS interventions were initiated upon 1st visit and progressed from BWS gait overground and on treadmill, to gait with front wheeled walker (FWW) and then no assistive device (AD).

Outcomes: On evaluation, ASIA testing was performed. Sit to stand transfer required max assist. After 8 visits focused on BWS to overground interventions, Pt was able to complete 10-meter walk test for gait speed and muscle power, 6 minute walk (6MWT) test for activity tolerance and gait distance, and Berg Balance Scale (BBS) to assess postural stability. Pt was unable to complete 10m walk on evaluation and on 9th visit was ambulating at 0.5 m/s with use of a FWW. Pt unable to complete 6MWT upon evaluation and on 10th visit ambulated 656 feet with FWW. After 25 visits, Pt ambulated 910 feet with no AD. BBS score on evaluation would be 4/56, as only able to sit independently. After 25 visits, Pt improved BBS to 49/56. Due to ceiling effect of BBS, Functional Gait Assessment was initiated on 25th visit. Pt scored 23/30, demonstrating to be outside of a fall risk for daily ambulation.

Discussion: This case illustrates the benefits of early gait training in a patient with incomplete TP, C6 ASIA D. Treatment was geared toward early WB and gait progression 2 months after initial injury in an outpatient setting. Treatment was progressed by providing BWS and decreasing support to least restrictive devices as soon as possible. Harness et al. has shown that individuals who had incomplete SCI had significantly greater gains in motor recovery over a six-month intense exercise period, including early WB. Due to progress with this individual and current research, this clinician would suggest early WB to begin in the acute and sub-acute rehabilitation stages to maximize functional recovery, specifically with patients with incomplete SCI and ASIA D classification.

Can physical therapy help a patient with proximal myotonic myopathy return to the gym?

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ABSTRACT BODY:

Background & Purpose: Proximal myotonic myopathy (PROMM) or myotonic dystrophy type 2 (DM2) diagnosed by genetic testing is a late onset autosomal dominant transmitted disorder affecting multiple systems. Clinical neuromuscular features include myotonia, proximal muscle weakness, fatigue, muscle pain and stiffness. This PROMM case focused on determining if a multi-modal physical therapy (PT) program could increase proximal muscle strength and allow a return to gym-based exercise participation.

Case Description: Patient is a 46 year-old stay at home mom with PROMM, managing her muscle tone with oral baclofen. Chief complaints were muscle pain and inability to stand and walk after a busy day or exercise. Regular exercise participation ceased which led to personal dissatisfaction. Manual muscle testing bilaterally found hip extension 3/5, abduction 4/5, knee flexion and extension 3/5. Aberrant movement was observed following maximal muscle contraction. Delayed muscle relaxation resulted in a ratcheting effect during movements requiring eccentric muscle control. Movement compensation included shoulder hiking, lumbar hyperlordosis, knee hyperextension during sit to stand and single/double-limb stance. Functional testing found loss of balance with left single limb stance eyes open (EO) 25 seconds (s) and bilaterally with eyes closed (EC); 30-second chair rise =10; High level mobility assessment tool (HiMAT) score of 38/54. PT was 1x week for 5 weeks with a 1-month follow-up reassessment.

Interventions focused on resistance training, postural stabilization using developmental positions, movement correction, single limb balance training, aerobic conditioning, and home program development. Education stressed complete muscle relaxation between repetitions (reps) and limited reps based on movement quality. A daily log of her activities and responses served as a basis to progress her program.

Outcomes: She returned to exercising 4-5 times/week alternating between the gym, running, and her PT home program. Hip and knee strength improved to 4+-5/5 on MMT. Single limb balance improved: EO 60s bilaterally; EC < 20s on left and <10s on right. 30-second chair rise doubled to 20. HiMAT improved 15% to 46/54. Patient satisfaction increased with exercise participation while sustaining ability to stand, walk, and run.

Discussion: Critical to the success in this PROMM case was evaluating the response to activity. Managing immediate effects included allowing for muscle relaxation between reps, limiting exercise reps based on muscle cramping and resting at onset of tremor indicating muscle fatigue. Monitoring cumulative effects was done by review of her daily activity log noting exercise type, amount performed and any symptomatic responses. Jump roping caused an exacerbation so was discontinued. Improvements were made in muscle strength, single limb balance, repetitive movement coordination, and overall functional status with decreased use of compensatory movements. Through PT the patient learned to manage her condition allowing her return to a regular exercise program.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: Turner C, Hilton-Jones D. The myotonic dystrophies: diagnosis and management. J Neurol Neurosurg Psychiatry. 2010;81:358-367.


Purpose/Hypothesis: This literature review examines functional and quality of life outcomes associated with hippotherapy for adults with neuromuscular impairments.

Number of Subjects: A total of 145 adult subjects were examined from all articles with an average age of 66.6 years. 98 subjects were male and 47 subjects were female.

Materials/Methods: Literature searches were conducted in PubMed, PEDro, Scopus, CINHAL, and Web of Science. Studies containing adult subjects with neurologic diagnoses or balance deficits receiving hippotherapy or therapeutic riding intervention were included. All study designs except for systematic reviews and case reports were included. Studies were excluded if subjects were children or did not have a neurologic diagnosis or balance deficits. Studies not in English were also excluded. 8 studies were included. Study quality was assessed with Downs and Black’s “Checklist for Measuring Study Quality.”

Results: 8 studies were included in this systematic review, including 2 single group comparison studies, 1 single subject comparison study, 3 randomized controlled trials, 1 non-randomized experimental study, and one prospective cohort study. Methodological quality for individual studies was fair for 7 studies and good for 1 study. There is moderate evidence that hippotherapy for individuals with balance or neuromuscular impairment improves scores on the Berg Balance Scale and Medical Outcomes Study 36-item Short-Form Health Survey as well as increases gait speed. One study demonstrated a short-term decrease in lower extremity spasticity and another study demonstrated a significant improvement in step length asymmetry ratio.

Conclusions: Hippotherapy improved balance, quality of life, and gait parameters in individuals with neuromuscular impairments in the studies included in this review. The reviewed studies show use of a variety of protocols for hippotherapy with these individuals. More studies including randomized controlled trials are needed to determine effectiveness and optimal parameters for treatment to maximize functional and quality of life outcomes.

Clinical Relevance: Based upon the limited available evidence, hippotherapy is an effective but underutilized intervention for adults with neuromuscular and balance impairments. Hippotherapy can be a safe and feasible intervention with this population and provides an alternative to traditional therapy.
TITLE: Reliability and Validity of Three Sitting Balance Scales in People with Hemiparesis: Preliminary Data

AUTHORS/INSTITUTIONS: J. Alzyoud, A. Medley, H. Barrett, H. Koeijmans, SCHOOL OF PHYSICAL THERAPY, TEXAS WOMAN'S UNIVERSITY, DALLAS, Texas, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Patients who have suffered neurologic diseases, resulting in hemiplegia, may be non-ambulatory or have limited mobility. Assessing sitting balance in these patients with valid and reliable tools is an essential element for developing a plan of care. This study investigated the reliability and validity of Sitting Balance Scale (SBS), Ottawa Sitting Scale (OSS), and Function in Sitting Test (FIST) in people with hemiparesis.

Number of Subjects: 15

Materials/Methods: Fifteen community dwelling volunteers (14 with stroke and 1 with multiple sclerosis) participated in this study (Mean time since stroke onset = 89 months). Data from 4 participants was used to examine interrater reliability, whereas data from 15 participants was used to examine intrarater reliability. Participants performed tests in random order. Performance for inter-rater reliability was scored by each rater during the live performance for the first 4 participants. Performance was video recorded and scored later to determine intrarater reliability. Testers were blinded to the total score for each measure. Testers noted ease of administering each test. The intraclass correlation coefficient was used to determine the interrater (ICC2,1) and intrarater (ICC3,1) reliability. Pearson correlation examined concurrent validity among scores on the three scales. MANOVA determined differences between individuals who were primarily non-ambulators (TUG score >35 s; n=9) and ambulators.

Results: The SBS, OSS, and FIST demonstrated excellent intrarater reliability (ICC3,1 = 0.95 to 0.99) and excellent interrater reliability (ICC2,1= 0.80-0.94). All three scales were significantly correlated to each other (r >0.78). The SBS and FIST demonstrated the strongest relationship (r = .914, p <.001). MANOVA revealed differences between non-ambulators and ambulators on all sitting balance measures as well as LE Fugl Meyer motor scores.

Conclusions: All three scales demonstrated good to excellent reliability. The SBS, OSS, and FIST are strongly correlated with each other indicating that the scales have face validity as well as concurrent validity. The strong relationship among scores on the scales suggests that determining which scale to use may depend on clinician preference. Clinicians may prefer to use the FIST or SBS over the OSS. The OSS took longest to administer and required a setup change to administer the items on foam. Instructions for the FIST and SBS were more readily understood by the participants in this study. Although some psychometric data is available for the FIST, all 3 scales need to be studied further to determine additional psychometric data and establish predictive validity.

Clinical Relevance: This study establishes reliability and validity for 3 sitting balance scales ensuring confidence for their use to assess sitting balance in individuals with hemiparesia.
Effect of short-term, intensive rehabilitation on motor impairment and function for stroke survivors in rural Jamaica

J.A. Feld, H.E. Josephson, T. Joyce, M. Mosley, M.A. Russo, Department of Orthopedic Surgery, Duke University School of Medicine, Duke University Doctor of Physical Therapy Division, Durham, North Carolina, UNITED STATES

Purpose/Hypothesis: Stroke is the second-leading cause of disability worldwide, and the leading cause of death in Jamaica. Persons residing in rural outlying areas often cannot access and benefit from the limited rehabilitation services provided in the country. This retrospective study examines the impact of an intensive rehabilitation program for persons with stroke in rural Jamaica. We hypothesized that an intensive, task-specific training program would result in significant and clinically meaningful improvements in gait speed, walking endurance, balance, and upper extremity function.

Number of Subjects: The study included 28 participants (61.9±10.3 years), 68% male, with a history of stroke (18.5±23.0, range 2-108 months post-stroke).

Materials/Methods: Participants were recruited from the parish of St. Elizabeth, Jamaica to participate in a five-day, intensive stroke rehabilitation program with pre and post training outcome measure testing. The rehabilitation interventions included neuromuscular re-education, gait training, task-specific upper extremity training, and balance training, with task-specific interventions tailored to each participant’s goals and disability status. Data collected during 4 camps from 2013-2015 was analyzed with Wilcoxon signed rank tests to determine if significant changes occurred between pre and post training for six outcome measures: 10-meter walk test, 6-Minute Walk Test (6MWT), Timed Up and Go (TUG) Test, Berg Balance Scale (BBS), Functional Gait Assessment (FGA), and Fugl-Meyer Assessment Upper Extremity (FMA-UE) Subscale. Cohen’s d effect size was calculated for each of the comparisons.

Results: There were significant differences found between pre and post training measurements for all outcome measures (p<.05). There were moderate effect sizes noted for the TUG (d=0.62), BBS (d=0.61) and FGA (d=0.75) and high effect sizes for the 6MWT (d=0.92), 10mWT (d=1.03) and FMA (d=0.92). Sixty-three percent of the participants reached the minimal clinically important difference (MCID) for 10mWT, while 32% and 26% reached the MCID for 6MWT and FMA-UE, respectively. Twenty-two percent of participants improved by one speed-based ambulation category from pre to post testing.

Conclusions: A one-week intensive, task-specific stroke rehabilitation program is an effective rehabilitation model for fostering significant and clinically meaningful improvements in functional outcomes in adults post stroke in rural Jamaica. Further research is needed to determine the long-term impact of this model of rehabilitation post stroke, and to identify benefits based on time post stroke and geographic area.

Clinical Relevance: High intensity rehabilitation camps can improve functional outcomes in patients post-stroke in populations with limited access to health care services including multi-disciplinary rehabilitation. This type of training program may have the greatest impact on increasing endurance, gait speed and upper extremity motor recovery while achieving a moderate impact on improving balance post stroke.
**TITLE:** Impact of Reactive Balance Training in a Patient With Chronic Incomplete Spinal Cord Injury: A Case Report  
**AUTHORS/INSTITUTIONS:** T. Drake, J. Mowder-Tinney, Nazareth College, Rochester, New York, UNITED STATES  

**ABSTRACT BODY:**  
**Background & Purpose:** Incomplete injuries account for 44% of all spinal cord injuries (SCI). Functional improvements after an incomplete SCI vary for each individual and can be especially challenging for those with chronic injuries. Falls are a significant problem among ambulatory patients with incomplete SCI. An efficient compensatory stepping reaction is an effective way to prevent falls. There is sufficient evidence on the use of balance training in patients with SCI to improve gait-related outcomes. However, research is lacking in the area of retraining reactive balance in incomplete SCI. The purpose of this case report was to assess the impact of providing functionally focused interventions that facilitated the utilization of challenging reactive balance strategies on balance and functional outcomes.  
**Case Description:** The client is a 58-year-old male, 18 months status post incomplete SCI as a result of thoracic level tumor removal and radiation therapy for malignant tumors found in the brain, trachea, and spinal cord. The client was able to ambulate independently with the inconsistent use of a straight cane in his left upper extremity, but reported falling ~2x/week while doing activities such as sit to stand transfers and actions requiring the displacement of an external load. The client was previously attending outpatient physical therapy 2x/week for 16 months, which focused on core strengthening and general balance activities with minor changes in objective measures. He continued with his program at that clinic but decreased attendance to 1x/week and started attending therapy 1x/week for eight weeks at a new clinic. The new therapy focused primarily on facilitating and retraining reactive balance to increase his ability to self-correct to prevent falls. Therefore, interventions were designed to challenge balance by the displacement of external loads during challenging functional activities.  
**Outcomes:** Following the 8-week intervention, fall frequency decreased resulting in no falls the last five weeks of interventions. Scores for the Timed Up and Go and the ABC Scale progressed to out of risk for falls and the Five Times Sit to Stand and the Six Minute Walk test reached greater than the MCIDs for each.  
**Discussion:** In addition to clinically significantly improving outcome measures related to falling and fear of falling, the client also improved in strength and aerobic capacity outcome measures. The results of this case report suggest that reactive balance training was not only beneficial in decreasing fall risk and increasing balance confidence, but may also have secondary benefits in improving strength and endurance. Future studies should focus on various ways to integrate reactive balance training into functional activity sessions.  
**References:** Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: Mansfield A, Inness EL, Komar J, Biasin L, Brunton K, Lakhani B, McIlroy WE. Training rapid stepping responses in an individual with stroke. Physical therapy. 2011 Jun 1;91(6):958-69.  

AUTHORS/INSTITUTIONS: T.F. Clark, H.J. Thompson, W.B. Dieter, FOX REHAB, Cherry Hill, New Jersey, UNITED STATES

ABSTRACT BODY:

Background & Purpose: Progressive Supranuclear Palsy (PSP) is a neurologic disorder affecting the brainstem and basal ganglia. PSP is characterized by postural instability, balance deficits, dysphagia, dysarthria, gaze deficits and Parkinsonism symptoms. There is no established protocol for the physical therapy treatment of PSP. The LSVT BIG program was developed for the treatment of Parkinson's disease (PD) and research has shown it to be an effective treatment for PD. Although the LSVT BIG program advocates the use of LSVT BIG for the treatment of secondary Parkinsonism, there is little to no published research regarding the use of LSVT BIG for PSP. The purpose of this case study is to examine the use of LSVT BIG program with a patient diagnosed with PSP.

Case Description: The patient in this study is a 65 year old woman diagnosed with PSP 3 years ago. She had previously participated in traditional physical therapy but was continuing to see a decline in function and experiencing falls. She was referred to PT for the LSVT BIG program by her neurologist. The patient was seen by one LSVT certified PT in her home, four times per week for four weeks for approximately one hour sessions as per the LSVT BIG protocol. The treatment sessions included 7 maximal daily exercises, 5 patient specific functional tasks, BIG walking, functional components of a hierarchy task and daily carry-over assignments. In addition, the patient performed the LSVT exercises one additional time on therapy days and twice on non-therapy days as her home exercise program.

Outcomes: The patient was evaluated on the first, tenth and 16th visit with the Chair Rise Test, Berg Balance Scale, Timed Up and Go and The Patient Specific Functional Scale. There was significant improvement in all outcome measures and a significant reduction in fall risk as demonstrated by the patient exceeding the clinical cut off scores for increased risk for falls in the Chair Rise Test, TUG and the BERG Balance Scale. The Patient Specific Functional Scale demonstrated improvement as the patient went from a higher level of disability to a lower level of disability.

Discussion: All outcome measures demonstrated improvement with a significant reduction in fall risk. In addition, this case study shows the effectiveness of the LSVT BIG program within the home environment. The program required no adaptation to be performed within the home and actually allowed for greater understanding of environmental barriers faced by the patient. Functional tasks could be completed within their actual environment without need for replication. When using the LSVT BIG program with this PSP patient verses a patient with PD, special consideration was given to the patient's vertical gaze palsy and diplopia but no further adaptations were necessary. Additional research using a randomized control trial is needed, but the LSVT BIG program appears to be an effective treatment option for patients with PSP.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old:
Title: Discordance between perceived and measured balance following stroke

Authors/Institutions: H. Goh, Physical Therapy, Texas Woman's University, Dallas, Texas, UNITED STATES

Abstract Body:

Purpose/Hypothesis: Patients with stroke often demonstrate fear of falling, sometimes, despite of relatively good balance capability. The discordance between perceived and measured balance in stroke has been found to impact gait recovery. It is hypothesized that fear of falling modulates avoidance behaviors and leads to physical inactivity. However, it remains unclear whether the discordance between perceived and measured balance affects patient's performance beyond physical domain, such as social participation and quality of life. The purpose of this study was to examine the effect of the discordance between perceived and measured balance on gait, functional independence, social participation and quality of life.

Number of Subjects: 75

Materials/Methods: 75 patients with stroke (Mean age = 66 years, 26 females) were tested. Perceived balance was measured by International Fall Efficacy Scale (FES-I) and measured balance was evaluated by Berg Balance Scale (BBS). 10m walk test, Barthe Index (BI), LIFE-Habit and WHO-Quality of Life Brief Version (WHO QOL-BREF) were also measured. We used a cut-off score of 27 on FES-I to categorize participants into low perceived balance and high perceived balance. A cut-off score of 42 on BBS was used to categorize participants into low measured balance and high measured balance. Discordance groups were those who had low perceived balance (FES-I>27) but high measured balance (BBS>42) and those who had high perceived balance (FES-I≤27) but low measured balance (BBS≤42). The categorization yielded a total of 4 groups. We compared group differences using one-way ANOVA and LSD post-hoc tests.

Results: 31 participants were classified as discordant (41.9%) in which 28 of them demonstrated low perceived balance despite high measured balance (37.3%). Discordance between perceived and measured balance did not have a significant effect on gait speed but had a significant effect on Barthe Index (p = .00), LIFE-Habit (p = .03) and physical domain of WHO QOL-BREF (p = .04). Post-hoc analysis revealed that those with high perceived balance but poor measured balance was more independent in ADL than those with low perceived confidence and poor balance (p = .01). They also tended to rate their physical domain of quality of life higher (p = .06). Furthermore, patients with low perceived balance but good measured balance tended to rate their physical domain quality of life lower than those who had high perceived balance and good measured balance (p = .06).

Conclusions: Discordance between perceived and measured balance significantly influence patients' independence in ADL and social participation. It might also have an impact of quality of life after stroke.

Clinical Relevance: Our study showed that the discordance between perceived and measured balance among stroke survivors was high (~42%). The mismatch between patient's perception and actual performance may have modulated their willingness to participate in their ADL activities and social life. Physical therapists working with patients with stroke should address both physical and psychological domains of balance performance.
The Effects of AlterG® Treadmill Training on Locomotor Function in an Individual Diagnosed with the Miller-Fisher Variant of Guillain-Barré Syndrome

T. Williams, J. Lynskey, Physical Therapy, A. T. Still University, Mesa, Arizona, UNITED STATES|K. Allegro, T. Nall, Touchstone Rehabilitation, Phoenix, Arizona, UNITED STATES

ABSTRACT BODY:

Background & Purpose: Body weight supported treadmill training has been shown to enhance recovery of locomotor function in individuals with neurological injuries and disorders. The AlterG® is a treadmill that uses advanced air pressure technology to decrease the body weight during use. It has been shown to promote balance recovery and improved gait function in patients with neurological impairments due to stroke, spinal cord injury, and multiple sclerosis. However, no evidence was found supporting the use of AlterG® treadmill training on individuals with Guillain-Barré Syndrome (GBS). The Miller Fisher Syndrome (GBS-MFS) is a rare variant of GBS, characterized by a triad of conditions: areflexia, ataxia, and ophthalmoplegia. The purpose of this case study was to evaluate the effects of AlterG® gait training on locomotor function in an individual with GBS-MFS.

Case Description: The patient is a 46 year old male diagnosed with Miller-Fisher Variant of Guillain-Barré Syndrome in August 2013. Treatment of this patient included 5 months in a subacute nursing facility (October 2013-February 2014), two months in an acute rehabilitation facility (February 2014 – April 2014) and outpatient therapy for 4 months (April 2014 – July 2014). At the beginning of this study, September 2014, the patient was attending a local gym 3-4 times per week while returning to work part-time. In addition, he was using a front wheeled walker at all times due to weakness and decreased endurance during gait. The patient’s goals were to increase bilateral lower extremity strength and increase walking endurance while discontinuing the use of an assistive device.

The patient participated in 18 sessions (3x/wk. for 6wks) of gait training using the AlterG®. Over the course of the sessions, time was increased from 30 to 60 minutes, percentage of body weight support was decreased from 40% to 20%, walking speed was increased from 1.8 mph to 2.7 mph, and walking distance increased from .98 miles to 2.7 miles.

Outcomes: At the end of the 6 week training period, the patient was no longer using his front wheeled walker for ambulation. His walking distance on the 6 minute walk test (6MWT) increased from 267m to 350m. The metabolic cost ($V_{O_2}$) of his walking decreased from 7.2 ml/min/kg to 5.92 ml/min/kg during the 6MWT. His time to complete the Timed up and Go (TUG) test decreased from 13.57s to 11.19s. His gait speed increased from .99m/s to 1.07m/s, and multiple spatiotemporal parameters of gait improved, including cadence, step length, stride length, double support time, swing stance ratio, and step length symmetry.

Discussion: This study provides initial support for the use of the AlterG® treadmill for gait training in an individual with GBS-MFS, and further supports existing reports of functional ambulatory benefits of body weight supported treadmill training in individuals with differing neurological disorders.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: 1. Lathan C, Myler A, Bagwell J, Powers C, Fisher B. Pressure-Controlled Treadmill Training in Chronic Stroke: A Case Study With AlterG. JNPT. 2015;39: 127–133.
TITLE: Ultrasound and Clinical Assessment of Supraspinatus Integrity in Manual Wheelchair Users with Various Duration of Spinal Cord Injury

AUTHORS/INSTITUTIONS: M. Finley, D. Ebaugh, Physical Therapy & Rehabilitation Science, Drexel University, Philadelphia, Pennsylvania, UNITED STATES; T. Trojian, College of Medicine, Drexel University, Philadelphia, Pennsylvania, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Shoulder pain is a debilitating problem for manual wheelchair users (MWCU) with spinal cord injury (SCI). Over 44% of long duration MWCU with shoulder pain show clinical signs of impingement while up to 71% of MWCU have documented rotator cuff tears. In long term MWCU, presence of clinical signs of impingement are associated with supraspinatus tendinopathy. However little is known about shoulder pathology in MWCU with shorter duration of SCI. Therefore, the purpose of this study was to assess supraspinatus tendon integrity among MWCU with short compared to long duration of SCI.

Number of Subjects: Fifteen participants (43.0±13.1yrs age) with SCI were stratified into 2 groups by duration of MWC use: <5 years (n=7) and >15 years (n=8).

Materials/Methods: Bilateral shoulder range of motion, special tests for subacromial pain syndrome, SAS (Hawkins-Kennedy, Neer, painful arc, palpation) and Wheelchair Users Shoulder Pain Index (WUSPI) were obtained. Presence of SAS was defined as positive findings on at least two tests. Standard shoulder musculoskeletal ultrasound (MSK-US) was performed by an investigator with >11 years’ experience (Teratech, Burlington, MA). For the purpose of this study the supraspinatus tendon was assessed for degenerative changes. Tendinopathy was graded as present or absent and qualified as mild/early or major/chronic. T-Tests compared groups on age and WUSPI (p≤0.05). Separate Chi Square tests of frequencies for clinical presentation of SAS and MSK-US findings were determined (p≤0.05). Phi correlation determined relationship of MSK-US and clinical SAS test findings and effect sizes determined.

Results: There was no difference in age (p=0.07) or WUSPI (p= 0.48) between groups. Frequency of SAS was not different (p=0.10, <5 years = 4/12, >15 years = 4/16) between groups. Frequency of SAS was not different (p=0.10, <5 years = 4/12, >15 years = 4/16) between groups. Medium effect (Cohen’s ω= 0.28) was found for between group MSK-US results. More shoulders in the >15 year duration group (62.5%) had degenerative changes in the supraspinatus tendon when compared to the <5 years group (33%). Qualitatively, degeneration was early/mild in the <5 years group, and progressively increased in severity with all changes in the >15 year group being classified as chronic/severe. Phi correlation showed a negative association between MSK-US and clinical SAS tests in the early duration group (φ= -1.2), and a strong association in the long duration group (φ= 0.78).

Conclusions: Clinical tests for SAS underrepresent the presence of tendon degeneration in early duration MWCU with SCI. Considering similar ages and shoulder pain levels between the two groups, over one-third of early duration MWCU already had degenerative changes on MSK-US. These degenerative changes were shown to increase in frequency and severity with 65% of the shoulders in the long duration MWCU (>15 years) having chronic supraspinatus tendinopathy with changes at the endplate.

Clinical Relevance: Clinical test for SAS may not reveal supraspinatus tendon degeneration supporting the role of MSK-US for early detection and possible intervention.
Background & Purpose: Stapedectomy is a surgical procedure performed to treat hearing loss as a result of impaired stapes movement. Symptoms of impaired stapes movement in the middle ear may include progressive hearing loss, tinnitus, imbalance and dizziness. Stapedectomy often reduces these symptoms and rarely results in worsening or persistent imbalance and vertigo. Patients may report slight dizziness and headache one to two days after surgery. Less common complications include tinnitus, partial facial nerve paralysis, perforated eardrum, temporary dysgeusia, and persistent vertigo. Currently, there is no literature on physical therapy management and rehabilitation of persons presenting with vertigo following a stapedectomy. This case report presents a patient with persistent vertigo following a stapedectomy treated with outpatient vestibular physical therapy.

Case Description: A 52 year old female presents to vestibular therapy with the chief complaint of vertigo status post right stapedectomy. She presents with positive right head thrust indicating a possible right sided vestibular dysfunction. She scored 28 on the Functional Gait Assessment and demonstrates difficulty performing ambulation with head turns and eyes closed. She presents with difficulty performing static balance sharpened Romberg with eyes closed compared to eyes open. She scored 44 on the Dizziness Handicap Inventory (DHI) indicating a moderate handicap and scored 60 on the Activities Specific Balance Scale (ABC) indicating a moderate level of functioning and prediction of future falls. She presents with slowed gait speed of 1.2m/s. In addition, she demonstrates decreased speed with performance of horizontal vestibular ocular reflex (HVOR) at 40% expected norm. Lastly, she reports vertiginous symptoms during pressure changes including blowing her nose, coughing, or inhaling deeply. These symptoms are uncommon following a stapedectomy.

Treatment included static standing balance with eyes closed both over ground and dynamic surface, horizontal/vertical VOR, and ambulation with head turns. Treatment included four 45-minute sessions.

Outcomes: At re-evaluation, she reports improvement with her overall balance confidence as noted with increased score of 75% on the ABC. She demonstrates improved vestibular function as noted with increased speed with performance of HVOR at 70% to 80% expected norm. Additionally, she presents with improved dynamic standing balance as noted with increased gait speed at 1.9m/s. Her score on the DHI remained unchanged at re-evaluation which may be due to a limited number of treatment sessions.

Discussion: Current evidence of physical therapy management in individuals following a stapedectomy is limited. This case report demonstrates the effectiveness of vestibular therapy for one individual following a stapedectomy. Although this patient presented with uncommon symptoms she demonstrates improvement. Vestibular therapy intervention may improve function and dynamic balance in individuals following a stapedectomy and is an area to be further explored.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old:


TITLE: The Role of the Physical Therapist in Health Promotion as Perceived by Patients with Neurological Pathologies: A Descriptive Study

AUTHORS/INSTITUTIONS: M. Ingman, DPT, St. Catherine University, Minneapolis, Minnesota, UNITED STATES|H. Von Arb, Mayo Clinic, Rochester, Minnesota, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: The purpose of this study was to investigate the perceptions of patients with neurological disability regarding the physical therapist’s (PT) role in promoting personal health behaviors (physical activity, healthy weight management, smoking cessation, and fruit and vegetable consumption).

Number of Subjects: 35

Materials/Methods: One hundred surveys were given to the clinical site for distribution to patients. Patients who met the inclusion criteria were identified by their primary PT. The PT aide asked patients to participate to avoid bias associated with being asked by the treating PT. Participants were instructed that they could complete the survey either in the clinic or at home. Participants were provided with a pre-addressed and stamped envelope to return their completed survey to the investigators.

Results: The mean age of the respondents was 52.3 years, 62.9% were male, average BMI = 28.1 and 73.5% reported having a neurological condition for at least 3 years. The majority of respondents believed physical therapists should advise them about physical activity (88.6%), smoking cessation (65%), and weight management (83%). Interestingly, 76% believed that PTs should suggest ways to maintain a healthy weight, however it was only addressed with 37% of the sample.

Conclusions: Respondents with chronic neurological conditions in an outpatient setting expressed the belief that PTs should advise them in the personal health behaviors of physical activity, weight management, smoking cessation, and fruit and vegetable intake. Although the majority of respondents believed weight management should be discussed in their therapy sessions, only 37% reported their physical therapist addressed their weight. This finding suggests a potential opportunity for physical therapists to have conversation with their patients on healthy weight management.

Clinical Relevance: The American Physical Therapy Association’s (APTA) vision states that the future of the physical therapy field is “transforming society by optimizing movement to improve the human experience”. One important aspect of optimizing movement is the promotion of health and wellness with patients. Physical therapy practice provides an optimal opportunity to promote wellness and provide education, considering the magnitude of time spent with patients over extended episodes of care to build rapport and assist in behavior modification. Current literature indicates that individuals with disabilities have a higher rate of negative health behaviors, leading to an increased risk of developing chronic disease. Additionally, patients with disabilities identify more barriers to healthy behaviors than the general population. Health promotion is especially important for the disabled population because while emerging technology is assisting in prolonging the lifespan of individuals with disability, the quality of life component may be lagging behind. This study reveals that patients do want their PTs to discuss and assist them with healthy behavior change.
TITLE: BIOMARKERS OF SPORT-RELATED mTBI RECOVERY

AUTHORS/INSTITUTIONS: J.B. Christy, G. Cochrane, A.B. Almutairi, Physical Therapy, The University of Alabama at Birmingham, Birmingham, Alabama, UNITED STATES| C. Busettini, Vision Sciences, The University of Alabama at Birmingham, Birmingham, Alabama, UNITED STATES| M. Swanson, K. Weise, Optometry, The University of Alabama at Birmingham, Birmingham, Alabama, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis: Diagnosis and monitoring of sport-related mTBI recovery are hindered by the absence of objective biomarkers. Standard imaging tests are often negative, suggesting that symptoms may be the result of both functional and metabolic neural alterations not well visualized with existing technology. The need for biomarkers is evident considering the evidence that repetitive concussions without full recovery between them generate a cumulative effect with an exponential increase in the probability of long-term deficits. The purpose of this study was to describe data for athletes without mTBI or with asymptomatic mTBI on novel tests of oculomotor and vestibular function. Data for these tests have not been previously reported.

Number of Subjects: N=21 athletes with asymptomatic sports related mTBI (mTBI) and n=25 control athletes; mean age = 13.5(SD=4).

Materials/Methods: Athletes were tested using a Neuro Kinetics Inc. I-Portal NOTC rotary chair. The chair includes a high-torque assembly inside an enclosure to achieve complete darkness. Binocular eye tracking is at 100 Hz, with a video system mounted inside goggles. A fast mirror galvanometer laser system projects dots or bars. Push buttons are available for reaction times and subjective vertical/horizontal. Tests of interest included: 1) predictive saccades (PRED), 2) antisaccades (ANTI: # of errors when attempting to move the eyes opposite of a target), 3) visual and 4) auditory reaction times (VRT/ART: time required to push a button in response to a light or beep), 5) saccades and reaction time (SaccRT: # of errors when attempting to move the eyes to a target and push a button indicating the target's direction), 6) subjective visual vertical and 7) horizontal (SVV/SVH: degrees off true vertical/horizontal) and 8) controlled rotation high impulse test (crHIT: Vestibular Ocular Reflex gain to yaw head movements at 1000 deg/sec²).

Data were analyzed using the NKI investigative software. Descriptive statistics included means and standard deviations. mTBI and control athletes were compared using independent samples t-tests (alpha=0.05).

Results: Athlete groups did not differ statistically on variables (p>0.05). Means (standard deviations) for each variable are reported for controls and mTBI, respectively: 1) PRED(#): left= 7.2(4.9); 6.9(5.8); 2) ANTI (%Errors): 57.74(23.01); 55.62(16.07); 3) VRT(ms): 326.87(91.72); 387.68(174.87); 4) ART(ms): 279.03(136.57); 338.60(152.41); 5) SaccRT(%errors): left=21.21(16.41); 15.76(10.80); right=13.88(11.73); 11.38(9.58); 6) SVV(asymmetry%): 0.93(0.76); 1.37(1.40); 7) SVH(asymmetry%): 0.92(0.78); 1.46(1.18); 8) crHIT(VORgain): right: 1.03(0.07); 0.97(0.09); left: 1.04(0.93); 1.01(0.06).

Conclusions: This is the first report of data for an athlete population on these tests, meant to identify and track recovery of individuals mTBI. The athletes with asymptomatic mTBI did not differ from controls which could indicate a level of recovery.

Clinical Relevance: These biomarkers of mTBI may help to identify athletes who are not yet recovered from mTBI and who would benefit from interventions to speed recovery for return to play.
Purpose/Hypothesis: There is limited research on how subtle differences in testing methods affect gait speed reliability and validity across patient populations [1]. The aim of the study was to evaluate the test-retest reliability and concurrent validity between the comfortable walking speed of an individual when they have knowledge of a testing situation, or knowledge of being observed, compared to their comfortable walking speed in a circumstance where they are unaware of being examined. The hypothesis is that there will be low agreement between the walking speed values obtained between the two conditions.

Number of Subjects: 31

Materials/Methods: A cross-sectional design was used to assess the walking speed of individuals with a peripheral vestibular disorder under two conditions: 1) a condition where the participant was unaware of being tested (unknown observer condition), and 2) the current, standardized method where the participant was provided instructions to "walk at your normal pace," (known observer condition). Gait speed was measured over a distance of 10 meters [2], and sufficient distance was provided for participants to achieve a steady state walking speed [3]. Testing was repeated over a 7-day interval.

Results: Test-retest reliabilities for gait speed measurements within each condition were excellent (ICC values of 0.92 - 0.96). Standard errors of measurement (SEM) and minimal detectable change (MDC\textsubscript{95}) values were 0.018 – 0.024 m/s and 0.04 – 0.06 m/s, respectively. Across the unknown and known conditions, the ICC was reduced to 0.80 suggesting some inconsistency in relative gait speeds across conditions. A paired t-test revealed that on average, individuals walked significantly faster ($p=.000$) in the unknown observer condition (mean=1.31, SD=0.18 m/s) compared to the known observer condition (mean=1.22, SD=0.16 m/s). The mean difference of 0.08 m/s is clinically meaningful. Bland-Altman analysis revealed a large systematic error ±0.14 to ±0.31 m/s between the two testing conditions.

Conclusions: Consistent values of preferred walking speed can be obtained within either testing condition over a 7-day period for individuals with vestibular dysfunction. However, although there is a positive correlation between measurements across the two conditions, a substantial mean difference in gait speed was found which indicates the walking speed values obtained in the two conditions do not tend to agree and are not comparable.

Clinical Relevance: For individuals with a vestibular disorder, there is a measurable difference in an individual’s walking speed that is influenced by the individual’s awareness of being observed or not being observed while walking. The potential for the observer effect to bias an individual's comfortable walking pace may raise serious questions about the validity of the standardized method used to assess comfortable walking speed across patient populations.
TITLE: Use of an Online Asynchronous Web-Based Platform Discussion Board for Individuals Sitting for the Neurologic Clinical Specialist Examination

AUTHORS/INSTITUTIONS: S. Trojanowski, Sinai-Grace Hospital, Detroit, Michigan, UNITED STATES; N.A. Riley, St. Ambrose University, Davenport, Iowa, UNITED STATES; A. Williamson, Chatham University, Pittsburgh, Pennsylvania, UNITED STATES; M.C. Beato, University of Central Florida, Orlando, Florida, UNITED STATES

ABSTRACT BODY:

Purpose: To help facilitate review of unfamiliar concepts and create study support in an online environment for individuals sitting for the Neurologic Clinical Specialist Examination.

Description: Various graduate and post-professional programs utilize web-based, asynchronous technology to reach students across the country. The NCS committee is charged with increasing the number of neurologic clinical specialists. Previous test takers have requested study review tools beyond the traditional resource list. The NCS Committee utilized Canvas, an online educational platform, to create an online community to support test takers. Several areas were previously identified by test takers requesting further review. Modules were created in the following areas: 1) Strategies to Prepare for the NCS Exam 2) Research Design, Statistics & EBP 3) Assessment Tools and Outcome Measures 4) Neurological PT within the Pediatric Population 5) Orthotic Management in Neurological PT 6) Professional Roles. Experts in these subject areas were recruited to facilitate these content areas and lead an active discussion forum. These module ran for 2 weeks each beginning in December 2015 running through February 2016. Modules also included a review of key concepts for the specialist practitioner based on the Description of Specialty Practice. There were discussion question posted in each module to facilitate dialogue and learning. Virtual study groups were also established in dedicated topics of CVA, Brain Injury and SCI. Test takers were connected with each other, in groups of 5-6, with suggestions to communicate via Google Hangout or Skype.

Summary of Use:

Summary:
- 198 participants requested to participate in the discussion board
- 144 activated the invite to the discussion board
- 21,364 total page views
- 8 virtual study groups
- 10 module facilitators and discussion facilitators

A post-test taking survey was sent in April 2016 via Survey Monkey:
- 86.11% would recommend participation to future applicants
- Feedback on potential new topics to include: Motor Learning/Motor Control, Vestibular Rehab, Teaching and Learning
- Suggestions to improve included more feedback to confirm answers and more guidance on discussion questions as well as starting the discussion board earlier and releasing all of the modules simultaneously.

Importance to Members: The purpose of the NCS Committee is to promote specialty practice and encourage therapists to pursue Neurological Specialization. This was a unique tool to promote virtual study groups and connect test takers with each other to promote a community and dialogue of specialty practitioners. Survey results will continue to guide improvements to information delivery.
TITLE: The Manifestation of Benign Paroxysmal Positional Vertigo (BPPV) in a Patient with Paraneoplastic Syndrome (PPS).

AUTHORS/INSTITUTIONS: D. Malamut, J.L. Fay, Vestibular Rehabilitation, NYU Langone Medical Center Rusk Rehabilitation, New York, New York, UNITED STATES

ABSTRACT BODY:

Background & Purpose: PPS is the result of an autoimmune response to a patient's cancer cells in this case resulting in peripheral neuropathy. The purpose of the case study is to describe the manifestation, symptoms, and treatment of BPPV in a patient with PPS.

Case Description: This is a case of a 65 year old female status post breast cancer surgery with the diagnosis of PPS resulting in a partial left hemiplegia. Over the course of 2 admissions including a total of 45 sessions of skilled vestibular therapy the patient experienced 7 separate clusters of BPPV episodes (always left posterior canal). Canalith repositioning was required as part of treatment in 18 of the vestibular sessions (+Hallpike tests). During pretreatment discussions the patient referred to the presence of vertigo only twice, and “spinning” only one time. Pre-session discussion before the remaining 15 BPPV treatments lacked any reference to the above descriptors.

The other 28 sessions were devoted to vestibular rehabilitation and improvement of motor control and strength on the left side.

The salient feature of the patient’s rehabilitation was the frequent recurrence of BPPV as revealed during Hallpike testing in spite of the patient’s not having complained of vertigo or spinning.

Outcomes: The patient, who arrived for evaluation in a wheelchair, over the course of two separate periods of treatment, progressed from a dependent status to rolling walker, straight cane, and finally, ambulation without assistive device. The patient’s balance improved such that she was able to turn her head, change direction while walking, and reciprocally walk up and down steps with intermittent use of the railing.

The patient progressed from an inability to perform the Functional Gait Index (FGA) to 20/30, Dizziness Handicap Inventory (DHI) improved from 70 to 44, and ABC improved from 47 to 64.

Discussion: PPS is an autoimmune disorder affecting the peripheral nervous system. The combination of vestibular weakness and motor control/strength issues is a tall order for the physical therapist. Under the circumstances, the possibility of BPPV might be overlooked. However, an attack on the peripheral nervous system could compromise the otolith making the patient vulnerable to BPPV. In this case, the patient infrequently reported vertigo (3 times) and only twice connected that vertigo with head position.

The success of this patient’s therapy depended on the success of serial treatments for BPPV, without which the formidable improvements in balance and mobility would have been impossible.

It is noteworthy that all manifestations of BPPV were on the side of the neuropathy.

BPPV is the most frequently occurring vestibular pathology. Patients do not always describe vertigo with change of head position. This patient used the expected description only 1/9 of the time. It is reasonable to suspect that the otolith might be compromised by a peripheral neuropathy. It is, therefore, suggested that the therapist be even more vigilant than usual regarding BPPV testing with the PPS patient.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: Pelosof LC, Gerber DE. Paraneoplastic syndrome: an approach to diagnosis and treatment. Mayo Clinic Proc. 2010; 85(9):838-854.


Balogh RW. Differentiating between peripheral and central causes of vertigo. J Neurol Sci 2004; 221;3.
TITLE: Predicting Discharge Using EuroQol (EQ-5D) Individual Scores: A Retrospective Study of Acute Stroke Survivors

AUTHORS/INSTITUTIONS: C. Denzer-Weiler, K. West, Inpatient Physical Therapy, Kessler Institute for Rehabilitation, Great Meadows, New Jersey, UNITED STATES|K.P. Hreha, Kessler Foundation, West Orange, New Jersey, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis: To determine if the admission FIM (total, motor and/or cognitive) can predict EQ-5D scores at admission.
To determine if the discharge FIM (total, motor and/or cognitive) can predict EQ-5D scores at discharge.
To investigate if the EQ-5D dimensions on admission predict discharge disposition and therefore serve as a prognostic tool.

Number of Subjects: 1325

Materials/Methods: EQ-5D measures health-related quality of life via patient and therapist subjective report in five dimensions (mobility, self-care, usual activities, pain/discomfort, anxiety/depression) and overall. Additional data was collected on age, length of stay, discharge disposition, and Functional Independence Measure scores on admission and discharge. Relationship between FIM and ED-5D was explored with a regression model. Predictive capabilities were examined using a predictive modeling technique.

Results: 1527 brain injury patients completed the EQ-5D. Charts without stroke diagnosis and those missing data (secondary to aphasia or cognitive deficits) were eliminated, resulting in N=1325 with a mean age of 72 years and average length of stay of 17 days.

The regression model examined all interactions between age and FIM scores using all possible interactions as covariates. Backward model selection was applied with adjusted $R^2$ as the section criterion. The predictability of admission FIM scores did not perform well based on adjusted $R^2$, (patient=0.0751, therapist=0.1077). At discharge, no correlations existed and the prediction observations were not strong (Adjusted $R^2$ patient = 0.1121, therapist=0.2233).

For discharge disposition, category collapsing eliminated small sample size (67.5% home, 27.0% skilled nursing/sub-acute). We computed the area under a receiving operating characteristic curve (ROC (AUC)) as a scoring metric of model performance. Gradient boosted tree algorithm proved best in predicting disposition of discharge (for both patient ($\mu = .8292$, SD=.0477) and therapist ($\mu=.8447$, SD=.0230) reported scores) at admission.

The specificity of the patient’s reported scores to determine a home discharge was 68%. The therapist’s report was 71%.

Conclusions: Due to a weak predictability of the EQ-5D based on the FIM, it appears that these assessments do not measure the same information and should independently be administered. Admission EQ-5D (patient or therapist reported) performed well at predicting discharge disposition in our sample. There is a need for further research to examine individual dimensions which lead to this determination.

Clinical Relevance: The EQ-5D is a useful tool for patients post-stroke in an inpatient rehabilitation setting. Our study provides information to aide in prediction of discharge disposition and suggests the EQ-5D is independent of the FIM score, however further modeling is required to conclude these findings.
Purpose/Hypothesis: The most commonly reported deficit following a cerebrovascular accident (CVA) is hemiparesis, defined as weakness on one side of the body. In addition, deficits in motor control, or impaired ability of the brain to regulate movement at a specific joint, are seen. Currently only subjective scales are clinically available to measure selective motor control following cerebral damage, but objective measures are needed. The purpose of this study was to formulate and evaluate a method that allows clinicians to easily and objectively measure voluntary motor control during any specific joint movement.

Number of Subjects: In this case series, three individuals post-stroke participated in this observational study.

Materials/Methods: Selected movements of three participants with CVA were assessed using smartphone applications, Hudl Technique 2-D video and Sensor Kinetic Pro acceleration data, as a more objective method for documenting and monitoring motor control improvement following a CVA. For acceleration data a formula was used to calculate the total resultant acceleration (TRA) for the participant’s tested extremity during the voluntary movement. Movements were analyzed for portions of range with observed loss of motor control and compared by time-stamp to acceleration date in the same periods (reaction time, movement time, abnormal movement time).

Results: Selected movements of three participants with CVA were assessed using smartphone applications, Hudl Technique 2-D video and Sensor Kinetic Pro acceleration data, as a more objective method for documenting and monitoring motor control improvement following a CVA. For acceleration data a formula was used to calculate the total resultant acceleration (TRA) for the participant’s tested extremity during the voluntary movement. Movements were analyzed for portions of range with observed loss of motor control and compared by time-stamp to acceleration date in the same periods (reaction time, movement time, abnormal movement time).

Conclusions: Visual observation of loss of motor control on the 2-D video coincide with increased frequency of peak acceleration noted in the accelerometer data.

Clinical Relevance: While further study is needed to investigate the reliability, validity, and feasibility of using smartphone applications in a broader clinical sample, it appears that this method may provide an objective way to objectively measure isolated or selective motor control and document improvement during stroke rehabilitation.
Not just an orthotic device: Use of torso-weighting can improve motor ability assessed with weights off in pilot test of people with multiple sclerosis

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Purpose/Hypothesis: For people with multiple sclerosis (MS) and limitations of gait and balance, customized placement of light weights using balance-based torso-weighting has improved motor ability in single-session assessment with weights on, establishing a potential orthotic effect. The purpose of this pilot test was to examine the effects of wearing the torso-weights over a multi-week period. We hypothesized that people would show greater improvement in motor performance after wearing light weights compared to a no-weight period or a period wearing sham weights. We examined possible therapeutic effects of this intervention by performing assessments with weights off.

Number of Subjects: 5 ambulatory participants with MS

Materials/Methods: Balance and gait were assessed at baseline and after periods of two to four weeks during which participants had no weights, or wore actual weights or sham weights for 2-4 hours each day. All participants experienced all three conditions. The order of the actual weight and sham weight conditions was randomized. Participants and assessors were blinded to active or sham condition. Measures included walking on an instrumented gait mat, the 6-Minute Walk Test, and the Sensory Organization Test. Torso-weighting involved applying weights (totaling 0.25-2 pounds) to a vest-like garment to improve reactive control following manual perturbations and resisted rotations at the shoulders and pelvis. Changes in performance after each of the three time periods were compared using repeated measures ANOVA; effect size for weighting condition was considered large if over 0.4. Participants completed a daily activity log to record falls experienced throughout the study periods.

Results: After the two-week period wearing actual weights, average increases were 7.4 composite score points or 14% for the Sensory Organization Test, 47.4 meters walked or 16.6% for the 6-minute Walk Test, and 12.5 cm/sec or 15% for gait velocity. Average performance for each variable decreased or showed negligible improvement after periods of no weight (13.4% decrease to 3.5% increase) or sham weight (5.8% decrease to 1.8% increase). The effect sizes for weighting condition were large ($f = 0.7$ to $0.9$). Participants reported no falls on daily activity logs during the weighted condition; falls occurred in both no-weight and sham periods.

Conclusions: Regular use of strategic torso-weighting versus no weights or sham weights can improve motor performance when assessed without weights.

Clinical Relevance: Strategic torso-weighting does not just act as an orthotic device, supporting function when donned. Improvement noted with weights doffed implies that motor learning may occur during a period of regular use of weights. Further research is warranted. The large effect size indicates that this study would have .80 power to detect differences among weighting conditions with a sample size of 8 people.
TITLE: Reactive Lateral Step Treadmill Training for Paretic Limb Step Initiation in Chronic Stroke

AUTHORS/INSTITUTIONS: L.D. Hedman, K. Horn, M. Sayranian, M. Krifka, M. Wu, L. Martin, Physical Therapy and Human Movement Sciences, Northwestern University Feinberg School of Medicine, Chicago, Illinois, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Community-dwelling stroke survivors (SS) have a high fall risk partly due to impaired paretic limb (PL) reactive stepping. The study’s objective was to assess the effect of reactive lateral step treadmill training (RLSTT) on reactive and voluntary PL lateral stepping in SS. We hypothesized that after RLSTT: SS will demonstrate increased frequency of reactive PL lateral step initiation, decreased use of external support during reactive PL stepping, changes in PL volitional lateral stepping characteristics, and decreased Four Square Step Test (FSST) time.

Number of Subjects: 4 SS (64 ± 3 years old) with chronic stroke (153.5 ± 141.7 months post) and 2 healthy control (HC) subjects (58.5 ± 3.5 years old).

Materials/Methods: Treadmill Assessment: SS stood with their feet perpendicular to the treadmill belt movement with even-weight bearing and with the PL closest to the front of the treadmill. SS were instructed to remain within a designated zone as they responded. The treadmill was accelerated to 0.7 mph for 3 seconds for 10 trials X 4 conditions: Non-Encouraged Single Task (NEST), Non-Encouraged Dual Task (NEDT), Encouraged Single Task (EST) and Encouraged Dual Task (EDT). Dual task consisted of SS naming items in a category until the treadmill started. NEST/NEDT: SS were instructed to respond as necessary to remain upright. EST/EDT: SS were instructed to initiate their response with the PL. Verbal feedback was provided. Successful trials (PL initiated first step, stayed in designated zone, no external support) were counted.

Voluntary Lateral Stepping: Vertical ground reaction forces (vGRF) for each foot and total center of pressure (COP) were recorded while subjects stood with equal weight bearing on 2 force plates and stepped laterally to a visual cue. All subjects completed the FSST. HC completed voluntary lateral stepping only. RLSTT Intervention: SS completed 6 sessions (2 sessions/week) consisting of EST and EDT, 40 trials each.

Results: Treadmill Assessment: During the pretest, SS were 43.8% more successful in EST/EDT compared to NEST/NEDT. From pre to posttest, SS demonstrated a 56% increase in trials initiated with PL and a decrease in trials requiring external support (pre=5%; post=0%). Voluntary Lateral Stepping: PL and NPL step duration was significantly reduced from pre to posttest (p=0.022). All PL stepping trials showed a stepping limb preload. This preload was absent in all non-paretic limb (NPL) and HC stepping trials. COP was displaced significantly towards the stepping limb during PL initiated stepping but not during NPL stepping (p = 0.007) or HC stepping. PL step duration was significantly longer than NPL step duration (p=0.012). There was no significant change in FSST time (p=0.231) from pre to posttest.

Conclusions: RLSTT may increase frequency of PL step initiation and voluntary lateral step speed. COP and vGRF differences between PL and NPL/HC stepping may reflect a more cautious strategy for PL lateral stepping.

Clinical Relevance: Increased use of the PL in reactive contexts and faster voluntary lateral stepping may decrease SS fall risk.
Clinical Recommendations for Exoskeletal Assisted Walking in the spinal cord injury population

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Purpose: Recommending musculoskeletal parameters to achieve successful exoskeletal assisted walking for individuals with SCI.

Description: Recent technological advances have dramatically changed the ambulation potential of individuals after SCI. Specifically, robotic exoskeletons afford non-ambulatory individuals with SCI the ability to walk through the use of a mechanized body suit and forearm crutches. The robotic exoskeleton is controlled by computer sensors activated by the user's trunk angle to replicate LE gait kinematics and enable the user to walk. Research is currently underway worldwide to determine the impact of Exoskeletal Assisted Walking (EAW) on a user's musculoskeletal, GI, and cardiopulmonary systems as well as the effects on balance, adiposity, pain, and spasticity. However, there is limited consideration in the literature of which individuals will be successful at EAW. Safety is the paramount concern when determining if an individual is an appropriate candidate for EAW, though rehabilitation services utilization, outcomes, and financial implications are also critical clinical selection components. With these components as our framework, we suggest clinical recommendations to assist clinicians' decisions regarding who is appropriate for EAW training. To date no such musculoskeletal recommendations exist to guide clinicians in patient selection into an EAW program.

Summary of Use: These recommendations are based on health data and feedback from both clinicians trained in EAW and manufacturers’ guidelines. These criteria present best clinical judgment regarding optimal participation in EAW training:

- SCI between C7-S1 (Ekso), T4-L1 (ReWalk, Indego)
- LE paresis
- \( \geq \) Grade 4 MMT B UEs
- Full ROM of shoulder IR/ER; shoulder and elbow flexion extension
- Good static sitting posture/alignment
- Independent transfers w/c to/from bed/car
- Independent manual w/c mobility
- Height = 5'2" - 6'3"
- Weight < 220 lbs
- Healthy bone density (T score > -2)
- Tolerant of 30 minute standing frame with dynamic UE use
- ROM: Ankle \( \geq \) 0 degrees, Hip extension \( \geq \) 0 degrees, Knees <10 degree extension deficit
- Minimal LE spasticity
- Ability to follow directions well/demonstrate learning
- Strong motivation to ambulate

Concern Areas:
- Uncontrolled spasticity
- Infection, pressure sores
- DVT
- Pregnancy
- Cardiopulmonary issues
- Psychiatric/cognitive issues
- Joint contractures limiting ambulation with crutches
- Wounds within device framework

Importance to Members: Advancements in robotic technologies presents previously unimaginable opportunities for individuals living with SCI. However, exoskeleton use is not appropriate for all individuals with paresis. Establishing clinician driven guidelines to assist in the candidate selection process provides a valuable rehabilitation tool, and a starting point for future candid discussions as the technologies continue to advance. These guidelines offer a starting point for a clinician to screen individuals for EAW in order to provide the safe, time and cost effective utilization of rehabilitation resources.
Title: The Clinical Effectiveness of Rhythmic Auditory Stimulation in Dynamic Balance and Gait Training in Patients with Parkinson's Disease: a Systematic Review

Authors/Institutions: T. Cox, R. Swiderski, N.S. Meneses, A. Lebiak, Physical Therapy, Southwest Baptist University, Springfield, Missouri, United States

Abstract Body:

Purpose/Hypothesis: The treatment of gait in patients with Parkinson’s disease is challenged by rigidity, spasticity, tremors, bradykinesia and other musculoskeletal disorders. Pharmacological treatment combined with physical therapy has been shown to improve these symptoms. Music Therapy and Rhythmic Auditory Cues (RAC) are interventions that have been shown to improve mood, emotional well-being, and quality of life in these patients. Rhythmic Auditory Cues combined with physical therapy may, theoretically, improve gait. This systematic review was designed to evaluate current research on the use of RAC in the physical rehabilitation of patients with Parkinson’s Disease, stage I-IV on the Hoehn and Yahr (H&Y) scale.

Therefore, the purpose of this study was to systematically review randomized controlled trials evaluating the effectiveness of RAC with gait training for patients with Parkinson’s disease.

Number of Subjects: NA

Materials/Methods: The following databases were systematically searched in March of 2016: CINAHLcomplete, Cochrane, MEDLINE, and SportsDiscus. Studies were accepted when they were randomized controlled trials (RCT), investigated the effects of external rhythmical cueing on gait and balance in patients with Parkinson’s disease; the intervention was applied to improve gait performance and balance, they were published within the previous 15 years, and scored at least 7 out of 10 on the PEDro scale. A total of 226 studies were initially identified, after duplicates and studies unrelated to RAC or Parkinson’s were removed, 7 articles were assessed for eligibility using the PEDro scale. One RCT received less than a 7 out of 10 rating on the PEDro scale and therefore was excluded, leaving 6 studies for review.

Results: Six RCTs were reviewed that investigated the effects of auditory cueing on gait and balance in patients with Parkinson’s Disease. Walking speed was measured in 5 of the RCTs. Outcome measures used to assess walking speed included the 10-meter walk test, 6-meter walk test, Dynamic Gait Index (DGI), Rapid Step-Up Test, Force Plate analysis, and the Posturo-Locomotion Manual Method (PLM). Balance was also measured in 4 RCTs. Outcome measures used to assess balance included the Berg Balance test, the Push and Release test, MiniBest, Smart Equitest, TUG, Functional Gait Assessment (FGA) and the Tinetti balance assessment tool. In all of the studies reviewed RACs were found to improve dynamic balance, motor function, and gait in those with a diagnosis of Parkinson’s disease.

Conclusions: Based on this review, there seems to be sufficient evidence for the use of RAC in the clinical setting for retraining gait and balance in patients with Parkinson’s disease. However, the authors of the studies that support the use of RAC agree that more research on the intervention should be done.

Clinical Relevance: RAC may be a beneficial intervention in improving outcome measures involved with gait and dynamic balance in patients with PD in Stage I-IV of the H&Y classification system.
TITLE: Predicting Future Falls in Community Dwelling Older Adults

AUTHORS/INSTITUTIONS: K.K. Cleary, Eastern Washington University, Spokane, Washington, UNITED STATES|E. Skornyakov, Neuroscience, Washington State University, Spokane, Washington, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: About 25% of community dwelling older adults report falling each year. It is important for physical therapists to first identify patients at risk, and then implement appropriate fall prevention measures. The purpose of this study was to determine which variables prospectively predicted fall status in a sample of community dwelling older adults.

Number of Subjects: Forty-five people aged 65 and older (x=84 years) participated in this study. To participate, subjects had to live independently and be able to walk inside their homes, with or without an assistive device, but without help from another person.

Materials/Methods: Subjects reported demographic and clinical characteristics, and completed the Timed Up and Go (TUG) test as a measure of balance performance. Interviews were conducted 3 and 6 months later to determine whether a subject had fallen in the most recent 3 months. Those who reported at least one fall 6 months after testing were classified as “fallers,” while those who had not fallen were classified as “non-fallers.” A standard logistic regression was conducted to determine whether any independent variables [age, fall history (yes/no), or balance performance (TUG score)] were predictors of fall status 6 months after baseline testing. Descriptive statistics, preliminary linear regression, and standard logistic regression were conducted in SPSS version 23.0.

Results: Preliminary linear regression results confirmed that multicollinearity was not a problem (all tolerance collinearity statistics > 0.1). Standard logistic regression results indicated that the overall model fit of the predictors (age, fall history, and balance performance) was good (-2 Log likelihood = 29.14) and statistically reliable in distinguishing fall status [$\chi^2 = 20.92, p < 0.01$]. However, the model only classified 82.2% of subjects correctly: 91.2% of non-fallers and 54.5% of fallers. Odds ratio indicated that a positive fall history and poor balance performance increased the likelihood of a fall occurring during the next 6 months.

Conclusions: Similar to existing literature, both fall history and balance performance were reliable fall predictors in this sample of community dwelling older adults. However, age was not a significant predictor of future falls in this study. Although the model correctly classified more than 90% of non-fallers, only about half of the fallers were correctly classified.

Clinical Relevance: About half of older adults likely to fall in the near future may be not be identified when using only fall history and TUG performance as predictors. Other independent variables may identify fallers with greater sensitivity, and warrant further investigation.
Purpose/Hypothesis: The Berg Balance Scale (BBS) and the Dynamic Gait Index (DGI) were developed to provide clinicians with standardized measurement tools to assess balance and falls risk in the elderly. The reliability of the BBS and DGI has been evaluated in many studies; however, the authors identified that many of the reliability studies provided their raters with custom standardized instructions beyond those listed in the original measures. Therefore, it is the authors’ intention to provide the users of the BBS and DGI with a manual, which includes original instructions combined with customized modifications, to transfer the reliability of these objective measures from a research environment to the clinical setting.

Number of Subjects: 13

Materials/Methods: Following review of reliability studies for the BBS and DGI, test items identified as having multiple interpretations were selected for further clarification. Operational instructions were created for these items to promote standardization. Instructional manuals were compiled using these operational instructions combined with the original instructions for the BBS and DGI. Instructional video examples demonstrating the expanded instructions were recorded. These resources were distributed to expert and novice clinicians, who scored video examples of two patients with chronic stroke using the developed standardized instructions. Following feedback from the clinicians, the manuals and videos were updated for additional clarification and then redistributed for scoring. The inter-rater reliability was then calculated for each subject and test separately. The pre-revision and post-revision inter-rater reliabilities were assessed.

Results: The inter-rater reliability improved from pre-revision to post-revision for both the BBS and DGI. For the BBS, patient one reliability scores improved from ICC 0.973 (95% Confidence Interval; 0.945, 0.990) to ICC 0.998 (0.985, 0.997), and scores for patient two improved from ICC 0.933 (0.864, 0.975) to ICC 0.982 (0.964, 0.993). Even greater improvements were noted for the DGI. For patient one, reliability scores increased from ICC 0.776 (0.435, 0.947) to ICC 0.913 (0.787, 0.979), and scores for patient two increased from ICC 0.770 (0.421, 0.946) to ICC 0.899 (0.752, 0.976).

Conclusions: Given the high reliability scores, the authors of this study suggest that this standardization method is one that can be replicated with success for additional outcome measures to improve reliability. Additionally, the use of these instructional videos and manuals can be used as a teaching tool for clinicians to standardize the performance of outcome measures within and between clinics. Future research is needed to assess the reliability of these instructional videos and manuals for physical therapy students.

Clinical Relevance: The objective of this project was to develop a methodology to improve the reliability of standardized outcome measures in the clinic. This methodology was found to have high inter-rater reliability when used in the clinical setting.
TITLE: Inertial sensor-based assessment of central sensory integration for balance after concussion

AUTHORS/INSTITUTIONS: G. Gera, J. Chesnutt, L.A. King, Oregon Health Sciences University, Portland, Oregon, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Background: Optimal balance control requires a complex integration of sensory information from the visual, vestibular and proprioceptive sensory systems. A recent study on over 200 service members with acute and subacute mild traumatic brain injury (mTBI) revealed that sensory integration was impaired when tested on a large commercial posturography platform (Haran et al. 2015). Recently body-worn inertial sensors have been proposed and validated as a means to measure postural sway outside the laboratory environment, in any location. The purpose of this study was to determine if accelerometer-based measures of postural sway performed during the modified Clinical Test for Sensory Integration for Balance (mCTSIB) would reveal sensory integration deficits in young adults with very mild and acute mTBI.

Number of Subjects: 119

Materials/Methods: Participants performed the mCTSIB, which includes 4 stance conditions, each lasting 30 seconds: Condition 1 - eyes open on firm ground (C1), Condition 2 - eyes closed on firm ground (C2), Condition 3 - eyes open on foam (C3), and Condition 4 - eyes closed on foam (C4). The inertial sensor was placed at L5-S1 and recorded 3D accelerations and angular velocity while wirelessly streaming data to a laptop (APDM, Portland, OR, USA) to provide a measure of postural sway area. The traditional clinical modified Balance Error Scoring System (mBESS) test of balance was also performed.

Results: Results: The mTBI group had larger postural sway compared to the control group for all 4 conditions; C1, C2 and C3 (p=0.07) and C4 (p<0.01). C4, the condition requiring use of vestibular function for balance, showed the largest difference between groups. In contrast, there was no group difference in the traditional mBESS (p=0.20).

In addition, more subjects in the mTBI group had abnormal sway than subjects in the control group. Specifically, 13% of controls had abnormal sway in C4 (vestibular) whereas 44.7% of subjects with mTBI had abnormal sway in C4. The proportion test was significant between groups (Z = -3.7; p = 0.0002). In contrast, the traditional mBESS classified equal proportions of people with abnormal balance and there was no difference on proportion between groups. Specifically, 15.7 % of the mTBI group had abnormal balance whereas 12 % of controls had abnormal balance by mBESS scores (z = -0.51 p = 0.61).

Conclusions: Body worn inertial sensors can detect balance deficits in very mild acute TBI that may otherwise go unnoticed. Most notable deficits in people post mTBI were in the condition that relies on sensory information from the vestibular system.

Clinical Relevance: This work represents a novel way to measures sensory interation using a commercially available inertial sensor that could be performed in the clinic.
TITLE: Quantifying the perceived challenge of walking after stroke by measuring sympathetic activation: a pilot study

AUTHORS/INSTITUTIONS: D.K. Rose, J. Daly, D.J. Clark, Brain Rehabilitation Research Center of Excellence, Malcom Randall VA Medical Center, Gainesville, Florida, UNITED STATES; S.A. Chatterjee, E.J. Fox, K.A. Butera, Physical Therapy, University of Florida, Gainesville, Florida, UNITED STATES; E. Porges, Aging and Geriatric Research, University of Florida, Gainesville, Florida, UNITED STATES; E.A. Christou, Applied Physiology and Kinesiology, University of Florida, Gainesville, Florida, UNITED STATES; D.M. Otzel, Geriatric Research, Education and Clinical Center, Malcom Randall VA Medical Center, Gainesville, Florida, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: The perceived challenge of walking contributes significantly to self-imposed avoidance of activity and participation after stroke. The concept of perceived challenge is closely related to assessments of balance confidence, falls self-efficacy and perceived exertion. These assessments rely on self-report, which is susceptible to subjective measurement bias. The development of an objective, physiologically-based approach to measure perceived challenge would be valuable for gauging walking impairment and recovery after stroke. One promising approach is to measure sympathetic nervous system (SNS) activity by recording skin conductance. Emotions of stress/anxiety/fear upregulate SNS responses and skin conductance is a well-established technique for robustly measuring SNS activity. Preliminary evidence from neurologically healthy adults suggests that SNS activity increases in response to the challenge of complex walking tasks. Here we extend this line of research by testing the feasibility and validity of this approach in adults post-stroke. We hypothesized that SNS activity measured by skin conductance in adults post-stroke will be responsive to the challenge of complex walking tasks conducted in laboratory and community settings.

Number of Subjects: 16 adults post-stroke

Materials/Methods: Adults with post-stroke hemiparesis performed lab-based walking tasks, including typical walking, walking with a verbal fluency task, walking in dim lighting, and walking over obstacles. Participants also performed 9 community-based walking tasks including stairs and ramps. During all walking tasks, skin conductance was recorded separately from the palmar surface of the left and right hands. Skin conductance outcome variables included the change (active minus resting) in skin conductance response rate (ΔSCR) and skin conductance level (ΔSCL).

Results: Skin conductance variables were strongly correlated for left and right hands (ΔSCL r=0.82; ΔSCR r=0.47), suggesting robust detection of the underlying changes in SNS activity. For the lab-based assessments, ΔSCL for verbal fluency (14.1±15.8%) and obstacle negotiation (18.2±15.4%) was greater than for typical walking (6.3±7.4%). For community-based assessments, ΔSCR ranged from 0.1 to 0.4 responses/second, with the highest response occurring during the stairs task. ΔSCL ranged from 9.0 to 31.9%, with the highest levels occurring during stairs and ramp tasks.

Conclusions: SNS activity measured by skin conductance in adults post-stroke is responsive to the challenge of complex walking tasks conducted in lab and community settings.

Clinical Relevance: The perceived challenge of walking (stress/anxiety/fear) contributes to avoidance of walking activities after stroke, which restricts participation in community ambulation and engagement in life roles. We seek to enhance the measurement of perceived challenge by development of an objective assessment based on SNS activity. By enhancing measurement, we will be better able to develop and test interventions that promote recovery of this important aspect of walking function.
**TITLE:** Influence of Aerobic Exercise Intensity and Mode on the Acute Brain-Derived Neurotrophic Factor Response Post-Stroke: Preliminary Results

**AUTHORS/INSTITUTIONS:** P. Boyne, D. Carl, D. Whitesel, J. Westover, C. Meyrose, J. Wilkerson, M. Gerson, K. Seroogy, B. Kissela, K. Dunning, University of Cincinnati, Cincinnati, Ohio, UNITED STATES|J.C. Khoury, Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio, UNITED STATES|D. Reisman, University of Delaware, Newark, Delaware, UNITED STATES|K. Dunning

**ABSTRACT BODY:**

**Purpose/Hypothesis:** Among healthy adults, high-intensity aerobic exercise (AEX) has been shown to acutely increase circulating levels of brain-derived neurotrophic factor (BDNF), a critical facilitator of neuroplasticity, motor learning and cognition. This finding has potential implications for stroke rehabilitation, as AEX-induced BDNF responses could be used to facilitate neurologic recovery. However, the acute effects of AEX on BDNF have not been previously reported for persons with stroke and the factors influencing the BDNF response are poorly understood. The purpose of this study was to assess the effects of AEX intensity and mode on the acute BDNF response post-stroke. We hypothesized that high-intensity AEX would elicit significantly greater BDNF responses than moderate-intensity AEX, whether performed on a treadmill or a seated stepper.

**Number of Subjects:** 16 persons (mean±SD age, 57±10 years; 6.5±4.2 years post-stroke).

**Materials/Methods:** Using a crossover design, subjects performed one 20 minute session each of moderate-intensity treadmill AEX (mean VO\(_{2}\) peak, 55±11 %VO\(_{2}\) peak; blood lactate at end of session, 1.5±0.7 mmol/L), high-intensity treadmill AEX (61±14 %VO\(_{2}\) peak; 5.1±2.8 mmol/L) and high-intensity seated stepper AEX (66±15 %VO\(_{2}\) peak; 8.4±4.4 mmol/L) in random order, one week apart. Both high-intensity AEX protocols used an interval training strategy involving 30 second bursts of intense effort (maximum safe walking speed or stepping cadence) alternated with 30-60 second rest periods. Serum samples obtained immediately before and after each session were analyzed for BDNF concentration. A fixed effects model incorporating the crossover design was used to examine changes within and between protocols (alpha, 0.05).

**Results:** Serum BDNF significantly increased during high-intensity treadmill AEX (23.0 to 27.1 ng/mL, +18%, p=0.007) and high-intensity seated stepper AEX (21.9 to 25.0 ng/mL, +14%, p=0.03), but not moderate-intensity AEX (25.5 to 26.6 ng/mL, +4%, p=0.59). Between-protocol differences were not statistically significant (p=0.12-0.63).

**Conclusions:** Unlike moderate-intensity treadmill AEX, high-intensity AEX elicited a significant acute increase in circulating BDNF, whether performed on a treadmill or a seated stepper. Future studies with greater power are needed to determine between-protocol differences and to confirm that the lack of significance for moderate-intensity AEX was not due to study sample size.

**Clinical Relevance:** High-intensity AEX appears to acutely increase BDNF post-stroke. Given the key role that BDNF is thought to play in neuroplasticity, motor learning and cognition, and the known beneficial effects of AEX on cardiovascular health, this promising intervention may accelerate many aspects of stroke recovery. The ability to achieve a significant BDNF response on a seated stepper, in addition to the treadmill, may facilitate clinical implementation in settings where seated exercise is more practical.
ABSTRACT BODY:
Purpose: We have tested an innovative body weight support device for the treatment of patients with gait and balance difficulties due to stroke, traumatic brain injury or spinal cord injury. The device uses differential air pressure inside a specially designed suit to effectively unweight some of patient’s body weight. Using the device, a patient’s effective body weight may be reduced by up to 50 percent. The air pressure support aids in sit-to-stand transitions so that a single therapist can safely transition any patient from a wheelchair to the system and conduct gait therapy. We hypothesize that providing a safe and comfortable means of supporting body weight using a pressurized suit on a mobile device for use in over-ground gait therapy will provide improved outcomes and increased satisfaction with therapy for both therapists and patients.

Description: We conducted an 18 patient feasibility study at North Memorial Medical Center, Minnesota, that included patients with stroke, spinal cord injuries, MS, peripheral neuropathy and other gait disorders. Our primary objectives were to test the ability of the device to unweight patients safely and comfortably and assess its usefulness to physical therapists. The protocol undertaken was to have a therapist assist the test subject into the pants and walker while seated and then have the patient rise from sitting to standing and walk and perform other appropriate physical therapies. An evaluator evaluated both the therapists and patient’s use of the system with respect to various design requirements. After experiencing the system patients and therapists were asked to fill out a questionnaire. All patient’s and therapist ratings were high. The performance of the system was determined to be acceptable with respect to design criteria. We also discovered novel ways to use the system such as to do lateral sidestepping, ball tossing, trips through hospital hallways and elevators. Several paraplegic patients were able to walk using KAFOs beneath the pressure suit, which was very enabling to them.

Summary of Use: The results of this study indicate that the system is safe and comfortable for patients and easy to use for therapists. The sit to stand feature was very effective at reducing therapists burden. The device also frees the therapist to focus on a patient’s gait therapy, since the patient is secure in the device. The system may help restore mobility and wellbeing more quickly, safely and cost-effectively than current unweighting treatment systems and practices.

Importance to Members: This new form of body weight support has potential for improving rehabilitation therapy to provide increased safety and satisfaction with therapy for both therapists and patients and improved outcomes. Beyond use for the rehabilitation of neurological disorders it has potential in many areas of physical therapy including: orthopedics, geriatrics, pediatrics, obesity and recreation and fitness.
Manipulation of Lateral Stability in Post-Stroke Gait

A.C. Dragunas, R. López-Rosado, K.E. Gordon, J.P. Dewald, Physical Therapy and Human Movement Sciences, Northwestern University, Chicago, Illinois, UNITED STATES

Purpose/Hypothesis: Maintaining lateral stability during walking is a particularly challenging task after a stroke. Typical stabilization strategies, such as modulation of foot placement and generation of frontal plane hip and ankle torque, may be partially disrupted or entirely unavailable to individuals with a stroke. Additional neural constraints, such as abnormal joint torque coupling patterns, may further limit the ability of individuals with a stroke. This study was designed to investigate the role of abnormal hip coupling on the ability of individuals with a stroke to maintain lateral stability during gait. Specifically, we investigated two hypotheses: [1] that individuals with a stroke have a reduced ability to actively control lateral stability and [2] that expression of abnormal coupling leads to increased lateral instability. Both hypotheses were investigated by analyzing stability metrics of post-stroke gait in environments where the requirements to generate hip extension and/or abduction torque was altered through the application of force fields at the waist.

Number of Subjects: 7

Materials/Methods: 2 females and 5 males, mean age 58 years (± 7.7 SD), performed treadmill walking trials in three force field environments and a baseline null field. The first field provided frontal plane stabilization, which we hypothesized would reduce lateral instability. The second field created a constant backward directed force in the sagittal plane, which we hypothesized would exacerbate the post-stroke extensor synergy. The third field was a combination of the previous two, which we hypothesized would also lead to reduced stability. Stability metrics collected include step width and variability, minimum lateral margin of stability, and center of mass excursion.

Results: Individuals with a stroke did not significantly change their step width, step width variability, or minimum lateral margin of stability when walking with force fields compared to baseline. Subjects did significantly reduce center of mass excursion when walking with external stabilization and the combination fields. Further, we observed increased center of mass veering in response to force fields compared to baseline.

Conclusions: That individuals with a stroke do not reduce their step width or step width variability in response to external stabilization is consistent with our first hypothesis that individuals with a stroke have a reduced ability to actively control lateral stability. The increased veering behavior in post-stroke gait may suggest the expression of abnormal neuromuscular control that may contribute to gait instability.

Clinical Relevance: Increased incidence of falling suggests that gait stability is substantially impaired after a stroke. These gait impairments may be the result of abnormal neuromuscular control of the lower extremity. This study serves as the first step in improving our understanding of the underlying mechanism controlling lateral stability in the stroke population, which may lead to improvements in therapeutic practice related to balance and stability during gait.
TITLE: The Effect of a Community Exercise Program on Functional Reach and Quality of Life in Community Dwelling Individuals with Spinal Cord Injuries

AUTHORS/INSTITUTIONS: M. Sliwinski, V. Alla, G. Akselrad, V. Buan, E. Kaemmerlen, Physical Therapy, Columbia University, Forked River, New Jersey, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: After an individual with a Spinal Cord Injury (SCI) completes the initial rehabilitation process, they often experience limited access to physical therapy services and fitness activities. This is often due to a lack of transportation, time, money, and increased health complications. Spinal Mobility is an exercise program specifically designed by physical therapists to address these issues by providing a post-rehabilitation exercise opportunity. This program enables access to proper equipment, to obtain education about proper exercise techniques to integrate in their daily routines, and provides a supportive community. In a time where inpatient rehabilitation has decreased by 60% for this population, it is necessary to determine if a program such as Spinal Mobility is effective in increasing overall physical function and quality of life (QOL) for this population. This retrospective study of two 8-week program sessions investigates these two issues via the Functional Reach Test and the Life Satisfaction Questionnaire (LiSAT-9). We hypothesize that the Spinal Mobility program will have positive effects on aspects of function and overall QOL for individuals with SCI.

Number of Subjects: LiSAT-9: 18 subjects. Functional Reach: 19 subjects.

Materials/Methods: Participants averaging 9 years post-SCI completed an 8-week program that included a three station circuit of strength training, aerobic exercise, and trunk stability. Pre and post data were collected using the Functional Reach Test and LiSAT-9. Functional reach was measured as the farthest distance the subject could reach with returning to the starting position independently. QOL was measured using the Life Satisfaction Questionnaire (LiSAT-9). Data were analyzed with SPSS through a paired t-test and Wilcoxon signed-rank test, respectively.

Results: Functional reach improved by a statistically significant (p < 0.001) average of 2 inches for all participants after the 8 week program. Additionally, 11 of the 19 subjects achieved functional reach improvements that met or exceeded the established Minimal Detectable Change for persons with SCI. The LiSAT-9 showed a statistically significant improvement (p = 0.017).

Conclusions: These findings are consistent with the hypothesis that a post-rehabilitation supervised exercise community program, Spinal Mobility, positively impacts the QOL and functional reach in individuals with SCI.

Clinical Relevance: In individuals with SCI, physical limitations including weakness, impaired balance, and reduced functional independence are contributing factors to community withdrawal and may be directly addressed through community exercise programs. Exercise in individuals with SCI not only improves these aforementioned impairments, but also increases their ability to be integrated participants in the community. A comprehensive fitness program designed by physical therapists, like Spinal Mobility, can be effective in improving QOL and functional reach. Thus, helping these individuals to achieve greater efficiency with daily tasks.
TITLE: Duration from Stroke Onset to Rehabilitation Admission: Impact on Discharge and Cognitive Functional Independence Measures

AUTHORS/INSTITUTIONS: C.A. Wamsley, J. Dekerlegand, Physical Therapy, Good Shepherd Penn Partners, Philadelphia, Pennsylvania, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: The Functional Independence Measure (FIM®) scale assesses physical and cognitive disability. A total cognitive FIM score includes: comprehension, expression, interaction, problem solving, and memory. Each item is scored from 1 to 7 respectively from dependence to independence. Stroke admissions at our 58 bed urban inpatient rehabilitation, had both a higher number of days from the onset of stroke to rehabilitation admission (etiology days) and a lower admission total cognitive (ATC) FIM score than the region and nation. Specifically, we investigated two hypotheses: [1] do patients with higher etiology days have a different discharge setting and [2] do patients with higher etiology days have lower ATC FIM scores.

Number of Subjects: 464

Materials/Methods: Retrospective review of FIM data for the period of January 1, 2013 through December 30, 2014 was obtained from the Uniform Data System. Data was aggregated into groups by discharge setting (home and skilled nursing facility) and duration from stroke onset to rehab admission (greater than 7 days versus less than 7 days). T-tests were used to assess for group differences.

Results: Of the sample, 355 were discharged home and 109 to a SNF. There was a significant difference (p < 0.001) between the home and SNF discharge groups in duration from stroke onset to rehab admission, 11.6 (± 14.9 SD) as compared with 18.0 (± 21.3 SD) mean etiology days. The home group mean ATC FIM of 17.3 (± 6.3 SD) was significantly higher (p < 0.001) than that of the SNF group of 13.3 (± 6.2 SD). In comparing the ATC FIM of the home group admitted ≤ 7 days (μ = 18.5, ± 6.0 SD) versus > 7 days (μ = 15.6, ± 6.3 SD) there is a significant difference (p < 0.001). The SNF group also had a difference (p < 0.01) in their ATC FIM for those admitted ≤ 7 days (μ = 15.3, ± 6.2 SD) versus > 7 days (μ = 12.2, ± 6.0 SD).

Conclusions: Results from this project suggest that stroke survivors admitted to inpatient rehab with a lower number of etiology days are more likely to result in discharge to home. Those patients with greater cognitive impairment were more likely to discharge to a SNF setting. Future research should assess if specific ATC cut-off scores can predict discharge setting upon admission to inpatient rehab.

Clinical Relevance: For stroke survivors, the shorter the duration of time to receiving rehabilitation services and the higher the admitting cognitive ability enhances their ability for a home discharge. This has relevance for shorter acute lengths of stay, cognitive impairment intervention, and disposition planning. Future considerations may be severity of illness, functional scores, and comparison to other populations.
Purpose/Hypothesis: This umbrella review was conducted to condense current systematic review literature on the benefits of body weigh supported treadmill training (BWSTT) as an intervention in the adult paraplegic spinal cord injury population.

Number of Subjects: Adults (ages 18+) who sustained a SCI that resulted in paraplegia as defined by ASIA levels B-D, regardless of chronicity.

Materials/Methods: A comprehensive search was performed on three separate databases: PubMed, Embase, and Cochrane. Inclusion criteria consisted of published systematic reviews in English, paraplegic adults with SCIs, interventions including BWSTT solely or in conjunction with other interventions, and outcomes focusing on gait speed and/or walking capacity.

Results: A synthesis of the systematic reviews included in this umbrella review contained no statistical significance when comparing a control group to the intervention group for improvements in gait speed. All included systematic reviews were unable to prove that BWSTT or BWSTT with functional electrical stimulation (FES) had a significant effect on walking capacity. The results were either inconclusive or favored the control group for enhancements in walking capacity.

Conclusions: There are no significant research findings to support the use of BWSTT as a primary intervention in the adult SCI population. More favorable data, though still not significant, suggest using BWSTT with a co-intervention such as FES to improve gait speed.

Clinical Relevance: Following our review of the literature and based on the current level of evidence, BWSTT alone or in conjunction with other interventions presents to be equally as effective as conventional over-ground training in the adult paraplegic SCI population. Due to the lack of sufficient evidence, and considering the added treatment time and resources necessary, we cannot recommend BWSTT as a superior therapy to improve gait speed or walking capacity in this particular population.
Purpose/Hypothesis: Parkinson's disease (PD) is the second most common neurodegenerative disease among older adults. A feature of PD includes some degree of cognitive impairment, occurring in approximately 5-20% of individuals. Approximately 80% of individuals develop dementia after 15-18 years. Previous work demonstrates that physical activity is favorably associated with cognitive function in individuals with neurological disorders, such as stroke. The nature of any association between physical activity and cognition in those with PD, however, is less known. The purpose of this study is to examine the association between free-living, accelerometer-assessed physical activity and cognitive function among adults with PD.

Number of Subjects: 23 adults with PD

Materials/Methods: Subjects were recruited from the local community with a neurologist-confirmed diagnosis of PD. The Montreal Cognitive Assessment (MoCA) was used to assess cognitive function. Subjects wore an ActiGraph GT1M accelerometer during all activities for seven days. Multivariable linear regression analysis was employed to examine the association between moderate-to-vigorous physical activity (MVPA) and cognitive function. Covariates included age, sex, and Hoehn and Yahr score (H&Y), a clinical rating measure of motor function in PD.

Results: The sample, with a mean age of 68.7 years, equally represented males and females. After adjusting for motor impairment (H&Y), for every 1 minute/day increase in MVPA, subjects had a 0.09 unit increase in MoCA-determined cognitive function ($\beta = 0.09; 95\% CI: -0.003-0.19; P=0.05$). When further adjusting for motor impairment, age, and sex, results were unchanged ($\beta = 0.09; 95\% CI: 0.004-0.19; P=0.04$). When expressed as a larger interval change, for a 10 minute/day (sample mean) increase in MVPA, participants had a 1 unit increase in MoCA-determined cognitive function ($\beta = 1.0; 95\% CI: 0.04-1.9; P=0.04$). Notably, the mean MVPA among those with normal ($\geq 26$ MoCA) and abnormal (<26 MoCA) cognitive function, respectively, was 12.7 minutes/day and 7.5 minutes/day.

Conclusions: The main finding of this study is that those with PD with greater engagement in MVPA had greater cognitive function, as measured by the MoCA. Notably, this finding persisted even after adjustment for age, sex, and degree of motor impairment. Limitations of the present study include the cross-sectional study design, precluding the ability to establish temporal sequence. Future confirmatory work, particularly studies employing a larger sample, including multiple measures of cognition, and utilizing more robust study designs (e.g., RCTs), are warranted.

Clinical Relevance: The present study provides suggestive evidence of a favorable association between free-living physical activity behavior and cognitive function among adults with PD. As such, clinicians may wish to promote safe, progressive forms of physical activity to their patients with PD and add education of these findings as a motivation factor.
Effect of axial weighting on burden of care and mobility after traumatic brain injury: A case report

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ABSTRACT BODY:

Background & Purpose: Traumatic brain injury with deep axonal injury (TBI) often results in cerebellar dysfunction, producing abnormalities in coordination, balance, gait, and learning. Current evidence on the effect of axial weighting on mobility in individuals with cerebellar pathologies is conflicting; however, to the knowledge of the authors, no studies evaluate the effect of axial weighting on burden of care. Thus, the purpose of this case report is to describe the effect of axial weighting on burden of care and mobility.

Case Description: M.T., a 38-year-old male who sustained a TBI 8 years prior, presented to physical therapy (PT) for impaired balance and ataxic gait. On evaluation, M.T. required maximum assistance for all activities of daily living and total assistance for ambulation. M.T. received 33 PT visits focusing on postural control, balance, and gait training with and without axial weighting over the course of 5 months. Outcome measures included: International Co-Operative Ataxia Rating Scale (ICARS), Functional Independence Measure (FIM), distance walked, and duration of unsupported standing balance.

Outcomes: ICARS scores improved from 72/100 at baseline to 60/100 without axial weighting and 51/100 with axial weighting. Average FIM scores, distance walked, and duration of unsupported standing balance were higher during weighted conditions than non-weighted conditions.

Discussion: There is limited literature on the effects of axial weighting for individuals with ataxia following TBI. This case study showed decreased burden of care with the use of axial weight. Future research is needed to determine whether the results of this study can be generalized to other individuals with ataxic gait.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.


Background & Purpose: This case report describes a complex vestibular patient, over the course of 3 years, highlighting otolaryngology procedures, vestibular test results and physical therapy (PT) outcomes.

Case Description: The patient was an 86 year old active community-dwelling male with history of severe bilateral hearing loss who underwent right cochlear implantation 2.5 years ago and developed post-operative right benign paroxysmal positional vertigo (BPPV) which responded to particle repositioning maneuvers. He continued to experience episodes of severe vertigo and was diagnosed with endolymphatic hydrops involving the left ear which was treated with chemical labyrinthectomy 2 years ago.

Outcomes: He initially presented to PT 3.5 years ago with right posterior canalithiasis BPPV. PT exam findings included: Dizziness Handicap Inventory (DHI) = 30/100, Dynamic Gait Index (DGI) = 22/24, Timed Up & Go (TUG) = 11.78 s. He was successfully treated with particle repositioning maneuvers. One year later, vestibular testing revealed normal caloric and rotary chair findings. He presented to vestibular PT 3 weeks after cochlear implant with recurrence of right posterior canal BPPV. During particle repositioning maneuvers a canal conversion occurred and patient responded to the right BBQ roll maneuver. Outcome measure scores at that time were: DHI = 52/100, DGI = 21/24, TUG = 12.53 s. Subsequently, he began experiencing episodes of vertigo, nausea/ emesis lasting hours, not consistent with BPPV. He was diagnosed by a neurotologist with left endolymphatic hydrops which did not resolve with medical management of low sodium diet and diuretic. Prior to left intratympanic gentamicin injection, Videonystagmography (VNG) testing was performed and revealed normal caloric output. The patient returned to PT 6 weeks later reporting imbalance. PT exam revealed a positive left head thrust and right beating post head shake nystagmus, consistent with an uncompensated unilateral peripheral vestibular hypofunction. Outcome measures at that time revealed: DHI = 50/100, TUG = 14.1 s, and 10 meter gait speed = .71m/s. The patient was provided with a cane for fall prevention and was educated in vestibulo-ocular reflex (VOR) and balance exercises. He was seen for 6 PT visits over the course of one year. Vestibular testing was performed one year later and revealed 100% left caloric weakness with mild bilateral involvement. At that time, patient was using a walker for ambulation and fall prevention and outcome measure scores were: DHI = 44/100, TUG = 18.01s, DGI = 14/24, and 10 meter gait speed = .71m/s.

Discussion: This complex vestibular case outlines medical and therapy evaluation, diagnosis and management for a patient with severe hearing loss and vertigo. Vestibular test results demonstrated patient’s progression from no peripheral vestibular involvement to unilateral hypofunction to mild bilateral involvement and these test findings clearly correlated with the decline in PT outcome measures.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: Brown KE, Whitney SL, Wrisley DM, Furman JM. Physical therapy outcomes for persons with bilateral vestibular loss. The Laryngoscope 2001;111:1812-1817.


**Title:** A Study of Patient Perceptions with Respect to Visual, Vestibular, Oculomotor Deficits, and Fatigue in People with Parkinson’s Disease.

**Authors/Institutions:** J.M. Berliner, B. Kluger, C.A. Foster, V.S. Pelak, R. Gisbert, M. Schenkman, Rehabilitation Sciences, University of Colorado, Denver, Denver, Colorado, UNITED STATES|C. McRae, University of Denver, Denver, Colorado, UNITED STATES

**Abstract Body:**

**Purpose/Hypothesis:** The purpose of this descriptive study is to understand perceptions of individuals who live with Parkinson’s disease (PD) with respect to fatigue, visual, vestibular, oculomotor and balance deficits. Specifically, this investigation examined the following: 1) what individuals with PD know about fatigue and how it impacts their daily life, 2) what types of visual, vestibular, and oculomotor deficits people with PD recognize, 3) what balance deficits people with PD experience, 4) how visual, vestibular, and oculomotor deficits may contribute to these balance deficits, and 5) do individuals with PD perceive that visual, vestibular, oculomotor, and balance deficits contribute to their fatigue?

**Number of Subjects:** 30 participants

**Materials/Methods:** A total of 30 individuals (15 men and 15 women) with PD participated in focus groups. A focus group question guide was used to probe the main topics and emergent themes. Participants were asked about visual, vestibular, and oculomotor deficits they experience and how these deficits affect them on a day-to-day basis. The discussions were recorded using audiotapes, transcribed, and entered into ATLAS.ti for coding and analysis. Participants also completed a demographic questionnaire and the Fatigue Severity Scale. We used inductive qualitative data analysis techniques to interpret patient responses. Several methods were employed to increase the validity of our results including analysis of coding frequency and triangulation, using multiple analysts.

**Results:** The following themes emerged: 1) visual, vestibular, and oculomotor deficits are present and recognized by people with PD, 2) they perceive that these deficits affect functional tasks including driving, navigating in busy/crowded places, reading, navigating escalators and moving walkways, negotiating stairs, and visually focusing while walking, 3) eye movement and visual deficits related to PD are not readily recognized or related to PD by health care providers, and 4) these participants indicated that they receive limited treatment from health care providers for visual and oculomotor deficits.

**Conclusions:** Visual, vestibular, and oculomotor deficits appear to be an under assessed and underreported finding in people with PD that have major impact on quality of life.

**Clinical Relevance:** Health care providers should be aware of potential visual, vestibular, and oculomotor deficits related to PD. These deficits should be identified, assessed and treated, when possible, to improve function and limit the impact on quality of life for patients with PD.
TITLE: Between Arms and Within Arm Position Matching Assessments Lead to Differing Findings in Individuals with Chronic Hemiparetic Stroke

AUTHORS/INSTITUTIONS: J. Drogos, J.P. Dewald, N. Gurari, PTHMS, Northwestern University, Chicago, Illinois, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Current literature suggests that position sensing is commonly impaired after stroke\(^1\). However, assessments measuring this modality suffer from subjectivity, lack of validity and reliability\(^2\), and are conducted by either a within arm or between arms task\(^3\). Our recent work demonstrated that participants with chronic stroke, diagnosed with deficits in position sensing on a clinical between arms assessment, do not have deficits on a within arm position matching assessment\(^4\). The aim of this study was to further our research by: 1) quantifying between arms position matching deficits using a robotic test that mimics common clinical approaches; and 2) learning if between arms position matching performance yields differing results than within arm position matching performance.

Number of Subjects: 6 participants (mean 52.2 yrs ± 7.1 SD) with chronic stroke (> 1 yr post; mean 16.2 yrs ± 10.1 SD) and a score of 2 for the elbow joint on the Revised Nottingham Sensory Assessment (rNSA) kinaesthetic task partook in this study.

Materials/Methods: Participants’ forearms were casted and rigidly fixed to a one degree-of-freedom (elbow flexion/extension) device(s). Within Arm Task: The participants’ forearm was extended and flexed quickly to avoid thixotropy effects\(^5\) and to accommodate the stretch reflex\(^6\) and then rotated to a starting location. Participants moved to a target location; were asked to remember that location; moved to 2 random locations; and lastly, returned to the perceived target location. 16 trials (8 trials x 2 target locations) were recorded for both the paretic and non-paretic arm during a passive and an active movement condition. Between Arms Task: This task was designed to mimic the between arms assessment on the rNSA. The reference forearm rotated passively to 2 random locations followed by a target location. The participant then actively rotated their opposite forearm to match the perceived location of their reference forearm.

Results: There were no significant differences in task performance between the non-paretic and paretic arms for either the passive or active within arm tasks. There was a significant effect of the reference arm for the between arms task (p=0.049), where absolute error when the paretic arm was the reference, 9.41±1.41°, was greater than the non-paretic arm, 5.61±1.22°.

Conclusions: Chronic stroke survivors who demonstrated a deficit in position sensing on the rNSA matched positions for both passive and active movements comparably within the non-paretic and paretic arm. However, there was a significant effect of arm during the between arms position matching task; participants matched more accurately with the paretic arm than with the non-paretic arm.

Clinical Relevance: These results demonstrate that a between arms position matching assessment, commonly performed in clinical settings, may not be a valid measure of within arm position matching deficits. Further research is needed to understand the differing neural mechanisms at work during within arm and between arms position matching tasks.

AUTHORS/INSTITUTIONS: D. Dirstine, O.G. Gallardo, Rancho Los Amigos National Rehabilitation Center, Hermosa Beach, California, UNITED STATES

ABSTRACT BODY:

Background & Purpose: Individuals with Juvenile Onset Huntington's Disease (JHD) may experience changes to gait and balance that lead to falls, high medical care costs, decline in functional mobility and independence, and increased caregiver burden. There is limited evidence regarding the impact of physical therapy interventions in JHD, however, several studies have demonstrated the beneficial effects of physical activity in the HD population. Cruickshank et al (2015) demonstrated that a 9-month multidisciplinary program consisting of weekly 60-minute aerobic and resistance training, thrice-weekly 60-minute home-based exercise program for strengthening and fine motor skill training, and cognitive/memory skills training resulted in positive neuroplastic changes and improvements in cognitive function in 15 individuals with HD. A 2-year rehabilitation program focused on physical exercise, social activities, and group/teaching sessions demonstrated sustained or improved physical function in four out of six participants and improved or stable QOL in all participants (Piira et al., 2014). The purpose of this case report is to describe a body weight support treadmill training program in an individual with JHD and its effects on the participant's fall incidence, caregiver burden, gait parameters, balance, and quality of life.

Case Description: FS is a 23-year-old male with JHD. The primary complaints included: frequent falls resulting in serious injury, poor balance, difficulty walking with assistance, involuntary movements, and decreased functional mobility that impact QOL and increased caregiver burden. Therapy consisted of 45-minute sessions delivered bi-weekly over 6 weeks on an AlterG treadmill. Variable speed and body weight support (BWS) were utilized to optimize gait kinematics and over-ground ambulation in order to improve balance and QOL and decrease falls incidence and caregiver burden. Outcome measures collected: balance and gait parameters using Balance Master and GaitRite, respectively; number of falls, and participant and caregiver QOL.

Outcomes: Improvements in gait parameters included: symmetry of single limb support, step length and cadence. Huntington Disease Quality of Life Questionnaire (HDQOL-C, Spanish version) illustrated improvements in caregiver quality of life. Reduction in falls was reported by caregiver via a fall log. FS conveyed improved quality of life via self-report.

Discussion: This case report demonstrates that AlterG treadmill training can enhance functional mobility, temporal-spatial characteristics of gait, and quality of life for the caregiver and an individual with JHD. FS showed functional improvements despite the progressive nature of JHD. Given the results of this case study, it may be feasible and appropriate for physical therapists to advocate for early, ongoing gait and functional mobility training. Further investigation is needed to determine optimal gait training parameters, duration of intervention, and expected outcomes in this population.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: Williams, S., Heron, L., France, K., Mulrooney, P., & Edmondston, S. J. (2014). Huntington's Disease: Characteristics of Fallers. *Physiotherapy Research International: The Journal for Researchers and Clinicians in Physical Therapy*, doi:10.1002/prl.1577 [doi]


TITLE: The Feasibility of Tracking Strength Gains Using the Supine Hip Extensor Manual Muscle Test in a Neurological Population

AUTHORS/INSTITUTIONS: J.M. Kuettel, Physical Therapy, Honor Health, Gilbert, Arizona, UNITED STATES|C. Sherlock, physical therapy, Northern Arizona University, Phoenix, Arizona, UNITED STATES

ABSTRACT BODY:

Background & Purpose: Hip extensor strength plays a key role in gait speed and proper gait mechanics in both healthy persons and persons recovering from neurological injury. Hip extensors maintain both upright trunk posture and forward momentum during gait. Patients with hip extensor weakness may compensate with a posterior trunk lean at initial contact, decreasing the demand on the muscle, which reduces gait speed and may increase energy cost. Gait speed is strongly correlated to hip flexor and ankle plantarflexor strength, however, several studies have found additional correlations between hip extensor strength and gait velocity.

Patients with neurological injury often demonstrate weakness of the hip extensors. For example, in patients recovering from CVA, the hip extensors on the hemiplegic lower extremity (LE) have been shown to have only 64% of the strength of the uninvolved LE due to a decrease in muscle mass, decrease in fiber length, and a smaller pennation angle. However, there are many barriers to measuring hip extension strength using the traditional prone position in the neurologic population including functional mobility, range of motion and pain. The supine hip extensor manual muscle test (MMT) has been shown to be a valid and reliable method to assess hip extension strength.

One purpose of this study was to determine if the supine hip extensor MMT can detect strength gains made in neurological patients between initial evaluation and discharge in an outpatient neurological physical therapy setting. Secondly, these results will be correlated to gait speed and balance scores as an additional predictor of fall risk.

Case Description: Participants, each clinically diagnosed with one of the following: cerebrovascular event (CVA), Parkinson’s disease (PD), imbalance/deconditioning, multiple sclerosis (MS), brain tumor, non-pressure hydrocephalus (NPH) were recruited from a physical therapy clinic in Scottsdale, AZ.

Outcomes: Upon initial evaluation, supine hip extensor strength was measured as described by Perry et al, gait speed was assessed using the 10m Walk test, and balance was measured using either Berg Balance Scale or Functional Gait Assessment. Each patient completed a course of neurologic physical therapy ranging from 7 to 37 visits. The measures were reassessed at discharge. 100% of patients in the study demonstrated increases in hip extensor strength, gait speed, and balance.

Discussion: Changes in hip extensor MMT were noted in all patients, indicating the supine hip extensor manual muscle test is a realistic tool to use in the neurologic population. Additionally, improvements were also noted in all patients gait speed and balance scores. Positive correlations to change in hip extension strength, gait speed and balance scores were noted.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: 1. Parvataneni K, Olney SJ, Brouwer B. Changes in muscle group work associated with changes in gait speed of persons with stroke. Clin Biomech. 2007;22(7):813-820.
9. Teixeira-Salmela L, Nadeau S, Mcbride I, Olney S. Effects of muscle strengthening and physical conditioning


Title: The JFK BIG Study: The Impact of LSVT BIG on Dual Task Walking and Mobility in Persons with Parkinson's Disease

Authors/Institutions: S. Isaacson, G.G. Fluet, Rehabilitation and Movement Sciences, Rutgers The State University of New Jersey, Iselin, New Jersey, United States | J. Lazaro, L.M. Moore, A.E. O'Brien, P. Duttaroy, A. Ray, JFK Medical Center, Edison, New Jersey, United States

Abstract Body:
Purpose/Hypothesis: LSVT-BIG is an exercise and self-cuing based treatment designed to decrease the impact of hypokinesia and bradykinesia on the functional mobility of persons with Parkinson's disease (PD). There is extensive literature supporting the use of LSVT-BIG for improving the performance of isolated mobility tasks. An overwhelming majority of persons with PD demonstrate a deterioration of their functional ability while performing a second task. This study tests the hypothesis that LSVT-BIG treatments decrease the negative impact of movement disorders on dual task performance in persons with PD.

Number of Subjects: 93

Materials/Methods: The records of 114 patients with a coded diagnosis of PD admitted to the outpatient rehabilitation department of a suburban hospital were reviewed. Demographics and data for 8 different outcome measures were extracted for all subjects that completed at least 14 of 16 scheduled sessions of LSVT BIG treatments. Data was analyzed for all subjects with pre and post testing data for a given measure.

Results: 93 subjects had records of pre and post-test TUG, TUG-MOTOR and TUG-COG scores. Average age of subjects was 59.5 years (sd=10.5) and average disease duration was 5.1 years (sd=5). Initial TUG scores for this group (13.25 sd=6.93) were slower than those in previously published studies of LSVT-BIG. Subjects demonstrated statistically significant decreases in time for TUG (3.3 sd=4.5), TUG-MOTOR (4.4 sd=5.8) and TUG-COG (4.7 sd=5.4). Concurrent motor and cognitive performance remained stable between tests. Dual Task cost for the mobility portion decreased at a statistically significant level for TUG-COG (7% sd=31%) but not for TUG-MOTOR (4% sd=32%).

Conclusions: These findings are consistent with our hypothesis that cuing strategies associated with LSVT BIG become internalized and decrease the negative impact of movement disorders on dual task performance. Dual task costs for TUG-MOTOR were only slightly smaller than those for TUG-COG at pre-test which is not consistent with the published literature. Improvement in dual task cost for TUG-COG was larger than that demonstrated for TUG-MOTOR. The stable cognitive performance when comparing pre and post treatment TUG-COG scores suggests that the use of LSVT BIG did not add to the patient's cognitive load during the performance of the combined mobility and cognitive tasks. The large decrease in the impact of the concurrent cognitive task on TUG-COG time suggests that this approach may improve the mobility and safety of patients with PD that present with impaired divided attention abilities.

Clinical Relevance: This study suggests that LSVT BIG treatment might also have a positive impact on mobility and cognitive performance while performing two tasks simultaneously in persons with Parkinson's disease.
Modified Locomotor Training Protocol Improves Gait Using a Novel Body Weight Support System and Orthoses

S.A. Ostertag, R.L. Mizner, Physical Therapy School, University of Montana, Lolo, Montana, UNITED STATES

Background & Purpose: Controversy exists regarding best practice for locomotor training (LT) after incomplete spinal cord injury (iSCI). Combining overground (OG) and body weight support (BWS) for LT may produce optimal results, but use of multiple trainers or robotics can be prohibitive. Further, BWS harness systems may restrict trunk motion which may limit the ability to improve pelvis and trunk control. This case study describes the effectiveness of using a less restrictive BWS system and AFOs in place of manual foot assistance in a modified Activity Based Locomotor Training protocol for an individual 27 months post iSCI.

Case Description: The patient was a 62-year-old woman with a traumatic iSCI and fusion of T12-L2. She had achieved modified independent ambulation in her home with bilateral AFOs and a walker. Her goal was to walk with one cane. Major barriers were hip/ankle weakness and back pain. Sixty minute LT treatments with BWS were completed twice a week for 8 weeks. Treatment focused on stand/step retraining with adequate BWS to allow for best kinematics without pain, step adaptability at slower speeds with less BWS, and sit to stand activities. The BWS system was a novel unweighting system that used neoprene shorts with pivoting support straps to allow for normal trunk motion. AFOs were worn for all LT interventions. Each BWS session was followed by 30 minutes of guided OG training in standing and sitting for motor control and balance retraining with carryover of transfers, standing, and gait skills. LT with BWS used one person assist primarily to stabilize the pelvis on the right, and minimized upper extremity support.

Outcomes: OG cadence improved from 52 to 62 steps/min over 25' and the patient advanced from her walker to unilateral cane use at home and short community distances. She improved with stand (2A to 3A) and step adaptability (2C to 2B) and walking (2B to 2C) on the Phases of Recovery assessment tool. She increased strength in seated hip medial/lateral rotators by .5-1 MMT grade, right hip extension from 2- to 2/5, and decreased bilateral ankle clonus from 1-2 beats to no beats. At initial exam, an RPE of 16/20 was reported and back pain level of 5/10 during walking. By discharge her RPE and pain reduced to 13/20 and 3/10 respectively. Concurrently, her confidence level for walking with a single cane went from an initial 20% up to 100% with treatment.

Discussion: The patient achieved meaningful improvements in ambulation with a modified LT program. Training with AFO’s allowed one person to safely assist and the novel BWS system provided a more comfortable and less restrictive support, facilitating increased demands on the trunk and hips as compared to traditional harness systems. We postulate that the increased demands contributed to the patient’s hip strength gains and improved stepping control. Her improved neuromuscular control of the pelvis during all phases of gait may have helped facilitate her advances in walking performance and enhanced the confidence needed to achieve her ambulation goal.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old:

TITLE: Evaluating the Efficacy and Intensity of Group Based Gait Training

AUTHORS/INSTITUTIONS: L.H. Lenhart, A. Huckstep, Physical Therapy, Rehabilitation Institute of Chicago, Chicago, Illinois, UNITED STATES

ABSTRACT BODY:

Purpose: Previous studies have highlighted the effectiveness of high intensity gait training for promoting neurorecovery and neuroplasticity. Traditionally, this training is done in a 1:1 setting. The purpose of this study is to continue to explore the effectiveness of gait training when conducted in a group model as well as determining if intensity of training is maintained when completed in a group.

Description: A group based model for high intensity gait training was developed and implemented with patients alternating between overground and treadmill training 3x per week for 4 weeks. Pre and post outcome measures were gathered including: 6 minute walk test, 10 meter walk test, and Berg Balance Scale. Intensity was measured throughout all treatment sessions with either the modified RPE scale (0-10) for patients on Beta Blockers and heart rate with the goal of 60-80% HR max for all other participants.

Summary of Use: This protocol has been used to successfully increase the frequency of high intensity gait training patients received in the face of insurance, staffing, and equipment barriers. This particular study focuses on objectively evaluating the intensity of training received to determine if high intensity was achieved.

Importance to Members: Research has clearly shown that intensity-based gait training is the most effective physical therapy intervention when looking to improve functional mobility in patients following stroke. Many studies recommend 60 minutes of high-intensity stepping/gait at least 5x per week that is performed with a 1:1 patient to therapist ratio. However, the current model is not feasible in the neuro day rehab setting. Insurance, staffing, and equipment shortages limit the ability of clinics to implement these research protocols. Previous pilots in the neuro day rehab setting have successfully implemented a group model that significantly increases the frequency of gait training for patients as well as the number of patients receiving gait training. This current study looks to more closely examine the intensity of the gait training received to offer more empirical evidence for the group model.
TITLE: Gait transition from locked knee-ankle-foot orthoses (KAFOs) to stance control orthoses (SCOs) in a patient with post-polio syndrome: A Case Study.

AUTHORS/INSTITUTIONS: A.N. Hudson, V. Rocha, A. Ortiz, School of Physical Therapy, Texas Woman's University, Houston, Texas, UNITED STATES| D. Meyer, M. Deaton, A. Mullen, Orthotics and Prosthetics Program, Baylor College of Medicine, Houston, Texas, UNITED STATES

ABSTRACT BODY:

Background & Purpose: To date, there have been multiple small research projects and pilots studies comparing KAFOs and SCOs. Some of these studies found benefits of stance control orthoses (SCOs); however, others have not. The purpose of our study is to systematically quantify differences in gait spatial-temporal parameters and kinematics in a patient with post-polio syndrome.

Case Description: A 52 year-old male with post-polio syndrome consented to participation. He used a locked KAFO and a single point cane for community ambulation. He was randomly assigned to a test condition; orthosis A or B (KAFO vs trial-fit SCO); after a rest break, the subject repeated testing procedures using the second orthosis. For the second session, the testing conditions were reversed. For each condition, the subject completed 10 walking trials on a 10 foot long walkway. We used Vicon 3D motion capture system and GaitRite portable gait analysis system for data collection.

Outcomes: According to a Functional Ambulation Profile, via the GaitRite system, our client's ambulation profile was more efficient while wearing the KAFO; however, a learning effect with the trial-fit SCO was noted, decreasing the difference between orthoses as he performed more walking trials. The client demonstrated a slight increase in knee flexion during swing in the trial-fit SCO and more normalized ankle kinematics in stance in the trial-fit SCO. Hip flexion increased in stance and swing in the trial-fit SCO.

Discussion: It appears that the degrees of freedom allowed by the trial-fit SCO creates more instability during walking making our patient walk with a lower functional ambulation profile. This decrease in stability resulted in the client utilizing a walker during ambulation with the trial-fit SCO, which likely caused increased hip flexion in stance and swing. Overall, kinematic analysis showed that the joint angles obtained during walking trials with the SCO approximated more to the expected joint angle norm values.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.

Purpose/Hypothesis: The purpose of this study was to identify a reliable and valid outcome measure to assess balance and ambulation for individuals with incomplete spinal cord injury (iSCI). Specifically, we sought to establish intra- and interrater reliability as well as construct validity for the Functional Gait Assessment (FGA). It was hypothesized that the FGA would prove to be a valid and reliable outcome measure for individuals with iSCI.

Number of Subjects: Twelve participants (11 male, 1 female) ages 32-73 with chronic motor iSCI were classified as either ASIA Impairment Scale (AIS) C (2) or D (10).

Materials/Methods: Subjects completed five outcome measures during a single test session including: lower extremity motor scores from the International Standards for the Neurological Classification of Spinal Cord Injury, FGA, 10 Meter Walk Test (10MWT), Walking Index for Spinal Cord Injury (WISCI-II), and the Spinal Cord Injury Functional Ambulation Profile (SCI-FAP). The FGA was completed twice in each session, once at the beginning and once at the end. Each subject repeated the FGA 45 minutes following the first FGA so the time between each test was standardized. Two teams of three student researchers conducted the study. Within a team, one student administered and scored all tests, another student scored only the FGA trials, while the third guarded, ensuring subject safety throughout the session. Additionally, an expert rater scored the FGA in 8/12 subjects. Interrater and intrarater reliability were calculated using the interclass correlation coefficient (ICC). FGA interrater reliability was calculated between raters within each group as well as between each rater and the expert. FGA intrarater reliability was calculated between FGA trial 1 and trial 2 for the four individual raters. Validity was calculated using Spearman’s Rho between the FGA, and the 10MWT, WISCI-II, and SCI-FAP.

Results: Interrater reliability for both groups was also excellent with ICC scores greater than .92 (p < .001). Interrater reliability against the expert was also excellent for all four raters, with an ICC greater than or equal to 0.92 (p < .001). Intrarater reliability was excellent with an ICC score of greater than .91 (p < 0.002) for all four raters. Validity of the FGA and 10MWT was -0.90 (p = 0.000), FGA and WISCI-II was 0.74 (p = 0.006), and FGA to SCI-FAP was -0.83 (p = 0.001).

Conclusions: The FGA is a reliable and valid outcome measure to use when assessing gait and balance in individuals with motor iSCI.

Clinical Relevance: The FGA provides clinicians with a single tool to utilize across a variety of neurologic diagnoses. In addition, the clinical utility is favorable requiring minimal equipment, training, and time.
Title: Professional Development Needs and Preferences of Physical Therapists and Physical Therapist Assistants Serving Patients with Multiple Sclerosis.

Authors/Institutions: K. Potter, A. Cummins, K. Evans, J. Kienstra, K. Lyon, K. Wellemeyer, Physical Therapy Education, Rockhurst University, Kansas City, Missouri, UNITED STATES

Abstract Body:

Purpose/Hypothesis: Persons with MS (pwMS) present with a wide variety of symptoms that require skilled care; thus, they may struggle to find healthcare providers with expert MS-related knowledge. Continuing education (CE) can benefit physical therapists (PT) and physical therapist assistants (PTA) treating pwMS. Little research exists that has explored the CE needs and preferences of providers serving pwMS. Turner et al found that an interdisciplinary and experienced group of MS providers desired education on fatigue, cognition, and disease modifying agents, and they preferred in-person CE courses. The purpose of our study was to explore the CE needs of PTs and PTAs specific to the care of pwMS, preferred methods for attaining CE, and facilitators and barriers related to seeking CE.

Number of Subjects: 33 (30 PT and 3 PTA)

Materials/Methods: PTs and PTAs were recruited via the healthcare provider list of the Mid America Chapter of the MS Society. Information was collected via an online survey with questions pertaining to: 1. Demographics, 2. Experience with pwMS, 3. Professional development needs, 4. Preferred methods for obtaining CE, and 5. Barriers and facilitators to obtaining CE.

Results: The majority (75%) of respondents had over 10 years of clinical experience and 68.8% worked in an outpatient setting. Nearly all (97%) treat fewer than 5 individual clients with MS per month. Few (6.25%) reported that their facility requires specific training pertaining to the management of pwMS. Topics of interest for CE were exacerbation management (64.5%), gait exam/training (61.3%), balance exam/training (58.1%), fatigue management (58.1%), and fall risk management (51.6%). The top five preferred methods for obtaining CE were in-person conferences (68.75%), scientific literature (34.38%), MS Society website and resources (31.25%), and inservice training and colleagues in own profession (both 28.1%). Facilitators to CE included an increase in knowledge base/competency (90%), interest in certain topic area (90%), pertinence to current caseload (86.7%), meeting licensure requirements (86.2%), and keeping up to date with research (83.3%). Barriers to CE included cost of travel (80%), time of travel (80%), social commitments (76.7%), professional commitments (76.6%), and cost of CE activities (70%).

Conclusions: PTs and PTAs desire CE in areas of MS care that are challenging to manage (e.g., fatigue and exacerbation management) and those that are closely related to the scope of PT practice (e.g., balance and gait). Despite greater availability of technology, PTs and PTAs identify in-person CE courses as the preferred method of obtaining new knowledge. Yet, cost and time of travel are key barriers to attending CE courses.

Clinical Relevance: Knowledge gained in this study can assist the APTA Academy of Neurologic Physical Therapists in developing CE courses for PTs and PTAs who treat persons with MS.
TITLE: Improving Voluntary Hand Function and Sensation of Post-Chronic Stroke Individuals Using ReIn-Hand System


ABSTRACT BODY:

Purpose/Hypothesis: More than two-thirds of people who have had a stroke have difficulties with reduced arm function, which can restrict a person's ability to perform everyday activities[1]. Though multiple studies have researched the effectiveness of different types of interventions, regaining hand function in individuals with moderate to severe impairment still remains a challenge due to the loss of volitional extension[2]. In this study, we explored if regaining hand function is still possible in individuals with chronic moderate to severe stroke, when they participate in an intensive and task-specific practice by using a device to aid hand opening. To do so, an electromyography-triggered neuromuscular electrical stimulation (NMES) system, ReIn-Hand (Reliable and Intuitive use of the hand) was used. The ReIn-Hand provides facilitation for hand opening during multi-joint arm movement, that can be used in a specific task in a selective and successful manner.

Number of Subjects: Seven participants with chronic stroke (>1-year post, mean: 13 years) and moderately to severely impaired upper limb (UE Fugl-Meyer (FMA) score 10-23) were recruited to participate in a 20-session intervention (3 sessions/6-8 weeks).

Materials/Methods: During each session, subjects performed 20-25 trials of required reaching, grasping, and releasing an object with the assistance of the ReIn-Hand. Pre and post outcome clinical assessments included UE FMA, Chedoke, MacMaster Stroke Assessment/Stage of the hand, Grip dynamometry, Box and Blocks Test, Active and Passive goniometrics for wrist and metacarpal phalangeal (MCP) flexion and extension (II, V fingers), Nottingham Stereognosis Assessment, and determination of the cutaneous Sensory Touch Threshold using monofilaments.

Results: At post test, the subjects demonstrated improved Stereognosis, Box and Blocks Test scores (paired T-test, p-value < 0.05), and passive range of motion (PROM) (two-way repeated measures of ANOVA with paired t-test as post-hoc, p<0.02, mean increase: 11° for the averaged PROM across the 3 joints).

Conclusions: These results suggest that using the ReIn-Hand during functional reaching and grasping activities may contribute to improvements in both sensation and voluntary hand control of the paretic arm in individuals with moderate to severe impairment following stroke.

Clinical Relevance: This results support the benefit of ReIn-hand future use in the research setting. Further research is needed to assess the effectiveness of the ReIn-Hand system in randomized controlled trials with a larger and more diverse post-stroke population. Testing the device in clinical and home-settings can help inform practice.
Use of Repetitive Transcranial Magnetic Stimulation (rTMS) with Boxing Sequences to Combat the Progression of Parkinson’s Disease: A Case Report

A.I. Merica, K.M. Johnson, Physical Therapy, The University of St. Augustine for Health Sciences, San Marcos, California, UNITED STATES|L.C. Riggioni, Physical Therapy, University of Florida, Gainesville, Florida, UNITED STATES

Background & Purpose: The use of repetitive Transcranial Magnetic Stimulation (rTMS) has been shown to improve the long-term potential for learning and retention in patients with Parkinson’s disease (PD). Research also supports the use of physical therapy (PT), specifically high repetitions with upper and lower body sequences like those found in boxing, in the management of PD as it enhances neuroplasticity within the brain. While rTMS has not yet been FDA-approved, its combined use with PT is promising for the management of impairments associated with PD. This case report aims to highlight the benefits of utilizing both PT, focused on coordination exercises like boxing sequences, in conjunction with rTMS to decrease the progressive effects of PD.

Case Description: The patient was a 69-year-old male, active farmer for the past 5 decades diagnosed with PD 10 years ago. He underwent concurrent rTMS treatment followed by PT. He presented with left sided coordination deficits and poor posture resulting in a decrease in dynamic gait balance. These activity limitations restricted him from returning to work on his farm and maintaining his livelihood.

Intervention: The patient underwent ten 1-hour rTMS sessions, 5 of which were followed by a 1-hour PT session focused on using boxing sequences for the upper and lower extremity, obstacles courses for dynamic balance and dual-task activities. He was given a home exercise program (HEP) to perform twice a day. High repetition of 20 times per exercise, reciprocal walking, combination of upper extremity cross body jabs and balance exercises were emphasized in his HEP.

Outcomes: The treatment goals were partially met by the time of discharge. He showed improvement in outcome measure (OMs) scores for the following: Four Square Step Test time decreased from 13 to 8.5 seconds (s); Single Leg Stance time increased from 8s and 5s on the right and left to 17s and 8s, respectively; Sharpened Romberg Test with eyes opened increased to >30s, with eyes closed increased from unable to perform to 9s and 11s (right and left foot forward, respectively); Dynamic Gait Index increased to 18/20; Parkinson’s Disease Questionaire-39 score improved to 43/100; mini Balance Evaluation Systems Test decreased to 1 step posterior. Results showed a positive trend measured by the above OMs and his ability to return to modified work duty. It should be noted that these results were not clinically significant when compared to measures of responsiveness.

Discussion: The use of both rTMS and PT focused on coordination like boxing may be beneficial in the management of symptoms associated with the progression of PD. The patient may gain greater benefits from this therapy combination with an increase in frequency further supported by his ability to return to work after only 3 weeks of treatment.


Parkinson's disease questionnaire - 39.
Timed up and go dual task; timed up and go..
Sharpened Romberg: Sharpened Romberg.
ABSTRACT BODY:

Background & Purpose: Patients who have had a stroke make the most functional gains within 3 years. Upper extremity function may take longer to recover but there hasn’t been much research focused on chronic stroke using evidence based interventions. The purpose of this study was to examine the outcomes of a 16-week intervention that combined modified constraint-induced movement therapy (mCIMT), scapular strengthening, mirror therapy, and mental imagery, for a patient 26 years post-stroke.

Case Description: The patient is a 33-year old male who had a resection of a brain tumor resulting in an aneurysm of the left middle cerebral artery when he was 7 years old. His goal was to improve the functioning of his right upper extremity. Outcome measures used were the Canadian Occupational Performance Measure (COPM), Fugl-Meyer Assessment- Upper Extremity (FMA-UE), Action Research Arm Test (ARAT), and the Closed Kinetic Chain Upper Extremity Stability Test (CKCUEST) that was modified to be done on elbows, and Manual Muscle Testing of his right upper extremity. The patient was given a 16-week home exercise program that was performed 2 hours a day 5 days per week, that consisted of 1.5 hours of CIMT and .5 hours of upper extremity weight bearing, mirror therapy, and mental imagery. The patient discontinued mirror therapy after 8 weeks, since he felt that he wasn't benefiting from it, and extended his CIMT to make up the time. Weekly check-ins were done to either modify or progress the program. Change scores for all measures and MDC and MCID scores were used to examine the clinical significant gains.

Outcomes: The patient had improvement in performance and satisfaction on the COPM specific to right upper extremity function with the greatest improvement being his goals to ride a bike with partial wrist extension, open a door with his right hand, creeping on hands and knees to play with his son, grabbing/releasing items, and to reduce the amount of time to put on a glove. He also improved in right upper extremity strength by 2-4.5 MMT grades for his shoulder, elbow and wrist. The modified CKCUEST improved significantly by 3.5 touches. He had clinically significant improvement of the motor portion of the FMA-UE from 35/66 to 42/66, exceeding the MDC of 5.2. The ARAT approached clinical significance with a change of 5 points.

Discussion: Although patients often plateau in function after 3-years after having a stroke, right upper extremity strength and functional gains were made with this patient after 26-years by completing a 16-week home exercise program. This is the first study conducted with a patient this long after having a stroke. The patient's motivation, adherence to the program, and meaningful goals set on the COPM, were keys to the successful program. Modified CIMT, scapular strengthening, mirror therapy, and mental imagery were a successful combination in improving strength and function for this patient with chronic hemiplegia.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.

TITLE: Determining Walking Activity in People with Stroke and Healthy Older Adults: A Comparison of Moderate and High Intensity Walking Minutes

AUTHORS/INSTITUTIONS: M. Roos, C. Heys, W. Thomas, A. Pinckney, S. Czastkiewicz, Physical Therapy, University of the Sciences in Philadelphia, Philadelphia, Pennsylvania, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: The Centers for Disease Control and Prevention recommends 150 minutes of moderate intensity exercise per week in at least 10 minute (min) intervals to maintain physical fitness. While it is known that people living with stroke spend less time walking than older adults and individuals with stroke (STROKE) spend on average less than 20 min performing moderate intensity walking. Many times walking intensity is not individualized to the person and instead fits in a noted range. In this study individualized cadence during moderate and high intensity walking was determined based on target heart rate (THR). The purposes of this study were to identify if the cadence during moderate and high intensity walking was more accurately determined with a 6 min walk test on a treadmill (TM) or overground (OG); to use cadence to identify the number of moderate (MOD) and high (HIGH) intensity min performed by people with stroke (STROKE); and to compare these intensity min with healthy, older adults (HEALTHY).

Number of Subjects: 6 STROKE and 9 HEALTHY have been tested to date.

Materials/Methods: Subjects underwent clinical testing while wearing the StepWatch Activity Monitor (SAM) (Modus Health, LLC; Washington, DC) and continued to wear SAM during waking hours for 1 week following the evaluation. Maximum heart rate (HR) was determined during 5 min of fast TM walking. Target HR was calculated using the Karvonen or modified Karvonen Formula (taking beta blockers). Moderate intensity walking was the cadence performed when walking at 50-70% THR while high intensity walking was the cadence used when over 70% THR. Subject’s cadence was determined during a 6 min walk test OG and on TM (random order) while receiving cues to maintain HR at moderate intensity.

Results: Data received was analyzed using a customized MATLAB program (MathWorks, Natick, MA). Kruskall Wallis Test compared TM vs OG and found no difference for test location for STROKE (p=.406) and HEALTHY (p=.429). Group averages were obtained using 3 days of walking data. Both groups walked considerably less than recommended. Participants with stroke walked an average of 7.75 (SD:5.7) min per day at MOD and 37.0 (SD:28.2) min at HIGH while those in HEALTHY group walked an average of 10.7 (SD: 5.5) min per day at MOD and 21.3 (SD:10.1) min at HIGH. Mann Whitney U test determined that no group differences existed between STROKE and HEALTHY in MOD (.289) and HIGH (p=.239) intensity minutes.

Conclusions: Walking intensity cadence can be performed using an assessment overground or on a treadmill. People with stroke and healthy older adults walk considerably less than recommended and demonstrated no significant group difference in the number of MOD and HIGH intensity walking minutes.

Clinical Relevance: Determining cadence during moderate and high intensity walking based on THR rate may be helpful in noting adherence to physical activity guidelines. Individuals need to be educated and assisted with incorporating moderate and high intensity walking minutes into their daily activities.
TITLE: Correlation between steps walked and functional outcome measures in patients post-Cerebrovascular Accident: a Pilot Study

AUTHORS/INSTITUTIONS: C. Adkins, L. Whitis, R.A. English, Rehabilitation Sciences, University of Kentucky, Lexington, Kentucky, UNITED STATES|L. Kerr, Physical Therapy, Bellarmine University, Louisville, Kentucky, UNITED STATES|K. Hart, Physical Therapy, Cardinal Hill Rehabilitation Hospital, Lexington, Kentucky, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: There is an increase in the number of people who suffer a Cerebrovascular Accident (CVA) each year, leading to an increased number of individuals needing rehabilitation for functional deficits resulting from the CVA. Recent studies have found increasing stepping dosage and specific ambulation practice has improved patient’s function, but no specific stepping dosage has been established. The purpose of this study was to determine if there is a correlation between the number of steps a patient post-CVA takes while in an inpatient rehabilitation facility and functional outcome measures. It was hypothesized that a larger number of steps taken would correlate to a higher functional level upon discharge.

Number of Subjects: four

Materials/Methods: Four individuals (3 female, 1 male) with the mean age of 76.3 years were included for analysis in the study. Subjects were administered functional outcome measures within 72 hours of admission and a FitBit was placed on the involved lateral ankle. Total steps taken throughout the rehabilitation stay were recorded weekly and outcome measures were taken again at discharge.

Results: There was a strong correlation between number of steps and all discharge objective measures, excluding the FIM motor sub-scale. Those that took more steps demonstrated better outcome scores on all tests. A negative correlation with statistical significance (p < 0.05) was shown between total steps and length of stay (r = -.967, p = 0.033), discharge 10-meter walk test (r = -.972, p = 0.028), and discharge TUG (r = -.989, p = 0.011). Statistical significance was also found between number of steps and initial TUG (r = -.978, p = 0.022).

Conclusions: A correlation was found between the number of steps taken and the discharge 10-meter walk test and TUG outcome measures for patients post-CVA. Both objective measures identify improvements in speed of gait and dynamic balance, indicating that increased steps may play a role in improved functional gait movements. These findings suggest when treating adults post-CVA in an inpatient rehabilitation facility, an emphasis in increasing number of steps taken daily may improve overall function and possibly decrease the length of stay.

Clinical Relevance: These results may indicate that increasing steps taken while in a rehabilitation facility may lead to improved independence and reduced risk of falling post CVA. This has significant implications for decreasing risk of injury and readmittance to healthcare facilities.
Examining the therapeutic benefits of amplitude-oriented exercise in Myoclonic Epilepsy Ragged- Red Fiber syndrome: A case study

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Background & Purpose: Myoclonic Epilepsy Ragged- Red Fiber (MERRF) is a rare multisystemic mitochondrial syndrome. It is clinically characterized by epilepsy, myoclonus and ataxia. Additional clinical manifestations observed include short stature, exercise intolerance, muscle atrophy, dementia and peripheral neuropathy. Physiologically patients with MERRF syndrome have shown neuronal loss in the spinal cord, brainstem and cerebellum, along with basal ganglia calcification and atrophy. Amplitude-oriented exercise has been shown to be an efficacious conservative management option for patients with Parkinson's disease but its effectiveness for other medical conditions is unclear. The purpose of this case report is to describe the effectiveness and outcomes of amplitude-oriented exercise for a 53 year-old patient diagnosed with MERRF syndrome.

Case Description: The patient was a 53 year-old female with a 31 year history of MERRF syndrome. She had a significant history of impaired balance and falls. Prior to therapeutic intervention the patient was averaging five to six falls per day.

The patient completed a 4-week amplitude-oriented exercise program modeled after the Lee Silverman Voice Treatment BIG® protocol under the supervision of a physical therapist. The same exercises were then continued independently by the patient for 8-weeks following treatment.

Outcomes: Following the completion of a 4-week amplitude-oriented exercise program, the patient demonstrated marked improvement in functional mobility and daily occurrences of falls. She demonstrated improvements in the Timed Up and Go from 16.6 seconds to 12.1 seconds and the Tinetti Balance Assessment from 6 total points to 19 total points after the therapist lead intervention phase. Both outcome measures demonstrated her decreased risk of falls at the 4 week mark. Additionally her report of fall frequency also decreased from 40 falls per week to 11 falls per week over the course of treatment. She demonstrated a 72.5% reduction in falls immediately following the amplitude-oriented exercise program and continued to have a 58.1% reduction in falls compared to the baseline measurements eight weeks following the completion of the program.

Discussion: A patient with MERRF syndrome who underwent an amplitude-oriented physical therapy program made significant improvements in mobility and fall risk. Further research is needed to determine the efficacy of utilizing a standardized exercise protocol involving high amplitude movements for treating similar patients.


The Effect of Sport-specific Dual Task on Gait Apraxia in an Older Athlete with Acquired Brain Injury: A Case Study

R. F. Skolky, R. Reoli, Physical Medicine and Rehabilitation, The Johns Hopkins Hospital, Baltimore, Maryland, UNITED STATES

Background & Purpose: Gait apraxia following acquired brain injury (ABI) can negatively impact functional mobility and increase risk for falls. To the authors' knowledge, there is sparse literature for treatment interventions for gait apraxia, including dual task on recovery of gait following ABI. The purpose of this case study was to assess the role of sport-specific dual task on recovery of gait in an older athletic patient with ABI.

Case Description: M.S., a 72 year old female, presented to acute inpatient rehabilitation physical therapy (PT) following cranioplasty removal and titanium mesh cranioplasty. M.S. had an extensive past medical history, which included right and left middle cerebral artery, right inferior cerebellar artery, and right anterior communicating artery aneurysm clippings. At evaluation, M.S. required minimum assistance from another person for transfers, and total assistance for gait, according to the Functional Independence Measure (FIM). She received 15 PT sessions over 13 days, before returning to the operating room for hardware removal due to repeat wound infection. Post procedure, M.S. received 33 PT sessions over 26 days. Treatments focused on meaningful sports-specific training for movement initiation and weight-shifting to address balance and gait impairments.

Outcomes: FIM (gait and transfers), Activity Measure for Post Acute Care (AM-PAC) Inpatient Basic Mobility Short Form, and total distance walked before seated rest break were used to assess M.S.'s progress. Total distance walked and FIM were assessed with and without sport-specific dual task. On average, without dual task, M.S. walked 38 feet with a FIM of 1 before requiring rest; during dual task, M.S. walked 135 feet with a FIM of 2 before fatigue. On discharge from PT, M.S. walked with contact guard assistance while performing dual task. Following her 48 PT treatment sessions, M.S.'s AM-PAC improved from 19/24 to 22/24.

Discussion: To the authors' knowledge, there is limited literature on the effect of dual task for treatment of gait apraxia. In this case study, the use of sports-specific dual task was found to improve distance walked and decrease burden of care, allowing M.S to return home with caregiver support. Future research is needed to assess whether dual task improves gait apraxia in persons with ABI.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.
TITLE: Semont Maneuver Versus Epley Maneuver For Canalolithiasis Of The Posterior Semicircular Canal: A Systematic Review

AUTHORS/INSTITUTIONS: B. Kinne, M. Perla, D. Weber, Grand Valley State University, Grand Rapids, Michigan, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Although the Semont maneuver was originally developed to treat patients with cupulolithiasis of the posterior semicircular canal, several studies have demonstrated successful outcomes when the Semont maneuver is used to treat patients with posterior canal canalolithiasis. The purpose of this systematic review was to evaluate the effectiveness of the Semont maneuver to treat canalolithiasis of the posterior semicircular canal as compared to that of the Epley maneuver.

Number of Subjects: N/A

Materials/Methods: Applicable research articles were obtained through a literature search of the Cumulative Index to Nursing and Allied Health Literature (CINAHL) Complete, ProQuest Medical Library, and PubMed databases using the search terms "Semont" AND "Epley" AND "randomized" AND "positional vertigo" OR "positioning vertigo" OR "positional nystagmus" OR "positioning nystagmus". The inclusion criteria for this systematic review were: (1) individuals diagnosed with canalolithiasis of the posterior semicircular canal, (2) the Semont or modified Semont maneuver as the intervention, (3) the Epley or modified Epley maneuver as the comparative intervention, (4) cessation of nystagmus as the outcome measure, and (5) randomized controlled trials. The Oxford Centre for Evidence-Based Medicine 2011 Levels of Evidence was used to assess the evidence level for all of the included studies, and the PEDro Scale was used to assess the methodological rigor for all of the included studies.

Results: A total of 82 articles were identified through a search of the three electronic databases, and three additional articles were identified through other sources. Six studies were ultimately included in the qualitative synthesis. In four of these studies, no statistically significant difference was identified between the Semont maneuver and the Epley maneuver. In other words, the Semont maneuver was equally as effective at treating posterior canal canalolithiasis as the Epley maneuver was.

Conclusions: In most cases, the Semont maneuver was equally as effective as the Epley maneuver at treating posterior canal canalolithiasis. In addition, the Semont maneuver should be considered as an alternative treatment option for patients with certain types of cervical, lumbar, cardiac, or respiratory pathologies.

Clinical Relevance: The first step of the Epley maneuver is the Dix-Hallpike position which requires both rotation and extension of the patient's cervical region. Patients with cervical pain may experience difficulties assuming the required position. In fact, it may be unsafe to perform the Epley maneuver if a patient has a medical history of certain cervical pathologies such as joint instability, disc herniation, previous surgery, recent trauma, or rheumatoid arthritis. Patients with lumbar pain, severe cardiac problems, or severe respiratory problems may also be unable to tolerate the first step of the Epley maneuver. Therefore, the Semont maneuver may be a safer treatment option for specific patients with posterior canal canalolithiasis.
**TITLE:** Development of a Clinical Stroke Pathway for Integrated Care in the Outpatient Setting for Individuals following Stroke

**AUTHORS/INSTITUTIONS:** M.A. French, J. Koch, Physical Medicine and Rehabilitation, Johns Hopkins Hospital, Baltimore, Maryland, UNITED STATES

**ABSTRACT BODY:**

**Purpose:** Integrated care pathways (ICPs) are pathways that aim to have ‘the right people, do the right things, in the right order, at the right time, in the right place, with the right outcome.’ As one of the leading causes of disability in the United States, ICPs for stroke have been developed to improve timeliness of intervention and utilization of the multidisciplinary team. Research suggests that ICPs during the acute management of stroke are beneficial. However, in the rehabilitation setting, few ICPs exist to improve the utilization of the multidisciplinary rehabilitation team or standardize outcome measures and evidence based interventions. Thus, the purpose of this article is to present a Clinical Stroke Pathway (CSP) developed at Johns Hopkins Hospital to facilitate referrals, guide interventions, and track outcomes during the rehabilitation phase of stroke.

**Description:** The CSP consists of a primary pathway and discipline specific pathways for each rehabilitation specialty, including neuropsychology, occupational therapy, physiatry, physical therapy, and speech language pathology. The primary pathway is to be used by all health care providers, including primary care physicians and rehabilitation providers. This portion of the CSP aims to facilitate the initiation of appropriate referrals for individuals following stroke. The discipline specific pathway aims to standardize the selection of appropriate objective measures and to assist in providing evidence based interventions. Lastly, within each specialty pathway, ‘orange flags’ are identified to generate referrals to other members of the rehabilitation team.

**Summary of Use:** The CSP is intended to be used by health care providers across the health care field for individuals following stroke. The CSP was developed specifically for the outpatient Brain Rehabilitation Program at Johns Hopkins Hospital, which treats individuals with stroke at various stages of recovery. In the outpatient setting, this tool is to be used at evaluation and every 4-6 weeks or if there is a change in function.

**Importance to Members:** Research supports the use of a multidisciplinary approach to the management of individuals following stroke. The CSP aims to improve accuracy and appropriateness of first time referrals to rehabilitation services from all providers. It is possible that this improved timeliness may result in better outcomes for individuals following stroke. Additionally, with ongoing changes in reimbursement, it is increasingly important that rehabilitation professionals provide objective data supporting our role through the use of outcome measures. Further research to evaluate practitioner adherence to the recommendations of the CSP, to determine the impact of improved referral patterns, and assess potential use of CSF across the continuum of care.
TITLE: Use of Balance Outcome Measures Among Physical Therapists in the Traumatic Brain Injury Population

AUTHORS/INSTITUTIONS: M.F. Lyon, Outpatient, TIRR Memorial Hermann, Houston, Texas, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Traumatic brain injury (TBI) is a major cause of disability in the United States. Postural control changes are common after TBI, 30% of individuals post-TBI complain of impaired balance. Previous work has concluded that a lack of evidence exists to support use of any particular balance assessment in this population. This survey was conducted to analyze the reported behaviors and influencing factors in balance measurement by physical therapists in individuals after TBI.

Number of Subjects: 55 physical therapists

Materials/Methods: A pilot survey was sent to 5 individuals chosen based on geographical location and practice setting practice to capture a heterogenous sample. The second phase utilized snowball sampling. An email was sent to the director of clinical education at 10 physical therapy education programs requesting that the DCE forward the survey to 2-5 facilities known to treat individuals with TBI. PsychData was be used for survey creation, administration, and data collection, which lasted 6 weeks.

Results: Fifty-five physical therapists from various regions responded to the survey; all reported working with an individual with a TBI in the last year and 88% reported using a balance outcome measure at least each 30 days. The most commonly reported measures were the Berg Balance Scale (BBS), Dynamic Gait Index (DGI), Functional Gait Assessment (FGA), Timed Up and Go (TUG), and High Level Mobility Assessment Tool (HiMAT). Setting had an impact on choice of measure, a greater percentage of acute care therapists reported using single limb stance (SLS), inpatient and outpatient therapists reported higher usage of test batteries. APTA membership, Neurology Section membership, Neurology Certification Specialization, and vestibular competence had an impact on tool choice. The most commonly reported reasons for choosing a balance tool were having the available equipment (14%), being comfortable with use of the measure (14%) with other diagnoses and speed of the measure (12%). In contrast, the least common reasons for choosing a balance outcome were recommendation/required use by facility (1%), recommendation by a professional organization (4%) and recently reading an article on the psychometric properties of a measure (3%). There was some variation in reported reasons between measures.

Conclusions: This survey found that the responding therapists used outcome measures, in a variety of settings, with high frequency. However, the measures they chose are not aligned with current recommendations from the TBI edge or TBI specific outcomes literature. Therapists chose measures based on convenience and familiarity.

Clinical Relevance: It is important to understand the factors that impact clinical decisions made by physical therapists. This is of particular concern in areas that have limited research, like balance measurement in the TBI population. A knowledge translation program focused on this or similar areas will be more successful by integrating an understanding of the motivations and facilitators found in this study.
Purpose: The purpose of early family activation during rehabilitation is to empower patients and caregivers to:
1. Take a more active role in recovery and discharge planning
2. Understand motor recovery post-stroke and application to their rehabilitation
3. Participate in early skilled repetition of training with family
4. Improve preparedness and rate of discharge to community setting

Description: Initially a literature review was completed to identify patient/family perception of education, preparedness for discharge, and knowledge of stroke prevention and risk for re-admission. Results demonstrated that inpatient rehabilitation is changing: medical acuity is increasing, length of stay is decreasing, productivity demands are higher, and patient outcomes are critical for the patient and hospital. The literature also suggests that patient and caregiver's perception of education/training received was inadequate at discharge leading to recurrent stroke, readmission, caregiver burnout/stress, and increased healthcare cost. Overall, findings indicate that innovative programs are needed to maximize successful discharge to community post-stroke.

Summary of Use: The early patient activation program includes three components delivered concurrently. Component one is the “Functional Program” which aims to improve continuity and repetition of functional mobility with family and staff. Component two includes “My Personal Health Goal” which allows patients to identify their goals and participate in development of exercises to promote salience. Component three includes the “Get Home Program” which focused on family education, repetition of exercises and training, and preparation for discharge. Family training is initiated within 10 days and continues weekly. Training is functionally patient-specific, and exercises are given for the weekend. Discharge and one month follow up surveys are being completed to identify patient's perception of education and training, utilization of goals and education, barriers at discharge, and hospital readmission. Information collected from ongoing surveys is used for enhancement of the early activation program. To date, 34 patients have completed the program.

Importance to Members: Trends indicate patients "strongly agree" that they benefit from goal setting and structured weekend activities, are prepared for discharge, and understood education. Comments at one month follow up are consistent with existing literature indicating that multiple opportunities for repetition with education and training are needed for improved patient perceptions of preparedness for discharge and the importance of patient-centered goal-oriented rehabilitation. Ultimately, therapists need to be innovative with programs to optimize repetition, improve early caregiver involvement, and maximize preparedness for discharge. Additional data over the next year will include Press Ganey patient satisfaction survey, discharge to community, and hospital readmissions.
ABSTRACT BODY:

Purpose/Hypothesis: Rigid exoskeletons are the state of the art in wearable robotics. These remarkable machines have enabled individuals who are unable to walk, to walk again. However, for those that retain the ability to walk following neurological injury, such as the majority poststroke, rigid systems may not be necessary to restore more normal walking behavior. Our group thus developed soft wearable robots (exosuits) made from garment-like, functional textiles. As previously described, forces generated by actuators are transmitted to the wearer’s paretic ankle during walking via the interaction of cable-based transmissions and the exosuit’s functional textiles. In preliminary, treadmill-based studies, we demonstrated that exosuits actively assist the paretic limb during walking in a manner able to improve ground clearance, increase propulsion symmetry, and, ultimately, reduce the high energy cost of walking after stroke. Nonetheless, the utility of exosuits in overground contexts has yet to be demonstrated. The present study evaluates the effects of a portable exosuit prototype on the overground walking function of persons poststroke.

Number of Subjects: Four subjects >6 mo poststroke.

Materials/Methods: Participants completed 2 days of testing. On day 1, participants’ baseline walking was evaluated. The 10-meter walk test (10mWT) measured short-distance maximum walking speed and the 6-minute walk test (6MWT) measured long-distance walking function. Following baseline testing, participants donned the exosuit and its actuator and were provided up to 12 minutes of exposure to walking with the exosuit delivering assistive forces (i.e., active). To enable evaluation overground, an untethered, waist-mounted actuator pack was used. Importantly, formal training on how to walk with the exosuit was not provided. On day 2, which took place between 1 and 2 weeks later, participants completed the 10mWT and 6MWT with the exosuit active. Changes in walking performance between the baseline and active testing conditions were measured as median±SIQR and compared to the known clinically meaningful differences of 0.14 m/s and 34.4 m for the 10mWT and 6MWT, respectively. Changes in walking speed per minute of the 6MWT were also evaluated.

Results: When walking with the exosuit active, participants walked 0.16±0.05 m/s faster during the 10mWT and 41±17 m farther during the 6MWT (Ps < 0.05)—changes larger than the established clinically important differences. The 41 m average gain in walking distance observed over the duration of the 6MWT was driven by an average gain of 0.12±0.01 m/s per minute of the test.

Conclusions: Exosuits offer a new opportunity for overground gait assistance for individuals who may not benefit from existing assistive devices.

Clinical Relevance: The exosuit technology has the potential to enable physical therapists to target the specific biomechanical deficits contributing to walking-related disability after stroke both in the clinic and directly in free-living settings.
TITLE: Kinematic comparison of three postural limits of stability tests in community-dwelling older adults.

AUTHORS/INSTITUTIONS: L. Allison, C. Wendt, A. Armstrong, R. Greer, A.M. Akridge, S. Wilson, Physical Therapy, Winston-Salem State University, Winston-Salem, North Carolina, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: The Functional Reach Test (FRT) is assumed to be a 'low tech' postural limits of stability test that predicts fall risk, despite prior studies demonstrating that it may do neither.\(^1\)\(^-\)\(^6\) No prior studies comparing the FRT with both the 'gold standard' computerized Limits of Stability® test (LOS), and the recently developed Sway Sled® test (SS), provided a kinematic analysis of how these tests are actually performed.\(^7\)\(^-\)\(^8\) The purpose of this study was to compare the movement strategies used to accomplish these three tests.

Number of Subjects: Participants were 15 healthy, community-dwelling older adults with a mean age of 71.4 ± 3.6 yrs (range 65-80 yrs). The majority were female (73%), white (80%), and taking less than four prescription medications (87%).

Materials/Methods: All consented participants performed all three tests (FR, LOS, SS) in one visit to the motion analysis lab. Full body markers captured motion at the ankle, knee, hip, pelvis, and trunk. For all tests, participants adopted a standardized, height-based foot placement.\(^9\) For the FR and SS tests, after test familiarization, three trials in each direction (anterior, posterior, left, right) were performed. For the LOS, one practice test and one scored test with targets in eight directions were performed. For analysis, five time points were identified in each completed motion, corresponding to Start, 25%, 50%, 75%, and Completion of maximal trunk excursion. For each joint, a 3x5 (Test x Time) RM-MANOVA with planned, post-hoc, Bonferroni-corrected paired samples T-tests analyses were performed.

Results: All overall multivariate tests were significant for Test, Time and Interactions, occurring most often in the forward and backward directions, and most often at the pelvis and trunk. Post-hoc results for the Forward direction are reported here. Significant differences between tests occurred most often at the pelvis and trunk, and most often as the motion progressed (50%, 75% and Completion). Significant differences were found between FR vs SS, FR vs LOS, and SS vs LOS. Differences were greatest between FR and SS, and least between SS and LOS, e.g. mean differences for the trunk at maximum excursion were 26 deg FR vs SS, and 10 deg. SS vs LOS.

Conclusions: Performance of the SS test most closely resembled the 'inverted pendulum' model of postural limits of stability, followed by the LOS, with the FR least similar. FR performance involves 'out of phase' backward motion at the knee with compensatory forward motion at the trunk, versus the 'in-phase' forward motion of the hip, pelvis and trunk in the SS and LOS.

Clinical Relevance: Restricted postural limits of stability are a risk factor for falls, and accurate measurement is important.\(^10\),\(^11\) These kinematic results extend and support prior research findings indicating that the FRT does not measure limits of stability. This may explain the limited predictive validity of the FR for falls.\(^12\)
TITLE: High Level Mobility Training in a Patient Lacking Balance Reactions: a case of Chronic inflammatory demyelinating polyradiculoneuropathy (CIPD)

AUTHORS/INSTITUTIONS: J.M. De Simone, Adult Outpatient Neurological Physical Therapy, NYU Langone Medical Center, Rusk Rehabilitation, Bronx, New York, UNITED STATES

ABSTRACT BODY:

Background & Purpose: CIPD, a peripheral autoimmune demyelinating neuropathy, may involve symmetrical proximal and distal weakness, altered sensation and hyporeflexia. Medical treatments (tx) may have positive results, but long term residual symptoms and activity limitations can occur. Physical therapy (PT) focused on balance training can reduce falls risk. Less research exists on the role of specific exercises, focused on the mechanisms of occurrence of falls, in improving balance. Several factors contribute to balance; the ultimate cause of a fall is a failure to recover from a loss of balance. Head and hip postural sway is increased in patients with CIPD, altering quiet stance posture and impairing re-balancing strategies in proprioceptive dominate tasks. Perturbation-based balance training may reduce falls by improving rapid balance reactions. This case study shows the use of modified high level mobility (HLM) interventions in a patient (pt) lacking balance righting reactions, due to CIPD, to improve dynamic mobility and static balance.

Case Description: 51 year old post-acute CIPD came to outpatient PT after 2 months (mos) acute rehab, 3 rehospitalizations for medical treatment, 2 mos of subacute rehab and 3 mos of home PT. Pt had impaired strength, motor control, sensation, balance, endurance, and fear of falling. Increased likelihood of falls noted in outcome measure scores, lack of stepping reaction and abnormal stance posture. Pt needed supervision (s) ambulating indoors with rolling walker (RW) and solid ankle foot orthosis (AFO) and wheelchair for outdoor mobility. Pt goal to return to running due to past history as marathoner. Pt had 9 months of individual PT sessions at 30-60 min and 30 min therapeutic exercise classes 1-2 times per week for a total of 38 visits. Tx used modified HLM challenges to improve righting reactions; postural perturbations progressed from tall kneel to standing, seated weight shifts progressed to forward and backward wall pushups, and early implementation of gait training without assistive device (AD).

Outcomes: 5 Time Sit to Stand 39.48 sec with BUE support to 8.99 sec, Timed Up and Go 18.85 sec to 10.09 sec, Gait speed (GS) normal 0.62m/s to 0.92m/s, GS fast 1.15m/s, Jogging GS 1.66m/s, Activities-Specific Balance Confidence Scale 0% to 65% and 6 Minute Walk Test 438ft with RW to 1210ft. By discharge, pt ambulated outdoors without AD and hinged AFO for 3 miles, and jogged overground with s.

Discussion: Return to high level mobility in a low level pt depends on balance control. Task specific exercises, addressing balance righting reactions with postural perturbations can be more effective than standard balance exercises by addressing sensori-motor impairments. This case shows the use of modified HLM techniques in a pt with significant balance impairments who returned to overground jogging. More research is needed to address task specific exercises focused on the mechanisms of occurrence of falls, to improve balance to achieve HLM goals.

TITLE: The cardiorespiratory effects of virtual reality gaming for upper extremity rehabilitation in chronic stroke

AUTHORS/INSTITUTIONS: L. Benton, E. Kuzio, T. Rethorn, A. Borstad, The Ohio State University, Columbus, Ohio, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: The cardiorespiratory effects of playing a virtual reality (VR) upper extremity rehabilitation games have not been studied in individuals with chronic stroke. Subjective reports from participants in our laboratory indicate a potential increase in cardiorespiratory demand during gaming. Because VR gaming is intended to be used in the home and the target population for this intervention is at risk for cardiovascular disease the extent to which gaming causes a cardiorespiratory response is of interest. The purpose of this study was to determine the cardiorespiratory effects of a single session of VR upper extremity gaming.

Number of Subjects: The participants were 8 individuals with a chronic stroke (≥6 months), age range 50-69, 3 females.

Materials/Methods: Participants were seen for one session. Criteria: Chronic hemiparesis with at least 10° of active wrist extension, at least 10° of thumb abduction/extension, at least 10° of extension in at least 2 additional digits, and the ability to repeat these movements 3 times per minute in the affected hand. The ability to follow 1-step directions. Baseline blood pressure, heart rate and SpO\textsubscript{2} were taken. The 6-minute walk test was used as a measure of VO\textsubscript{2max}. and the RPE scale, blood pressure, heart rate, SpO\textsubscript{2}, and respiratory rate measures at baseline, and the Borg Rate of Perceived Exertion (RPE) scale were monitored approximately every 5 minutes during and 5 minutes after game play.

Results: One participant could not begin the protocol secondary to blood pressure blood pressure higher than the criteria for exercise following chronic stroke (160/100) and one participant was stopped mid-testing based on blood pressure higher than the stopping criteria. 7 participants completed the 6-minute walk test. VO\textsubscript{2max} range was 5.7-9.4. Average VO\textsubscript{2max} was 7.7. On average, participants experienced an increase in heart rate, during game play from a mean of 70 BPM to 87 BPM after 10 minutes of play. Participant RPE also increased from 7.3 at baseline to 14.4 at 10 minutes of play. Overall there was no change in blood pressure or SpO\textsubscript{2} during play.

Conclusions: These preliminary data suggest that there is an exercise response in these individuals with chronic stroke during VR gaming for rehabilitation of the upper extremity. Reduced VO\textsubscript{2max} combined with cardiovascular risk factors in this population reinforce the importance of monitoring vitals signs before and during gaming.

Clinical Relevance: Clinicians are more frequently being required to recommend and monitor exercise programs at a distance such as those delivered in the home using virtual reality gaming. The cardiorespiratory response during VR gaming may be benificial or place a patient at risk if their vitals signs and exercise response are not monitored.
The Effects of a Dynamic Balance and Core-Stability Program on Improving Functional Mobility and Decreasing Falls in a Person with Spinocerebellar Ataxia Type 3: A Case Report

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Background & Purpose: Spinocerebellar ataxia (SCA) is a group of autosomal dominant disorders that causes progressive degeneration of the cerebellum and its connections. Individuals with this condition often have one parent with the condition. Generally, signs and symptoms begin in mid-adulthood, with the average age of onset in their early 30s. They typically survive 10-20 years after symptoms first appear. People diagnosed with Spinocerebellar Ataxia Type 3 (SCA-3) often exhibit problems with coordination and balance as well as speech difficulties, dystonia, rigidity, spasticity, tremors, bulging eyes, double vision and sleep disruption. Falls are a significant concern in individuals with SCA-3 as it can reduce mobility, degrade their health and have physical and social ramifications. Currently, there is no pharmacological management of the motor symptoms of SCA-3. This leaves physical therapy (PT) intervention as one of few treatments that can address this condition.

Case Description: A 34 year old male patient (pt) diagnosed with SCA-3 since 2011 with significant fall history was treated in an outpatient (OP) PT clinic for progressive balance deficits and gait instability. Pt presented with wide base of support, ataxic gait pattern with high-guard position of upper extremity and decreased gait speed. Pt used a straight cane for ambulation. Pt had two falls in the last four months. The pt sustained an ankle sprain after he fell while descending stairs. Pt reported another fall when he attempted to sit on a chair on wheels and it slide out from under him. Pt suffered a large abrasion on his forehead when his head hit a wall. Intervention focused on static and dynamic balance training in all postures, core stabilization, coordination, gait training and functional training.

Outcomes: Pt completed 10-weeks of PT, twice a week for 45-60 minutes. Progression of balance, using Berg Balance Scale (BBS), was assessed at initial evaluation [38/56], re-evaluations at week 5 [50/56] and week 10 [51/56]. In addition, pt’s walking ability, using Timed-Up and Go (TUG), was assessed at initial evaluation [23.7 seconds], re-evaluations at week 5 [19.3 seconds] and week 10 [17.3 seconds]. In addition, pt subjectively reported no falls during the course of PT treatment.

Discussion: This case demonstrated that PT is a successful intervention for reducing falls and increasing postural stability in an individual with a progressive neurological disease of the cerebellum. The results show a significant increase in the BBS scores as well as a decrease in TUG times after interventions. Participation in a dynamic balance and core-stability training program is useful for decreasing falls and injury caused by SCA-3.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old:

TITLE: Characterizing differential post-stroke corticomotor drive to the dorsi- and plantarflexor muscles during resting and volitional muscle activation

AUTHORS/INSTITUTIONS: R. Zarzycki, S.M. Morton, T. Kesar, S.A. Binder-Macleod, Physical Therapy, University of Delaware, Newark, Delaware, UNITED STATES\[J.A. Palmer, School of Medicine, Emory University, Atlanta, Georgia, UNITED STATES\]

ABSTRACT BODY:
Purpose/Hypothesis: Imbalance of corticomotor excitability between the paretic and nonparetic limbs has been associated with the extent of upper extremity motor recovery post-stroke,\[1-4\] is greatly influenced by specific testing conditions such as the presence or absence of volitional muscle activation,\[5-7\] and may vary across muscle groups.\[8\] However, despite its clinical importance, post-stroke corticomotor drive to lower extremity muscles has not been thoroughly investigated. Additionally, while conventional gait rehabilitation strategies for stroke survivors focus on paretic limb foot drop and dorsiflexion impairments, most contemporary literature has indicated that paretic limb propulsion and plantarflexion impairments are the most significant limiters to post-stroke walking function.\[9-11\] The purpose of this study was to compare corticomotor excitability of the dorsi- and plantarflexor muscles during resting and active conditions in individuals with good and poor post-stroke walking recovery and in neurologically-intact controls.

Number of Subjects: 29 individuals post-stroke (16 fast-, 13 slow-walkers) and 14 controls
Materials/Methods: All participants underwent transcranial magnetic stimulation targeting the M1 hotspot of tibialis anterior (TA) and soleus muscles during conditions of rest and voluntary muscle contraction. Motor evoked potential (MEP) amplitude for each muscle was recorded using surface electromyography for the resting and active conditions. Corticomotor symmetry was calculated as the ratio of the average paretic (nondominant) divided by the nonparetic (dominant) MEP amplitude for each muscle during each condition.

Results: Both the fast-walking and slow-walking stroke subjects showed improvements in corticomotor symmetry in the TA muscle during the active versus resting condition (fast, \(p = .01\), slow, \(p = .02\) ) while the control group showed no differences between conditions. Soleus corticomotor symmetry showed no difference between resting or active conditions in any group. When compared to the TA, the soleus showed lesser corticomotor symmetry between paretic and nonparetic limbs in individuals the slow-stroke group during active muscle contraction but not during rest (\(p = .01\)). Reduced soleus corticomotor symmetry was a result of suppressed corticomotor drive to the paretic muscles and enhanced corticomotor drive to the nonparetic muscles versus the controls. This patterns was most exaggerated in the slow-stroke group.

Conclusions: These results demonstrate that atypical corticomotor drive exists in both the paretic and nonparetic lower limbs post-stroke and implicate greater severity of corticomotor impairments to plantarflexor versus dorsiflexor muscles during muscle activation in stroke survivors with poor walking recovery.

Clinical Relevance: Future studies could determine if rehabilitation strategies that address neural function in both the paretic and nonparetic lower limbs and that promote corticomotor balance to plantarflexor muscles may translate to improvements in post-stroke walking function.
TITLE: Haptic vertical perception measurement is reliable using the iPhone

AUTHORS/INSTITUTIONS: M.L. Rescott, K. Smith, A. Borstad, The Ohio State University, Columbus, Ohio, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Currently there are no widely-used bedside measures to evaluate an individual’s perception of vertical. Our lab previously developed an iPhone application, Haptic Vertical Analyst (HVA) which seeks to quantify an individual’s subjective haptic vertical (SHV) performance in both an eyes open (EC) and eyes open (EO) condition. The purposes of this study were to: establish the test-retest reliability of the HVA application, determine the relationships between SHV performance in EO versus EC condition and between performance on the HVA application versus the Bucket Test. We hypothesized that there would be a strong correlation between the two tests that would help support use of the HVA application as a bedside measurement for evaluating a patient’s perception of vertical.

Number of Subjects: Number of Subjects: 16

Materials/Methods: Healthy participants were tested on their SHV and their subjective visual vertical (SVV). Using the HVA application, participants rotated an iPhone until they determined it was vertical. The HVA application recorded the participants’ error from true vertical in degrees. Participants performed 7 trials EO and 7 trials EC. Mean error and standard deviations were calculated for each condition. Twelve participants returned 7 days later to repeat the HVA. The Bucket Test was used to quantify participants’ SVV as they attempted to align a straight line vertically without external visual cues. Participants’ error in degrees were recorded for each trial. Twenty trials were performed with 10 starting on a right rotation and 10 on a left rotation. Overall mean error was calculated.

Results: The SHV data showed a normal distribution in a Shapiro-Wilk test. Participants demonstrated significantly more error during the EC condition (mean=7.5°) when compared to EO (mean=2.9°) (matched-pairs t-test p>|t| = 0.0004). The test-retest reliability of the HVA app performance was good (ICC=0.834; mean difference=0.305), EO (mean difference 0.12, SE=0.41), and EC (mean difference 0.33, SE=0.48) conditions. Although no statistically significant relationship was found between the SHV and SVV tests, there was a positive trend in performances on the tests (r=0.46, p>F = .088).

Conclusions: The results of this study suggest that the HVA application is a reliable tool for assessing SHV over time. The differences in performance between the EO and EC trials might be attributed to unique constructs being tested. The correlational trend between the HVA and Bucket Test suggest that measuring SHV might have concurrent validity with SVV, but limitations in sample size and variability limit applicability of these findings.

Clinical Relevance: At this time there is no bedside measure used to quantify a person’s perception of vertical, which might be useful in predicting fall risk and assessing clinical improvement in people with various vestibular disorders or stroke. The HVA application seeks to fill this gap, but more research is needed to establish the validity of this measure in a clinical setting.
Background & Purpose: Benign Paroxysmal positional vertigo (BPPV) is one of the most common causes of dizziness. BPPV occurs when detached otolith debris called otoconia either float freely into the semicircular canals (canalolithiasis) or become attached to the cupula (cupulolithiasis). The goal for treatment of cupulolithiasis BPPV is to detach the otoconia and reposition debris back into the utricle. In horizontal canal (HC) cupulolithiasis BPPV, the otoconia can be attached to the anterior arm of the canal (canalith side) or posterior arm (utricle side). The Casani Maneuver has been found to be an effective treatment for HC cupulolithiasis with use of acceleration and head positioning to detach otolithic debris and reposition them into the utricle. The maneuver is quick, easily performed and has a high success rate however, the Casani maneuver is primarily used to detach debris from the utricle side of the HC. The Cupulolith Repositioning Maneuver (CuRM) can be used to treat both locations of debris in HC cupulolithiasis BPPV. In the initial position of the CuRM, the patient’s head is turned 135 degrees towards the affected side, vibration is applied to the mastoid in the 1st and 4th position and each position is held for 3 minutes for a total of 15 minutes to complete the maneuver. The CuRM requires increased time and training to perform however, has been shown to be an effective treatment of HC cupulolithiasis no matter where the attachment of otolithic debris is. The purpose of this abstract is to demonstrate the successful treatment of HC cupulolithiasis BPPV by first attempting the Casani Maneuver and then the CuRM if the patient continues to present with HC cupulolithiasis on follow up visit.

Case Description: Patient A is a 47 year old male who presented to vestibular therapy with report of dizziness and vertigo with changes in positions. Patient presented with Ageotropic nystagmus consistent with Right HC Cupulolithiasis. Patient B is a 56 year old female who presented to vestibular physical therapy with report of sudden vertigo. Patient presented with Ageotropic nystagmus consistent with Left HC Cupulolithiasis. Both patients were initially treated using the Casani Maneuver twice. On the patient’s next visits they continued to present with HC Cupulolithiasis. The Patients were then treated using the CuRM technique. On both patients final visits they presented with negative bilateral roll tests and no longer reported symptoms of vertigo.

Outcomes: With use of video-Frenzel goggles, patients presented without nystagmus in bilateral roll tests on follow up visit and reported performing bed mobility without vertigo.

Discussion: This case series describes 2 patients with HC cupulolithiasis that were first treated using the Casani maneuver due to the maneuver being quick, easy and effective. Patients continued to present with HC cupulolithiasis and were treated using the CuRM maneuver with the impression that the otolithic debris may be attached to the canalith side of the HC. On final visits both patients presented with negative findings for HC BPPV.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.
TITLE: Effectiveness of a Community-Based Cycling Intervention for Parkinson’s Disease on Motor Symptoms and Quality of Life

AUTHORS/INSTITUTIONS: H. Tipp, SPT, Physical Therapy, University of Michigan-Flint, Flint, Michigan, UNITED STATES|M. Davis, Psychology, University of Michigan-Flint, Flint, Michigan, UNITED STATES|R.D. Seidler, PhD, Kinesiology, University of Michigan-Ann Arbor, Ann Arbor, Michigan, UNITED STATES|V. Kotagal, MD, MSc, Neurology, University of Michigan-Ann Arbor, Ann Arbor, Michigan, UNITED STATES|K. Chou, MD, Neurology, Neurosurgery, University of Michigan-Ann Arbor, Ann Arbor, Michigan, UNITED STATES|T. Wu, MSc, Kinesiology, University of Michigan-Ann Arbor, Ann Arbor, Michigan, UNITED STATES|N.S. Miller, PhD, Psychology, University of Michigan-Flint, Flint, Michigan, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Parkinson’s Disease (PD) is a neurodegenerative disorder with both motor and cognitive symptoms. Medications are primarily used to mitigate PD symptoms, but their effectiveness is limited and decreases over time, which can negatively affect the quality of life for individuals with PD. Exercise has shown potential as an adjunctive therapy to improve PD symptoms beyond medication alone; however, few studies have considered feasible exercise options that can be readily implemented in the community. Pedaling for Parkinson’s™ (PFP) is a community-based, exercise program, offered by local YMCAs, where individuals with PD ride stationary bikes vigorously (60-80% of their maximum heart rate and 80-90 pedal revolutions/minute) for an hour, three times per week. The current study tested the effectiveness of PFP for improving motor symptom severity and quality of life (QoL) in individuals with PD after 8 weeks of participation in the program.

Number of Subjects: 12

Materials/Methods: We recruited 12 participants prior to starting PFP; all participants regularly attended PFP for 8 weeks. Participants were tested OFF their anti-parkinsonian medications to reduce the influence of their medications. Data were collected at three different time points: baseline, and at 4- and 8-weeks of PFP participation. We administered and recorded the Movement Disorder Society-Unified Parkinson’s Disease Rating Scale: Motor Subscale (MDS-UPDRS) to measure motor symptom severity. MDS-UPDRS ratings were performed by a movement disorder specialist blinded to participants’ time in PFP. We also administered the Parkinson Disease Questionnaire (PDQ-39), a self-reported measure, to measure QoL.

Results: Separate one-way ANOVAs revealed marginally-significant improvements in PD motor severity ($p = .07$) and statistically significant improvements in QoL after 8 weeks of PFP participation ($p = .04$). We also considered the clinical significance of the observed improvements. The improvements observed for PD motor severity (4 points) met the criteria for a minimally clinically important improvement in the MDS-UPDRS. Similarly, the improvements observed for the PDQ-39 (3.86 points) exceeded the criteria for a meaningful change (1.6 points), but failed to meet the clinically relevant change criterion used in other studies (5.39 points).

Conclusions: Clinically-, and to some extent, statistically-significant improvements were found for both PD motor severity and QoL following 8 weeks of PFP participation. These findings suggest that PFP is an effective community-based exercise intervention for mitigating both the motor symptoms and QoL issues associated with PD.

Clinical Relevance: PFP is a cost-effective, community-based adjunctive therapy for effectively mitigating PD motor symptoms and QoL. The program can be easily implemented in a range of different exercise facilities with existing exercise equipment, and can be used to treat multiple patients at the same time.
TITLE: Ready to Be Steady: Correlation of balance measures used in traumatic brain injury rehabilitation.

AUTHORS/INSTITUTIONS: C. Tefertiller, A. Natale, K. Hays, D.R. O'Dell, Physical Therapy, Craig Hospital, Denver, Colorado, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: The purpose of this report is to evaluate the correlation among three balance measures used in individuals with traumatic brain injury (TBI).

Number of Subjects: Subjects for this report were recruited from a larger RCT comparing the effect of two interventions on balance after TBI. All 45 subjects met the following criteria: ≥ one year post TBI; ≥ three months beyond completion of formal PT; and able to independently ambulate in the home environment. To be enrolled, subjects also needed to self-report ongoing balance challenges and demonstrate deficits on standard outcome measures for balance.

Materials/Methods: After an initial phone screening, all appropriate individuals participated in a baseline assessment completed by a blinded physical therapist to determine overall severity of balance deficits and the underlying balance systems impaired. The Community Balance and Mobility total score (CB&M), the Balance Evaluation Systems Test (BESTest) and the Activities Balance Confidence scale (ABC) were all measured in 45 subjects with TBI who met the inclusion criteria previously described. The CB&M is a clinical balance measure used to detect mobility impairments on tasks commonly encountered in the community environment and has been shown to be valid and reliable in TBI.1,2 The BESTest is clinical tool assessing balance impairments across six contexts of postural control and has been validated in the stroke population.3 The ABC is a self-report tool that measures confidence in performing ambulatory activities without falling and has been validated in the TBI population2 and shown to be reliable in the stroke population4.

Results: Evaluation of the 45 subjects demonstrated statistically significant (p<0.01) positive correlations at baseline between balances measures to include the following: BESTest and CB&M (r = 0.847, 95% confidence interval [CI] = 0.736, 0.913); ABC and BESTest (r = 0.474, 95% CI = 0.210, 0.674); ABC and CB&M (r = 0.399, 95% CI = 0.120, 0.620).

Conclusions: The CB&M and BESTest demonstrate a very high positive correlation while the ABC (self-report) is only moderately correlated with both the CB&M and the BESTest.

Clinical Relevance: The CB&M and BESTest may provide similar information when clinically evaluating individuals with TBI who have balance dysfunction. Although the BESTest has not yet been validated in the TBI population, the strong positive relationship demonstrated with the CB&M in this cohort provides an indication for the importance of additional research on this measure in the TBI population. The BESTest also provides information regarding the specific balance systems underlying balance impairment which may be beneficial in guiding clinical practice as high internal consistency has been demonstrated in other neurologic populations5. Self-report scales may also be beneficial when assessing balance dysfunction in this population, but clinical measures such as the CB&M and BESTest may also be needed to provide a more in depth clinical picture.
TITLE: Functional fitness in an older adult stroke population.

AUTHORS/INSTITUTIONS: A. Bahoura, Z. Liu, S. Shoka, K. Choe, D.E. Adamo, Physical Therapy, Wayne State University, Detroit, Michigan, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Clinical guidelines for the management of stroke recommend physical activity as part of the rehabilitation process as evidence suggests it can improve physical fitness and reduce the impact of stroke-induced disability. However, there is a gap in knowledge when determining the specific physical fitness needs for each individual post-stroke. The purpose of this study was to: 1) investigate differences in the Senior Fitness Test between individuals who suffered a stroke and age-gender matched controls and, 2) determine the feasibility of using the SFT in an older adult stroke population.

Number of Subjects: Fourteen older adults (73.4 ± 6.2 years) who suffered a stroke participated in the study. Findings were compared to previously tested age-gender matched controls.

Materials/Methods: The SFT tasks included: upper (# of arm curls) and lower (# of chair rises) body strength, upper (reaching to the middle of the back with both hands) and lower (reaching with the arm to the toes of an extended leg) body flexibility, endurance (walk distance in 6 minutes or # of steps in place for 2 minutes) and dynamic agility (walk 8 feet, turn around and return to start position). A personal profile was furnished to compare individual performance scores to SFT standardized normative and criterion-based reference scores. A feasibility survey was administered. Independent t tests were conducted to determine group differences in SFT measures. Descriptive statistics were used to report feasibility data.

Results: For SFT tasks, significant group differences were found for the endurance test $t(26) = 4.22; p < .001$, lower body flexibility $t(26) = 2.3; p < .05$ and dynamic agility $t(26) = 2.1; p < .05$ as individuals who suffered a stroke showed less endurance, restricted ability to reach their toes and were slower to rise from a chair, walk 8 feet and return to a sitting position when compared to healthy age-gender matched controls. However, performance on lower body strength, upper body strength and upper body flexibility tests were similar for both groups. SFT measures increased awareness of physical activity needs; the back scratch test (upper body flexibility) was ranked most difficult and the 6 minute walk test was ranked the least difficult.

Conclusions: Post stroke, individuals are unaware of what specific types of exercise, such as flexibility and/or strength training, will delay the progression of functional loss and promote independence in self-care tasks. Feasibility outcomes suggest the SFT is a useful tool to increase awareness about the relationship between functional fitness and the risk associated with loss of independence.

Clinical Relevance: Physical therapists may find the SFT a useful tool to administer to their stroke patients as part of standard care and in preparation for discharge to home or community based settings. Continued participation in physical activity helps to maintain functional gains obtained during therapy and promotes a model health and wellness for which the patient is an active contributor.
TITLE: Vestibular deficit in Charcot Marie Tooth disease

AUTHORS/INSTITUTIONS: A.N. Dennis, A. Fangman, Rehab Therapies, University of Washington Medical Center, Seattle, Washington, UNITED STATES

ABSTRACT BODY:

Background & Purpose: Persons with Charcot Marie Tooth disease (CMT), or hereditary motor and sensory neuropathy (HMSN), present with deficits of the peripheral nerves, including motor, sensory, and cranial nerves. Specifically, the vestibulocochlear nerve has been identified as impaired in persons with CMT. Cranial nerve 8 is integral for gaze stabilization, spatial orientation, and postural control. Currently, there is no literature describing the impact of vestibular rehabilitation on persons with CMT. The purpose of this case study is to describe a vestibular impairment in a client with CMT and determine the value of vestibular intervention on postural control, activities, and participation.

Case Description: Number of subjects: 1

Materials/methods: 57 year old female, diagnosed with CMT 40 years prior, presented to an outpatient clinic for balance training. The client was seen for 6 physical therapy visits over 4 months. Interventions included vestibular adaptation, strength training, aerobic exercise, postural control exercise, and a home exercise program. Outcome measures included the dynamic gait index (DGI), dynamic visual acuity (DVA), and modified clinical test of sensory integration on balance (mCTSIB).

Outcomes: The client demonstrated improved postural control, ability to maintain grip, improved spatial orientation when negotiating obstacles (especially turns), decreased rate of headaches, and the ability to resume scuba diving. She scored lowest on item 3 of the DGI, which assesses horizontal head turns, and this improved over the course of treatment. Her DVA improved from a 4 line difference to a 3 line difference, indicating improved functional use of the vestibular ocular reflex. Postural sway on the mCTSIB decreased. The outcome measures utilized in this case were not sensitive enough to capture the real changes in activity and participation this client experienced.

Discussion: This case study suggests that clients with CMT benefit from vestibular rehabilitation. Vestibular rehabilitation is under prescribed and if used, clients with CMT can have significant improvement in spatial awareness, postural control, activities, and participation in their life roles.

TITLE: c-VEMP, FGA and SOT IN ATHLETES WITH mTBI

AUTHORS/INSTITUTIONS: A.B. Almutairi, J.B. Christy, G. Cochrane, Physical Therapy, The University of Alabama at Birmingham, Birmingham, Alabama, UNITED STATES| C. Busettini, Vision Sciences, The University of Alabama at Birmingham, Birmingham, Alabama, UNITED STATES| M. Swanson, K. Weise, Optometry, The University of Alabama at Birmingham, Birmingham, Alabama, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Current diagnosis of mTBI is based primarily on symptoms, although athletes reportedly complain of balance problems. Objective clinical and diagnostic tests are needed to track recovery and guide interventions for athletes with mTBI. The purpose of this study was to describe data obtained from the Cervical Vestibular Evoked Myogenic Potential (c-VEMP) test, Sensory Organization Test (SOT) and Functional Gait Assessment (FGA) in athletes with and without sport-related mTBI. The hypothesis was that athletes with mTBI would have scores that were significantly different from control athletes.

Number of Subjects: Control Athletes (n=27; 18 males). Athletes with mTBI (n=22; 13 males). Mean age=13.5(4.0). Mean weeks since mTBI=67.5(144).

Materials/Methods: All athletes were screened using otoscopy and tympanometry. Saccular function was tested using cVEMP (Intelligent Hearing Systems, Inc.), 500Hz tone burst, and published methodology. P13,N23 amplitudes were corrected for baseline EMG and used to calculate the corrected Interaural Amplitude Difference ratio (cIAD). Data of interest from the six conditions of the Sensory Organization Test (SOT) (Natus, Inc) included the composite score (0-100), and the vestibular, visual and somatosensory ratios (i.e. conditions 5, 4 and 2 divided by condition 1, respectively). Functional Gait Assessment (FGA, 0-30) provided a measure of dynamic balance and walking. Descriptive statistics included means and standard deviations. Athlete groups were compared using independent samples t-tests (α=0.05).

Results: There was a statistically significant difference between the mTBI group and controls on cVEMP corrected Interaural Amplitude Difference (cIAD) ratio (p<0.05). Mean cIAD (mTBI) = 20 (SD=16.64). Mean cIAD (control) = 11.60 (SD=7.98). 27% of athletes with mTBI had cIAD ratios >25%. Mean SOT composite scores were similar (p>0.05): mTBI=61.45(15.41) and control=66.89(11.4). 18% of the mTBI group and 7.40% of the control group had a vestibular ratio < 0.20. FGA scores were also similar (p>0.05): mTBI=27.06(2.7); control=28.57(1.99). Athletes with mTBI had the most difficulty on conditions requiring tandem walking or walking while turning their head.

Conclusions: This data provides limited evidence that athletes with mTBI may present with an abnormal cVEMP which could contribute to poor use of vestibular information for balance. Most of the athletes with mTBI in this sample were asymptomatic, had normal cVEMP responses and normal SOT which may indicate a certain level of recovery. The FGA should be modified for children and adolescents since many of the items are not challenging, even for athletes with mTBI. Future studies should examine athletes at early, mid and late stages of recovery using these measures, combined with measures of vestibular, oculomotor and vision function, and a modified FGA.

Clinical Relevance: Athletes with mTBI may have aberrant use of vestibular information for balance which warrants specific interventions for optimal return to sport and participation.
TITLE: Validity and responsiveness of the Visual Vertigo Analogue Scale

AUTHORS/INSTITUTIONS: E. Dannenbaum, Vestibular Rehabilitation, Jewish Rehabilitation Hospital, Laval, Quebec, CANADA| G. Chilingaryan, J. Fung, Jewish Rehabilitation Hospital research site of the Montreal Interdisciplinary Rehabilitation Research Center, Centre intégré de santé et de service sociaux de Laval L'Hôpital juif de réadaptation, Laval, Quebec, CANADA|

ABSTRACT BODY:

Purpose/Hypothesis: Participation in work or leisure activities is often hindered by dizziness provoked by dynamic visual environments for vestibulopathic clients. We have previously devised a Visual Vertigo Analogue Scale (VVAS) to capture the severity of self-reported dizziness provoked by visual stimulation. This study aims to validate the VVAS against standardized, comprehensive questionnaire for visual vertigo, the Space Motion Discomfort-1 (SMD1) which is a subscale of the Situational Characteristics Questionnaire (SITq), as well as the Dizziness Handicap Inventory (DHI). We also aimed to examine the capacity of VVAS to detect change before and after vestibular rehabilitation, in comparison with standardized dizziness assessments.

Number of Subjects: 116 adults referred by a neurologist or otolaryngologist for outpatient vestibular therapy were consecutively recruited during their first session of physical therapy. Clients with significant co-morbid conditions, who did not speak English or French or consent to participate, were excluded.

Materials/Methods: At the initial assessment and at their final session of vestibular rehabilitation, participants completed three questionnaires: DHI, VVAS, and the SITq. The clients completed the same questionnaires. The SITq was analyzed in two ways: using the SMD1 outcome measure derived from the suggested SITq algorithm by Jacob et al (2009) and by calculating the average score of all the SMD1 items (SMDavg). Poisson regression was used to explore the relationship between different outcome measures. The clients were stratified into 2 groups: those who had a significant clinical change in their DHI score post treatment (change of more than 18 points) and those who did not. Non-parametric independent t-test (Wilcoxon Mann Whitney) was applied to compare the VVAS and SITq changed scores between the two DHI groups.

Results: The mean age was 62.7±15.6 and 78/116 (67%) were female. The pre-treatment mean (SD) scores were: DHI 42.1(22.7), VVAS 23.9(24.6), SMD1 38(3.3) and SMDavg 0.7(0.07). There were significant associations in VVAS (p<0.0001) with both SMD1 (βvas 0.02) and SMDavg (βvas 0.03). With regards to the questionnaires’ ability to detect change, the mean change in pre and post test scores were: DHI 27.4 (15.6), VVAS 13.3 (18.2), SMD1 1.2 (2.2) and SMDavg 0.4(0.5). The Wilcoxon Mann Whitney revealed statistically significant differences between the 2 DHI groups: VVAS (p=0.0002), SMD1 (p=0.02) and SMDavg (p=0.0001). There was slightly less variance in the VVAS scores.

Conclusions: Changes in VVAS scores corresponded to those of SMD1 and SMDavg scores. Furthermore, the VVAS was able to detect change in clients symptoms post treatment as well as the SITq.

Clinical Relevance: The VVAS is a quick and simple test for clients to complete and easy for evaluators to calculate the score. As this scale shows validity and responsiveness to change, it can be used to detect clients with visual vertigo and to verify the progression of the client’s symptoms.
**ABSTRACT BODY:**

**Background & Purpose:** Evidence suggests that high intensity interval treadmill training (HIT) produces greater functional improvements compared with conventional therapy in the stroke population. Evidence also suggests that reciprocal arm swing facilitates gait speed recovery. When implementing HIT program, patients are allowed to use upper extremity support (UES), however the inhibition of reciprocal arm swing may interfere with functional recovery. The following case report illustrates the benefits of using reciprocal arm swing during HIT on gait speed and skill acquisition in a patient (pt) after brain tumor resections (BTR).

**Case Description:** A 40 y/o F who underwent two BTR in 2005 and 2016 was referred to outpatient physical therapy (PT) to address change in functional status. The pt presented with left hemiparesis and impaired gait speed. She was able to walk without an assistive device, but was unable to run. She attended PT for one hour, twice a week receiving a HIT program with a body weight support system. Intensity was measured using the Rate of Perceived Exertion (RPE) scale, where the pt was to walk or run at her fastest tolerated speed for 10 intervals of 30 seconds on, 60 seconds off. Fastest tolerated speed was defined as 0.1 MPH below the speed at which the pt demonstrated a mechanical fault. Following each successful trial, the speed was increased by 0.1 MPH.

**Outcomes:** During the initial examination, pt's over-ground gait speed was 2.19 ft/s. The HIT program was implemented at the first visit, she tolerated a maximum speed of 2.8 MPH with an RPE 14-16. She used UES during the first 10 visits secondary to fear. After 10 visits, her maximum speed increased to 4.2 MPH with an RPE 13-15 and improved her over-ground gait speed by 22%. On the 11th visit UES was discontinued to encourage reciprocal arm swing. During her first treatment with reciprocal arm swing, her maximum gait speed was 4.0 MPH with an RPE 15-17. At visit 13, pt transitioned to running in order to continue to increase speed. After 10 visits using reciprocal arm swing, her maximum running speed increased to 7.0 MPH with an RPE 13-15 and her over-ground gait speed improved by 40%.

**Discussion:** Pts after BTR are often limited in their ability to perform high-level mobility skills. Based on current research, patients with chronic stroke utilizing HIT protocols experienced greater functional improvements when compared to moderate intensity ones. However, the current HIT protocols fail to stress the importance of reciprocal arm swing. This case report highlights the benefits of combining reciprocal arm swing with the HIT protocol to enhance gait speed and functional recovery. The HIT intervention fosters neuroplasticity and motor recovery, while reciprocal arm swing facilitates trunk rotation, weight shifting and increases ground reaction force. By combining these two interventions, the pt was able to increase her gait speed and acquire a new skill, running.

**References:** Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: Boyne P, Dunning K, Carl D, Gerson M, Khoury J, Kissela B. Within-Session Responses to High-Intensity Interval Training in Chronic Stroke. Med Sci Sports Exerc. 2015 Mar; 47(3): 476-84.


Lau KW, Mak MK. Speed-dependent treadmill training is effective to improve gait and balance performance in patients with sub-acute stroke. J Rehabil Med. 2011; 43: 709-713.

Purpose: The need for objective, reliable, sensitive measures in order to track the effectiveness of the treatments we offer as physical therapists has been well established. In order to be able to compare different treatments and optimize our interventions, the ability to sensitively measure the target of therapy that is being addressed is essential. In the area of ambulation, a multitude of measures and methodologies are available to assess, quantify and characterize walking ability. Nearly all of the measures currently available, however, are explicitly identified to be used with individuals who do not require assistance to walk. Establishing valid, reliable ways of measuring walking ability for those who require assistance with walking is essential in order to improve the effectiveness of the treatments we offer in this area. Guiding considerations and a proposed method for measuring ambulation ability in those who require assistance will be presented.

Description: This presentation will identify the need and establish the importance of determining a means of measuring and characterizing walking ability in individuals who are unable to walk without assistance. Potential options for achieving this across different populations will be briefly identified, and then further consideration will be given to individuals following stroke, specifically in the acute inpatient rehabilitation environment. Obstacles to measuring walking ability in this population in a consistent, objective, and reliable way, and guiding principles to address these obstacles will be presented. A proposed method of measuring walking ability in individuals in this setting who are unable to walk will be introduced. Preliminary data from an ongoing study piloting the use of this measure in individuals following stroke in the inpatient acute rehabilitation setting will be presented.

Summary of Use: A methodology for reliable, objective, sensitive measurement of walking ability in individuals following stroke who are unable to walk without assistance has been proposed. Data is currently being collected regarding the feasibility and utility of this methodology, with the prospect of informing future studies in this area.

Importance to Members: Development of a practical, reliable, sensitive measure of walking ability for those who are unable to walk without assistance is an essential step in maximizing effectiveness of rehabilitation treatments in this population. The proposed methodology offers initial work in this important area, and this presentation is hoped to create opportunities for ongoing dialogue in those interested in this area.
TITLE: Effect of cumulative head impacts on postural control in college soccer athletes

AUTHORS/INSTITUTIONS: T.E. Leahy, Doctor of Physical Therapy, Lynchburg College, Lynchburg, Virginia, UNITED STATES|T.G. Bowman, Athletic Training, Lynchburg College, Lynchburg, Virginia, UNITED STATES|K.M. Breedlove, University of Delaware, Newark, Delaware, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Changes in neurocognition and in gait have been found in athletes without reported concussion. The purpose of this analysis was to determine the effect of multiple head impacts sustained in a normal season on postural control in soccer athletes as measured by the Limits of Stability test.

Number of Subjects: 30

Materials/Methods: Volunteer NCAA Division III soccer athletes (16 women, 14 men) underwent pre and post season LOS testing with NeuroCom VSR Sport as part of a larger study. Head impacts during practices and games throughout the 15 week season were measured with the xPatch (X2 Biosystems, Seattle, WA, USA). The xPatch stored location, frequency, and magnitude (linear and rotational accelerations) of head impacts. The effect of head impacts on postseason LOS performance was assessed using ANCOVA. Independent variables were: gender, pre-season scores, cumulative number of head impacts. Separate analysis was run for each dependent LOS variable: reaction time (RT), movement velocity (MVL), endpoint excursion (EPE), max excursion (MXE) and directional control (DCL).

Results: For RT neither pre-season scores nor number of head impacts had a significant effect on post-season scores. Number of head impacts had a significant effect on post-season scores for both MXE ($F_{1,29} = 13.74$, $p<.01$) and EPE ($F_{1,29} = 6.8$, $p<.05$). Fit coefficient scores of -0.54 and -0.53 for MXE and EPE respectively indicate poorer scores with increasing number of head impacts. No significant effect on DCL or MVL was noted.

Conclusions: Reaction time variability may have masked a potential effect of head impacts in this small sample. The number of head impacts accrued throughout a soccer season had a possible detrimental effect on athletes’ max excursion and endpoint excursion on the post-season limits of stability test.

Clinical Relevance: The reduction in MXE and EPE suggest that as athletes accrue head impacts across a season, they demonstrate less confidence in their limits of stability and less accuracy in reaching a target. On the playing field that insecurity in dynamic postural control could translate to an increased risk for sustaining injury. Further studies with larger numbers of subjects are needed to explore the potential risk associated with cumulative head impacts sustained in soccer.
Title: Does high intensity exercise have a greater positive impact on ambulation than standard care in the chronic stroke survivor?: A systematic review of the literature

Authors/Institutions: C. Caruso, C. Comstock, A.L. McKenna, S. Nixon, A. Wonneberger, C.M. Tyrell, Thomas Jefferson University, Cinnaminson, New Jersey, UNITED STATES

Abstract Body:

Purpose/Hypothesis: Stroke is the leading cause of adult disability, often because of its profound impact on ambulation. It may leave a survivor of stroke with gait impairments such as decreased walking velocity, impaired endurance, and/or an asymmetrical gait pattern. Historically, physical therapy has been successful in assisting the recovery of walking for this population, but in order to optimally induce positive neuroplastic changes in the brain, recent research has suggested the use of high-intensity exercise. To date, there is not a consensus on whether high intensity exercise is safe and/or effective in the treatment of gait abnormalities after stroke. The purpose of this systematic review is to assess the effectiveness of high-intensity exercise on the improvement of gait deficits in survivors of chronic stroke as compared to standard care.

Number of Subjects: 7 research articles

Materials/Methods: A systematic review of the literature was completed in accordance to the PRISMA guidelines, using the PEDro scale to assess for risk of bias. Five data bases were searched with the following terms: "high-intensity" AND "stroke" AND ("walk" OR "gait"). Inclusion criteria consisted of: (1) intervention with high-intensity (2) author defined participants as having "chronic" stroke, and (3) ≥1 gait-related outcome measure.

Results: Seven articles were included in this systematic review. Six of the 7 articles utilized high intensity ambulation as the intervention, while the final article utilized cycle ergometry and resistance training. Of those that utilized ambulation training, all found significant improvements in endurance, and 5 of the 6 found significant improvements in walking velocity. Although only one study evaluated gait mechanics, it was found that there was improvement in paretic single limb stance time and a trend toward improved symmetry as compared to the standard care group. The article that utilized high-intensity cycle ergometry and resistance training did not find any differences in walking endurance or gait speed when compared to the standard care group. Across all 7 studies, there was only one single adverse event reported.

Conclusions: This review suggests that high-intensity, walking-specific exercise is a safe, effective intervention that may be used to assist in improving gait speed, endurance, and gait mechanics in the population of chronic stroke survivors. It may in fact be superior to both standard care ambulation training and high intensity mobility training of other kinds, but more research needs to be done to confirm this assertion.

Clinical Relevance: Physical therapists should consistently utilize their skills in evaluation of exercise response when working with patients with chronic stroke to ensure safety during mobilization. When medically appropriate, therapists should consider the integration of higher intensity, task-specific ambulation training with this patient population, especially when the patient's goals include a desire to improve the above described gait deficits.
TITLE: Vibrotactile Feedback Improves Locomotor Function in Lower Extremity Amputees


ABSTRACT BODY:

Purpose/Hypothesis: Impaired locomotor function and falls are common following lower extremity amputation. A major barrier to restoring locomotor function is the lack of sensory feedback from the prosthetic foot. The objective of this pilot study was to investigate if the incorporation of a novel vibrotactile feedback system into a comprehensive physical therapy program would improve locomotor function in lower extremity amputees.

Number of Subjects: A total of 7 participants have completed the study to date (3 experimental). The average age of the participants was 52.1 years +/- 6.6 years, the average time since amputation was 26.4 months +/- 30.1 months. Four of the participants had transfemoral amputations; the other three had transtibial amputations.

Materials/Methods: The current study is a randomized controlled single blind trial. All subjects received sixteen 90 minute physical therapy sessions over 8 weeks. Subjects in the experimental group received vibrotactile feedback proximal to their amputation during therapy, while control subjects did not. The vibrotactile feedback was delivered in response to pressure sensors located in the prosthetic shoe corresponding to the great toe, heel, and metatarsal heads. Locomotor function was assessed using the 10 meter walk test (10MWT), the 6 minute walk test (6MWT), timed up and go (TUG), TUG-Cognitive (TUG-Cog), and the amputee mobility predictor (AMPPro). Data was collected at Weeks 0, 4, 8, 12, and 16 to assess both treatment effects and carryover.

Results: Preliminary data analysis indicates that participants in the experimental group demonstrated greater improvements in fast walking speed as measured by the 10 meter walk test compared to control group (average improvement, .25m/s versus .10m/s at 8 weeks). In addition, these differences were maintained during the follow up period (average improvement, .28m/s versus .11m/s at 16 weeks). Improvements were also observed in the 6MWT, TUG, TUG-Cog and AMPPro. However, these improvements were similar between groups.

Conclusions: Physical therapy was shown to improve functional scores in all outcome measures and spatiotemporal parameters for individuals ambulating with a unilateral lower extremity prosthetic limb. Vibrotactile feedback, coupled with traditional therapy, appears to enhance locomotor function as measured by the AMPPro, 10MWT, velocity, cadence, and stride length.

Clinical Relevance: The addition of vibrotactile feedback to a comprehensive physical therapy program appears to promote greater improvements in mobility in individuals with lower extremity amputation compared to physical therapy alone. Once validated with continued study, these preliminary findings could support the addition of vibrotactile feedback to rehabilitation programs for individuals with lower extremity amputations.
**Title:** Biomechanical and Functional Benefits of Central Power Wheelchair Drive Controls for an Adult with Cerebral Palsy


**Abstract Body:**

**Background & Purpose:**

The influence of seating and positioning components on the posture and function of the wheelchair user has been well documented. A critical part of a power wheelchair evaluation is the ability to access and utilize the controller for driving and power functions. This can take precedence over other seating priorities and lead to poor positioning and postural alignment. There is limited evidence of the impact of the placement of the power wheelchair controller on the postural alignment, comfort, pressure distribution, function, or ease of use. To our knowledge, the controller’s placement has not been studied for its effect on the posture and function of the user. We present a case where several biomechanical attributes of seating and function were assessed using a traditional side mounted controller and a midline mounted controller in an adult with cerebral palsy. He demonstrated better postural alignment, pressure distribution and perceived comfort and control using drive controls centrally mounted compared to side mounted.

**Case Description:**

Our subject is a 21 year old male diagnosed with cerebral palsy, with bilateral hemiparesis with involvement of the right more than left, and with a history of multiple orthopedic surgical procedures for limited range of motion. He was a long time power wheelchair user with an armrest mounted controller using his left hand for driving. His seated posture was markedly asymmetrical with extraneous movements, requiring lateral supports to maintain an upright forward facing posture. He was evaluated in a power wheelchair with an armrest mounted controller and in the same wheelchair and seating components with the controller centrally mounted.

Several measures were used to assess his posture, weight distribution and effort while driving a power wheelchair with the controller mounted in each position. Pressure mapping was used to compare weight distribution on the seat, 3D kinematics was used to compare the position and movement of his head, trunk, and extremities, and dynamic electromyography to compare muscle activation under both conditions.

**Outcomes:**

Use of the center mounted controller improved all areas assessed. He demonstrated larger surface area pressure distribution with fewer areas of high pressure concentration, more upright, erect sitting posture and improved head position with his eye gaze forward and he drove the wheelchair with less extraneous movements of his extremities and less force.

**Discussion:**

The placement of the controller in midline has benefits for the power wheelchair user compared to the controller positioned on one side. This case presentation demonstrated a better pressure distribution, posture and less force to drive with center mounted controls. Larger studies are being pursued to confirm these findings in a larger patient population.

**References:** Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old:

TITLE: Relationship of Balance and Quality of Life and Participation in People Received Antiepileptic Drugs

AUTHORS/INSTITUTIONS: Y. Chiu, T. Marshall, B. Coleman, D.T. Fosburgh, School of Physical Therapy, Marshall University, Huntington, West Virginia, UNITED STATES|P. Wen, Occupational Therapy, Florida International University, Miami, Florida, UNITED STATES|S.K. Shah, Neuroscience, Marshall University, Huntington, West Virginia, UNITED STATES|R. Neal, Back & Spine Center, Cabell Huntington Hospital, Huntington, West Virginia, UNITED STATES|J. Liu, Applied Science & Technology, Marshall University, Huntington, West Virginia, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: The most commonly reported side effects of antiepileptic drugs (AEDs) include dizziness and gait ataxia, which may cause imbalance and increase risks of falling. The purpose of this study was to examine the relationship between balance function and quality of life and participation in people who received AEDs and were admitted to an inpatient epilepsy monitoring unit (EMU) routine. We hypothesized that there would be a trend between balance function and quality of life, and participation in people who received AEDs. (i.e. people with better balance function have higher quality of life and better participation.)

Number of Subjects: Six subjects with a history of epilepsy (n = 6; 2 male/4 females; mean age = 45.7 ± 8.3 y.o.) were recruited from an inpatient epilepsy monitoring unit of a regional medical center. As part of medical standard of care, all participants were admitted to an EMU for advanced differential diagnosis and medication adjustment. Every participant was consented before participating in this study.

Materials/Methods: Demographic information of participants, such as age, gender, onset of epilepsy, fall history, AEDs, diagnosis, etc., was collected on Day 1 of EMU. In addition, all consented participants received a clinical balance assessment: Functional Gait Assessment (FGA), and completed a quality of life and a social participation assessments: Quality of Life in Epilepsy (QOLIE-31) and the Participation Assessment with Recombined Tools-Objective (PART-O). FGA is a 10-item balance test that assesses postural stability during various walking tasks. QOLIE-31 is a quality of life questionnaire that contains seven multi-item scale, including seizure worry, emotional well-being, energy/fatigue, cognition, medication effects, social function, health status and overall quality of life. PART-O is an objective measure of participation with three domains (productivity, social relations, and out and about), representing functioning at the societal level. Because of small sample size, descriptive statistics was used to describe and summarize the findings, and to show if any patterns/trends emerged in this study using plots/figures.

Results: AEDs prescribed in this study were Levetiracetam, Phenytoin, Sodium Channel Blockers, and Gabapentin. Between FGA and QOLIE-31, a positive trend was found in the items of energy/fatigue, emotional well-being, cognition and seizure worry; a negative trend was found in the items of social function and medication effects. Between FGA and PART-O, a positive trend was found in all three domains: productivity, social relations, and out and about.

Conclusions: Based on the findings in this pilot study, people with epilepsy who had better dynamic balance function had higher quality of life and better social participation. Future study with a bigger sample size is needed to make appropriate statistical inferences.

Clinical Relevance: Better understanding of the relationship between balance function and quality of life, and participation can address the potential needs for balance intervention in people with epilepsy.
**TITLE:** An innovative intervention for people on waiting list for vestibular rehabilitation

**AUTHORS/INSTITUTIONS:** E. Dannenbaum, J. Fung, Vestibular Rehabilitation, Jewish Rehabilitation Hospital, Laval, Quebec, CANADA|C. Loo, R. Perrotti, R. Posthuma, A.J. Weng, X. Yang, Physical and Occupational Therapy, McGill University, Montreal, Quebec, CANADA

**ABSTRACT BODY:**

**Purpose/Hypothesis:** Dizziness and imbalance are common symptoms in people with vestibular dysfunction. The use of virtual reality is becoming popular and can target visual desensitization for those who experience increased anxiety and postural instability with moving visual stimulus. Our goal was to investigate if people on the waiting list for vestibular rehabilitation would benefit from a visuolocomotor training program.

**Number of Subjects:** This study recruited 9 adults who were on the waiting list for outpatient vestibular physiotherapy. People who had significant co-morbid conditions or with Paroxysmal Positional Vertigo (BPPV) were excluded.

**Materials/Methods:** The C-Mill (Motekforce Link) is a treadmill (walking area 70 x 300 cm) that offers visual projections and auditory cues for gait training. We custom-designed a training protocol of ten 1-hour sessions, completed over an average of 5 weeks. The protocol consisted of a warm-up, followed by 6 tasks of 3-10 minutes each, ending with a cool-down period off the treadmill. The protocol used programs projected directly on the treadmill, and/or displayed on a large television screen in front of the treadmill.

Outcome measures included the Dizziness Handicap Inventory (DHI), the Visual Vertigo Analogue Scale (VVAS) and the Functional Gait Assessment (FGA). Each subject was assessed 1 week before the intervention, on the first and last session and one week follow-up. At the first session the participant signed an informed consent form and was tested to confirm the absence of BPPV.

**Results:** All but one participants reported symptomatic relief with C-Mill intervention, with 5/9 demonstrating improvement in all 3 outcome measures. There were not any subjects who withdrew from the study or missed scheduled sessions. Based on the DHI at baseline, 3/9 participants were classified as ‘mild’ (0-30), 4/9 ‘moderate’ (31-60), and 2/9 ‘severe’ (61-100). The average improvement from baseline to termination was 36.36% (SD=18.36%), and 42.43% (SD=23.82%) at follow-up. VVAS scores generally corresponded with DHI scores in terms of severity and decreased with C-Mill intervention. The average improvement from baseline to termination was 43.58% (SD=34.90%), and 54.59% (SD=31.95%) at follow-up. All participants demonstrated improvement in postural stability as assessed by the FGA; however, 7/9 had scored above 22/30 at baseline. The average improvement was 21.64% (SD=27.27%) at termination, and 21.89% (SD=33.64%) at follow-up.

**Conclusions:** Most participants benefitted from C-mill training. It is feasible to include a customized training protocol while clients are on waiting list for vestibular rehabilitation.

**Clinical Relevance:** The primary goal of this study was to determine the feasibility of continued research and clinical use of the C-Mill for vestibular rehabilitation. We have shown that, with certain adjustments, this tool can be integrated in a vestibular rehabilitation program.
Purpose/Hypothesis: Stepping training performed at higher intensities (i.e., workload) has been shown to significantly improve walking function in individuals after hemiparesis post-stroke. In intact individuals, training intensity is often estimated using cardiovascular (heart rate; HR) or metabolic measures (maximal O\textsubscript{2} uptake; VO\textsubscript{2max}). In the clinical setting, however, equipment may not be readily available to assess these measures. The rate of stepping (i.e., steps/min) has been used to estimate walking intensity using HR or metabolic equivalent of tasks (METs) in intact adults. Use of stepping rate may facilitate assessment of training intensity in patients post-stroke, although the neuromuscular and cardiorespiratory impairments of this population may alter physiological responses. The goal of the present study was to evaluate changes in stepping rate with cardiovascular and metabolic measures of intensity in individuals with chronic stroke.

Number of Subjects: 28 with chronic stroke, 11 healthy controls

Materials/Methods: Subjects performed a modified graded treadmill test, during which cardiopulmonary/metabolic measures were collected on a breath by breath basis (K4b\textsuperscript{2} Cosmed. Rome, Italy). Subjects also wore validated accelerometers on the ankle of their paretic limb (StepWatch) to estimate stepping rates. During testing subjects walked at 0.1 m/s for 1 min, with speeds increased by 0.1 m/s per min until the test was terminated using established criteria. Rate of stepping (steps/min), HR, and VO\textsubscript{2} were averaged per min, and classified at Light, Moderate (Mod), or High levels of activity by percentage of age-predicted maximum HR (%HR max) and METs in intact adults based on published physical activity guidelines. Unpaired and paired t-tests were used to analyze results with significance determined after Bonferroni correction (p < 0.0041).

Results: For subjects post-stroke, significant differences in steps/min were found between intensities categorized by %HR max and METs between all categories (Light versus Mod versus High). Differences between stepping rate were found for stroke and control groups at Mod and High intensity categorized by %HR max.

Conclusions: Stepping rate increased at higher intensities as categorized by %HR max and METs, suggesting that the use of rate of stepping may be a potential way to differentiate levels of intensity for forward treadmill walking in individuals with chronic stroke. Individuals post-stroke had a decrease stepping rate at Mod and High intensities categorized by %HR max when compared to healthy adults.

Clinical Relevance: Monitoring step rate may be a way for clinicians to assess level of intensity for adults with chronic stroke. Limitations included possible sensitivity error of StepWatch at higher speeds of treadmill walking for healthy adults. Future studies should focus on larger sample sizes and stepping rate at High intensity to further assess differences between healthy adults and patients with chronic stroke.
ABSTRACT BODY:

Purpose/Hypothesis: The purpose of this systematic review is to assess the treatment efficacy of mechanical chair repositioning procedures for Benign Paroxysmal Positional Vertigo (BPPV), and to compare these results to the established efficacy of the manual canalith repositioning procedure.

Number of Subjects: 1409 patients in 9 studies who had confirmed posterior or horizontal canal BPPV and underwent treatment using mechanical chair repositioning procedures.

Materials/Methods: A systematic review utilizing PubMed, CINAHL and Embase was used to identify potential studies. Independent title and abstract reviews were performed by two of the investigators to determine inclusion for full text review. Inclusion criteria were 1) identified posterior or horizontal canal BPPV, 2) treatment with a mechanical chair, 3) resolution of nystagmus or alleviation of symptoms as the outcome measure, and 4) the study was a RCT, case series, retrospective study, or case study. Two different investigators then performed independent full text reviews. Data extraction was performed assessing immediate and long term treatment effectiveness as determined by objective and subjective findings, timing of the post-treatment assessment, and timing of long term follow-up.

Results: Nine studies met the inclusion and exclusion criteria and were used in this review. The immediate post-treatment success rate ranged from 67 to 100%. The success rate, when measured 2 weeks to 6 months after the treatment ranged from 71 to 97.5%. Based on the Oxford Centre for Evidence-Based Medicine criteria, the majority of the included studies were Level III or IV. Based on these results, the overall GRADE score was a C, indicating a weak recommendation for the mechanical chair treatment.

Conclusions: This is the first study to collect and synthesize data from studies assessing the efficacy of mechanical chair treatments for BPPV. Due to methodological differences in the reviewed studies, no direct statistical comparisons between mechanical chair and manual treatments can be made. However, the results in these studies are comparable to the reported 67 to 89% success rate with the manual canalith repositioning procedure. The cost effectiveness of the chair cannot be supported or refuted. Future studies should adopt a standardized treatment protocol, including a control group, established definitions of success, and follow-up time points in order to provide consistency and allow for statistical comparison of the results.

Clinical Relevance: While mechanical chair repositioning procedures have been recommended for patients that are unable to tolerate manual treatments due to frailty, patient size, or complexity, their efficacy as an alternative intervention is not well documented. Based on the results of this review, neither intervention was found to be superior, and no difference in adverse effects between the two can be determined. However, the studies in this review are of low quality, therefore, a recommendation for the use of mechanical chair treatments cannot be made at this time.
Symmetry and smoothness of pedaling improves with increased workloads in individuals with chronic stroke

S. Linder, A.B. Rosenfeldt, A. Bazyk, S. Ozinga, A. Penko, J. Alberts, Biomedical Engineering, Cleveland Clinic, Cleveland, Ohio, UNITED STATES

Purpose/Hypothesis: Individuals post stroke often experience muscle imbalance or asymmetric lower extremity motor control, which can lead to difficulty completing bipedal tasks such as transfers and ambulation. Cycling presents a model to examine phasing, timing, and symmetry of power output of lower extremity (LE) movements in individuals with stroke without the confounding variable of maintaining balance. The aim of this study is to characterize pedaling kinematics during a maximum effort cardiopulmonary exercise test (CPX) in individuals with chronic stroke.

Number of Subjects: Nineteen individuals who experienced an ischemic stroke at least 6 months prior and displayed residual hemiparesis participated in the study.

Materials/Methods: Subjects underwent a CPX on a Lode Excalibur Sport upright stationary bicycle. A continuous incremental protocol was employed starting at 20 Watts (W) and increasing by 20 W every two minutes until achieving 100 W, at which time workload was increased by 40 W every two minutes. Pedaling kinematic data was collected. Symmetry index (SI), a measure of force contribution from the affected and unaffected extremities, and low torque duration (LTD), number of degrees of the pedal cycle where net torque was below ten percent of that revolution’s maximum net torque, were calculated from the torque data. Roughness index (RI), a measure of smoothness, was calculated from the cadence data. Data were compared at three stages: minimal (20W), maximal (the individual’s maximal W), and the middle workload for that individual.

Results: As resistance increased, pedaling became more symmetrical as measured by the SI$_{\text{min}}$ (p=0.04), SI$_{\text{max}}$ (p<0.01), and downstroke SI (p<0.01). In contrast, the affected LE contributed to greater asymmetry on the upstroke (p<0.01). As resistance increased, RI improved from 7.6 to 5.3 to 3.7 at the minimum, middle, and maximum workload, respectively (p<0.01). Similarly, LTD improved from 119.8 to 80.7 to 58.2 degrees at minimum, middle, and maximum workload, respectively (p<0.01).

Conclusions: Pedaling symmetry in individuals with chronic stroke improves as workload increases. By separating the pedaling stroke into a downstroke and upstroke component, we were more accurately able to discern the contribution of the affected and unaffected LE. With increasing workloads, the affected LE produced greater positive torque on the downstroke; consequently, the affected LE also contributed to a greater negative torque on the upstroke.

Clinical Relevance: This study provides important insight to how individuals with stroke respond to increasing workloads, which has important implications for exercise prescription. Increased contribution of the affected LE on the downstroke and upstroke with increasing workloads maybe the result of impaired phasic muscle activation. Cycling is a feasible intervention for individuals post stroke has the potential to play a role in improving symmetry and regaining function with bipedal tasks such as transfers and gait.
Purpose/Hypothesis: Parkinson’s disease (PD) affects the motor component of the CNS with symptoms that may lead to balance impairments and falls. This systematic review aimed to determine which test is the most optimal for assessing fall risk in patients with PD, the Mini-BESTest or Berg Balance Scale (BBS).

Number of Subjects: Six studies were included in this systematic review.

Materials/Methods: The search included PubMed, Cochrane, ScienceDirect, Medline and CINAHL databases; select journals; and hand search of relevant references. We used a combination of keywords such as Parkinson AND postural stability OR instability OR balance impairments AND Diagnostic accuracy OR validity OR psychometric properties. Inclusion criteria: study design had to be prospective longitudinal cohort, published within the last 10 years with participants who had a definitive diagnosis of PD without significant comorbidities that may cause balance impairment and able to walk.

Investigators were randomly assigned to perform searches and review the included studies. The Diagnostic Appraisal Quality Scale (DAQS) was used to assess the study quality.

Results: A total of 213 studies were identified and 6 met the inclusion criteria. Only one study tested patients on and off medication and the remaining studies tested patients on medication. Studies provided data for either 6, 12 months or both. BBS was included in 3 studies (n=342) while MiniBEST was included in 5 studies (n=326). Both tests demonstrated fair to good diagnostic validity reported as sensitivity, specificity, likelihood ratios and area under the curve (AUC). The cutoff scores provided in these studies varied from 47-52 for the BBS and from 16-21 for the MiniBEST.

Conclusions: Both tests appear to be fair to good predictors of fall risk in patients with mild-moderate PD within 6–12 months, however, the prediction is more accurate for 6 months. The lack of a uniform cutoff score creates uncertainty in assigning fall risk for patients with PD.

Compared with the MiniBEST, the BBS ceiling effect makes it more appropriate for patients with lower function. Additionally, the Mini-BEST provides the clinician with assessment of more domains of postural stability. Although these tests may predict falls in patients while on medication, it may be pertinent for future studies to also test patients while off medication, as falls are more likely occur during the off cycle.

Clinical Relevance: Despite the fact that both tests have similar predictive validity, the clinician should consider additional factors, such as ceiling effect of the test, patient level of impairments and domains of postural stability to be examined when choosing the most appropriate test.
TITLE: Comparison of the FGA and DGI in a Community-Based Exercise Program

AUTHORS/INSTITUTIONS: J.F. Greany, K.A. Greany, E. Hussey, Health Professions/Physical Therapy, University of Wisconsin - La Crosse, La Crosse, Wisconsin, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: The Dynamic Gait Index (DGI) and Functional Gait Analysis (FGA) are two outcome-based measures designed to assess a person's ability to modify balance during walking tasks. Both measures are valid, reliable, and easy to use. The goal of this study was to compare the DGI and FGA in a community-based exercise program for adults with neurological disorders.

Number of Subjects: 43 subjects (71.1 years ± 12.1; 19 females, 24 males) with Parkinson's disease, Multiple Sclerosis or other neurological disorders participated in the study.

Materials/Methods: Subjects attended a 12 week physical activity program (2x/week) for 60 minutes. Outcome measures (DGI and FGA) were assessed at baseline and after completion of the program. Additional outcomes measured were the Timed Up and Go (TUG), 5 timed Sit to Stand (5xSTS), and 6 minute walk test (6MWT). Correlation coefficients, effect sizes and paired t-tests were calculated as well as the Minimal Detectable Change (MDC) score.

Results: There was a significant difference in pre/post scores for the FGA (20.1 ± 6.7 to 21.5 ± 5.2) with a medium effect ($d = -0.49$) and no difference for the DGI (18.5 ± 4.5 to 19.4 ± 3.2) with a small effect ($d = -0.38$). There was an excellent association between the DGI and FGA ($r=0.93$). Concurrent validity was examined and both clinical tests were excellent, however, FGA associations were slightly greater than DGI. MDC values were similar between FGA and DGI for subjects with Parkinson's disease (2 points) and slightly greater (4 points) for FGA compared to the DGI (3 points) for subjects with post stroke.

Conclusions: There was excellent concurrent validity between the FGA and DGI with other outcomes measures suggesting that both tests are useful tools for evaluating mobility in persons with neurologic conditions. In this group of participants with neurologic conditions, a significant change in scores was seen in the FGA, but not the DGI, from baseline to completion of the program. The FGA test may be more sensitive to detect smaller changes in abilities with an individualized physical activity program. The scoring for the FGA is more descriptive for ranking the performance. The FGA and DGI both incorporate challenges to walking such as change in speed, head turns, stepping over obstacles, pivoting, and the use of stairs. However, the FGA also includes several additional tasks (walking with decreased vision, a narrow base of support, and walking backwards)

Clinical Relevance: The excellent concurrent validity between the FGA and DGI with other outcomes measures indicate that both tests are useful tools for evaluating mobility in persons with neurologic conditions. However, the FGA test may be more sensitive to detect smaller changes in abilities with an individualized physical activity program.
TITLE: Use of subjective symptoms to diagnose BPPV in an individual with bilateral eye globe removal.

AUTHORS/INSTITUTIONS: J. Jackson, Physical Therapy, Moss Rehab, Philadelphia, Pennsylvania, UNITED STATES

ABSTRACT BODY:

Background & Purpose: Benign paroxysmal positional vertigo (BPPV) is one of the most common forms of vertigo. BPPV presents as a sudden onset of vertigo due to changes in head position. BPPV is generally tested and diagnosed through the Dix Hallpike and/or Roll tests by examining the presence of nystagmus. Observing nystagmus during positional testing is the most common method to identify BPPV but Balatsouras et al, identified a subset of 25% of patients who do not present with nystagmus and report the subjective symptoms of BPPV. The purpose of this case study is to describe the use of subjective report in the absence of nystagmus to determine the presence of BPPV.

Case Description: The patient was a 28 year old male presenting to inpatient rehab 10 days status post gunshot wound to the face and left thigh resulting in bilateral globe ruptures and facial fractures, with concomitant traumatic brain injury. Bilateral evisceration was performed to both eyes with implants placed and eyelids sewn shut. During a treatment session the patient presented with complaints of dizziness and “feeling as if the room is spinning” while rolling on the mat. The symptoms were reproduced with subsequent rolling to the left and right, each time with symptoms lasting for less than 1 minute.

Outcomes: The Dix Hallpike was performed to the right side due to the greater complaint of dizziness when rolling to the right; subjective report was used to determine results of testing. The patient reported symptoms within 5-10 seconds of being lowered into the Dix Hallpike position demonstrating a latency. The patient’s symptoms lasted for <30 seconds before stating that the feeling of dizziness had passed. Canalith repositioning treatment (CRT) was performed for right canalithiasis three times total during the treatment session with no reports of dizziness during the final CRT. Dix Hallpike was performed the next day to the right side with the patient stating no subjective reports of dizziness. Dix Hallpike was performed on the left side with a latency of 5 seconds and subjective report of dizziness lasting <30 seconds. CRT was performed for left canalithiasis two times with no report of dizziness during the final test. Roll test was performed with the patient stating no reports of dizziness. The left Dix Hallpike was reassessed the next day with no subjective report of dizziness.

Discussion: Subjective symptoms alone were successfully used to determine presence of BPPV in this patient for whom nystagmus was not possible to assess. Following determination of BPPV the patient was treated with CRT resulting in a resolution of symptoms. The findings of this case study demonstrate that BPPV can be appropriately assessed without the need to observe nystagmus in patients that can accurately report symptoms. The use of subjective symptoms was effective in this case, but there are few studies that have studied BPPV solely based on subjective symptoms. More research needs to be performed in this area to determine treatment results of those presenting with purely subjective BPPV.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: Balatsouras, D.G., Korres, S.G. (2012). Subjective benign paroxysmal positional vertigo. Otolaryngology Head and Neck Surgery, 146(1), 98-103.

AUTHORS/INSTITUTIONS: D. Chamberlain, C. Bradley, S. Hansen, C. Johnson, N. Reber, DPT, Franklin Pierce University, Hesperus, Colorado, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Post treatment guidelines for BPPV are a topic of debate and ongoing research. According to a recent survey distributed to members of the Vestibular Rehab Special Interest Group of the APTA Neurology Section and the American Balance Society, over 75% of practitioners recommended post treatment restrictions at least occasionally. Research to resolve this debate in the vestibular rehabilitation community has yielded mixed results. The purpose of this systematic review was to determine if postural and activity restrictions are more beneficial than no post treatment restrictions following canalith repositioning treatment for BPPV.

Number of Subjects: N/A

Materials/Methods: A comprehensive electronic search of literature from January 2005 to January 2016 was performed using the following databases: PubMed, CINAHL, MEDLINE, and Google Scholar. Search terms included "epley" OR "benign paroxysmal positional vertigo" OR “BPPV” OR “canalith” OR “semont” AND “restrictions”. Abstracts of articles were reviewed for relevance. References in articles were manually searched for additional articles. Articles were then examined for inclusion and exclusion criteria. The PEDro scale was used to determine the quality of the studies.

Inclusion criteria included: Patients must be clinically diagnosed with BPPV, intervention for BPPV must be a repositioning maneuver, group comparison must be between those receiving post maneuver restrictions and those receiving no restrictions, and studies must be randomized controlled trials (RCTs). Exclusion criteria included: Published before January 2005, non peer-reviewed, case studies, retrospective studies, meta-analyses, cohort studies, and PEDro scores <4/10.

Results: Eleven articles were selected for analysis, yeilding an average PEDro score of 5/10, and a total of 1,296 patients from all studies. Multiple outcome measures were utilized, including the Dix-Hallpike maneuver, the visual analog scale (VAS), head dizziness index (HDI), vertigo scale, and subjective patient report.

No statistical differences were found on recurrence of BPPV between restriction and no restriction groups. Comparisons of postural restrictions used between studies was difficult due to the variability of duration, type, and amount of restrictions prescribed. Patients given restrictions (cervical collar, sleeping position) often reported discomfort, sleep disturbances, and restrictions in ADL.

Conclusions: According to the results of this systematic review, there are no statistically significant benefits in prescribing postural and activity restrictions following canalith repositioning maneuvers for the treatment of benign paroxysmal positional vertigo. Future research is recommended however due to systematic review limitations including the wide variety of outcome measures and types of restrictions used between studies.

Clinical Relevance: As activity and postural restrictions do not appear to increase the efficacy of repositioning maneuvers for patients with BPPV and in fact may increase patient discomfort and decreased function, they are not recommended.
TITLE: Feasibility of a Carepartner Integrated Telehealth Rehabilitation Program for Persons with Stroke: A Case Series

AUTHORS/INSTITUTIONS: S. Blanton, Rehabilitation Medicine, Emory University, Atlanta, Georgia, UNITED STATES|S. Dunbar, Nell Hodgson Woodruff School of Nursing, Emory University, Atlanta, Georgia, UNITED STATES|P.C. Clark, Byrdine F. Lewis School of Nursing and Health Professions, Georgia State University, Atlanta, Georgia, UNITED STATES|

ABSTRACT BODY:

Background & Purpose: Stroke is a leading cause of adult disability and creates significant family strain. Family members are a key component in stroke recovery, but they frequently experience high levels of burden, including increased anxiety, depression and social isolation when they assume the role of carepartner. The objective of this study is to evaluate the feasibility and acceptability of a novel, carepartner focused intervention (CARE-CITE) designed to foster problem solving and skill building while facilitating carepartner involvement in the application of constraint-induced movement therapy (CIMT) for the upper extremity. This psycho-educational intervention is structured to provide general stroke recovery content and enhance the home-based application of CIMT by teaching the carepartner ways to foster a more therapeutic, autonomy-supportive environment (characterized by empathy, problem-solving, choice and reduction of controlling language). The central hypothesis underpinning this research is that a theory-based, carepartner-centered intervention focused on skill building and problem-solving will improve stroke survivor physical function while reducing carepartner negative outcomes and increasing accessibility of participation.

Case Description: Six female carepartners of patients with stroke, mean age 64 years old (range 54-74), reviewed the CARE-CITE intervention (6 education modules) in the home environment through an electronic tablet or personal computer. Carepartners rated each module for usefulness, ease of use, acceptability, and time to complete. Four expert rehabilitation researchers (physical therapist and nurses) also evaluated the CARE-CITE intervention for accuracy, feasibility, acceptability, problem relevance and ease of use.

Outcomes: Carepartner satisfaction ratings were assessed using a 5-point Likert-type response scales ranging from 1=strongly disagree to 5=strongly agree. On average, all CP agreed or strongly agreed that the modules were useful (4.42), easy to use (4.60) and acceptable (4.41). Mean total satisfaction score was 4.45, and average review time was 15 minutes per module. Expert reviewers agreed or strongly agreed that each module was accurate (4.95), feasible (4.8), easy to use (4.86) acceptable (4.96) and had appropriate problem relevance (4.65).

Discussion: The outcomes from the feasibility assessment of this case series suggest that the CARE-CITE intervention may be a viable educational program for carepartners of patients with stroke. Currently a randomized control trial is underway to evaluate the impact of the intervention on carepartner mental health, family conflict around stroke recovery and stroke survivor upper extremity function. The overall significance of this research plan is to increase understanding and further development of interventions in rehabilitation to foster family involvement in the rehabilitation process and to promote more integrative therapy strategies throughout physical therapy practice.


Harris JE, Eng JJ, Miller WC, et al. The role of caregiver involvement in upper-limb treatment in individuals with

The relationship of ankle and foot sensation to functional gait performance.

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Purpose/Hypothesis: Somatosensory information from the foot is critical to human balance control. However, the relationship of individual sensory inputs to gait performance and postural control is not clear. The purpose of this study is to examine the relationship of ankle and foot sensation (vibration threshold, tactile sense, and ankle joint position sense) to gait/balance performance.

Number of Subjects: 45 healthy adults with right leg dominant (Age: 45 ± 23 yo; 14 male)

Materials/Methods: All participants were screened prior to data collection. Participants were excluded from this study if they presented with abnormal findings upon neurological exam, had a positive Dix-halpike and roll test, and scored less than 19 in the Dynamic Gait Index, 21 in Functional Gait Index, and less than 67% in the Activities-specific Balance Confidence scale (ABC). A handheld bio-thesiometer (Bio-Medical Instrument Co, Newbury, Ohio, USA) and a set of monofilaments (Touch-Test Sensory Evaluator, North Coast medical Inc., Morgan Hill, CA) were used to measure the vibration threshold (VT) and tactile sensitivity (TS), respectively. Vibration threshold and tactile sensitivity were measured at six different sites on the plantar surface, including big toe, 1st metatarsus, little toe, 5th metatarsus, middle arch, and calcaneus (heel), plus the lateral and medial malleoli. Ankle joint position error (JPE) was tested by using an isokinetic dynamometer (CSMI Cybex Norm, CSMI, Boston, MA) for both dorsi-plantar flexion (DF) and inversion-eversion (IE). Subjects also performed a Sensory Organization Test (SOT) (Neurocom Clackmas, OR, USA) following the sensory tests. A composite score for both VT and TS was determined by averaging measures across all sites tested. Similarly, a composite score for JPE across was calculated by averaging measures across both conditions. Linear regressions were used to examine the relationship between foot sensations (composite score of VT, TS and JP), and the functional gait performance (DGI & FGA score) and fear of falling (ABC scale).

Results: Separate linear regressions were performed to predict DGI, FGA and ABC based on composite VT, TS and JP scores. Significant regression were found (F(3,42)=7.56, p < .001), with an R² of .36 for DGI and (F(3,42)=3.95, p < 0.05), with an R² for .22 for FGA. Only VT composite score was a significant predictor for DGI (Beta = -.60, p < .001) and FGA (Beta = -.46, p < .01). No significant regression was found for ABC.

Conclusions: Vibration threshold was identified as a key predictor of both the DFI and FGA, but not for the confidence to perform activities. Our results suggested that vibration threshold may provide critical sensory for the maintenance of dynamic postural control and function. Further study with a larger sample size is needed to enable subgroup analyses and determine site-specific contributions of the foot to gait performance.

Clinical Relevance: To the extent that vibration threshold is related to fall risk, screening and intervention to enhance vibration sense may be beneficial for fall risk prevention and intervention.
**Title:** Exploring the relationship between disease severity, executive function, and a dual task paradigm in people with Parkinson’s disease

**Authors/Institutions:** C.M. Criminger, C. Swank, Texas Woman’s University, Dallas, Texas, UNITED STATES

**Abstract Body:**

**Purpose/Hypothesis:** Walking requires motor skill and executive function to negotiate the environment; of which both are progressively impaired in people with Parkinson’s disease (PD). Dual task gait paradigms attempt to assess this motor-cognitive interplay during walking. The purpose of this study was to explore the relationships between motor impairment, executive function, activities of daily living, and dual task gait in people with PD.

**Number of Subjects:** 36

**Materials/Methods:** Thirty-six individuals with PD were assessed on motor impairment [United Parkinson’s Disease Rating Scale, motor section (UPDRS III)], executive function [Repeatable Battery for the Assessment of Neuropsychological Status (RBANS)], daily function [Schwab & England (S&E) ADL scale] and dual task gait [Timed Up and Go (TUG) with manual and cognitive distractors]. Relationships were analyzed by Pearson product-moment correlation coefficient and stepwise multiple linear regression.

**Results:** Participants [UPDRS III, $M=26.28$ RBANS, $M=85.69$ (18$^{th}$ %ile), S&E, $M=80.83\%$] averaged 13.89±10.76 seconds and 15.40±10.96 seconds on the TUG manual and TUG cognitive respectively. The RBANS total and subscale scores (immediate memory, visuospatial/constructional, language, attention, delayed memory) were poorly related to both the TUG manual ($r = -0.052$ to -0.312) and TUG cognitive ($r = -0.035$ to -0.277). There was a moderately strong relationship for TUG manual and UPDRS III ($r = 0.485$) and S&E ($r = -0.15$) and between TUG cognitive and UPDRS III ($r = 0.489$) and S&E ($r = -0.621$). Only the UPDRS III was predictive of TUG manual performance ($R^2 = 0.275; F_{(1,34)} = 12.89$) and S&E of TUG cognitive performance ($R^2 = 0.385; F_{(1,34)} = 21.29$).

**Conclusions:** Both motor impairment (UPDRS III) and daily function (S&E) contributed to deficits in dual task gait performance. However, in our sample of people with PD executive function as assessed by the RBANS did not appear to contribute to dual task gait performance. Considering our sample scored in the 18$^{th}$ percentile for executive function, perhaps the RBANS and subscales measure different aspects of executive function than required during dual task gait paradigms.

**Clinical Relevance:** Motor impairment and daily function only partially account for the dual task gait performance. Though executive function likely contributes to motor-cognitive interplay in dual tasking, clinicians may find it useful to measure executive function using various methods.
Background & Purpose: Balance disorders are the second most common complaint in patients that have sustained traumatic brain injuries (TBI). Early balance dysfunction in patients post-TBI has been correlated with delayed functional recovery. In the balance and vestibular population, vestibulo-ocular reflex (VOR) training has been shown to improve gaze stability and postural control. The purpose of this case report is to explore a patient’s neurologic and vestibular presentation following TBI, provide rationale for the interventions chosen, and discuss the patient's outcomes following a course of customized vestibular and balance rehabilitation.

Case Description: The patient was a 20-year old male with mild TBI (GCS 13) after his second motor vehicle accident within a year. He presented with impaired static and dynamic standing balance, abnormal gaze stability, below average use of vestibular cues for balance, and impaired cervical kinesthesia, which contributed to decreased independence with functional tasks and mobility. Treatment included gaze stabilization training during static and dynamic standing balance tasks, cervical joint position awareness training, and eyes closed standing balance on compliant surfaces. The patient received this intervention for 60 minutes daily across four consecutive days. Standardized assessments pre- and post-training included: Berg Balance Scale (BBS), Dynamic Gait Index (DGI), Dynamic Visual Acuity (DVA), Sensory Organization Test (SOT), and cervical Joint Position Error test (JPE).

Outcomes: Following four days of customized vestibular and balance rehabilitation, with emphasis on the aforementioned impairments, the patient demonstrated improvements in static and dynamic balance, increased use of vestibular input for balance, and improved cervical kinesthesia. He showed meaningful change by surpassing the MDC/MCID’s for the following outcome measures: BBS increased from 50 to 55/56, DGI increased from 14 to 20/24, SOT composite score increased from 71 to 82, and cervical JPE reduced by 40%. Additionally, he had an approximate 25% increase in use of vestibular cues for balance.

Discussion: With customized vestibular and balance rehabilitation, the patient showed improvements in cervical repositioning accuracy, static balance, and dynamic balance. It is likely that such significant improvements made over such a short period of time can be attributed to experience-dependent neuroplasticity, with particular emphasis on the specificity of interventions chosen, the intensity with which they were prescribed, and the amount of repetition with which the patient performed the activities. This case demonstrates that, even with a relatively short intervention period, vestibular and balance rehabilitation that is tailored specifically to the patient’s deficits can produce meaningful change. Future research should explore other cases where interventions were applied over a short period of time, and may include indicators of which exact intervention included in the above plan of care may be the most effective.

TITLE: Changes in gait kinematics during the Two Minute Walk Test under dual task conditions in individuals with Parkinson’s disease

AUTHORS/INSTITUTIONS: A.B. Rosenfeldt, A. Penko, T. Dey, A. Bazyk, M.C. Streicher, J. Alberts, Cleveland Clinic, Cleveland, Ohio, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Activities of daily living often require the ability to dual task (DT), or simultaneously perform two attention-demanding motor or cognitive tasks. Under DT constructs, individuals with Parkinson’s disease (PD) typically exhibit a “posture second” strategy, where inadequate attention is allocated to gait and postural stability when challenged with a secondary task. The purpose of this study was: 1) To compare the distance covered in an over ground Two Minute Walk Test (2MWT) under single task (ST) and DT conditions in individuals with PD; 2) To characterize changes in gait parameters observed during ST and DT conditions using a three-dimensional biomechanical gait analysis under similar conditions.

Number of Subjects: Twenty-three subjects, mean age 63.7±7.0 years, diagnosed with idiopathic PD participated in this observational study.

Materials/Methods: Individuals with idiopathic PD performed the 2MWT under the following conditions: 1) Over ground walking alone (2MWT<sub>ST</sub>); 2) Serial 7s (2MWT<sub>COG</sub>); 3) Holding a cup of water (2MWT<sub>MOTOR</sub>). The 2MWT<sub>ST</sub> and 2MWT<sub>COG</sub> were then performed on the Computer Assisted Rehabilitation Environment (CAREN) system, a virtual reality system with a fully integrated three-dimensional motion capture and a self-paced treadmill system.

Results: There was a significant difference in over ground distance walked between the 2MWT<sub>ST</sub> (518.7 ± 85.2 ft.) and 2MWT<sub>COG</sub> (432.3 ± 98.2 ft.) (p<0.001) and between the 2MWT<sub>ST</sub> and 2MWT<sub>MOTOR</sub> (467.7 ± 76.4 ft.) (p=0.002). Individuals walked similar distances during the 2MWT<sub>ST</sub> and 2MWT<sub>COG</sub> on the CAREN system (p=0.59, 0.58, respectively). During the 2MWT<sub>COG</sub> individuals displayed a significant decrease in arm swing, velocity, cadence, step length, and a significant increase step width (p<0.05) as determined by the CAREN gait analysis.

Conclusions: Individuals with PD ambulate similar distances overground and on a self-paced treadmill. On both mediums, participants walked a significantly shorter distance during the 2MWT under DT conditions. The difference can be attributed to changes in gait parameters such as velocity, cadence, and step length.

Clinical Relevance: By identifying gait parameters that are associated with DT loss, therapists may be able to provide more targeted treatments to improve gait performance. Being able to link overground and treadmill training is useful as the treadmill is a commonly used intervention in rehabilitation settings.
TITLE: One trial learning of elbow movements in people with chronic stroke: Influence of spasticity zones.

AUTHORS/INSTITUTIONS: S. Subramanian, Physical Therapy, University of Texas Health Science Center at San Antonio, San Antonio, Texas, UNITED STATES|A.G. Feldman, Neurosciences, Université de Montréal, Montreal, Quebec, CANADA|S.O. Therapy, School of Physical and Occupational Therapy, McGill University, Montreal, Quebec, CANADA|

ABSTRACT BODY:

Purpose/Hypothesis: The ability of people to re-learn motor tasks after stroke involving the more-affected spastic upper limb (UL) is an essential component of motor recovery. The studies involving the more-affected side have failed to account for the presence of angular zones in which spasticity interferes with movement production. Previous studies have identified deficits in the ability of patients with stroke to regulate motoneuronal thresholds throughout the whole biomechanical range of the elbow, resulting in angular zones in which muscles cannot be deactivated (spasticity zones). The influence of spasticity zones on motor learning was investigated by comparing the adaptation of elbow movement to a new load within and outside identified spasticity zones. We hypothesized that the ability to learn UL movement may be influenced by the presence of spasticity zones.

Number of Subjects: 12 subjects with stroke, 8 controls

Materials/Methods: Subjects with stroke (Fugl-Meyer scores:21-62/66) and age-matched controls made rapid 50° horizontal elbow extension movements from an initial 3° to a final 6° target. Sixteen blocks of 6-10 trials each were practiced in 1 (control subjects) or 2 sessions (stroke subjects; 1 week apart). In Session 1 (control and stroke), movements were made in mid joint range (spanning spasticity zones) and in Session 2 (stroke), movements were restricted to a joint range that did not involve the spasticity zone. Spasticity zones in stroke subjects were identified by estimating the threshold joint angles at which stretch reflex responses occurred in elbow flexors despite the instruction to relax muscles and not to intervene. In each block, movements were alternatively not loaded or loaded by a position dependent load (30% MVC at the final position). Subjects were instructed to extend the elbow to the final target in a single fast and accurate movement and to correct movement errors as soon as possible. Visual feedback of elbow position and speed was provided. Error correction strategies were identified by the angular positions before correction and were compared between groups and sessions.

Results: In Session 1, error correction ability significantly differed between subjects with stroke (correction in 1-4 trials) and controls (correction in 1-2 trials). For the same stroke subjects, the number of trials needed to correct errors significantly improved, with the majority needing only 1-2 trials in Session 2.

Conclusions: Results suggest that spastic resistance of the muscles may influence the ability to display behavioral improvement in people with stroke. The presence of spasticity zones may confound the interpretation of motor learning studies and lead to the erroneous conclusion that the patient has deficits in motor learning when only muscle activation/relaxation is the problem.

Clinical Relevance: The presence of spasticity zones should be accounted for during therapy prescription for patients and may help in the development and implementation of personalized rehabilitation programs.
Purpose/Hypothesis: Falls are a serious public health issue for the elderly. Falls are the leading cause of death from injury among older adults, and cost the United States’ healthcare system over $30 billion dollars a year. There is evidence to support that falls prevention programs (FPP) reduce fall risk, however most older adults are not given information about reducing fall risk, and many do not participate in prevention programs. Studies to determine barriers and facilitators to older adult participation in FPP have been conducted outside the US, however, there is a lack of research on these factors for elders in the US. The purpose of this study was to determine community dwelling older adults’ perceived barriers and facilitators for participating in a FPP in the US. This data can be used to develop future programs that will be more accessible to seniors, and therefore increase the likeliness of participation so that risk can be reduced.

Number of Subjects: Twenty one participants (n=21), community dwelling adults aged 55 years and older, were recruited from a senior housing center and a senior center in the Boston area.

Materials/Methods: Participants voluntarily completed an anonymous survey created by the investigators. The survey questions included information regarding age, fall history, past participation in FPP, and perceived barriers and facilitators for participation. Responses were recorded in Excel, and descriptive statistics used to rank order responses in terms of frequency.

Results: Nine out of 21 participants, or 43%, reported a fall within the last year. Only 5 subjects (24%) stated that they had received information on how to reduce risk of falls in the past. The most common barriers identified among respondents in order of frequency were: (1) a lack of transportation (62% of participants), (2) cost of programs (52%), and (3) language barrier (48%). The most frequently endorsed facilitators to participation cited by participants were: (1) proximity of program to home (81%), (2) class time of one hour or less (71%), and (3) free/no cost to participate (67%).

Conclusions: It is imperative that effective FPP be designed and offered to community dwelling older adults in the US to reduce fall risk. The data from this study suggests that FPP should be offered close to seniors’ homes or provide transportation, and should be offered for free or at a very low cost to encourage participation. Additionally, classes should be offered in multiple languages, and individual class times should be limited to one hour or less.

Clinical Relevance: Health professionals must routinely provide education and interventions to older adults regarding fall risk. Programs are being offered to community dwelling older adults in the US more frequently than in the past, yet participation rates remain low. The perceived barriers and facilitators to attendance must be addressed to encourage greater participation, reduce morbidity and mortality, improve quality of life, and lower the burden of healthcare costs associated with falls.
Step by Step - Stair Training in a Patient with Chronic Stroke: A Case Report

K. Garrett, K. Mallini, Physical Therapy, University of St. Augustine for Health Sciences, St. Augustine, Florida, UNITED STATES

Background & Purpose: Recovery of walking after a cerebrovascular accident (CVA) is a primary rehabilitation goal and an indicator of functional independence. Stair training has been shown to improve lower extremity strength, step length and reduce fall risk in individuals with chronic CVA. Changes in gait speed and endurance which are important for community ambulation, have not been well documented in the literature. The purpose of this case report is to describe the use of stair training as an intervention to improve gait speed, endurance, and balance in a patient with chronic CVA.

Case Description: The patient was a 79 year old male who suffered a right CVA four years prior and presented to outpatient physical therapy with persistent gait dysfunction, balance impairments, poor strength, endurance and back pain. He was limited in performing daily activities and participating safely in the community. Strength testing revealed residual weakness throughout the left lower extremity including the hip and knee flexors and extensors. He ambulated with a single point cane and demonstrated left circumduction and hip hiking during swing phase. He required moderate assistance to negotiate stairs. In addition to traditional physical therapy, a stair training regimen was implemented 2 times per week for 7 weeks. Throughout the intervention, a reciprocal gait pattern was used and assistance was provided by the physical therapist as needed.

Outcomes: Post-test assessment performed at discharge revealed that the 10 Meter Walk Test (10 MWT) improved from 0.23 m/s to 0.29 m/s. The 6 Minute Walk Test (6 MWT) improved from 43.28 meters with a single point cane to 145.09 meters without an assistive device. Patient confidence on the Activities-specific Based Confidence (ABC) Scale improved from 50% to 81.3%. The Berg Balance Scale (BBS) score improved from 31/56 to 52/56, indicating low fall risk. In addition, the patient was successfully able to negotiate thirteen stairs with a reciprocal gait pattern and supervision assist. The greatest improvement was noted to be the 6 MWT by the distance covered as well as the ability to perform the activity without his cane.

Discussion: Gait, endurance, balance and confidence all improved over the course of physical therapy. There were minimal clinically important differences (MCID) with the 6 MWT and the BBS. The 6 MWT and the BBS also met the minimal detectable change (MDC). Additionally, there was a small meaningful change in the MCID with the 10 MWT. The outcomes in this case report suggest that stair training may be a viable intervention to make meaningful changes in function and participation for patients with chronic stroke.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.


TITLE: Long-Term Robotic-Assisted Gait Training Effects on Hip Stiffness and Kinematics in Hemiparetic Stroke

AUTHORS/INSTITUTIONS: J. Park, S. You, Physical Therapy, Yonsei university, Wonju, KOREA (THE REPUBLIC OF)|Y. Shin, M. Park, Department of Rehabilitation Medicine, Pusan National University School of Medicine, Busan, KOREA (THE REPUBLIC OF)

ABSTRACT BODY:

Purpose/Hypothesis: Walkbot Robotic-Assisted Gait Training (RAGT) has recently gained widespread acceptance among neurorehabilitation clinicians because it renders superior advantages of an intensive, repetitive, resistive, fun, task-specific gait training paradigm with comparable results to conventional stroke rehabilitation. The present study was to investigate the long-term effect of Walkbot RAGT on hip joint stiffness kinetics, kinematics, and clinical function characteristics in spastic hemiparetic stroke. We hypothesized that Walkbot RAGT would influence on hip joint stiffness, kinematics, and clinical function characteristics in spastic hemiparetic stroke.

Number of Subjects: 16

Materials/Methods: A total of 16 adults with hemiparetic stroke underwent progressive, Walkbot RAGT (40 minutes) combined with the conventional physical therapy (40 minutes) for 5 days per week over an average of 43 sessions for 8 weeks. Clinical outcomes included Functional Ambulation Category (FAC), modified Rankin scale (MRS), Korean version of the modified Barthel index (K-MBI), modified Ashworth scale (MAS), and hip joint kinematics, kinetics, and stiffness before and after intervention.

Results: After the intervention, the Wilcoxon signed-ranks test showed significant effects of FAC, MRS, and K-MBI ($P < 0.05$). The maximal hip flexion angle showed significant improvements in the paretic ($P=0.004$) and non-paretic leg ($P=0.013$). No changes were observed on MAS in the paretic knee and ankle joint. The maximal hip joint extension in the paretic leg was increased, but did not reach statistically significant $P$ values. The active torque ($P=0.000$), resistive torque ($P=0.001$), and stiffness ($P=0.001$) in the paretic leg improved significantly.

Conclusions: Walkbot RAGT is important additional treatment to improve the torque of volitional movement associated with spasticity in individuals with hemiparesis. Our findings might be useful for selecting treatment for increased hip joint stiffness in individuals with hemiparesis.

Clinical Relevance: The results suggest that Walkbot RAGT is safe and effective for relearning gait pattern and help to restore functional movement independence in stroke neurorehabilitation.
Title: Development and outcomes of a community-based golf and exercise program for people with Parkinson’s disease

Authors/Institutions: M.F. Veltman, Rehabilitation Services, Norton Healthcare, Louisville, Kentucky, United States | E. Ulanowski, M. Danzl, Bellarmine University, Louisville, Kentucky, United States

Abstract Body:

Purpose: The purpose of this special interest report is to describe the development, implementation, and outcomes of a novel and innovative community-based golf and exercise program for individuals with Parkinson’s disease (PD).

Description: An estimated one million people in the United States are diagnosed with PD (male:female ratio of 1.5:1 and >90% are over 50 years old). Over 75% of golfers are men with 61% of golfers over the age of 50. Exercise improves quality of life (QOL) in people with PD and exercise improves golf performance in the general population. Research has yet to examine the effect of a community-based golf and exercise program for individuals with PD.

Summary of Use: The expressed needs of individuals with PD in the community served as the impetus for the creation of a community-based golf and exercise program. The unique combination of expertise from physical therapists and golf professionals supported development of a program to enhance golf skills while meeting the specific needs of those with PD from the perspective of movement systems specialists. The program consisted of a 6 week golf and exercise program with one 90 minute session/week. The first 5 weeks included: 1) golf instruction led by a golf professional and 2) exercise led by a physical therapist to address the task-specific movements of golf and deficits associated with PD. The sixth and final week included a warm-up and golf scramble to allow participants to socialize and apply the skills they had learned. Pilot data for the 6-week clinic includes pre- and post-measures relating to QOL (PD Questionnaire-39) and golf performance (driving distance and club head speed) for 8 participants. Statistical significance was not reached, likely due to sample size and the absence of normative values related to golf in this population, however, improvements were noted in QOL, average driving distance, and average club head speed for 7 of 8 participants. Resources that enabled successful implementation included a golf course willing to participate in the program and sponsorship by a local healthcare organization’s resource center to cover expenses and assist with marketing and contacting participants. Additionally, 5 Doctor of Physical Therapy (DPT) students volunteered to support and assist participants.

Importance to Members: This is the first report to describe and examine a community-based program integrating golf instruction with exercise for individuals with PD. This program was designed from current evidence and inspired by individuals with PD who served as catalysts to its creation. Involving DPT students is paramount to educating the next generation of practitioners about the value of interprofessional collaboration and moving therapy beyond the walls of the clinic. Descriptions of the design, implementation, and outcomes of this program, as well as reflections regarding potential limitations and future recommendations, are presented to empower physical therapists who are interested in developing this type of program in their local communities.

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ABSTRACT BODY:

Background & Purpose: The use of non-invasive neuromuscular electrical stimulation (NMES) and/or manual therapy to treat respiratory dysfunction in patients has not been well documented in the literature. The purpose of this report is to discuss potential benefits of neurofeedback re-training respiratory muscles through NMES and manual therapy to improve symptoms and increase function.

Case Description: A 57 year old male with stenosis from C4-7 and central cord syndrome status post traumatic SCI, presented with a left-sided elevated hemidiaphragm (EHD). The left median and ulnar nerve somatosensory evoked potentials (SEPs) were absent post injury and no effusions were noted on ultrasound. Second day post injury, the patient underwent C3-7 laminectomy, C3-T1 posterolateral instrumentation and arthrodesis with use of an autograft. Upon admission to acute inpatient rehabilitation, the lungs were clear to auscultation with no wheezes, rales or rhonchi, no noted coughing, or hypoxemia throughout stay. After one month, the patient first reported symptoms of dyspnea following prolonged upright sitting. The patient received NMES below bilateral 10th ribs, combined with timed manual diaphragm release technique (DR) for three sets of 10 repetitions with a one minute interval rest.

Outcomes: Resolution of dyspnea was reported by the patient after the initial treatment. After nine days and four treatments, the patient was able to use the incentive spirometer with a 500mL increase. Radiologic film showed a significant decreased left-sided EHD. The patient’s Functional Independence Measure (FIM) scores for transfers and walking improved from a score of 1 to 3 and from a 0 to 4 after six weeks of inpatient rehabilitation, respectively.

Discussion: Diaphragm involvement post cervical injury may be overlooked, but it can be directly addressed with neuro/musculoskeletal interventions to aid in pulmonary and functional recovery. A novel treatment targeting the diaphragm through NMES and manual techniques such as DR, may be a safe and effective treatment for patients with dyspnea and EHD. A systematic investigation is needed to examine the individual effectiveness of each modality.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: 1. Rocha, T., Souza, H., Brandão, D. C., Rattes, C., Ribeiro, L., Campos, S. L., ... & de Andrade, A. D. (2015). The Manual Diaphragm Release Technique improves diaphragmatic mobility, inspiratory capacity and exercise capacity in people with chronic obstructive pulmonary disease: a randomised trial. Journal of physiotherapy, 61(4), 182-189.


TITLE: Examination of Perceived vs. Actual Weight and Height of Full-Time Wheelchair Users

AUTHORS/INSTITUTIONS: E. Meade, R.M. Brown, Hearing and Speech Sciences, Pi Beta Phi Rehabilitation Institute, Vanderbilt University Medical Center, Nashville, Tennessee, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Accurate weight and height measures are important for implementing screening and health interventions, especially in individuals with disabilities. However, it is often difficult to obtain accurate weights in this population, as they may be unable to use a traditional scale. The purpose of this study was to examine differences in full-time wheelchair users’ actual, self-reported and previously recorded height and weight.

Number of Subjects: Fifty three full-time wheelchair users were recruited from the Adult Seating and Mobility Clinic. Inclusion criteria included being at least 18 year old, the ability to communicate and provide consent, and the ability to transfer during the evaluation.

Materials/Methods: Single group, cross-sectional design was used. Participants completed a survey of self-reported height and weight, length of time using a wheelchair and attitudes towards health and health advocacy. Patients were weighed using either a wheelchair scale or a Hoyer lift scale and height was recorded to determine accurate measurements. Electronic medical records (EMR) were analyzed to determine most recent height and weight records.

Results: There were no statistically significant differences in patient’s measured weight, self-reported weight, and the weight recorded in the EMR. The average of the absolute value of the difference between patients’ self-reported weight and actual weight was 9.94 pounds. This difference may contribute to decreased accuracy of medical interventions and decreased quality of care. 64% of subjects underestimated their weight. The average reported length of time since the patient last knew their accurate weight was 65.59 weeks and the average length of time since weight was recorded in the patients’ electronic medical record was 41.20 weeks with a max of 268 weeks. 33% of patients reported their health was poor to fair, while 67% reported their health was good to excellent. 47% of subjects did not express any ideas of how to use their accurate height or weight information. 19% of subjects reported they would talk to their doctor about their weight.

Conclusions: Full-time wheelchair users go long periods, up to a year or more, without being weighed or having their height measured. These individuals frequently have chronic health conditions and take numerous medications. Physicians often prescribe interventions and medication dosages based on patient’s height and weight. Basing medical decisions on dated measurements in the EMR or underestimated self-reporting can negatively impact patient health. Additionally, many patients did not know what to do with their accurate height or weight, suggesting that this population may benefit from education concerning weight management and health advocacy.

Clinical Relevance: To optimize patient care and health outcomes, full-time wheelchair users require access to being weighed on a regular basis. The EMR should reflect accurate anthropomorphic measurements. Physicians should be aware that this population tends to underestimate their weight. This population may also benefit from education on weight management.
**Title:** Examination of Vestibulo-Ocular Dysfunction and Recovery in Adolescent and Collegiate Athletes Post-Concussion: A Case Series

**Authors/Institutions:** K.N. Stone, D.J. Lott, S.Z. Sutton, Physical Therapy, University of Florida, Lakewood, Colorado, UNITED STATES

**Abstract Body:**

**Purpose/Hypothesis:** The primary objective of this study was to determine if baseline vestibulo-ocular dysfunction was correlated with prolonged recovery in adolescent and collegiate athletes post-concussion and to assess whether targeted physical therapy interventions were associated with improvements in objective measures over the course of treatment. A secondary objective was to evaluate the relationship between vestibulo-ocular deficits and self-reported symptoms in this population.

**Number of Subjects:** 8

**Materials/Methods:** Data was collected for eight athletes (age 17.3 ± 3.7 years) diagnosed with a sports-related concussion over a 12-week period at two outpatient physical therapy clinics. Participants were included based on the presence of vestibulo-ocular dysfunction at initial evaluation. Selected outcome measures included the King Devick Test, Post-Concussion Symptom Scale (PCSS), near-point convergence (NPC), self-paced saccades, and vestibulo-ocular reflex testing.

**Results:** The change in King Devick scores across treatment was strongly correlated with recovery time. King Devick scores at initial evaluation and change in vertical saccade scores across treatment were moderately correlated with recovery time. There was a significant improvement from initial evaluation to discharge in all vestibulo-ocular outcome measures as well as the number of symptoms and symptom severity scores on the Post Concussion Symptom Scale.

**Conclusions:** Greater improvements in King Devick test scores across treatment may be associated with shortened recovery time frames after a concussion. Higher King Devick test scores at initial evaluation may also be correlated with a prolonged recovery. Further research is needed to determine the impact of physical therapy interventions on vestibulo-ocular dysfunction and role of the King Devick test as a predictor of recovery in athletes who have suffered a concussion.

**Clinical Relevance:** Sports-related concussion is an increasingly recognized public health concern. Vestibulo-ocular dysfunction has been linked to prolonged recovery and can lead to difficulty with reading, poor visual-based concentration, and delayed processing during sport. Research to date has been limited by inconsistent methods for vestibulo-ocular testing and its use in tracking recovery throughout the rehab process. The results of this study provide a stepping-stone for the use of vestibulo-ocular outcome measures to track recovery in athletes who have suffered a concussion. Additionally, this study establishes a foundation for future experimental studies to examine the utility of physical therapy interventions in this population.
**TITLE:** Gait and balance in Alzheimer’s disease: a retrospective data analysis of function across varying levels of cognitive impairment

**AUTHORS/INSTITUTIONS:** M.R. Landers, D. Contreras, J. Heim, K.J. Nelson, University of Nevada, Las Vegas, Las Vegas, Nevada, UNITED STATES; J.M. Nash, J.K. Longhurst, Cleveland Clinic Lou Ruvo Center for Brain Health, Las Vegas, Nevada, UNITED STATES

**ABSTRACT BODY:**

**Purpose/Hypothesis:** It was once thought that Alzheimer’s disease (AD) affected mostly cognition with minor motor impairment; however, it is becoming apparent that motor impairment may also be a prominent feature. The aim of this study was to gain a greater understanding of motor impairment in AD by exploring how gait and balance are affected. Specifically, we sought to determine if gait and balance function become more severe as cognition worsened. We hypothesized that balance and gait would be worse for those in the lower quartiles of cognitive function compared to those in the upper quartiles.

**Number of Subjects:** Retrospective data of 419 patients with brain health conditions and an initial evaluation for physical therapy at the Cleveland Clinic Lou Ruvo Center for Brain Health were extracted from electronic records. Of those 419, 140 were diagnosed by a neurologist with AD (age=77.3±9.7; 60 males, 80 females) and were analyzed for this study.

**Materials/Methods:** Patients were stratified into cognitive quartiles using scores from the Montreal Cognitive Assessment (MoCA): 0-9 (very severe cognitive impairment), 10-14 (severe cognitive impairment), 15-20 (Moderate to severe impairment), 21-30 (mild to moderate impairment). These categories were then compared across the following measures: fall history (1 year, 30 days, and fall injury), 5 times Sit To Stand (5STS), Timed Up and Go (TUG), TUG cognitive (TUGcog), Preferred Gait Speed (PGS), Fast Gait Speed (FGS), 6 Minute Walk Test (6MWT), and Mini Balance Evaluation Systems Test (MBT).

**Results:** There were no statistically significant differences among the 4 quartiles for fall history (ps≥.452), 5STS (p=.436), TUG (p=.095), FGS (p=.228), 6MWT (p=.499), MBT (p=.262); however, there were for TUGcog (p=.028) and PGS (p=.042). The mild to moderate impairment quartile was significantly faster than two of the other quartiles (moderate to severe, p=.023; severe, p=.004; and, very severe, p=.055) for the TUGcog. For PGS, the mild to moderate was significantly faster than the very severe quartile (p=.036) and the moderate to severe was significantly faster than the very severe quartile (p=.020).

**Conclusions:** Balance and gait dysfunction is prominent at all levels of cognitive impairment in AD. However, walking impairment, especially with cognitive demand, is more prominent in those with more severe cognitive impairment.

**Clinical Relevance:** Balance and gait deficits are prominent features of AD and, based on these results, appears to get worse as cognitive impairment progresses. These progressive deficits represent potentially mitigable motor impairment features of AD that warrant physical therapy.
Aggressive Mobilization in a Minimally Conscious State: A Case Report

S. Balkan, Spinal Cord Injury, Brooks Rehabilitation Hospital, Jacksonville, Florida, UNITED STATES|P. Spigel, J. Fernandez, C.L. Beaulieu, H.E. Foster, Brooks Rehabilitation Hospital, Jacksonville, Florida, UNITED STATES|

Background & Purpose: Early neurorehabilitation has shown benefit for individuals with disorders of consciousness (DOC) and the prognosis of recovery is higher for those in a minimally conscious state (MCS). However, few studies have investigated the use of aggressive mobilization to promote recovery. This case report investigates the relationship of aggressive mobilization in an individual with DOC on expressive communication, motor response and emergence from DOC.

Case Description: The individual is a 30-year-old male who sustained a severe traumatic brain injury (TBI) with a Glasgow Coma Scale (GCS) score of 3 from a motor vehicle collision. Upon admission to inpatient rehabilitation 28 days' post-injury, he presented with a GCS of 9, the ability to visually localize to and fixate on people, absent head and trunk control, absent vocalizations or verbalizations, and absent volitional movements of all extremities. He was diagnosed MCS and enrolled in the low-level TBI program. The active treatment intervention included two weeks of daily aggressive mobilization protocols (AMP) for 60 minutes and multidisciplinary rehabilitation with monitoring of his expressive communication and motor responses. The individual was progressed from standing frame to Erigo®Pro locomotor training on a treadmill with partial body-weight support. Complicating factors included initial blood pressure response with acclimation to upright.

Outcomes: Following two weeks of aggressive mobilization the individual demonstrated improvements in expressive communication and motor scores. There was an apparent positive association with the pairing of higher intensity mobilization and stimulation utilized during locomotor training on a treadmill with partial body-weight support by Day 8. The GCS score with initiation of treadmill improved from 10 to 14. The individual’s MCS was considered resolved two weeks post-AMP and as expressive communication improved it was discovered there was an underlying expressive aphasia component.

Discussion: This case illustrates the potential for resolution of MCS with aggressive mobilization. The association of higher intensity mobilization, such as locomotor training, with improvements in communication and motor response is consistent with other studies linking cognitive benefits post TBI with mobilization. Specific barrier to progression of early mobilization was orthostatic hypotension and a barrier to response evaluation was the expressive aphasia. The outcomes suggest that the use of high intensity mobilization and multidisciplinary rehabilitation may be an effective strategy toward an increase in activation and emergence from MCS. Future research should focus on improving the strength of evidence and on examining activation prior to, during, and post mobilization.

Title: Feasibility and effectiveness of vestibular practice within two small outpatient orthopedic clinics in the Nashville Metro Area

Authors/Institutions: A. Tapp, N. Wilson, E. Bursi, Results Physiotherapy, Nashville, Tennessee, United States

Abstract Body:

Purpose/Hypothesis: The purpose of this report is to describe the development of a part time vestibular specialty practice within two small outpatient orthopedic offices in the Nashville Metro Area. Dizziness is a common complaint among adults with an incidence of 35.4% in adults over the age of 40. Many physicians and patients alike may not associate their neighborhood physical therapy clinic with being able to treat dizziness, but, as physical therapists, we know that physical therapy can be the most effective treatment for many causes of dizziness.

Number of Subjects: All subjects referred to one of two therapists at two different clinics with a diagnosis or complaint of dizziness from January 2016 – January 2017. As of June 2016, 32 patients are included in the sample from therapist at one clinic. Rates of referral are increasing and with the addition of data from a second clinic, we expect to have 100 subjects in the final sample.

Materials/Methods: We plan to track patients from January 2016 through January 2017 including referral source, distance travelled to clinic, diagnosis, visits per patient and overall outcomes utilizing Focus on Functional Outcomes (FOTO), we well as Dynamic Visual Acuity (DVA) and the Functional Gait Assessment (FGA) where indicated. Based on this data we hope to show the importance of including resources for patients with dizziness in outpatient orthopedic clinics due to the high prevalence of these conditions. With the full data set we plan to further investigate which particular aspects of the FOTO questionnaire are impacted by vestibular rehabilitation as well as overall patient satisfaction scores.

Results: From August 2015 through June 2016, 22.4% of total patients seen had a diagnosis of dizziness and, in the last 3 months, 37.5% of patients seen have had complaints or referrals for dizziness. Diagnoses seen include BPPV (48.1%), peripheral hypofunction (12.7), cervigogenic dizziness (16.7%), central dizziness (14.8), and some combination of multiple diagnoses (7.2%). Referral sources include primary care providers (24.1%), Ear Nose and Throat Specialists (53.7%), direct access (11.1%) and, Neurology (1.8%). Total visits range from 2 to 29 and average change in FOTO score is + 18.68 indicating significant improvement in function across all causes of dizziness.

Conclusions: It is feasible to develop a vestibular specialty practice within an outpatient orthopedic clinic with a 30 - 40% vestibular population. Physical therapy treatment for patients with vestibular dysfunction is effective within this setting as well.

Clinical Relevance: Outpatient physical therapy practices are likely missing a large population of patients with dizziness in their immediate communities. Clinicians should be encouraged to pursue referral sources for patients with vestibular dysfunction as well as continuing education related to the diagnosis and treatment of vestibular disorders in order to better serve this population.
Background & Purpose: West Nile Virus (WNV) is a mosquito-borne Flavivirus. Around 80% of all viral infections in humans have little to no symptoms. West Nile meningitis (WNM) can occur in approximately 1% of cases, leading to acute flaccid paralysis, varied body impairments, functional limitations, and participation restrictions. Evidence-based rehabilitative approaches include orthotic management, robotic assisted gait training (RAGT), aquatic therapy, and body-weight supported treadmill training (BWSTT). The purpose of this case study is to describe effective dosing parameters of physical therapy in restoring function in an individual with WNM.

Case Description: HW was a 66-year old male with history of low back pain, cervical surgery, and left foot drop. HW presented to the ER with a 102°F fever, photophobia, and diplopia which was found to be WNM. Symptoms included sudden-onset weakness worse in the left arm and right leg, inability to bear weight, and trunk instability. At evaluation, HW was non-ambulatory and required moderate to maximum assistance for bed mobility and transfers. HW attended 55-minute land-based physical therapy twice per week for 20 weeks and 55-minute aquatic therapy once a week for 20 weeks for a total of 72 sessions. Treatments included RAGT, functional electrical stimulation (FES) bike training, BWSTT, and bilateral knee-ankle-foot-orthotic (KAFO) training. To complement his therapy sessions, HW also participated in Strength Unlimited (SU), a community wellness program at TIRR under the guidance of a fitness specialist. HW attended SU 6 times a week for a minimum of 2 hours a day for 20 weeks, completing 15 FES bike, 12 aquatic therapy, and 38 one-on-one sessions.

Outcomes: At initiation of therapy, HW required minimal assistance to ambulate in aquatic therapy, total assistance for BWSTT, 42kg BWS during RAGT. After week 8 (34 sessions), HW progressed to supervision with ambulation in aquatic therapy, moderate assistance for BWSTT, 15kg during RAGT, and total assistance with bilateral KAFOs with drop locks with left platform walker to ambulate. By discharge (73 sessions), HW maintained supervision with ambulation in aquatic therapy and was able to ambulate with custom stance control bilateral KAFOs with left platform walker and close supervision for 170ft.

Discussion: Previous work has shown persons attending outpatient rehabilitation greater than 3 times a week encountered barriers such as insurance limitations and burden of cost. Therefore, the use of an in-house community wellness program concurrently with skilled physical therapy can reduce financial burden without sacrificing functional recovery. The efficacy of integrating personal trainers as part of a patient’s rehabilitative care has been shown in other neurological diagnoses. Increased frequency of physical therapy is important in functional recovery. This case study demonstrated the effects of incorporating a community wellness program within the plan of care of a patient with quadriplegia to help further drive recovery.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old:


TITLE: Poor sleep quality in people with painful neuropathy

AUTHORS/INSTITUTIONS: M. Alshehri, A. Alenazi, S. Alothman, C. Siengsukon, P. Kluding, Physical Therapy and Rehabilitation Science, University of Kansas Medical CT, Mission, Kansas, United States

ABSTRACT BODY:

Purpose/Hypothesis: Sleep is known to have a direct influence on glucose metabolism and insulin sensitivity. Previous studies have shown that people with pain due to diabetic peripheral neuropathy (DPN) have decreased sleep quality (SQ) compared to the general population using various subjective questionnaires. However, the Pittsburgh Sleep Quality Index (PSQI), the standard self-report sleep quality questionnaire, has not been used to assess SQ among patients with DPN. Therefore, the purpose of this study is to examine SQ using the PSQI and assess the relationship between SQ and pain in people with DPN.

Number of Subjects: Eighteen participants (mean age= 58.1 years, SD±5) with DPN who were sedentary, had type 2 diabetes, and peripheral neuropathy were analyzed.

Materials/Methods: This is a secondary analysis of data collected in a larger study of aerobic exercise in people with DPN. At baseline, participants completed the PSQI to assess SQ and the Brief Pain Inventory (BPI) to assess clinical pain. BPI is comprised of two components: the Pain Severity Index and the Pain Interference Index. Descriptive statistics were calculated. Pearson’s correlations were used to assess the relationships between PSQI, Pain Severity Index, and the Pain Interference Index. Alpha was set at=0.05.

Results: The study showed 14 out of 18 participants (77.8%) scored > 5 on PSQI (mean 9.94 ±4.35) indicating poor SQ. On the BPI, the mean score of pain severity index was 3.36±2.21, and the mean score of pain interference index was 3.54±2.9. The area of daily living most affected by pain was sleep (mean 4.1±3.03). There was a significant positive correlation between PSQI and BPI-Pain severity index (r= 0.642, p = 0.004) and between PSQI and BPI-Pain interference index (r= 0.591, p = 0.01).

Conclusions: A large majority of individuals with DPN reported poor SQ. Furthermore, poorer sleep quality was significantly associated with higher pain severity and more interference with daily living. Interestingly, sleep was reported as the activity of daily living that was most affected by pain. As sleep modulates glucose metabolism, insulin sensitivity, and pain transmission, future studies are needed to determine if addressing poor SQ would impact perception of pain as well as diabetes management.

Clinical Relevance: Poor SQ was found to be highly prevalent in a sample of individuals with DPN and may contribute to perception of pain. From a pragmatic point of view, sleep and pain may interact with each other in influencing glycemic control. Therefore, novel interventions should be considered to address sleep as well as pain in these individuals, which may impact diabetes management.
Re-assessing the use of ankle-foot orthoses in individuals with chronic stroke impairments: Is the initially-prescribed orthotic still warranted?

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Background & Purpose: Decreased foot clearance during swing is a common impairment during walking in individuals after stroke. Ankle foot orthoses (AFO) are often prescribed within the first 3 months after stroke to improve foot clearance and stance phase control. Changes in walking function occur up to a year or more post-stroke, however, re-assessment of the effects of the prescribed AFO on walking function rarely occurs in individuals with chronic stroke. Assessment after long-term AFO use may be warranted to ensure optimal walking function and recovery. The purpose of this case series is to describe and compare biomechanical outcomes of walking with and without a prescribed AFO in three adults with chronic stroke impairments who have used their prescribed AFO for over 6 months.

Case Description: Three adults 1-2 years post stroke were assessed 6 months to 2 years after initial AFO prescription (Subject 1: solid-ankle AFO; Subjects 2 and 3: articulated AFO). All demonstrated similar motor recovery as evidenced by Fugl-Meyer scores (avg: 24.7/34±0.3) and the average walking speed was 0.85±0.28 m/s. Biomechanical assessments included 10 trials each of walking at a self-selected pace with and without their AFO. A 14-camera motion capture system recorded 3-D kinematics while ground reaction forces and surface electromyograms were recorded from bilateral lower extremity muscles.

Outcomes: Biomechanical testing revealed differences in walking speed, kinematics, and muscle activation between the AFO and no-AFO conditions. Two subjects demonstrated increased walking speeds (avg: 0.82 m/s vs. 1.09 m/s) and stride lengths (avg: 112 cm vs. 126 cm) when using their AFO. Foot clearance and swing phase control also improved as evidenced by neutral ankle alignment and improved peak knee flexion during swing (32° to 42°). In contrast, stance phase control was negatively impacted by AFO use in two subjects based on the presence of knee hyperextension and decreased ankle dorsiflexion in terminal stance. In one subject, AFO-use was associated with improved timing of tibialis anterior muscle activation, but the amplitudes of activation were reduced in both the tibialis anterior and gastrocnemius muscles in the other subject. In the third subject, AFO use negatively impacted stance and swing phase biomechanics, with little change in velocity or spatiotemporal characteristics.

Discussion: Although evidence supports the use of an AFO to improve walking function in some individuals post stroke, little is known about long-term AFO use and whether initially prescribed AFOs continue to improve walking in these individuals. Outcomes from this case series suggest that re-assessment after long-term AFO use is warranted and may be useful for identifying the need for AFO adjustment or when an AFO is no longer needed. Further, changes in muscle activation with AFO-use suggest that there are trade-offs that should be considered when recommending long-term AFO use.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.


Purpose/Hypothesis: Gait speed has been referred to as the 6th vital sign. However, many people with spinal cord injuries are non-ambulatory and thus depend on wheelchairs for locomotion. The Wheelchair Propulsion Test (WPT) examines wheelchair propulsion speed, propulsion technique, and frequency of pushes. Currently in the literature, there is a dearth of reliability and normative data on the WPT. The purpose of this study was to determine the reliability of and normative values for the WPT using different manual wheelchairs.

Number of Subjects: Fifty healthy young adults (25 females and 25 males; 18-30 years) participated.

Materials/Methods: Subjects performed wheelchair propulsion at a comfortable speed over 10m using three different techniques (both upper extremities, dominant upper extremity with the ipsilateral lower extremity, and all four extremities). Three types of wheelchairs were used: standard lightweight, older model of an ultra-light (ultra-light 1), and newer model of an ultra-light (ultra-light 2). Three trials were performed for each technique in each wheelchair. One tester manually started a Brower Timing System and the other tester used a stopwatch. Both testers counted the frequency of pushes for each trial. Intraclass Correlation Coefficients (ICC) (2,2) were used to determine the inter-rater reliability of speed and frequency of pushes. Separate one-way ANOVAs were used for speed and frequency of pushes to determine differences among the three wheelchairs for the both upper extremities technique. Bonferroni post hoc tests were then conducted to determine the significance of the differences between different pairs of wheelchairs.

Results: The lowest ICC value recorded between the Brower Timing System and the stopwatch was for the ultra-light 1 wheelchair for the all extremities technique (ICC=0.876). All other ICC values were above 0.91. Speed using the both upper extremities technique was significantly lower with the lightweight wheelchair (1.25±0.27 m/s) compared to ultra-light 1 (1.32±0.27 m/s; P < 0.05) and ultra-light 2 (1.37±0.28 m/s; P < 0.001). Frequency of pushes was significantly greater with the lightweight wheelchair (9.11±1.77) compared to ultra-light 1 (8.33±1.61; P < 0.05) and ultra-light 2 (8.44±1.78; P < 0.05). The two ultra-light wheelchairs were similar for both speed and frequency of pushes.

Conclusions: The inter-rater reliability of the WPT is strong, irrespective of the propulsion technique utilized. Differences in speed and frequency of pushes between lightweight wheelchair and ultra-light wheelchairs may influence wheelchair recommendations given the prevalence of upper extremity overuse injuries in active wheelchair users such as young adults with paraplegia.

Clinical Relevance: The WPT can easily be administered in a variety of settings since inter-rater reliability was strong between the stopwatch and Brower Timing System, thus requiring the use of only a stopwatch and a 10-meter distance. Normative values for young adults have been provided for speed and frequency of pushes using both upper extremities in lightweight and ultra-light wheelchairs.
TITLE: Hip muscle activation during a step-up task post-stroke: a pilot study


ABSTRACT BODY:

Purpose/Hypothesis: Stroke is a leading cause of disability and fourth cause of death for American adults. Common abnormal coupling patterns post-stroke include hip extension, adduction and knee extension; or hip flexion, abduction and knee flexion. These patterns have been extensively studied in walking activities; however, the study of stepping-up tasks is limited. The purpose of this pilot study was to quantify hip muscle activation of the non-paretic (NP) and paretic (P) lower limbs during stepping and stance phases of a step-up task. We hypothesized that when stepping with their NP while standing on their P limb, individuals post-stroke would generate increased muscle activation of the following groups in the paretic lower limb: hip extensors, adductors and knee extensors following the common coupling patterns observed in other standing activities.

Number of Subjects: Subjects were community ambulators, able to step up and down a 4” high step, and diagnosed with a unilateral brain lesion (>1 year); N=5. Subjects’ balance perception was assessed by the Activity Balance Confidence (ABC) Scale (x=84%). Lower Extremity (LE) functional movement was determined by the LE Fugl-Meyer (x=20.2).

Materials/Methods: Subjects were secured in an overhead safety harness and instructed to stand in a comfortable position. They performed 24 randomized forward step-up trials; 12 leading with P limb and 12 leading with NP. Electromyographic (EMG) input from Gluteus Maximus (GMax), Gluteus Medius (GMed), Adductor Longus (AddL), and Rectus Femoris (RecFem) were collected for both the stepping and stance limbs. Maximum EMG value within the same limb and muscle was used to normalize EMG data.

Results: Activation of a hip extensor (GMax), hip flexor/knee extensor (RecFem), hip abductor (GMed) and adductor (AddL) were calculated for stance and stepping limbs. Due to the small sample size, the non-parametric Wilcoxon signed rank tests were used to compare P and NP limbs. Similar hip muscle activation patterns were found in both P and NP stance and stepping limbs, including GMax activation. However, there were trends of muscle activation differences: RecFem and AddL were increased while GMed was decreased in the P stance limb.

Conclusions: Higher muscle activation of RecFem (knee extensor) and AddL (hip adductor) on the P stance limb are consistent with the abnormal coupling of the lower limb normally observed post-stroke, partially supporting our hypothesis. GMax symmetrical muscle activation in both P and NP limbs in the stepping limb did not support our hypothesis. Further research is needed to compare hip muscle activation in individuals post stroke and control subjects, and whether this activation correlates to joint torques generated at the hip and knee.

Clinical Relevance: Potential differences in muscle activation of hip adductors and knee extensors in the supporting limb may impact performance of stepping up tasks in individuals post-stroke. Identifying movement problems that limit the ability of individuals post-stroke to successfully navigate stairs can help guide physical therapy interventions.
TITLE: The Effects of Mirror Therapy on Upper Extremity Function Post-Stroke: A Systematic Review

AUTHORS/INSTITUTIONS: J.P. Slaughter, E.J. Bright, A.R. Dean, S.P. Klein, K.D. Ross, M.C. Strange, C.C. Wellborn, Physical Therapy, University of Mississippi Medical Center, Pearl, Mississippi, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: The purpose of this study was to determine if mirror therapy (MT) improved upper extremity function in patients post-stroke

Number of Subjects: 5 articles were included in the study

Materials/Methods: The following selection strategy was used to assess the eligibility of the articles. A title screen was conducted based on the review's purpose. All abstracts were reviewed to determine if eligibility criteria were met, and the remaining articles were screened for the inclusion/exclusion criteria. Inclusion criteria consisted of studies that were randomized control trials comparing conventional treatment and/or sham treatment to MT, UE weakness/paresis, and the Functional Independence Measure (FIM). Exclusion criteria included Mirror Image Movement Enabler or robotics and MT as a control group. Study quality was evaluated using the PEDro scale. PEDro is a 10-point scale developed to assess the internal validity of clinical trials in physical therapy. A higher PEDro score indicates higher quality. Studies were also scored using the 2011 Centre of Evidence Based Medicine (CEBM) scale. This 5-level scale, in which lower numbers indicate higher levels of evidence, identifies a study's strength of evidence based primarily on study design.

Results: The search strategy, as described previously, yielded five studies meeting all specified requirements. The mean PEDro score was 6.2 with a range of 5 to 7. The CEBM levels of evidence included three level II studies and two level III studies.

Conclusions: The inclusion of MT as a therapeutic intervention for patients post-stroke has been shown to improve UE function. Evidence in four out of the five articles demonstrated that MT led to statistically significant improvements in function, as shown by increased FIM scores, when compared to conventional therapy and/or sham therapy. While motor function was evaluated using different clinical outcome measures, the studies reviewed demonstrated good evidence that MT led to increased motor function in patients post-stroke. There was no evidence of improvement in spasticity. In the PubMed search for this study, the available evidence was graded as a B because of a mixture of strong and weak studies. Although the evidence in this study demonstrated statistically significant results, clinical significance has yet to be consistently proven.

Clinical Relevance: This systematic review provides evidence to support the use of MT as a therapeutic intervention in patients post stroke. Since MT is inexpensive and does not require continuous one on one therapist supervision, it should be considered as a cost effective adjunct to conventional therapy when managing patients with chronic or subacute stroke. More research is needed to determine if MT leads to consistent clinically significant improvement.
Eccentric Training Mitigates Persistent Motor Control Deficits and Improves Spinal Learning After Spinal Cord Injury.

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ABSTRACT BODY:

Purpose/Hypothesis: To determine if a novel intervention designed to target persistent deficits in eccentric motor control would improve recovery and learning in a murine model of spinal cord injury (SCI).

Number of Subjects: Human Participants (n=3)
- Incomplete SCI (n=2)
- Uninjured Control (n=1)

Sprague-Dawley Rats (n=37)
- Naive (n=10)
- SCI Flat Treadmill (n=9)
- SCI Downhill Treadmill (n=9)
- SCI Unexercised (n=9)

Materials/Methods: Human participants were either uninjured or had incomplete SCI (AIS C or D). Rodents were naive or received a severe (250kdyn) incomplete SCI at T8. Kinematic data were collected during flat treadmill walking at a comfortable pace. Angle-angle diagrams were constructed by plotting knee vs. ankle joint excursions to assess intralimb coordination and 5 gait cycles were analyzed per participant/subject. For rodents, training was delivered 34-41d after SCI at either a 0° flat or 5.7° decline. Sessions included four, 5min walking bouts separated by 20min of rest to prevent muscle soreness. For EMG detection, bipolar electrodes were implanted into the tibialis anterior (TA) and semitendinosus. EMG onset/offset timing during weight acceptance was compared between groups. Spinal learning was assessed at 42d using an instrumental learning paradigm 24hrs after spinal cord transection at T2 to isolate the lumbar cord. Briefly, a stimulating electrode was implanted into the TA and a contact electrode was affixed to the hindpaw. Extension of the limb completed a circuit resulting in stimulus delivery to the TA and limb flexion. Learning was evident when the contact electrode was held out of the solution to prevent shock. In sister groups, protein quantification of proinflammatory cytokines (TNFα, IL-1β) was performed via enzyme-linked immunosorbent assay using fresh tissue collected from the lumbar cord.

Results: Persistent deficits in eccentric motor control were identified in both human participants and animal subjects noted by impaired intralimb coordination during weight-acceptance. In rats with SCI, downhill training restored intralimb coordination (p<.05) as well as EMG timing and amplitude. Downhill-trained rats also demonstrated reduced trunk instability (p<.05) and toe drags (p<.05) compared to rats who underwent flat training. Finally, downhill training reduced pro-inflammatory cytokines (p<.05) and promoted greater adaptive plasticity in the lumbar cord as evidenced by greater centrally-mediated spinal learning (p<.05).

Conclusions: Deficits in eccentric motor control persist chronically following human and experimental SCI. In rodents, downhill training in the chronic phase of SCI promoted adaptive plasticity in the spinal cord that translated to improvements in locomotor performance.

Clinical Relevance: Eccentric-focused, downhill treadmill training provides a simple adaptation for clinical practice that produces robust central and behavioral recovery in experimental SCI. Our work suggests that training persistent eccentric motor deficits after SCI may increase the ceiling of locomotor recovery for individuals with incomplete SCI.
TITLE: Reliability and feasibility of the JFK Coma Recovery Scale–Revised (CRS-R) in the acute care setting

AUTHORS/INSTITUTIONS: C.P. Da Silva, School of Physical Therapy, Texas Woman's University, Houston, Texas, UNITED STATES| E. Anderl, Physical Therapy, TIRR Memorial Hermann, Houston, Texas, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Among individuals experiencing disorders of consciousness (DOC) following brain injury, most clinically important is the distinction between vegetative state (VS) and minimally conscious state (MCS). The diagnostic accuracy of behavioral assessments is questionable, and up to 43% of patients with DOC are misdiagnosed as being in VS. The correct diagnosis is of prognostic importance considering the differing attitudes regarding life-sustaining treatment and therapeutic interventions for patients in these diagnostic categories. The JFK Coma Recovery Scale-Revised (CRS-R) is the highest recommended bedside behavioral assessment for DOC; however, its psychometric properties have been studied minimally outside of the inpatient rehabilitation setting. The purpose of this study was to investigate the reliability and feasibility of the CRS-R in the acute care setting and compare reliability across raters with different levels of experience.

Number of Subjects: One patient experiencing DOC following a severe traumatic brain injury and 11 physical and occupational therapist raters working in the acute care setting participated in this study.

Materials/Methods: The CRS-R was administered to a patient during his acute care hospital stay, and the assessment was video recorded. Therapist raters participated in formal CRS-R training and passed a post-test to ensure adequate understanding of scoring guidelines. Each rater independently scored the CRS-R recording on 2 occasions greater than 7 days apart.

Results: The CRS-R required 41 minutes to administer to this patient. The patient was positioned in supine with head of bed elevated to 45 degrees, and humidified oxygen was delivered through a tracheostomy mask. One PT administered the entire assessment, and a second person was needed only to observe responses during the Auditory Function Scale. Interrater agreement for CRS-R total score was good with a coefficient of variation of 0.24 or 24%. When comparing total scores from raters with <5 years of experience working with patients experiencing DOC to raters with more experience, more variation was observed among raters with more experience (0.31 vs. 0.12). Considering level of consciousness, there was 73% agreement both between and within raters.

Conclusions: The CRS-R is a feasible test for evaluating patients experiencing DOC in the acute care setting. Preliminary findings suggest that the CRS-R has a high level of interrater and intrarater agreement, especially considering distinction between VS and MCS. The variation in the scores of the more experienced raters may be explained by the wide range of experience in this subgroup (5-18 years). Additional research with a larger patient sample size is necessary.

Clinical Relevance: Patients diagnosed with MCS who receive specialized post-acute services demonstrate a high rate of emergence from MCS. It is essential to have a reliable test to distinguish between levels of consciousness in the acute care setting to determine the most appropriate next level of care.
TITLE: The Visual Detection of Doorway Affordances in People with Parkinson Disease

AUTHORS/INSTITUTIONS: B. Sidaway, A. Aaroe, G. Desrosiers, Physical Therapy, Husson University, Bangor, Maine, UNITED STATES| M. Albert, Physical Therapy, Advance Rehabilitation, Cedartown, Georgia, UNITED STATES| C. Morell, Coppola physical therapy, Concord, New Hampshire, UNITED STATES| J.A. Stuart, Physical Therapy, Maine General Medical Center, Augusta, Maine, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: During typical daily activities individuals often have to walk through doorways or between objects obstructing their path. To successfully negotiate such environmental barriers, adaptive postural changes must occur. An essential condition for the visual guidance of action in cluttered environments is that an individual can accurately perceive what actions are afforded by a particular situation given the individual's capabilities. Research has shown that healthy young individuals turn their shoulders while walking through a doorway when the width of that doorway is ≤ 1.3 times their shoulder width and that they can perceive this critical width visually without walking. This implies that the movements are constrained by individuals' perception of the environment in body-scaled units. The present work examines whether this body-scaled metric is altered in people with Parkinson disease (PD) and hence, is the visual affordance of doorway passability altered in people with PD.

Number of Subjects: Sixteen people with PD participated along with 16 healthy age-matched participants and 16 younger adults.

Materials/Methods: An adjustable aperture was constructed consisting of two foam boards hung from a rail attached to the ceiling. The boards touched the floor creating an aperture similar to a doorway whose width could be adjusted in small increments. A digital video camera mounted on the ceiling above the aperture recorded the participants walking through the gaps. Participants walked through a randomly ordered series of apertures scaled to their individual shoulder width. Participants also had to visually judge a similar series of apertures to determine if they could walk through the gap without turning. Finally, participants had to estimate their eye height on a nearby wall.

Results: In comparison to healthy participants, people with PD initiated shoulder turning to go through the doorway at larger apertures relative to their shoulder width (M = 1.61 x) and also judged wider apertures (M = 1.69 x) as impassable through visual observation alone. When participants had to estimate their eye height on a nearby wall, individuals with PD were significantly less accurate in their estimates than the other groups (PD: M = 10.1%; Healthy Elderly: M = 6.29%; Healthy Young: M = 4.79%).

Conclusions: The affordance for aperture negotiation is significantly impacted by PD; people with PD view apertures differently from age-matched healthy individuals. The inaccuracy of eye height estimation may contribute to this altered affordance perception.

Clinical Relevance: These findings suggest that some of the motor symptoms exhibited by people with PD might have a perceptual underpinning. Management of PD might benefit from the evaluation and treatment of affordance detection.
High Intensity, Variable Stepping Training and Balance Training Improves Gait and Balance in an Older Adult Post-Stroke

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Background & Purpose: High intensity, variable stepping training has been associated with improved gait, endurance and quality of life in individuals post-stroke. High intensity references heart rate or rate of perceived exertion (RPE) during training and quantity of steps. Most participants in high intensity stepping training research have been less than 75 years old. The purpose of this case report is to investigate the effects of high intensity variable stepping training and balance training in an older adult post stroke with a significant medical history.

Case Description: The patient was a 78-year-old man six months post right cerebral vascular accident with a history of cardiovascular disease and a previous stroke. After his stroke he received physical therapy in inpatient rehabilitation, at a skilled nursing facility and through home health. For this case report he participated in ten one-hour sessions of physical therapy over five weeks as a patient in a university physical therapy course as well as seven sessions in an outpatient physical therapy clinic during the same time period. On initial evaluation he was primarily using a wheelchair for mobility in all settings and a wheeled walker one to two times per day with assistance for very short distances in his home. The university course intervention sessions focused on high intensity, variable stepping training (RPE goal 7/10; patient consistently maintained RPE 5-7/10), balance training and bed mobility to improve functional mobility and endurance. Outpatient sessions included limited gait training, neuromuscular electrical stimulation to his quadriceps, limited strengthening and balance training.

Outcomes: The patient showed meaningful improvement in the following outcome measures (pre-, post-intervention): Postural Assessment Scale for Stroke (PASS) (17/36, 28/36), the Short Falls Efficacy Scale – International (FES-I) (22/28, 14/28), and self-selected gait speed (0.13 m/s, 0.23 m/s). Maximum distance walked without rest improved from 60 to 255 ft. Additionally, post-intervention walker ambulation was his primary means of mobility within his home and he was regularly walking short distances with a walker outside for the first time since his stroke.

Discussion: Improvement of 11 points in the PASS from pre to post-testing exceeds the established minimal detectable change. An improvement in Short FES-I is important as balance self-efficacy has previously been independently associated with activity and participation post stroke. Self-selected gait speed, although still very slow, improved by 0.1 m/s which meets the minimal clinically important difference. Due to concurrent interventions in a university course as well as outpatient physical therapy the contribution of specific interventions to the outcomes is unknown. High intensity, variable stepping training along with balance training should be considered as an intervention for older adults post-stroke.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: French MA, Moore MF, Pohlig R, Reisman D. Self-efficacy mediates the relationship between balance/walking performance, activity, and participation after stroke. Top Stroke Rehabil. 2016;23(2):77-83.


Title: Outcomes Following an Adaptive Rock Climbing Program in a Person with an Incomplete Spinal Cord Injury: A Case Report

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Abstract Body:

Background & Purpose: Individuals with spinal cord injury (SCI) often present with impairments which can interfere with the ability to participate in certain leisure activities like indoor rock climbing. There is a lack of research studying whether individuals with SCI can safely return to rock climbing. The purpose of this case report was to document outcomes following an indoor rock climbing program in someone with an incomplete SCI.

Case Description: The participant was a 60 year old male who sustained a C3-C6 ASIA D SCI in a central cord pattern 4 1/2 years prior to the start of the program. At initial evaluation, he presented with global limitations in muscle strength, especially on the right side. Increased upper extremity flexor tone and lower extremity extensor tone were noted (Modified Ashworth scores = 1+). He was able to walk with lofstrand crutches independently community distances. The participant was only able to climb 30% of a 28' wall with maximal assistance of two people to place his feet, help lift him and keep his hips close to the wall and a third person to belay. He was unable to climb unassisted.

Outcomes: Outcome measures included passive range of motion, flexibility, muscle strength, forearm and hand girth, balance as measured by the Mini-Balance Evaluation Systems Test (Mini-BESTest), ability to climb, quality of climbing and quality of life as measured by the Quality of Life Profile for Adults with Physical Disabilities (QOLP-PD). The intervention included two 90-minute sessions each week for a period of 20 weeks. One session per week consisted of traditional physical therapy sessions including therapeutic exercise and simulation activities and the second session took place at an indoor rock climbing gym. At the conclusion of the study, he was able to climb 48% of the 28' wall independently except for the weighted dynamic rope and 100% of the wall with minimal assistance of one for foot placement. Improvements were seen in his ability to weight shift on the wall, remain close to the wall, place his feet, reach for the pegs, and open his hands while reaching. His score on the Mini-BESTest increased from 15/32 to 17/32 which did not exceed the minimal detectable change (MDC) value. He made improvements in all categories of the QOLP-PD while changes in range of motion, flexibility, muscle strength and girth were variable.

Discussion: A rock climbing program focusing on strengthening and task specific rock climbing activities may have helped our participant meet his goal while also improving certain aspects of range of motion, flexibility, strength and certainly effecting quality of life. Certain individuals post SCI are able to return to leisure activities like rock climbing and it is our belief that physical therapists should help facilitate a return to higher level activities in certain individuals with SCI. Future research is required to further study the effects of rock climbing on a larger population.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: Velikonja O, Curić K, Ozura A, Jazbec SS. Influence of sports climbing and yoga on spasticity, cognitive function, mood and fatigue in patients with Multiple Sclerosis. Clin Neurol Neurosurg. 2010;112(7):597-601.


TITLE: Disability and environmental factors in spinal cord injured 2008 Wenchuan earthquake victims seven years after the disaster

AUTHORS/INSTITUTIONS: H. Li, Disaster medical science, Sichuan University, Chengdu, Sichuan, CHINA

ABSTRACT BODY:

Background & Purpose: Natural disaster like earthquake can make profound influence on survivors' physical and mental recovery, particularly in an area with disadvantage for access to medical and psychological interventions. In summer 2008, there was a major earthquake (Wenchuan earthquake) in western China, leaving thousands of varieties of traumatic injuries including spinal cord injury (SCI). All of these victims received urgent medical interventions, immediately-followed by acute rehabilitation interventions, and discharged with a home exercise program and suggestion of home modification if needed. However, how these survivors from the earthquake rehabilitate is still not very clear. Thus, the purpose of this was to understand and describe long-term medical and psychosocial challenges and needs of victims with SCI from the earthquake in China.

Case Description: This was a cross-sectional study with data collected for comparison with results from previously studies on patients with SCI. Twenty-five subjects were randomly selected from a list of Wenchuan earthquake survivors with SCI were evaluated by a rehabilitation team. The assessment instruments included general demographic information, a Modified Barthel Index (MBI) for activities of daily living (ADL), visual analog scale (VAS) for pain, SF-36 for quality of life, and Nottwil Environmental Factors Inventory Short Form. All of these assessed data were compared with norms from previous studies.

Outcomes: It was found that SF-36 scores were poor in all 8 domains as compared with the "norm" value. Activities of daily living, pain, and environmental factors inventory were also as good as other previously published data in patients with SCI.

Discussion: Almost 8 years after the Wenchuan earthquake, victims with SCI still had complex medical and psychosocial needs. Most of those needs might be met with relatively low-cost interventions. County level rehabilitation centers seemed underequipped, and staff lacked training. Vocational and educational rehabilitation measures as well as psychological counseling are of pivotal importance.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.

Background & Purpose: Improvements in balance, confidence, function, and subjective complaints of dizziness are expected following vestibular and balance rehabilitation. When a patient's performance declines or fluctuates during the course of care, clinical judgment is required to guide appropriate referrals and recommendations related to continued services and/or discharge planning. It is important for physical therapists to identify characteristics of persistent postural-perceptual dizziness (PPPD), which will be included in the next edition of the International Classification of Diseases (ICD-11) in 2017. Pharmacological management has been shown to be advantageous for PPPD and physical therapists must be able to recognize PPPD and make appropriate referrals when necessary.

Case Description: A 47-year-old woman with a history of anxiety, chronic dizziness, and imbalance displayed initial improvements with balance and vestibular rehabilitation but had a decline in balance following acute physiological distress. Past medical history included migraine, chronic depression, anxiety, tachycardia, and a history of ear infections as a child. Vestibular testing revealed abnormal vestibular evoked myogenic potentials with reduced responses bilaterally. Patient displayed full extraocular movements without nystagmus and no visible nystagmus was observed using infrared goggles. Positional testing for benign positional vertigo was negative. CT imaging showed thinning of the superior semicircular canal but no obvious dehiscence and MRI showed nonspecific mild-to-moderate white matter disease. Audiometric testing indicated a sensorineural loss on the right and mixed loss on the left. Chief complaints included: dizziness, nausea, and imbalance. These complaints were provoked by fast movements and visual patterns.

Outcomes: At baseline, the patients gait speed was 0.58 m/sec, which improved to 0.94 m/sec midway through training (visit 9). When outcomes were obtained shortly after her denied disability claim, her gait speed had decreased to 0.67 m/sec. Her initial composite Sensory Organization Test score of 71 improved to 79 after 9 sessions of rehabilitation, but decreased to 61 when assessed following the 18th session. Following the 18th session the patient was diagnosed with PPPD and Sertraline Hydrochloride (Zoloft) was prescribed. Following the administration of Sertraline, the patient was reassessed and showed improved functional gains in gait velocity (0.95 m/sec), composite Sensory Organization Test score (77). Additionally the Functional Gait Assessment improved from 17/30 to 23/30.

Discussion: If a clinical presentation, such as depicted in this case report, is not identified and is left undiagnosed, the ramifications could include denied medical claim and termination of their physical therapy. Most importantly, not recognizing PPPD and failing to initiate pharmacologic interventions, could result in prolonged rehabilitation with suboptimal functional outcomes and increased healthcare costs.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: Bittar, R.S. and E.M. Lins, Clinical characteristics of patients with persistent postural-perceptual dizziness. Braz J Otorhinolaryngol, 2015. 81(3): p. 276-82.


Background & Purpose: Spinal cord injury (SCI) affects approximately 12,000 Americans per year; 20% of these injuries result in sensory and motor complete tetraplegia. This case study will describe an individual with high cervical SCI above the C5 vertebra, with focus on considerations for determining the physical therapy (PT) plan of care in the inpatient rehabilitation setting.

Case Description: A 33-year-old male with C2 AIS A classification participated in inpatient physical therapy for approximately 8 months. This individual received PT for impairments including decreased cardiopulmonary status requiring mechanical ventilation, decreased motor function, impaired sensory integrity and abnormal muscle tone, leading to functional limitations in all aspects of mobility and activities of daily living. This case study discusses how PT interventions facilitated return to the community by maximizing function and health status. Specific interventions included upright tolerance training, therapeutic exercise, neuromuscular re-education, functional electrical stimulation (FES) and wheelchair prescription. Emphasis was also placed on importance of patient and caregiver education for optimal results.

Outcomes: Despite significant physical challenges related to high tetraplegia and ventilator dependency, PT interventions contributed to a successful multidisciplinary team-driven approach and allowed the patient to return to community setting including employment.

Discussion: PT treatment for patients with high tetraplegia requires collaboration with other disciplines to integrate ideas for progression of mobility skills and promote independence. Examination and assessment of global physical systems functioning and impairments assists with directing goals and interventions for accessing technology, adaptive equipment, and modified exercise regimens to promote long-term wellness in the tetraplegic patient.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.
**Title:** The Effect of Deep Neck Flexor Training on Dynamic Balance in an Individual with a Whiplash-like Injury: A Case Study

**Authors/Institutions:** B. Fitzpatrick, M.A. French, Johns Hopkins Hospital, Baltimore, Maryland, UNITED STATES

**Abstract Body:**

**Background & Purpose:** Whiplash-like injuries frequently occur in the setting of traumatic events. While neck pain is the most common symptom associated with whiplash, research also supports the presence of balance dysfunction with whiplash. These balance deficits are likely related to abnormalities of the cervical afferent information important for the vestibulocollis reflex (VCR) and the cervico-collic reflex (CCR). Although balance deficits are present, physical therapy (PT) interventions typically address the cervical spine dysfunction, specifically deep neck flexor strength and range of motion, rather than balance deficits following whiplash. Thus, this case study aims to present the effect of deep neck flexor training on dynamic balance in an individual with whiplash-like injury.

**Case Description:** E.W., a 79 year old female, presented to outpatient PT 14 months after being diagnosed with a concussion due to a motor vehicle accident. E.W.’s primary complaints included neck pain, dizziness, and imbalance. On evaluation, E.W. was found to have severe forward head posture and increased thoracic kyphosis. E.W.’s cervical range of motion (ROM) was limited with tenderness over sternocleidomastoid (SCM) and upper trapezius bilaterally. Dix-hallpike, roll test, and head thrust were negative bilaterally; however, subjectively E.W. reported dizziness of 2/10 with head thrust test. Additionally, E.W. scored a 12/24 on the Dynamic Gait Index (DGI) and was able to maintain Romberg stance with eyes open (EO) on a firm surface, eyes closed (EC) on a firm surface, and EO on a foam surface for 30 seconds each. She was able to maintain EC on a foam surface for 2 seconds. At evaluation, a home exercise program was prescribed including strengthening of deep neck flexors and postural musculature. E.W. had 4 PT appointments over the course of 1 month with emphasis on deep neck flexor strength and postural correction. DGI and Modified Clinical Test of Sensory Integration and Balance (mCTSIB) were primary balance outcome measures.

**Outcomes:** One month after initial evaluation, the patient’s DGI score improved to 21/24, indicating a decreased risk of falling. Additionally, E.W. was able to maintain Romberg EC on foam for 8 seconds. The patient reported no neck pain (0/10); however, E.W. continued to have neck stiffness that limited her cervical ROM.

**Discussion:** E.W. made significant improvement in DGI with PT intervention focused on improved cervical strength and posture. While the evidence is limited, other research has shown that PT intervention aimed at improving neck cervical range of motion, muscular strength, and endurance can improve balance. The findings of this case report indicate that improving deep cervical flexor strength and endurance may improve dynamic balance in patients with whiplash associated neck pain. Further research is needed to determine the physiologic link between cervical strengthening and balance and role this may play in VCR and CCR.

**References:** Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.

The effects of fatigue on balance in individuals with Parkinson’s disease: influence of medication and brain-derived neurotrophic factor genotype

M. Baer, B. Klemetson, D. Scott, J. Navalta, A. Murtishaw, J. Kinney, M.R. Landers, University of Nevada, Las Vegas, Las Vegas, Nevada, UNITED STATES

Purpose/Hypothesis: The purpose was to investigate the effects of fatigue on balance in individuals with Parkinson’s disease (PD). Because falls in this population can have deleterious consequences, it is important to understand the influence of fatigue and PD medications on balance. We hypothesized that balance and gait would decay after a fatiguing condition. Additionally, since brain-derived neurotrophic factor (BDNF) genotype has been shown to be related to motor performance, we explored its role in balance performance and response to fatigue. We hypothesized that those with a Methionine (Met) allele genotype would have poorer gait and balance and would have a poorer response to a fatiguing condition.

Number of Subjects: 27 subjects (age= 65.4 years, SD= 8.1; males= 14, females= 13) with neurologist-diagnosed idiopathic PD. Of the 27, 13 were genotyped for BDNF as Valine (Val)/Val, 11 as Val/Met, 2 as Met/Met, and one refused.

Materials/Methods: Subjects were tested over two days separated by a week with the first day being “on” PD medication and the second day being “off” PD medication. On both days, subjects completed a balance and gait pre-test (i.e., mini-Balance Evaluation Systems Test, computerized dynamic posturography (sensory orientation and motor control), functional reach, Timed Up and Go, instrumented walking mat) followed by a fatiguing treadmill condition and then a post-test (same as the pre-test).

Results: There was no statistically significant interactions between time (pre and post) and medication (on and off) for anticipatory postural responses (ps≥.382), adaptive postural responses (ps≥.405), dynamic balance (ps≥.187), sensory orientation (ps≥.208), or any gait characteristics (ps≥.355). Likewise, results from the time main effects did not demonstrate any statistically significant decays in balance or gait performance following the fatiguing condition. Additionally, subjects categorized as having the Val/Met or Met/Met genotype also did not show any significant differences in balance or gait (ps≥.111) and response to a fatiguing condition (ps≥.070) compared to subjects with the Val/Val genotype.

Conclusions: The fatiguing condition used in this study did not have a detrimental effect on balance and gait in individuals with PD. Likewise, there were no differences between the “on” or “off” PD medication state for measures of balance and gait. Additionally, individuals with a BDNF Met allele (Val/Met or Met/Met) did not have poorer balance performance and response to a fatiguing condition compared to those with the Val/Val genotype.

Clinical Relevance: Our findings support the notion that PD medications do not help postural instability, one of the four cardinal signs of PD. This highlights the importance of balance training by physical therapists in PD. Additionally, our findings suggests that therapists can fatigue individuals with PD without the fear of a significant decay in gait and balance function.
Purpose: The purpose of the National Center for Testing Treatments in Chronic Spinal Cord and Traumatic Brain Injury (NCTT) is to develop a multicenter research consortium that will serve as a data repository and conduit for participation in observational and interventional research studies.

Description: The NCTT is a prospective, observational, multicenter research study. Subjects who are at least 18 years old, have a history of spinal cord and/or brain injury, and are able to provide consent and authorization to share prior medical records may be included. Subjects are excluded if they have a life expectancy of less than 6 months, have a co-existing disease that precludes diagnosis of SCI or TBI, or are unable to adhere to study requirements. Potential subjects are recruited through community support groups, informational letters, media releases, and a clinicaltrials.gov posting. From January 2016 through June 2016, 40 subjects have enrolled. Target is 5000 subjects over 10 years.

Data is collected from self-report questionnaires, clinical assessments, and medical records. Information collected includes history of the injury, treatment and rehabilitation, medical history, quality of life, functional status, and repeated measurements of pain, disability, community integration, cognition, strength, sensation, upper extremity function, gait, and balance. Blood, saliva and urine specimens are collected to measure biologic markers related to injury and treatments. The NCTT surveys subjects on their research participation interests with a goal of targeting future projects to meet identified needs.

Descriptive statistics will be used to summarize demographics and subjects' research interests. Correlational statistics will be used to describe clinically relevant relationships that are discovered.

Summary of Use: The NCTT database classifies and characterizes subjects with SCI/TBI based on multiple criteria, including type and severity of injury, functional status, associated medical issues (such as depression and pain), and neurological function. This data is used to refer subjects to research studies that are appropriate for their level of functioning, relevant to their interests, and focused on recovery in the chronic phase of injury.(1,2,3)

The NCTT is intended to address common issues with research design that are specific to the chronic SCI/TBI patient populations, including recruitment of clinically and medically stable, homogeneous study groups. It also makes potential subjects aware of studies that may be of interest to them.(4,5)

Importance to Members: The usefulness of current research is often limited by inconclusive findings, low enrollment, and the heterogeneity of the SCI/TBI patient populations. We aim to address these inadequacies in study design by establishing this database, sample repository, and research referral system. The NCTT will provide a framework for well-designed and adequately powered research studies, which will lead to an enhanced evidence base for clinical practice in the chronic SCI and TBI patient populations.
TITLE: Improved interlimb coordination in walking in people with Parkinson’s disease using an arm swing cuing device


ABSTRACT BODY:

Purpose/Hypothesis: Parkinson’s disease (PD) leads to severe, progressive neuromotor deficits. In gait, the effects of these deficits can be seen as decreased step length, arm swing, and velocity, and impaired interlimb coordination. Physical therapy targets these impairments with cues to encourage proper movement, but improvements often dissipate without the cuing. Literature has shown that gait parameters such as velocity, step length, and cadence can be changed in response to a cuing device, but it is unclear whether the use of such a device can lead to improved interlimb coordination during gait. This question is especially relevant as poor interlimb coordination is correlated with increased fall risk in populations including those with PD. The purpose of this work was to explore the effects of ArmSense, a wrist-based device that encourages larger arm swing, on coordination during self-paced treadmill walking. We hypothesized that use of the device would result in increased amplitude arm swing and more normalized interlimb coordination than walking without cues.

Number of Subjects: Three people with PD (2 males, 1 female; mean age 63.3) and three control subjects (1 male, 2 females; mean age 29.9). Subjects with PD had a mean PIGD score of 3.33 and all walked without assistive devices. All control subjects were free of neurological injury or musculoskeletal injury that could affect walking.

Materials/Methods: Following 15 minutes of walking to acclimate to the self-paced treadmill, 3 trials of 2 minutes were conducted under each of two conditions: no cues, and vibratory cue to encourage larger arm swing. Target arm swing was individually determined by measuring average angular change at each wrist during walking with no cues, then increasing that angle by 20%. Subjects were instructed to swing their arms until they felt the vibration on each swing. Interlimb coordination was calculated as the point estimate relative phase between body segments. Wilcoxon rank sum tests were performed with Bonferroni corrections to determine the significance of differences in relative phase between groups and conditions.

Results: People with PD demonstrated a significant improvement in diagonal limb coordination (one arm with the opposite leg) when using ArmSense (p=0.004) versus without cuing, while the control subjects showed no significant change (p=0.41).

Conclusions: When cued to walk with a larger arm swing, subjects with PD demonstrated a decrease in relative phase between diagonal limbs (with the phase value moving closer to the normally-expected value of 0 degrees). It is notable that subjects only received cues for arm swing amplitude, not for any temporal gait parameters.

Clinical Relevance: Encouraging larger arm swing during gait may lead to improved interlimb coordination in walking for people with PD. This improvement can be seen after just one session of using a portable cuing device. Devices such as ArmSense may be a valuable adjunct to sessions of skilled physical therapy, facilitating continued patient improvement between sessions and even after PT has ended.
Cerebellar transcranial direct current stimulation interferes with corticospinal excitability during motor training

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Purpose/Hypothesis: The cerebellum plays a key role in motor learning and cerebellar activity can be modulated using transcranial direct current stimulation (tDCS). The aim of this work was to determine if visual-spatial motor learning and neurophysiologic measures are affected by cerebellar tDCS (ctDCS) when delivered during motor training. We hypothesized that anodal ctDCS would result in greater learning compared to sham ctDCS. It is unknown if neurologic populations such as cervical dystonia respond to training with ctDCS.

Number of Subjects: 15

Materials/Methods: A two group (anodal vs sham), double-blind design was implemented. 15 healthy adults (7 female, age 28.8±10.5 years) completed one session of finger tracking with simultaneous anodal or sham ctDCS. Bilateral ctDCS was delivered using 2mA. Anode: level of the mastoid process and inion, along the midline of the head; cathode: buccinator muscle ipsilateral to the training hand. The tracking task involved index finger flexion and extension using a potentiometer to control a cursor displayed on a screen. Tracking training with simultaneous ctDCS was completed in two 15 min epochs with a 5 min break. Tracking accuracy and corticospinal excitability was measured immediately before and after the training period. Corticospinal excitability was determined using transcranial magnetic stimulation single pulse peak to peak amplitude of the motor evoked potential (MEP) and cortical silent period (CSP) in the first dorsal interosseous.

Results: Tracking accuracy was increased in both groups at posttest (p < 0.001); with no difference between groups (p =0.144). MEP amplitude change scores were significantly different between groups (p = 0.014). Single pulse MEP was increased in the sham group (p < 0.0001), indicating increased excitability from baseline while the anodal group displayed a decrease in excitability (p = 0.003). There were no between group differences for CSP (p = 0.275), yet within group CSP duration was significantly prolonged in the anodal group, suggesting increase in inhibition (p < 0.001) while unaffected in the sham group (p = 0.065). Participants with cervical dystonia are currently being tested.

Conclusions: Neurophysiologic measures of brain excitability indicate that anodal ctDCS interferes with the normal increase in cortical excitability following a motor training activity. However, with this task there is no clear advantage of anodal ctDCS compared to sham during training to improve visual-spatial tracking accuracy.

Clinical Relevance: ctDCS is a potential method to facilitate motor learning. This study supports the use of ctDCS to modulate cerebellar activity. Neurologic conditions such as cervical dystonia may not respond to ctDCS in the same manner due to abnormalities that are present in cerebello-thalamocortical pathways. Before clinical trials are completed in cervical dystonia, responses to ctDCS combined with motor training should be assessed.
Purpose/Hypothesis: Physiological complexity depicts one's capacity to adapt to stress and is reduced with age and disease. The purposes of this study were to 1) compare physiological complexity on level and grass surfaces between participants with chronic stroke and those without disability and 2) to examine the magnitude of differences in complexity from level to grass surfaces between groups. We hypothesized the group with stroke would demonstrate lower levels of physiological complexity across surfaces and a greater magnitude of change between surfaces compared to their healthy counterparts indicating less adaptability with more challenging surfaces.

Number of Subjects: Thirteen participants with chronic stroke (7 male; mean age 55.2 ± 10.5 yrs; 76.8 ± 54.3 months post stroke; 6 left hemiparesis) and 12 gender and age (+/- 5 years) matched participants without disability (6 male; mean age 53.1 ± 10.2 yrs.) completed this prospective, cross-sectional study.

Materials/Methods: During a single testing session participants completed two-minute walking tasks around a level-indoor and grass-outdoor course at their preferred pace while wearing wireless inertial measurement units (IMUs) on each lower extremity segment (thigh, shank, foot) and pelvis. Multivariate multiscale entropy was calculated from the tri-axial accelerometer signals from the IMUs and converted to a complexity index score for analysis. Between group differences were analyzed with a multivariate analysis of variance (MANOVA) incorporating all lower extremity segments as dependent variables, followed up with discriminant analyses as appropriate.

Results: Between group main effects from the MANOVA revealed significant reductions in complexity indices for the stroke group compared to the controls on both level and grass surfaces (p=.00). Discriminant analysis confirmed these differences between groups and demonstrated a greater contribution from all nonparetic limb segments to the overall differences between groups on both surfaces (r>.57). There was no significant difference in magnitude of change in complexity indices from level to grass surfaces between the stroke and control groups (p=.29).

Conclusions: In support of our hypothesis, the stroke group demonstrated significantly reduced physiological complexity of gait on level and grass surfaces compared to matched, healthy controls indicating less adaptability of gait in various environments. The stroke group's lower complexity indices of their nonparetic segments contributed most to these differences suggesting greater compensation within that limb on both surfaces. The lack of significant difference between groups in magnitude of change in complexity signified no less adaptability of gait from level to grass terrains in both stroke and healthy states.

Clinical Relevance: Training walking on uneven terrains is as important as training walking on level-indoor surfaces in order to improve adaptability across different environments. Focusing intervention on improving movement in the nonparetic limb may be beneficial to adaptation.
TITLE: The Temporal Relationship Between Stress and Spasticity


ABSTRACT BODY:

Purpose/Hypothesis: Recent studies have suggested that stress may be a factor in spasticity severity. Multiple studies into stress modulation of neuropathic pain have revealed a ten-day delay between the occurrence of significant stressors and latent flares in pain intensity. Current evidence indicates this is due to delayed effects of stress-released thyroxine (T4) on central sensitization of pain pathways. Spasticity involves activation of both 1A muscle spindle input and alpha motor neuron output, the expression of both may be modulated by this same stress hormone. It is plausible that severity of spasticity may also show salient increases ten days after significant stressors. This study's purpose is to begin exploring the temporal relationship between stress and spasticity, to see if some patients experience latent episodic increases in spasticity due to stress.

Number of Subjects: Participants ranged from 48-84 years old. They included a male with CVA history, a female with primary lateral sclerosis, and a female with history of CVA and thyroidectomy.

Materials/Methods: Each day for 12 weeks, participants completed stress and spasticity inventories. Stress was quantified with a visual analog stress scale (VASS) and spasticity using a functional scale evaluating the degree of difficulty to perform a standard daily task due to spasticity severity (VAFS). Quantitative criteria were established defining peak stress and peak spasticity impact days. Final temporal relationship results between stress and spasticity impact analyzed with serial lag correlations for 0-14 day lags.

Results: After 7 weeks of data collection from participants with CVA Hx, preliminary findings indicate one participant consistently manifests sharp impact on spasticity related function ten days after criterion high stress days. A second participant with CVA Hx is reporting no change in spasticity-related function at any regular intervals after high stress days. This second participant is a thyroid cancer survivor, post complete thyroidectomy, on stable daily levothyroxine. Since her thyroid hormones are medically managed and unaffected by stress, T4 sensitization is eliminated. Data collection is ongoing with detailed serial lag analysis on all participants to follow.

Conclusions: Based on preliminary results, there is evidence to suggest that increases in CVA-related spasticity may occur ten days after high stress episodes in some people. This relationship is not observed in a post thyroidectomy individual, lending support to the hypothesis that latent ten-day effects may be due to T4 central sensitization.

Clinical Relevance: Therapists and patients are frequently at a loss to explain episodic increases in spasticity severity. If a consistently delayed link between stress and spasticity is established for some individuals it would give patients, caregivers, and therapists the ability to understand and predict episodes of increased functional difficulty following high stress days.
Case-Control Study of Impairments Associated with Recovery from Lateropulsion after Stroke: Logistic Regression Analyses

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ABSTRACT BODY:

Purpose/Hypothesis: The purpose of this retrospective, case-control study was to determine how demographics and severity of stroke impairments at admission to inpatient rehabilitation distinguish patients who recover from lateropulsion from those who do not. We hypothesized that factors associated with lateropulsion would differ by lesion side and that patients with persistent lateropulsion would have impairments related to learning postural control.

Number of Subjects: 134 subjects with lateropulsion after stroke (69 with right brain lesion and 65 with left brain lesion).

Materials/Methods: Patients with lateropulsion ("pusher syndrome") and admission motor Functional Independence Measure scores < 31 and contralesional lower extremity Fugl-Meyer motor scores < 19/34 were included. Burke Lateropulsion Scale scores of 2 or greater at time of discharge from inpatient rehabilitation indicated persistent lateropulsion; scores of 0 or 1 indicated resolved lateropulsion. Logistic regression tests included: age, gender, admission Motricity Indices, limb placement error, and cognitive Functional Independence Measure scores. Chi-square analyses compared groups for neglect. Project was approved by Institutional Review Board.

Results: Older age and worse admission motor status for patients with left brain lesion distinguished those with persistent lateropulsion at discharge. For right brain lesion, related factors were older age, greater admission limb placement error and lower cognitive Functional Independence Measure scores. Visuospatial neglect did not influence recovery from lateropulsion.

Conclusions: Older age and severe impairments were associated with delayed recovery from lateropulsion in a manner specific to lesion side.

Clinical Relevance: The study provides evidence that lesion side and admission characteristics are useful in early decision-making for duration of rehabilitation, selection of interventions and discharge planning.
TITLE: The Effect of Rhythmic Auditory Stimulation (RAS) on Gait Parameters in Individuals Who Have Experienced a Brain Injury: A Systematic Review


ABSTRACT BODY:

Purpose/Hypothesis: To synthesize and critically evaluate all evidence on the effectiveness of Rhythmic Auditory Stimulation (RAS) on improving gait parameters in individuals who have experienced a brain injury.

Number of Subjects: 361 total subjects

Materials/Methods: PEDro, CINAHL, PubMed, Cochrane and Proquest Health Management were searched for articles evaluating the effect of RAS on cadence, stride length, velocity, and/or symmetry. These articles underwent quality assessment using the PEDro scale. Data pertaining to the study's methodology and outcomes was extracted. To increase homogeneity, articles evaluating similar interventions (metronome only, music only and a combination of metronome and music) were pooled. Effect sizes were also calculated for each study that had between group comparisons.

Results: A total of 12 articles met the eligibility criteria (11 analyzing the effects on stroke, and 1 on traumatic brain injury [TBI]). The mean PEDro score for the quality of these articles was 5/10. Using a metronome on individuals with stroke, five studies found significant improvements in gait velocity, two reported improvements in stride length, two revealed improvements in cadence, and one reported improvements in gait symmetry. Three articles used music therapy on individuals with stroke; two found improvements in gait velocity, one found an increase in cadence, and one reported improvements in stride length. Four articles evaluated the combination of metronome and musical therapy as a form of RAS in individuals with stroke. Four articles found a significant improvement in gait velocity, three found improvements in stride length, two reported increases in cadence and two yielded improvements in symmetry. The study regarding RAS using music therapy in those with TBI reported significant improvements in gait velocity, cadence, stride length and symmetry. The combination of metronome and music as a form of RAS produced a larger treatment effect than either method alone.

Conclusions: Strong evidence exists supporting the use of a combination of metronome and music therapy to improve gait velocity in individuals with stroke. Moderate evidence was found in support of improvements in several gait parameters with the use of metronome, music, and the combination of metronome and music in individuals with stroke. Weak evidence exits supporting the use of a metronome to improve gait symmetry in individuals with stroke and for improving gait velocity, cadence, stride length and gait symmetry in those with TBI.

Clinical Relevance: This systematic review shows that use of RAS can improve gait parameters in those with brain injury. Suggested parameters include 15-30 minute sessions, five days per week with a duration of anywhere from 3-6 weeks. RAS is a simple and cost effective intervention that can be utilized in the clinic and as a home exercise program.

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Background & Purpose: Prior research evaluating the effect of body weight support treadmill training (BWSTT) on individuals with traumatic brain injury (TBI) has lacked consistency in administration of the intervention. The NeuroRecovery Network (NRN) established a locomotor training protocol that has shown promising results for individuals with spinal cord injury, yet no research has been completed to determine the feasibility of using this protocol in those with TBI. The purpose of this case report was to determine the feasibility of implementing the NRN protocol in someone with a TBI and to document outcomes of such a program on balance, gait and community integration.

Case Description: The participant was a 38 year old male who sustained a TBI 21 years prior to the onset of the study. He presented with decreased sensation, increased tone and limited strength on the right side. He was able to ambulate community distances without assistive device independently but walked with slower than average gait speed, decreased cadence, limited step length and decreased stride length on the right. He scored a 37/56 on the Berg Balance Scale (BBS) and reported he fell about once per month. His score (8/29) on the Community Integration Questionnaire (CIQ) indicated impaired home and social integration.

Outcomes: Outcome measures included balance as measured by the BBS; quality of gait as measured by the Rancho Los Amigos Observational Gait Analysis Scale; gait speed, stride length, step length and cadence as measured by the GAITRite Portable Gait Analysis System™ and community integration as measured by the CIQ. The intervention followed the therapy portion of the NRN protocol and was provided for 90 minute sessions, three times per week for eight weeks. At the end of the study, his BBS score improved from 37/56 to 43/56. Observable changes were noted in the quality of his gait in that increased right hip external rotation at pre-swing and excessive hip abduction at mid-swing were corrected, however increased ankle inversion at midstance was introduced. Left step length improved although changes in gait speed, cadence, stride length and right step length did not exceed minimal detectable change (MDC) values. The CIQ score improved 3 points but this change did not exceed the MDC value.

Discussion: Outcomes from this case report suggest that use of the NRN protocol may be feasible in individuals with TBI. There were improvements in balance and certain aspects in gait, but due to the chronicity of his TBI, 24 sessions may not have been long enough to allow for the participant to receive the full potential benefit of this intervention. Further research with a greater sample size is necessary to provide more support for the intervention.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old:

Vestibular Rehabilitation for Clinical Management of Bilateral Superior Semicircular Canal Dehiscence: A Case Report

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Background & Purpose: Despite a strong body of evidence for vestibular rehabilitation, research is lacking for effective clinical management of patients with bilateral superior semicircular canal dehiscence (SSCD) with endolymphatic hydrops (EH). Although the physical therapy (PT) profession has newly established clinical practice guidelines for vestibular rehabilitation, they are not specific to the treatment of SSCD. The purpose of this case report is to describe the effects of PT involving gaze stabilization and sensory reweighting for the treatment of a patient diagnosed with bilateral SSCD.

Case Description: The patient was a 56-year-old woman with a chronic otologic history involving bilateral SSCD and EH. She had been experiencing symptoms for 26 years before seeking PT. Also, she had consulted with over 30 different physicians and undergone multiple vestibular surgeries, none of which were able to eliminate her symptoms. The patient's body structure and function impairments included constant headaches, dizziness with head rotation and eye movements, sensitivity to sounds and lights, tinnitus, autophony, Tullio phenomenon, and instability during gait. She also reported hearing her own heartbeat and eyes blink. Her activity limitations included the inability to perform lower extremity dressing, driving, and playing her flute. Her participation restrictions included not taking part in social gatherings, going to church, driving longer than 30 minutes, playing with her dogs, and not being able to teach flute lessons. Interventions included vestibular habituation and adaptation exercises, balance and gait training, and patient education. Physical therapy services were provided 1-2 times per week for 11 weeks.

Outcomes: The patient had a reduction in symptoms with significant functional improvements. She had improved scores on Lower Extremity Functional Scale (43/80 to 52/80), the Dynamic Gait Index (19/24 to 24/24) the Dizziness Handicap Inventory (86/100 to 68/100), and the Sharpened Romberg (2 seconds to >30 seconds). She was able to drive for up to 5 hours without symptoms, participate in social interactions involving multiple auditory and visual stimuli, and return to playing her flute symptom-free for short 20-minute intervals. She was discharged from PT services with a plan to pursue surgical interventions within the following year to correct the structural dehiscence and hopefully alleviate her remaining symptoms.

Discussion: For a patient with a complex otologic history and a diagnosis of bilateral SSCD and EH, vestibular rehabilitation was an effective management option. This case report supports the previous research for the effectiveness of gaze stabilization and sensory re-weighting for treatment of vestibular dysfunction. Despite the chronic nature of the patient’s symptoms, she was still able to make significant functional improvements from PT. The information gained from this case report can help guide clinical decision making when creating a plan of care for a patient with a complex otologic history.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: 1. Hagr, A. Superior canal dehiscence syndrome. J King Saud Univ. 2010;17(2):57-72. doi: 10.4197/Med.17-2.5


TITLE: Effects of Nustep Seat Position and Cadence on Muscle Activation in Patients with Chronic Stroke

AUTHORS/INSTITUTIONS: K.M. Bowerson, S.N. Beaujean, A.M. Mira, S. Galen, V.M. Pardo, Physical Therapy, Wayne State University, McGregor, Ontario, CANADA

ABSTRACT BODY:

Purpose/Hypothesis: The Nustep total body recumbent stepper is widely used by clinicians to improve cardiovascular health and physical performance. There is a lack of information regarding the effects of seat position and stepping cadence on muscle activation when exercising on the Nustep. The purpose of this study was to investigate changes in electromyographic (EMG) activation in lower extremity muscles while exercising at two different seat positions (and at two speeds) in subjects with chronic stroke.

Number of Subjects: Twenty-four participants (16 female, 13 right hemiparesis, and mean age 61 ± 14.5 years)

Materials/Methods: Participants were positioned on the Nustep for the standard (far) position (10-15 degrees of knee flexion at maximum pedal extension) and the near position (30-35 degrees of knee flexion). A 10 minute trial of stepping was performed to determine the self-selected speed (SS). EMG surface electrodes were then applied to the rectus femoris, vastus medialis, semitendinosus, soleus, medial gastrocnemius, and tibialis anterior muscles bilaterally. The force and EMG output during maximal voluntary contraction (MVC) of each muscle were measured simultaneously using surface EMG and a hand-held dynamometer. The participants then performed 4 bouts of 5 minutes of stepping with a 5 minute rest in between each experimental condition (SS speed near seat, SS speed far seat, 80 steps/min near seat, and 80 steps/min far seat). EMG data were recorded at 10 second intervals during the 2nd, 3rd and 4th minutes of each experimental condition and were normalized to MVC. A descriptive analysis was performed followed by a repeated measures ANOVA to examine differences in muscle activation between experimental conditions, hemiparetic side, and muscle groups.

Results: There were no significant differences in muscle activation between the 4 experimental conditions. However there were significant differences in muscle activation based on hemiparetic side (Left p=0.014, Right p<0.001). Post-hoc analyses revealed that participants with right hemiparesis had significantly different muscle activation (p<0.05) in 12/16 comparisons on the non-affected side vs 4/16 comparisons on the affected side. Participants with left hemiparesis had significantly different muscle activation (p<0.05) in 11/16 comparisons on the non-affected side vs 9/16 comparisons on the affected side. The semitendinosus muscle showed the greatest difference in mean muscle activation between the affected and non-affected side in both patients with right hemiparesis (37.7 % of MVC) and left hemiparesis (21.4% of MVC), while the amplitude differences in other muscle groups were smaller.

Conclusions: This preliminary study has demonstrated that activation of leg muscles was different between participants with right and left hemiparesis during recumbent stepping.

Clinical Relevance: The ability to activate the semitendinosus in the stroke population could be of interest to clinicians, who may want to include recumbent stepping as an intervention during stroke recovery.
TITLE: Endothelial Function and White Matter Microstructure are Associated with Executive Function in Older Adults

AUTHORS/INSTITUTIONS: N. Johnson, Rehabilitation Sciences, University of Kentucky, Lexington, Kentucky, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Advancing age is associated with endothelial dysfunction (1). Age-related declines in endothelial function can lead to cardiovascular disease and cognitive decline. Little is known about the potential relationship between endothelial function, white matter (WM) microstructure, and executive function in older adults without cardiovascular disease. This study explored the relationship between measures of endothelial function (reactive hyperemia index; RHI), WM microstructure, and executive function.

Number of Subjects: 36

Materials/Methods: Participants were 36 older adults (13 males) between the ages of 59 and 69 (mean age = 63.89 years, SD = 2.94). Executive function was evaluated using the Trail Making Test (TMT). The Trail Making Test (TMT) is a reliable and valid assessment of executive function that is related to WM microstructure and overall brain health (2, 3). Reactive hyperemia was evaluated using the EndoPAT 2000 (Itamar Medical, Israel). Peripheral arterial tone (PAT) is a measure of the digital pulsatile volume changes to a reactive hyperemia challenge at the fingertip, and a RHI is calculated. WM microstructure was assessed using diffusion tensor imaging (DTI) MRI. All imaging data were acquired on a 3T TIM Siemens scanner at the University of Kentucky’s Magnetic Resonance Imaging and Spectroscopy Center. All imaging data were analyzed using our previously published protocols (4, 5). We determined the relationship between executive function, endothelial health, and WM microstructure.

Results: Results indicated a positive relationship between RHI and WM microstructure in the genu and body of the corpus callosum. RHI and WM microstructure demonstrated a positive relationship with executive function, such that superior endothelial function and WM microstructure were associated with smaller increases in the amount of time required to complete Trail B compared to Trail A (Trail B – Trail A). Tractography results provided a physiological basis for this relationship. Specifically, the RHI-WM microstructure relationship observed in the corpus callosum primarily involved tracts interconnecting frontal regions, the superior frontal gyrus and frontopolar cortex, associated with high-level cognitive function.

Conclusions: These findings suggest that superior endothelial function may help to attenuate age-related declines in WM microstructure in portions of the corpus callosum that interconnect homologous prefrontal regions involved in executive function.

Clinical Relevance: Age-related declines in cognitive function can lead to a loss of functional independence. Modifiable lifestyle factors such as physical activity and exercise have been shown to attenuate age-related declines in cognitive function, while simultaneously improving vascular health. Endothelial function, a measure of vascular health, may play a mediating role in the relationship between fitness and brain health. This study has provided a step forward towards understanding the relationship between vascular health, WM microstructure, and cognitive function.
Purpose: As the number of individuals with disabilities requiring mobility assistance increases, there is a greater need for therapists to be trained in Seating and Mobility. CMS require that a trained professional complete an evaluation in order to approve the purchase of a wheelchair. The Clinician Task Force and industry leaders are collaborating with the APTA Neurology Section to develop expectations for seating and mobility. Suppliers of Complex Rehab Technology (CRT) express frustration with the inability to access Physical (PT) and Occupational therapists (OT) that are knowledgeable in seating and mobility. Lack of access to trained professionals puts patients at risk for further medical complications such as pressure ulcers and limited mobility due to poor fitting equipment.

Description: To address this need, part-time and full-time clinical experiences for entry-level DPT students were developed. Learning experiences encompassed specific evaluation and outcome measures for comprehensive assessment and equipment recommendations including clinical decision algorithm, inter-professional clinics, and working directly with suppliers in the clinic, workshop, school and home environments. In addition to the Clinical Performance Instrument (CPI), students completed a clinical evaluation and some completed reflections. A follow-up survey was conducted to determine impact on practice after graduation.

Summary of Use: To date 3 entry-level DPT students have completed full-time 8-week clinicals in Seating and Mobility and 2 students have completed a part-time integrated clinical. All the students met the established passing criteria on the CPI. The diversity of case mix covered the full spectrum (Musculoskeletal, Neuromuscular, Cardiopulmonary, Integumentary and other: GI, GU, Renal, Metabolic, Endocrine) and the entire lifespan. All the full-time students rated the experience as “Excellent clinical learning experience”, “Time well spent and would recommend this clinical education site to another student.” A part-time student indicated: “The skills I learned here will carry over to any setting that I am in for the future.” Sample reflections included: “Starting from day one I have been rocked by the severity of disability that has been placed in specialized wheelchairs and the care and dedication to detail that goes into each one of those chairs”; “The sheer amount of evaluations on a daily basis allowed me to get ample practice with evaluation skills and subjective/history taking skills; “Due to the variety of patients I was able to practice a wide variety of evaluation skills from simple muscle/ROM testing to more detailed vision or coordination skills.”

Importance to Members: Training of future professionals in the area of Seating and Mobility, specifically Complex Rehabilitation Technology (CRT), is essential to improving access and facilitating the best patient outcomes. With specifically designed experiences, specialty settings can provide entry-level students with unique experiences that address this identified need and support the development and refinement of their entry-level skills.
The Effect of Mirror Therapy and Repetitive Task Training on Persons with Chronic Stroke

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ABSTRACT BODY:

Background & Purpose: Of the 700,000 Americans who sustain a cerebrovascular accident or stroke each year, almost two thirds survive and require intensive rehabilitation. However 30%-66% of patients with stroke lack functional use of the paretic upper extremity even at 6 months post stroke. The purpose of this study is to investigate the effect of mirror therapy and repetitive task training on upper extremity function for persons with chronic stroke. Mirror therapy (MT) and Repetitive task training (RTT) are two approaches to stroke rehabilitation that are currently used for patients with chronic hemiplegia. Although both of these approaches have been supported by literature, it is important to look at their validity when used in combination with other forms of treatment. Research has been done by looking at the effects of combining both of these treatment protocols with other forms of therapy, however these therapies have not been used often in combination with each other. There also is a limited amount of research on using these two treatment methods in combination with other treatment methods for patients with chronic hemiplegia due to stroke including home exercise programs.

Case Description: Four adults aged 22-67, who had suffered a stroke, participated in the study. The subjects were a sample of convenience recruited from local outpatient clinics via flyers and referrals.

Outcomes: Participants received twice weekly in-clinic, 60-90 minutes/sessions and individualized home program 4 days/week. Session components included 6 planar exercises with mirror box and supervised practice of 3 functional tasks. A minimum of 150 total repetitions were required for each component. The home program replicated the in-clinic sessions. Primary measures were the Patient Specific Functional Scale (PSFS) to measure functional gains and the Fugl-Meyer UE Assessment (FMA) to measure neuromotor change. The secondary measure was the Motor Activity Log (MAL) to measure amount of use (AOU) and perceived quality of movement (QOM). All measures were taken at 1 week prior, at 2 and 4 weeks of the intervention, and 2 weeks post-intervention/follow-up. Change scores between pretest and posttest/follow-up were compared to established minimum detectable change (MDC). All participants reached the MDC in the FMA between pretest and posttest/follow-up. Three participants also reached MDC in the PSFS; one participant improved but did not reach MDC. One participant reached MDC in the AOU scale, however, three participants clinically improved in their MAL QOM. Although not all participants reached MDC in the MAL, all increased the number of items they attempted from an average of 17.5 items at pretest to 22.75 items at follow-up.

Discussion: The outcomes of this case series design suggests that mirror therapy in conjunction with repetitive task training intervention and a home exercise program is a useful therapy technique for improving upper extremity function in persons with chronic stroke.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old:
8. Takeuchi, N., & Izumi, S., "Rehabilitation with Poststroke Motor Recovery: A Review with a Focus on Neural
Purpose/Hypothesis: Fatigue is a common Multiple Sclerosis (MS) symptom. It is known to worsen with physical exertion over time. Spasticity, another common MS symptom, is thought to worsen as fatigue increases, but little literature exists to support this. The purpose of this study was to examine the effects of fatigue on spasticity in MS. We hypothesized that as fatigue during a mobility task increased, so would spasticity. If correct, our hypothesis would suggest that these two primary symptoms of MS are interrelated, and that treatment of one may result in effects on the other.

Number of Subjects: 17 subjects with a definite diagnosis of MS recruited from local area MS centers.

Materials/Methods: A randomized controlled crossover design was used. Ambulatory MS subjects were randomized into walking (W) and resting (R) groups. Spasticity was tested using the Modified Ashworth Scale (MAS). After spasticity testing the (W) group performed a maximum effort 6-minute walk to induce fatigue while the (R) group lay supine for 6 minutes to minimize fatigue. Fatigue was measured before and after each 6-minute condition using the Visual Analog Scale of Fatigue (VAS-F). Immediately following either 6-minute condition the MAS was repeated. This was repeated for three consecutive trials and then followed by a 2-week detraining period. Subjects then crossed over, performing whatever type of activity [(W) or (R)] they did not participate in initially.

Results: 17 subjects (mean EDSS = 3.45) completed the study. In the (W) group, mean pre- to post- fatigue MAS scores decreased from 1.054 to 8.27, (p = .015) indicating subjects displayed less spasticity when fatigued. In the unfatigued condition, spasticity did not change significantly. VAS-F pre to post fatigue scores increased 35.19mm (p>.001) in the (W) group, indicated that the walking resulted in increased fatigue.

Conclusions: Contrary to expectations, persons with MS who increased their fatigue through fast walking had decreased spasticity as measured by the MAS, suggesting that spasticity decreased, rather than increased with increasing fatigue. These findings however should be interpreted with caution as the trial subjects had relatively mild spasticity and overall disability. Therefore, repeating this study with more disabled participants is indicated. Additionally, the possibility that a fatigue-inducing task other than walking might have resulted in greater spasticity cannot be ruled out.

Clinical Relevance: Spasticity and fatigue are common findings in MS and both are known to impact mobility. Mobility is also known to worsen as fatigue increases in pwMS. However, the results of this study suggest that spasticity decreases rather than increases with fatigue in pwMS, indicating that the worsening of mobility with increasing fatigue is not due to spasticity. Clinicians should therefore be cautious in ascribing worsening gait in fatigued pwMS to increased spasticity, and consider alternative hypotheses.
Propofol Induced Myoclonus After IV Sedation: A Case Study

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Abstract Body:

Background & Purpose: Propofol is commonly used to induce general anesthesia. Myoclonus, a quick involuntary jerking secondary to neurological insult, as induced by Propofol, is poorly understood. Animal and human case studies primarily address the medical signs, symptoms and the surrounding circumstances under which myoclonus was observed in conjunction with Propofol. Physical therapy (PT) as an intervention is not specifically addressed. The purpose of this case study is to describe the history, evaluation and PT treatment of a 21-year-old female student who experienced Propofol induced myoclonus after a dental procedure.

Case Description: JC was evaluated in outpatient PT 2 weeks after her wisdom teeth were removed under IV Propofol sedation. Upon examination, JC demonstrated involuntary jerking of the trunk to the right in weight bearing and in supine. Her myoclonus worsened with activity. JC’s impairments of bilateral hyperreflexia (L3 and S1) and general lower extremity muscle weakness (MMT= 4/5) limited her functional mobility (i.e. impaired balance and ataxic gait deficits), as seen in her Timed Up and Go (TUG) performance (44 seconds) and prevented her from participating in school. JC was seen for 24 visits over 11 weeks for PT interventions including strengthening, balance and coordination activities, as well as introduction of “novel” environments and gait training.

Outcomes: After 4 weeks (12 PT visits), JC reported being at 85% of her prior functional level, although she continued to have difficulty navigating crowded environments. Though she completed the TUG in 5 seconds, had restored normal reflexes, and demonstrated improved lower extremity strength (5-/5), JC’s Activity Specific Balance Confidence Scale-6 (ABC-6) was 48.33%. Shortly after re-evaluation, JC experienced a setback of increased myoclonic activity with ambulation and exercises as well as intermittent myoclonic episodes at night. This resulted in medication alterations of discontinuing Clonazepam and initiating Lamotrigine. By 9 weeks (22 PT visits), she met 90% of her goals, was able to run on a treadmill, ascend and descend stairs with 1 rail, and perform plyometric exercises without myoclonus. At discharge (24 PT visits), JC met 100% of her goals, demonstrated normal strength (5/5), improved balance confidence (ABC-6 =78.33%), and navigated stairs inclines independently without rails while carrying her backpack. She returned to school the following semester.

Discussion: While the pathophysiology of Propofol induced myoclonus remains unclear, JC benefitted from PT intervention. Her strength, balance, motor control and ability to perform functional tasks improved over the course of PT treatment facilitating the return to participating in school activities. This case study describes the clinical presentation and identifies potential benefits of PT for a young woman with Propofol induced myoclonus.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.:


Exercise Program For A Patient With Sjögren’s Disease: A Complex Patient Case Study

Y. Salem, C. Holmes, H. Liu, Physical Therapy, University of North Texas Health Science Center, Ft Worth, Texas, UNITED STATES

Background & Purpose: Sjögren’s is a systemic autoimmune disease that affects multiple systems and parts of the body. Symptoms may include pain, stiffness and neuropathies. Symptoms may remain steady, worsen, or, uncommonly, go into remission. Symptoms vary from very mild to debilitating symptoms that greatly impair functioning. The purposes of this case study are to describe a patient with Sjögren’s disease with multiple systems involvement and propose a physical therapy management for this condition.

Case Description: The patient was a 60-year-old female diagnosed with Sjögren’s disease four years before the intervention. The patient presented with severe motor and sensory peripheral polyneuropathy affecting the legs (proximal more than distal). The patient demonstrated multisystem involvements with significant impairment in balance and walking and was restricted from many ADL secondary to pain and increased risk of falls. The patient participated in an 18-month, one session per week, moderate intensity, progressive exercise program focusing on walking exercises, balance training and strengthening exercises for the core and lower extremities. The intervention was designed to address specific impairments identified during her physical therapy examination.

Outcomes: Measurements were taken before and after the 18-month of exercise and at 2-month follow-up. After the intervention, the patient showed considerable improvements in measures of physical function, quality of life (SF-36), and neuropathic signs and symptoms as measured by the Leed Assessment of Neuropathic Symptoms and Signs (LANSS). Improvements were maintained at follow-up. The subject’s gait speed increased from 0.89 to 0.113 m/s; Timed Up and Go test improved from 19 to 11 s; single leg stance improved from not able to 5.44 s; grip strength increased from 12 to 18 kg (right) and from 8 to 13 (left); and dynamic gait index improved from 11 to 20. The patient Six-Minute Walk Test distance increased from 7,20 feet to 1, 270 ft. Close monitoring of the patient indicated that the exercise program was well tolerated and there is no adverse events.

Discussion: This case report describes an exercise program that was associated with positive long-term changes in physical function, neuropathic signs and symptoms and quality of life without causing injury in an individual with Sjögren’s disease.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: 

Wouters E, Leeuwen N, Bossema K, Booesma H, Bijlsma J, Geenen R.
TITLE: Use of the Ekso Bionics Exoskeleton Robotic Assisted Mobility Device with Acute Rehabilitation Patients: Preliminary Results

AUTHORS/INSTITUTIONS: V.A. Flaherty, C. Anderson, K. Ball, K. Furman, Physical Therapy, Marianjoy Rehabilitation Hospital/Northwestern Medicine, Aurora, Illinois, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: The purpose of this investigation was to assess the clinical effectiveness of the Ekso Bionics Exoskeleton with acute rehabilitation patients. The primary aim was to evaluate the changes in functional outcomes following use with the Ekso.

Number of Subjects: The participants represented a convenience sample of six patients referred to physical therapy for ambulation training with the use of the Ekso. Diagnosis included four patients with stroke, one patient with a traumatic brain injury; and one patient with critical illness myopathy.

Materials/Methods: This was a prospective, non-randomized, observational study with pre and post measurements following Ekso training. There was no change in clinical protocol. The primary outcomes included were the 10 meter walk test; FIM Mobility scores (Transfers and locomotion); and the functional reach test.

Results: Six patients completed training with the Ekso. Participants included four males/two females; age range from 44–66 years with a mean age=55.6 years (SD=8.14 years). Number of days from onset of disability to the first Ekso treatment ranged from 8–26 days, with a mean onset of 13.5 days (SD=6.8 days). Total number of Ekso treatments ranged from 4-8 sessions (mean=6.16 sessions, SD=1.83 sessions) distributed across a time frame of 5-35days. Pre-Ekso treatment 10-meter walk test mean score was 0.258 and post-treatment was 0.443 (t=2.871, p=.035). Pre-Ekso mean FIM Transfer score was 3.5 and post-treatment was 4.8 (t=-4.00, p=.01). Pre-Ekso mean FIM Locomotion score was 2.17 and post was 4.17 (t=-3.873, p=.012). Pre-Ekso treatment for functional reach mean score was 3.0 and post was 8.38 (t=3.074, p=.054). Total walk time in the Ekso ranged from 5.2 to 31.2 minutes per treatment with a mean of 14.8 minutes (SD=7.04 minutes). Total up-time in the Ekso ranged from 18.5 minutes to 49.01 minutes per session with a mean of 30.24 minutes (SD=9.36 minutes). Total steps in the Ekso ranged from 110 to 759 with a mean of 416 steps (SD=194 steps). As expected, the longer the duration of Ekso “up-time” the more likely the patient was to take more steps (R=.806, p≤.0001).

Conclusions: The preliminary results revealed significant positive clinical changes with the functional outcomes related to the 10-meter walk test, FIM transfer score, and FIM locomotion score. Changes for the functional reach test were not statistically significant. More importantly, from a clinical practice standpoint, the correlation between “up-time” and increased number of patient’s steps demonstrates the potential value of this device related to neuroplastic retraining.

Clinical Relevance: The use of a robotic assisted mobility device is an emerging technology for use in physical therapy that requires ongoing investigation; however, this device shows promise to promote neuroplastic changes for ambulation recovery. Future efforts should evaluate the added value of a robotic assisted mobility device in comparison to traditional physical therapy treatment alone with the chronic patient population.
**TITLE:** The Effects of Rhythmic Auditory Stimulation on Gait Characteristics in An Individual With Young-onset Parkinson Disease: A Case Study

**AUTHORS/INSTITUTIONS:** R.S. Kakar, S. Fishel, A. Alteri, C. Brown, C. Coleman, I. Ford, L. Hilgner, N. Murad, Physical Therapy, Ithaca College, Ithaca, New York, UNITED STATES

**ABSTRACT BODY:**

Background & Purpose: Parkinson disease (PD) is a neurodegenerative disease affecting up to 10 million people worldwide, with 10% having a young-onset PD (YOPD). The most common signs and symptoms of typical PD (rigidity, tremor, bradykinesia, postural instability, and dystonia) progress at a slower rate with YOPD. Interlimb asymmetries and temporospatial gait deviations are byproducts of varied combinations of symptom presentation causing gait instabilities that may contribute to fall risk in persons with PD. The purpose of this case study was to assess the impact of a single session of rhythmic auditory stimulation (RAS) during treadmill walking on upper and lower extremity gait characteristics and symmetries for a patient with YOPD.

Case Description: Participant was an active 35 year old male diagnosed 6 years ago with tremor dominant YOPD currently at stage 2.5 on the modified Hoehn and Yahr scale. His medications included levodopa, monoamine oxidase inhibitors, and dopamine agonists. At the time of testing he was in an 'ON' phase of his levodopa. He displayed symptoms both axially and bilaterally, with his more involved side being the right. He reported an untreated right clavicle fracture 9 months ago.

Instrumentation: Noraxon® instrumented pressure treadmill and MR3® software were used to capture cadence, gait velocity, step length, stance symmetry, and double limb support. The iPad® application Sparkmotion® was used to measure arm swing angular displacement (ASAD) in the sagittal plane.

Methodology: Baseline gait variables were collected during 2 min warm-up walk on a treadmill. Subsequently, the participant performed 10 min of treadmill walking while matching his cadence to a RAS set 5% above baseline. Data was recorded every 2 min during the intervention. An immediate post-intervention and a 10 min follow-up data collection were performed without RAS for the variables of interest.

Outcomes: The greatest differences were noted in single leg stance (SLS) duration symmetry and ASAD. SLS had a 2% increase in symmetry while ASAD increased 11.6° on the right and 13.4° on the left with minimal changes in symmetry. Additionally, cadence and self-selected velocity increased by 4 beats per minute and 0.8 m/s respectively. Step lengths increased by 0.03m on the right and 0.04m on the left without increased symmetry. Double stance increased by 0.6% of the gait cycle.

Discussion: The findings in this study suggest that a single 10 min treadmill intervention using RAS can result in immediate improvement in temporospatial gait parameters that potentially correlate to decreased fall risk in the YOPD population. Results were consistent with those reported in the literature for effects of RAS on cadence, gait velocity, and step length. Additionally, RAS can improve ASAD and stance symmetry, which can potentially improve gait and local dynamic stability. Further research is warranted regarding the long-term impact of RAS in overground walking in individuals with YOPD.

**References:** Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: 1. Cole MH, Silburn P a., Wood JM, Worringham CJ, Kerr GK. Falls in Parkinson’s disease: Kinematic evidence for impaired head and trunk control. Mov Disord. 2010;25(14):2369-2378.
TITLE: The Effect of Rhythmic Auditory Stimulation on Gait Outcomes in Adults with Non-Progressive CNS Diagnoses: A Systematic Review

AUTHORS/INSTITUTIONS: J. Cominsky, C. Joyce, S. Leschen, M. Raab, J. Schwartz, R.M. Hakim, Physical Therapy, University of Scranton, Scranton, PA, Pennsylvania, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: The purpose of this systematic review was to determine the effects of rhythmic auditory stimulation (RAS) on gait outcomes in adults with non-progressive CNS diagnoses.

Number of Subjects: N/A

Materials/Methods: A literature search (2006-2016) of Cochrane Library, CINAHL, ScienceDirect, MEDLINE/PubMed was conducted using search terms: (Rhythmic auditory stimulation OR auditory rhythm OR externally controlled stimulation OR mechanically controlled cueing OR music therapy) AND (gait training OR gait OR walking OR ambulation OR treadmill training) AND (non-progressive neurological diagnoses OR stroke OR cerebrovascular accident OR Traumatic brain injury). Search limits: English, human subjects, and peer-reviewed RCTs. Selection criteria: adults 18 years and older with non-progressive CNS diagnoses, intervention including RAS training and a measure of gait outcomes. Two reviewers independently assessed each article for methodological quality and came to a consensus using PEDro guidelines.

Results: A total of 27 articles were screened for eligibility. Following detailed appraisals, 6 RCTs met the criteria. PEDro scores ranged from 5 to 7/10 (avg=6.5). Samples ranged from 16 to 155 subjects (total=272) with acute (200) and chronic stroke (72). Treatment parameters varied widely with durations ranging from 4 days to 6 weeks in clinical settings. RAS was delivered by means of a metronome in all 6 studies with 2 studies also using music. Primary outcome measures included gait parameters, Dynamic Gait Index (DGI), Timed Up and Go (TUG), and the 10 Meter Walk Test. Secondary outcomes included: Berg Balance Scale (BBS), standing balance (Biosway), Fugl-Meyer lower extremity scale, Stroke Specific Quality of Life (SS-QOL) Scale, and EMG recordings. Five out of the 6 studies were clinically and statistically significant in improving gait outcomes using RAS. Four of 6 studies found significant improvements in velocity, stride length, cadence, swing symmetry, double support, and step length. Two studies found significant gains in BBS scores and standing balance. Additional benefits of utilizing RAS included increased EMG activity of the lower extremity, peak-to-peak joint angular displacement, and QOL.

Conclusions: There is moderate to strong evidence supporting the use of RAS in gait training for patients with non-progressive CNS disorders, in particular patients with acute and chronic stroke. Limitations included small sample sizes, lack of long-term follow-up, and short study durations. Future RCTs should focus on determining optimal mode and parameters for RAS training.

Clinical Relevance: Clinicians should consider the use of RAS gait training in patients with non-progressive CNS disorders to improve gait outcomes. RAS is feasible and easily implemented in the clinic in order to improve gait outcomes and recovery in functional ability. Improvements may be seen in as few as 4 days, but the literature most commonly suggested 30 minutes/day, 5x/week, for 3 to 6 weeks duration.
TITLE: The effect of bilateral limbs rehabilitation training on post-stoke patients

AUTHORS/INSTITUTIONS: Q. wu, X. wang, rehabilitation, North China University of Science and Technology, Tangshan, Hebei, CHINA|H. Liu, Y. Salem, Physical Therapy, UNT Health Science Center, Fort Worth, Texas, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis: Functional recovery of extremities is essential for patients with stroke to perform daily activity of living (ADL). In clinic, a patient with hemiplegia due to stroke often receives therapeutic exercise interventions to improve motor functions of both upper and lower extremities. Currently, for rehabilitation of extremities, whether emphasis should be on the affected extremities only or on both affected and unaffected extremities is still not clear. Therefore, the purpose of this study was to compare the effects between unilateral and bilateral extremities therapeutic exercise training on the motor functioning and muscle activities in patients with stroke.

Number of Subjects: Sixty patients with hemiplegia at sub-acute stage were recruited from a local rehab hospital for this study.

Materials/Methods: This was a randomized control trial with two groups: rehab training on affected side only (G1) and training on both affected and unaffected sides (G2). Patients were randomly assigned to G1 (n=30) or to G2 (n=30) for 45 minutes/day, 5 times/week, for 4 weeks. The interventions for both groups were task-based strengthening and stretching exercises, but the sets of each exercise were different: G1 usually had 25-30 minutes on the affected side followed by 20-25 minutes on the unaffected side; while G2 had all 45 minutes on the affected side. Assessments were conducted at baseline and post-intervention, including Motor Assessment Scale (MAS), Fugl-Meyer Assessment (FMA) and surface EMG (sEMG) activity of deltoid, biceps brachi, triceps brachi, rectus femoris, biceps femoris, and tibialis anterior. One-way analysis of variance with repeated measure was used for data processing.

Results: G2 showed significant improvement in MAS, MVC, and sEMG activities (integrated EMG and RMS) of all tested muscles (P<0.05) when compared within group (pre-verse post-within G2) as well as when compared between groups (G1 verse G2). However, such significant improvements were not identified in FMA (P>0.05) regardless for comparison within G2 group or for comparison between G1-G2 groups.

Conclusions: Results from this study indicate that task-oriented exercises on unaffected side might be able to facilitate or strengthen the effects of therapeutic interventions on muscle activities and motor recovery on the affected side. The effects from bilateral interventions are even better than those from only unilateral (affected side) interventions. MAS might be better in assessing motor functioning than FMA for patients in sub-acute stage.

Clinical Relevance: Bilateral therapeutic interventions seem to be more beneficial for functional motor improvement for patients with sub-acute stroke. Due to limited conditions, this study intervention time is short and lack of long-term effect observation, further study is needed.
TITLE: Effects of Cutaneous Cueing in Step Initiation Anticipatory Postural Adjustments in Stroke Survivors

AUTHORS/INSTITUTIONS: M. Dowdal-Osborn, Doctorate of physical therapy program, Concordia University St. Paul, Minneapolis, Minnesota, UNITED STATES| D. Kukulka, University of Minnesota (retired), Minneapolis, Minnesota, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Step initiation is preceded by a series of electrical and mechanical events that constitute anticipatory postural adjustments (APAs). These APAs are highly predictable in persons without neuromuscular impairments and are known to be advantageously influenced with sural nerve stimulation. This study was designed to investigate step initiation APAs in stroke survivors in a reaction time paradigm under two “go” cues: (1) sural nerve stimulation; (2) visual light onset. This study investigated 2 hypothesis: (1) Reaction times for vertical ground reaction force, medial-lateral and anterior-posterior center of pressure (COP) and tibialis anterior (TA) and gluteus medius (GM) onsets will be shorter with sural stimulation go cue than a visual go cue and (2) vertical ground reaction force, speed of force onset, medial-lateral and anterior-posterior COP, and TA/GM EMG of the stepping limb will be enhanced with sural stimulation go cue than a visual go cue.

Number of Subjects: 15

Materials/Methods: Fifteen participants, 9 males and 6 females with a median age of 60 (35-84) and median years since stroke of 7 (1-20), participated in a stepping reaction time paradigm under two “go” cues: (1) sural nerve stimulation; (2) visual light onset. Subjects performed 30 steps with each leg given randomly assigned go cues. Four primary outcomes were assessed: (1) Loading forces; (2) COP excursions; (3) EMG activity in bilateral TA and GM muscles; (4) Reaction times of loading forces, COP and EMG onsets.

Results: Sural cueing significantly increased vertical loading, COP and EMG reaction times across all conditions of the stepping trials. The sural cue also produced significantly faster vertical loading compared to a visual cue. The loading amount and speed, EMG activity and net COP displacement were significantly influenced by the stepping condition (paretic or non-paretic).

Conclusions: The results of this study are the first to report the ability to improve both reaction times and various aspects of the APA with sural cueing in a stroke population. As prolonged reaction times are believed to be a major predictor of falls and APAs are diminished in stroke survivors, these results promote training studies for improving reaction times and APAs.

Clinical Relevance: APAs may be impaired in healthy elderly and neurologically involved individuals. These impairments have a variety of implications including increased fall risk and gait initiation difficulties. Understanding how step initiation APAs may be altered to release a step faster, easier, or more efficiently may lead to novel rehabilitation approaches in a broad range of patient populations. Interventions that assist with an earlier release of a first step in stroke survivors may hasten gait recovery by normalizing step initiation. A more rapid step release may improve balance recovery from unpredictable perturbations thereby reducing fall incidence.
Purpose/Hypothesis: The purpose of this systematic review was to determine the effect of virtual reality (VR) on improving balance, gait and mobility in adults with Parkinson's Disease (PD).

Number of Subjects: N/A

Materials/Methods: A literature search of MEDLINE/PubMed, Science Direct, SpringerLink, Google Scholar, and CINAHL was conducted (2006-2016). Search terms included: (Parkinson's Disease OR Parkinson's OR PD) AND (virtual reality OR visual augmented feedback OR VR) AND (balance OR gait OR mobility). Search limits: English, humans, and peer-reviewed. Selection criteria: diagnosis of PD, intervention included VR, outcomes of balance/gait/mobility, and RCT. Two reviewers independently assessed each study for methodological quality and came to consensus based on PEDro guidelines.

Results: A total of 1,112 articles were screened for eligibility. Following detailed appraisals, 8 RCTs met the selection criteria. PEDro scores ranged from 5/10 to 8/10 (mean = 6.6). Sample sizes ranged from 20-44 participants (256 total; avg. age 66.5 y/o) with mild-moderate PD (H&Y Stages I-III). Treatment parameters varied at 2-5 sessions/wk (30-60 min) with 6.5 wks average duration (range 4-12 wks). Seven studies used VR systems with a force plate (FP) and external display [4 of 6 fixed (2 Wii Fit), 2 dynamic] and one used a handheld controller with no force plate (Wii). Training was administered by a PT during the “on” phase of medication for all participants. Primary outcomes included: standing balance (SOT, rhythmic weight shifts, BBS, FRT, SLS), gait (DGI, TUG, 10MWT, tandem gait, obstacle crossing) and mobility/ADLs (MBI, STS, PDQ-39, UPDRS2). Statistically significant improvements were found between the experimental groups vs. the control groups for balance in 3 studies (Wii Fit, dynamic FP, Wii), gait in 2 (Wii Fit, dynamic FP) and mobility in 2 (Wii Fit, Wii). Statistically significant improvements were found within both groups for balance in 3 studies (fixed FP, dynamic FP, Wii), gait in 1 (fixed FP), and mobility in 2 (Dynamic FP/Biodex, Wii).

Conclusions: Findings are mixed as to whether VR is superior to traditional PT, however there is moderate evidence that VR combined with exercise and/or treadmill training improves balance, gait and/or mobility in persons with mild-moderate PD. Limitations included widely variable treatment parameters and outcomes, small sample sizes and complex equipment used in some studies. Future research is needed to define VR treatment parameters to optimize balance, gait and mobility outcomes in this population.

Clinical Relevance: Commercially available VR systems (i.e., Wii, Wii Fit) were equally as effective as other dynamic and fixed FP systems to enhance balance, gait and mobility in patients with mild-moderate PD. Effective protocols included VR combined with exercise and/or treadmill training for 20-30 mins, 2-3X/wk for 6-12 weeks duration. Based on the evidence, clinicians should consider the use of VR (Wii or Wii Fit) as a safe, feasible adjunct to the treatment of patients with PD in clinical and home settings.
**Title:** Physical Therapy Service Utilization and Outcomes for Youth with Concussion  

**Authors/Institutions:** J. Hugentobler, B. Kurowski, C. Quatman-Yates, CCHMC, Cincinnati, Ohio, UNITED STATES | A. Lennon, Outpatient Orthopedic and Sports Rehabilitation Department, Mercy Health, Cincinnati, Ohio, UNITED STATES | M.C. Sroka, Occupational Therapy Department, Ohio State University, Columbus, Ohio, UNITED STATES | I. Gagnon, Physiotherapy, Montreal Children's Hospital, Montreal, Quebec, CANADA

**Abstract Body:**

**Purpose/Hypothesis:** Physical therapists are recognized as an important part of the multidisciplinary care team for management of patients with persistent symptoms after concussion. Impairment-based systems have been proposed to guide management of persistent symptoms following concussion. The purpose of this study was to describe the dominant impairment domains and outcomes of patients presenting to outpatient physical therapy.

**Number of Subjects:** 175 patients (108 females, 67 males; mean age, 14.2 years; range, 6-21 years)

**Materials/Methods:** Data were extracted from outpatient physical therapy medical records of a large, metropolitan pediatric medical center from November 1, 2014 to January 31, 2016. Patient records were eligible for analysis if the patient was referred to physical therapy for post-concussion interventions. Two trained, independent reviewers evaluated each identified patient record to classify the type of impairments present (musculoskeletal, physiological, and/or vestibulo-ocular) and outcome (good, fair, poor, or unable to be determined). Impairment classifications were based on a set of pre-determined criteria relative to the standardized assessment and documentation protocols used by physical therapists at the institution. Outcome classifications were based upon a predetermined set of criteria relative to Post-Concussion Inventory Symptom Scale (PCSI) scores, outcome measures, resolution of documented physical exam impairments and return-to-pre-injury activity. Descriptive statistics and frequencies counts were computed for the full set of patient records with regard to the reviewer assessments. For all records with initial and final PCSI total symptom scores available, a paired samples t-test comparing initial to final scores was performed.

**Results:** The percentage of patients falling into each classification is as follows: 86.3% had musculoskeletal impairments, 74.7% had physiologic impairments, and 87.9% had vestibulo-ocular impairments. Outcome classifications resulted in 108 (61.7%) and 48 (27.4%) patients classified as having good and fair outcomes, respectively. Six (3.4%) individuals had poor outcomes or showed no improvement and 13 (7.4%) had outcomes that were unable to be determined. A subset of records had both PCSI from initial and final visits assessments available (85 female, 52 male mean 14.38 ± 2.46 years). There was a statistically significant decrease in PCSI scores from initial visit (22.1 ± 20.86) to the final visit (9.15 ± 15.35) (p < 0.001). The mean decrease in scores was 12.95 with a 95% CI ranging from (CI of 9.6 to 16.28).

**Conclusions:** A majority of patients following concussion presented to physical therapy with musculoskeletal, physiologic and/or vestibulo-ocular impairments. A significant improvement in PCSI is found for those individuals from their initial visit compared to their end, as well as an ability to achieve good and fair outcomes with treatment.

**Clinical Relevance:** Physical therapists are well-suited to be among the providers of care for pediatric patients with persistent post-concussion symptom deficits to achieve satisfactory outcomes.
Title: Stress Reduction Techniques for the Treatment of Brain Injury: A Systematic Review


Abstract Body:

Purpose/Hypothesis: In the United States, the annual occurrence of traumatic brain injury (TBI) has increased from a reported 1.4 million in 2004 to 1.7 million in 2010. Each year, greater than 5% of individuals with TBI require long-term assistance with activities of daily living. Symptoms commonly experienced by individuals who have experienced TBI can include pain, fatigue, depression, anxiety, and/or decreased concentration. In healthy populations, yoga and mindfulness practices have been shown to improve attention, memory, executive function, management of stress and overall well-being. There is reason then, to investigate the influences of yoga and mindfulness practices on the treatment of impairments and functional limitations associated with TBI. The objective of this systematic review is to determine the effectiveness of yoga and mindful practice on symptoms associated with TBI.

Number of Subjects: 15 articles were included in this review.

Materials/Methods: A systematic literature search was conducted on the following databases: PubMed, CINAHL, SportDiscus, Cochrane Library, Research Gate, ProQuest, and Physiotherapy Evidence Database (PEDro). Quality of articles was analyzed using the PEDro or MINORS scales, depending on the type of research design. Inclusion criteria included articles that were: published in peer-reviewed journals, had an experimental design, used objective outcome measures, included yoga and/or mindfulness, and were available in English. Exclusion criteria included: research that included psychotherapy or cognitive behavioral therapy, and unavailability of full text articles.

Results: Fifteen studies satisfied eligibility criteria. Outcomes showed significant, positive effects on both psychological and physical well being for individuals with TBI after yoga or mindful practice. Psychological improvements included increases in memory, attention, and mental health. Outcomes also showed a reduction in symptoms of depression, anxiety, post-traumatic stress disorder, mental fatigue and pain. Physical benefits included improvements in response time as seen on neuropsychological testing and in visual scanning ability. None of the included studies found any adverse effects from the use of yoga or mindful practice.

Conclusions: Use of yoga and mindful practice in the treatment of TBI may lessen the severity of commonly experienced symptoms.

Clinical Relevance: Physical therapists may consider the use of yoga or mindful practice to address symptoms such as pain, fatigue, depression, anxiety, and/or decreased concentration in patients with TBI. Patients with increased attention and memory may have less difficulty when learning new tasks that are introduced during physical therapy treatment. Improvements in such skills may allow the patient to progress through their treatment with less need for repetition for reinforcement and ultimately, greater independence. A subjective decrease in pain may improve function and allow the patient to complete more tasks such as gait training or activities of daily living with greater ease, leading to increased function.

AUTHORS/INSTITUTIONS: A. Chou, Physical Therapy, NYU Rusk Rehabilitation, Brooklyn, New York, UNITED STATES|D. Kao, Physical Medicine and Rehabilitation, NYU Rusk Rehabilitation, New York, New York, UNITED STATES

ABSTRACT BODY:

Background & Purpose: Currently there is limited research on the effects of physical therapy interventions for patients with Neuromyelitis Optica (NMO). Intensity of treatment tends to be conservative due its similar disease process as seen in Multiple Sclerosis. The purpose of this study is to discuss the safety and outcome of administering a high intensity, inpatient rehabilitation (IPR) regimen for patients with NMO.

Case Description: A 30 year old female presented to IPR with a diagnosis of NMO and was treated with a five day course of high dose methylprednisolone, five treatments of plasma exchange, and one dose of rituximab prior to IPR admission. Clinically, she presented with a flaccid right lower extremity upon admission. Functional Independence Measure (FIM) scores for transfers and ambulation were 3 and 1, respectively. The patient received daily 90 minute sessions of high intensity IPR consisting of ambulation with body-weight support or manual assistance (averaging 100 feet) for approximately 32% of the treatment plan and strengthening exercises (specifically forced-use sit-to-stand transfers until fatigue) for 31% of the treatment plan for three weeks, five times a week.

Outcomes: Over the week admission, she demonstrated significant clinical and functional gains which decreased burden of care upon discharge. The patient’s final manual muscle test grades were 2-/5 for hip flexion, 3+/5 for hip abduction, 1/5 knee flexion, 2-/5 knee extension, 2-/5 ankle dorsiflexion and 0/5 for ankle plantarflexion. FIM scores for transfers and ambulation at the end of 19 days were both 5.

Discussion: This is the first reported case of a patient benefiting from intensive inpatient rehabilitation incorporating strenuous physical activity. High intensity physical strengthening exercises should not be avoided if the patient is able to tolerate and may be effective to prescribe for patients with NMO. More defined research is needed to determine if there is an optimal dosage of treatment for this patient population.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: 1. Nechemia, Y., Moreh, E., Weingarden, H., Bloch, A., Givon, U., Vaknin-Dembinsky, A., ... & Zeilig, G. (2016). Effectiveness of multi-disciplinary rehabilitation for patients with Neuromyelitis Optica. The journal of spinal cord medicine, 39(3), 311-316.


Background & Purpose: Charcot-Marie-Tooth disease (CMT) is an inherited, progressive polyneuropathy that can affect motor and sensory pathways, and in severe cases, cause respiratory failure. Quality of life in CMT is found to be impacted by fatigue, balance, mobility deficits, weakness, and pain, but can be improved through physical activity. Performing low to moderate intensity exercise regularly is therefore encouraged to maintain health benefits and improve quality of life, and persons with CMT are more likely to perform regular physical activity if able to complete functional activities and utilize assistive devices independently. The purpose of this study is to discuss the clinical process and implications of power wheelchair prescription for improved independence with mobility in a complex case of CMT.

Case Description: A 40 year old male diagnosed with CMT at age 8 was admitted to an acute inpatient rehabilitation facility due to a progressive decline in strength and respiratory failure resulting in mechanical ventilator dependence. While participating in a physical therapy plan of care including strengthening, balance, and gait training, he was also evaluated for power wheelchair mobility. This process included a postural and anatomical assessment with significant findings of thoracolumbar scoliosis and pelvic asymmetry, an interface pressure mapping study evaluating pressure distribution on various wheelchair cushions, and trials of power wheelchair bases with multiple seat functions.

Outcomes: The patient ultimately selected and was prescribed a custom midwheel drive power wheelchair with power tilt, recline, seat elevator, and a skin protection and positioning cushion with a lateral wedge. He was able to propel the power wheelchair over community distances independently, utilize the seat elevator to complete transfers to standing from the elevated height with assistance, and demonstrate greater participation in moderate intensity exercise.

Discussion: Current research about CMT, though limited, describes the health and quality of life benefits of exercise in this population. Fatigue is a very common symptom of CMT, linked to physical activity, stress, and mental exertion, and significantly reduces a person’s ability to participate in recommended exercise. In this case, though the patient was partially ambulatory, he was limited due to strength, endurance and respiratory deficits, and impacted profoundly by fatigue. Power mobility allowed him greater independence during mobility and decreased assistance with transfers while conserving energy for critical activities of daily living and prescribed daily exercise. Insurance coverage for power wheelchairs in diagnoses such as CMT or other debilitating neurological diseases impacted by fatigue is limited. More research into the impact of power mobility devices in these populations may help to encourage more frequent insurance authorization of specialty wheelchairs that can reduce the effects of fatigue.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old:


Purpose/Hypothesis: Our previous experiments demonstrated modulation of the amplitude of the axonal Compound Action Potential (CAP) by electrical stimulation. To verify assumption that glutamate released from axons could be involved in this phenomenon, the modification of the axonal CAP induced by glutamate was investigated. Objectives. The main objective of this research was to verify the hypothesis that axonal activity would trigger the release of glutamate which in turn would interact with specific axonal receptors modifying the amplitude of the action potential.

Number of Subjects: CD-1 mice of both sexes, 1 to 3 months old, kept in normal day light/dark cycle were used in all experiments.

Materials/Methods: Segments of the sciatic nerve were exposed to exogenous glutamate in vitro, and compound action potential was recorded before and after glutamate application. The release of radioactive glutamate analog from the sciatic nerve exposed to exogenous glutamate was also evaluated using electrophysiological recording.

Results: The glutamate-induced increase in CAP was blocked by different glutamate receptor antagonists. The effect of glutamate was not observed in Ca-free medium, and was blocked by antagonists of calcium channels. Exogenous glutamate, applied to the segments of sciatic nerve induced the release of radioactive glutamate analog demonstrating glutamate-induced glutamate release. Immunohistochemical examination revealed that axolemma contains components necessary for glutamatergic neurotransmission.

Conclusions: The proteins of the axonal membrane, can under the influence of electrical stimulation or exogenous glutamate change membrane permeability and ionic conductance leading to a change in the amplitude of CAP. We suggest that increased axonal activity leads to the release of glutamate that results in changes in the amplitude of CAPs.

Clinical Relevance: Repetitive generation of the action potentials in the peripheral nerve would result in non synaptic, glial and/or axonal release of glutamate. This phenomenon, representing axonal plasticity could explain beneficial effects of repetitive muscle activation on the recovery from the injury.
Purpose/Hypothesis: Research shows a link between pursuit eye movements, visual processing, and postural control, and current evidence suggests these links are different in individuals with Autism Spectrum Disorder (ASD). For those with ASD, few studies quantitatively examine visuomotor integration and its influence on postural stability. The purpose of this study was to observe individuals with ASD and those with typical development (TD) in order to identify and characterize differences in how visual information and eye movement are used for postural control.

Number of Subjects: Three adolescents with ASD (Age 16 ± 4) and 3 adolescents in the TD group (age 14 ± 4) completed the study, enrollment is ongoing.

Materials/Methods: This study was conducted in a community setting at the Fort Worth Museum of Science. The experiment consisted of balance testing, including the Limits of Stability (LOS) and The Clinical Test for Sensory Integration (CTSIB), on a forceplate while wearing the ETG 2.0 eyetracking system. The CTSIB requires quiet standing with eyes open, eyes closed, and wearing a translucent dome. The LOS requires a shift in center of pressure (CoP) to reach 9 target positions displayed on the screen. Data were analyzed with t-tests.

Results: ASD adolescents had higher sway and stability indices than TD across all conditions of the CTSIB. During LOS testing the ASD group had lower postural control than the TD group in 5 of the 9 target positions. Overall, ASD group took a longer time to complete the task, which is a proxy for movement accuracy, since the task advances when participants meet “hit” criteria for each target. Pursuit eye movements and stabilization of targets showed greater variability in ASD group compared to TD. Moreover, the ASD participants did not improve their performance across the 3 trails of the LOS.

Conclusions: These preliminary data support our hypothesis that individuals with ASD would have greater postural instability than TD controls. These impairments may be linked to increased variability and less accuracy of pursuit eye movements. When visual context was eliminated, individuals with ASD demonstrated markedly greater impairment in stability. When LOS were tested, the ASD group showed greater difficulty maintaining postural control during CoP shift. Preliminary eye movement data suggests that atypical gaze patterns relate to impairments in stability. Further studies are necessary to investigate this atypical visiomotor integration and its possible role as a fundamental feature of ASD.

Clinical Relevance: Postural stability depends heavily on visuomotor integration. Research has identified differences in the eye movements of individuals with ASD and this might account for atypical postural stability. Difficulty controlling posture interferes with daily activities and increases the risk of falls and as such, adversely affects social interaction, self-care, speed of completing tasks and participation with peers.
Purpose/Hypothesis: Individuals with Multiple Sclerosis (MS) experience impairments in both motor and cognitive function resulting in interference during simultaneous motor-cognitive tasks (i.e., walking while talking). In this study we explored specific domains of mobility and cognitive function that impair dual-task function and the predictive value of these measures on prospective falls. We hypothesize that simple motor tasks will correlate with different domains of cognitive function than complex motor or dual-tasks. Further, we suspect that dual-task performance will be related to history of fall risk and strengthen the prediction of future falls.

Number of Subjects: To date, 4 subjects have completed testing mean (SD) age: 48.8 (7.8) years; symptom duration: 22.5(13.9) years; 4 females.

Materials/Methods: Individuals completed the following tests in a single session: quantitative measures of strength and sensation; gait (i.e., Timed Up and Go (TUG), Two Minute Walk Test, Six Spot Step Test (SSST)); dual-task/complex gait (i.e. Walking While Talking Test (WWWT) and TUG-Cognitive (TUGCog)); California Verbal Learning Test (CVLT); Delis-Kaplan Executive Function System Sorting (D-KEFS); Paced Auditory Serial Addition Test; Symbol Digit Modalities Test (SDMT); Short-Form 36 and Brief Pain Inventory (BPI). Retrospective falls and near-falls information for the past month and year was also acquired. Fall diaries were maintained for 6 months following testing with monthly reminders from the study team. Pearson correlations were used to examine relationships among motor and cognitive performance and reports of falls. Due to the small sample size in this preliminary analysis, R-values >0.9 were considered strong relationships.

Results: Better performance on processing speed (SDMT) and executive function (D-KEFS) tasks was strongly related with better performance on complex motor tasks (SSST: r=0.99; p=0.07 and r=-0.96; p=0.18); TUGCog: r=-0.964; p=0.036 and r=-0.96; p=0.04). Reports of increased pain (BPI) were related to poorer performance on cognitive tests (CVLT: r=-0.98; p=0.02; PASAT: r=-0.97; p=0.03). The number of near-falls, where an individual reported a trip or stumble but was able to regain balance, was related to both cognitive (CVLT: r=-0.9; p=0.01) and dual-task performance (WWTT: r=0.91; p=0.09). The number of reported falls was strongly related to strength (r=-0.996; p=0.004) and dual-task performance (WWTT: r=0.91; p=0.09). Future analysis will include forthcoming prospective falls data, inclusion of demographic confounders and prediction modeling to determine potential biomarkers for fall risk.

Conclusions: Specific cognitive domains are associated with complex motor performance; motor-cognitive dual-task and cognitive performance strongly relate to retrospective reports of falls and near-falls in individuals with MS.

Clinical Relevance: Assessment of objective motor and cognitive measures along with subjective survey measures may improve the classification of individuals with MS, provide insight into targeted goals for rehabilitation, and aid in fall prediction.
ABSTRACT BODY:

Background & Purpose: NMDA encephalitis is an autoimmune encephalitis, most commonly seen in females with ovarian teratomas. Presentations vary but there are typically several stages of illness beginning with symptoms such as headache, nausea and respiratory illness. Within 2 weeks, behavioral changes such as anxiety, paranoia, and delusions may be present. Progression includes seizures, impaired consciousness, autonomic instability, and central hypoventilation. Movement disorders may include orofacial dyskinesias, myoclonus, choreoathetosis, dystonia and rigidity. Prompt diagnosis and treatment with immunotherapy and tumor removal contribute to a positive prognosis. Often patients require 3-4 months of hospitalization. Approximately 75% of patients recover or have mild cognitive disability at 18-24 months. To date there are no case reports describing the physical therapy management of adults with acute NMDA encephalitis. The purpose of this case presentation is to describe the characteristics of this disease, timing of recovery, acute physical therapy management and outcomes.

Case Description: 33-year-old female with NMDA encephalitis transferred from an outside hospital with a 1-month history of progressive psychiatric symptoms, seizures, autonomic instability, and respiratory distress that necessitated a tracheostomy and gastric tube. Treatment included immunotherapy and resection of an ovarian teratoma. PT was initiated on admit to the Neuro ICU, where she remained for 1 month, given persistent medical instability. PT aimed at prevention of secondary complications and restoration of functional mobility was provided 3-5/wk over the next 3 months, at which time she transitioned to rehabilitation.

Outcomes: Initial exam revealed impaired consciousness with eye opening to auditory stimulation, no localization or command following, restlessness with impaired coordination of limb movements and orofacial dyskinesias. Intervention focused on ROM and upright positioning. Over the next two months she progressed to standing and gait with assist. Coordination progressively improved. Barthel Index was 10/100 at 1 month and 60/100 at 2 months. Agitation and impulsivity were prevalent but improved with treatment in a quiet environment, medication timing and goal-directed tasks. At 3 month discharge she ambulated 300’ with contact guard, TUG 20 sec., TUG-Cog 44 sec., Barthel 60/100. At 2 yrs reports caring for children with family support, drives and does volunteer work.

Discussion: Despite a complex and prolonged course, an understanding of symptoms and long term outcomes associated with NMDA encephalitis helped to guide management of this patient. As most patients achieve good long term outcomes, care was directed towards restoring independent function vs. a compensatory approach. The patient was mobilized early and progressively challenged given the anticipated outcome. Early intervention likely contributed to the prevention of secondary complications and perhaps shortened rehab stay.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: Dalmau J, Gleichman AJ, Hughes EG, et al. Anti-NMDA-receptor encephalitis: a case series and analysis of the effects of antibodies. Lancet Neurol. 2008; 7:1091-1098.


Wingfield T, McHugh C, Vas A, et al. Autoimmune encephalitis: a case series and comprehensive review of the
Seated Trunk Control Training in Adults Post Stroke: Do Focus of Attention Strategies Impact Lateral Excursion Performance and Learning?

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Purpose/Hypothesis: Instructional cues provided during functional task training may impact a patient's performance and learning. Few studies have examined the impact of focus of attention instructional strategies in adults post stroke. Recently, adults 1-2 months post stroke with impaired sitting balance produced greater lateral weight shift towards their unaffected side when provided with external focus (EF) (on movement effect) rather than internal focus (IF) (on body movement) instructions during a seated weight shifting task. However, task retention, weight shifting technique, and movement to the unaffected side were not examined. Our study was designed to extend this work to adults with chronic stroke and to remedy aforementioned issues.

Number of Subjects: 12 adults (mean age 61.4 ± 13.8, 6 months to 13 years post unilateral stroke), who had good trunk control (mean score 51 ± 2.9 out of 56 for function in sitting test-FIST) were randomly assigned to receive IF or EF instructions during seated balance training. Exclusion criteria was severe hemineglect (<44/54 on the star cancellation test) or the inability to follow multistep commands.

Materials/Methods: Adults performed familiarization trials, consisting of lateral weight shifting, after which they viewed a video of a physical therapist demonstrating proper weight shifting technique. Next, IF and EF groups performed 3 trials of seated weight shifting to unaffected and affected sides per experimental phase: acquisition, short term retention (STR, 5 minutes later), and long term retention (LTR, 7 days later). IF was told to shift your body weight as much as possible towards your right or left hip without using your arms. EF had targets at shoulder height and arm length and told to move your shoulder as close to the target as possible without using your arms. During STR and LTR adults were told to shift your body weight as much as possible towards your right or left without using your arms. Mean lateral excursion of center of pressure was measured via pressure mat.

Results: No group differences (P>.05) emerged for demographics and FIST. 2 groups x 3 phases mixed model ANOVAs on mean lateral excursion scores per movement to unaffected and affected sides produced no main effects or interactions (P>.05). Surveys revealed groups adhered to their cue type.

Conclusions: Adults with chronic stroke and high levels of sitting balance produced similar lateral weight shift performance and learning regardless of instructional cues. These findings differed from previous findings in those with acute stroke, obtained during acquisition trials. Also, mean lateral excursion scores were retained by all adults regardless of group and movement direction during STR and LTR.

Clinical Relevance: Impact of IF or EF instructions on automatic control processes and/or working memory load were not evident in this population and task. The role of instructional cues requires further study for this specific task and remains unresolved for clinicians to date.
TITLE: Effects of Levodopa on Adaptation of Protective Stepping in People with Parkinson’s Disease

AUTHORS/INSTITUTIONS: D. Peterson, F.B. Horak, Neurology, Oregon Health & Science University, Beaverton, Oregon, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Protective steps in response to postural perturbation (e.g. slips) are critical to avoid falls (1) and are impaired in people with Parkinson’s disease (PD) (2,3). Training may improve protective stepping (4); however, given the importance of dopamine for motor learning, people with PD may have an altered ability to improve reactive stepping. Further, levodopa, a commonly prescribed dopamine replacement drug, may affect how people learn (5). However, the degree to which dopamine replacement therapy with levodopa affects the ability to learn stepping responses is unknown. Therefore, our purpose is to test the effect of levodopa on postural motor learning in people with PD. We hypothesize that improvements will be more pronounced OFF levodopa than ON levodopa.

Number of Subjects: 22 individuals with Parkinson’s disease (PD)

Materials/Methods: Twenty two people with PD completed 2 days of testing (day 1= Step training, day 2= retention testing) either ON or OFF levodopa. After a 6-8 week washout, participants came back into the laboratory to repeat the same 2-day testing, but in the opposite levodopa state. The order of levodopa state was randomized across participants. Step training included 50 anterior-posterior (AP) support surface perturbations, 25 forward and 25 backward, arranged in 5 blocks of 10 trials, which resulted in protective steps. Retention testing (24 hours later) included 10 AP perturbations. The primary outcome was peak displacement of the center of mass (COM) after the perturbations.

Results: People with Parkinson’s disease improved center of mass displacement during over the course of one day of perturbation training (p=0.01). A medication by training effect was observed (p=0.013) such that people with PD improved performance more when ON levodopa than when OFF. Improvements while ON levodopa were retained 24 hours (p=0.004).

Conclusions: Previous upper extremity work has suggested people with PD may learn better while OFF levodopa than ON. Our results suggest that for postural perturbations, improvement in performance is not better OFF levodopa. In fact, our results suggest that levodopa may have a beneficial effect.

Clinical Relevance: Although more research is necessary, these results suggest that for people with PD, protective step training for fall prevention (5) may be more effective if completed while optimally medicated with levodopa.
TITLE: Falls Prevention Training in Acute Inpatient Rehabilitation

AUTHORS/INSTITUTIONS: H. Batistick-Aufox, J.K. Lebduska, Rehabilitation Medicine, NewYork Presbyterian Hospital/Weill Cornell, New York, New York, UNITED STATES|Y. Chiu, M. Frager, H. Lee, S. Wong, S. Babyar, Department of Physical Therapy, Hunter College, New York, New York, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis: The primary purpose of this study was to evaluate if the choice of setting of Fall Prevention Training (1:1 vs. group) affects the occurrence of falls after discharge from acute inpatient rehabilitation. A secondary purpose was to determine if at-home compliance with training suggestions differs for those with or without report of falls after discharge. We hypothesized that fall occurrence would not be different for training setting and that compliance with training suggestions would be related to decreased fall occurrence in the six months after discharge from inpatient rehabilitation.

Number of Subjects: 300 English-speaking subjects admitted to acute inpatient rehabilitation and received Fall Prevention Training prior to discharge were included. Subjects were able to ambulate with minimum assistance upon discharge and consented to this study which was approved by the Institutional Review Board. Subjects ranged in age from 18-90 with various diagnoses.

Materials/Methods: Subjects were divided into three groups: those who received Individual Training, Group Training, and those who had a caregiver present due to cognitive deficits. The Caregiver group received Fall Prevention Training either in a 1:1 setting or in a group. Data collected from the inpatient rehabilitation stay included 10-min walk test speed, Functional Independence Measure, and Montreal Cognitive Assessment scores. Subjects with Montreal Cognitive Assessment scores < 26 were required to have a caregiver present during training. Six-month follow-up phone interviews were completed by 61% of the subjects. The phone survey included questions about fall occurrence, compliance with suggestions from Fall Prevention Training, and demographic questions.

Results: Group, Individual, and Caregiver groups were similar in age, 10-min walk test, and change in Functional Independence Measure scores during inpatient rehabilitation. Admission and discharge Functional Independence Measure scores were lower for the Caregiver group compared to Group or Individual training groups. Falls were reported in 26% of all respondents. Fall occurrence was similar for group (23%) and Caregiver groups (29%); 36% of the falls received Individual Training. The distribution of fall occurrence was not statistically significant across training groups ($\chi^2 = 1.97$, df=2, $p = .374$). Participants reported good to excellent compliance with most training suggestions, regardless of fall status. Suggestions requiring equipment repair or structural changes to the living environment had the least compliance.

Conclusions: Our study found that Fall Prevention Training setting did not affect fall occurrence after discharge from inpatient rehabilitation. Participants used suggestions from training and the degree of implementation of these did not influence report of falls in the 6 months after discharge.

Clinical Relevance: Selecting the training setting based on the needs of the patient and including a caregiver when cognitive issues were present appears to be a successful way to implement Fall Prevention Training during inpatient rehabilitation.
TITLE: Postural, Balance, and Pain Improvements in a Patient with Spinal Cord Injury in Response to Visceral Manipulation

AUTHORS/INSTITUTIONS: R.H. Holsinger, International Center for Spinal Cord Injury, Kennedy Krieger Institute, Baltimore, Maryland, UNITED STATES | R.H. Martin, Dept. of Physical Medicine and Rehabilitation, Johns Hopkins School of Medicine, Baltimore, Maryland, UNITED STATES

ABSTRACT BODY:
Background & Purpose: Visceral manipulation is used to help correct restrictions around viscera through gentle, specific techniques. These restrictions can result in pain, decreased mobility, and postural abnormalities. This case report describes the postural, pain and static and dynamic sitting balance changes in a patient after one treatment with visceral manipulation.

Case Description: Patient is a 32-year old man with a history of C4 AIS A tetraplegia resulting from a gunshot wound in 2003. Patient has a past medical history significant for multiple urinary tract infections requiring hospitalizations and disruption in therapy services, suprapubic catheter placement, intracranial hemorrhage in 2011 secondary to autonomic dysreflexia, and extensive MRSA osteomyelitis of the left foot and ankle resulting in left transtibial amputation in 2014. Patient has received medical follow-up and PT and OT at Kennedy Krieger Institute’s International Center for Spinal Cord Injury since 2009. Pain, balance, and posture were assessed prior to, throughout, and after all interventions. Patient’s abdomen and thorax were assessed for fascial restrictions. Therapist identified restrictions isolating to the right kidney, root of the mesentery and the ileocecal valve. Therapist used anterior and posterior approach with patient in supine to contact the inferior pole of the right kidney and release it from its restrictions. Therapist then assessed the root of the mesentery in supine and released the inferior leaf bilaterally and superior leaf at midline. Therapist finished with assessing the five abdominal sphincters, including the ileocecal valve for proper function. Finding all dysfunctional and the ileocecal valve affecting the others, this therapist corrected the ileocecal valve through induction. All sphincters found to be functional at end of session and no further fascial restrictions palpated on abdomen or thorax. Patient reassessed for outcome measures at end of session.

Outcomes: Following intervention, patient reported low back pain of 0 (started at 6). His functional reach improved by 2.8cm to the right, 2.5cm to the left, and 1.3cm anteriorly. Postural improvements were measured through angulation of body landmarks. Cervical flexion, cervical sidebending, posterior pelvic tilt, and lumbar kyphosis each improved by 7 to 24 degrees.

Discussion: The additional of visceral manipulation to ongoing PT, resulted in improved posture, balance, and pain in this patient. The outcomes suggest visceral manipulation may be a safe and beneficial intervention to complete with patients with spinal cord injury. More research is needed to determine the efficacy of visceral manipulation in this population. Visceral manipulation may be beneficial in adjunct to PT to improve patient’s posture, sitting balance and pain outcomes.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: Barral, Jean-Pierre. Visceral Manipulation II. Vista, California: Eastland Press, 2007.


TITLE: Reliability of the Alter-G Anti-Gravity Treadmill Two-Minute Walk Test and Its Effect on Balance in the Elderly

AUTHORS/INSTITUTIONS: J.F. Brewer, A.D. Lewis, K.J. Lucas, J.P. McCright, J.L. Mitchell, Hardin-Simmons University, Abilene, Texas, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: (1) To determine the reliability and cardiopulmonary effects of the Two-Minute Walk Test (2MWT) among older adults using the AlterG anti-gravity treadmill; (2) to determine the effects on functional balance after the use of the AlterG.

Number of Subjects: Eleven (M=5, F=6) elderly residents (mean age=84.7 + 4.32 yrs) from an assisted living facility.

Materials/Methods: Subjects provided informed consent, completed a cognitive exam, medical history, Par-Q risk, and physician approval. Baseline over-ground 2MWT, Four Square Step Test (FSST), and Frailty and Injuries: Cooperative Studies of Intervention Techniques (FICSIT) were administered on each subject with systolic blood pressure (SBP), heart rate (HR), and oxygen saturation (SaO2) levels obtained prior to, during, and after each 2MWT. Subjects were assisted into the AlterG for a familiarization session of treadmill ambulation with progressively increased body weight support to 60%. Participants then completed randomized Trials 1 and 2 on two separate days. Trial 1 consisted of completion of two AlterG 2MWTs, FSST, and the FICSIT. Trial 2 consisted of two over-ground 2MWTs, FSST, and the FICSIT. An Intraclass Correlation Coefficient (ICC) was computed to determine the reliability of the 2MWT on the AlterG and over-ground. Repeated measures ANOVA analyze differences in distance walked, HR, SBP, and SaO2 on the AlterG and over-ground 2MWTs.

Results: Two-minute walk over-ground distance averages were 266.8' vs. 216.5' on the AlterG treadmill. ICCs indicated a higher test-retest reliability for the 2MWT when performed over-ground (0.971, p<0.001) versus on the AlterG treadmill (0.686, p<0.050). No significant changes in either the FSST or FICSIT were found following either the over-ground or the AlterG 2MWTs. Results of the repeated measures ANOVA revealed a significant increase in HR within trials for the 2MWT performed over-ground on day one (p<0.001) and day two (p<0.048). Significant differences in SaO2 were also found on day one (p<0.005) and day two (p<0.012), but no changes in SBP were noted. No significant changes in HR, SBP, or oxygen saturation were found between trials for the 2MWT when performed on the AlterG.

Conclusions: Physiological and distance walked results of the 2MWT performed over-ground versus the AlterG are not comparable. Greater distances were recorded more consistently on the over-ground test and produced more physiological changes in subjects’ HR and SaO2 levels. Neither test significantly affected static or dynamic balance outcomes.

Clinical Relevance: The over-ground 2MWT may be easier to administer in the clinic because it requires less time, less equipment, and results in better reliability than the same test performed on the AlterG. However, this data also shows that there was no significant change in balance post AlterG 2MWT among those in assisted living facilities. From this, we infer that in the elderly, fall risk neither increases or decreases after a 2-minute AlterG locomotion session and appears safe regarding the subject's measured balance.
TITLE: The effect of six minutes of walking on perceived fatigue and physical performance in people with multiple sclerosis: a systematic review

AUTHORS/INSTITUTIONS: D. Chen, E. Dorsey, L. Kelley, L. Walsh, E.T. Cohen, Rehabilitation and Movement Sciences, DPT-South, Rutgers, The State University of New Jersey, Stratford, New Jersey, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: It is common for people with multiple sclerosis (MS) to experience an increase in symptoms and a declination in physical performance in response to prolonged activities such as the 6-minute walk test (6MWT). The purpose of this systematic review was to examine the effect of the 6MWT as a standardized bout of work on perceived fatigue and measures of physical performance in people with MS.

Number of Subjects: N/A

Materials/Methods: A search of the Scopus, Ovid Medline, and CINAHL databases was conducted in October of 2015 using the keywords multiple sclerosis, fatigue and walking. The inclusion criterion was experimental or quasi-experimental research studies that measured perceived fatigue and/or measures of physical performance before and after a 6MWT in people with MS. Because of the paucity of literature, a manual search was also conducted through forward/backward tracking of cited references. Two reviewers developed a consensus rating of validity of each study using MacDermid's Evaluation of Effectiveness of Study Design (MEESD). The MEESD has a range of 0-48, with 48 meaning the highest quality.

Results: Six studies met the inclusion criterion and were included in this systematic review. The median MEESD score was 38/48 (range 30-43, IQR=3.0). The studies included people with Extended Disability Severity Scale scores of 1.5-6.5 (low to moderate disability). Five of the articles measured perceived fatigue using a visual analog scale of fatigue (VAS-F). Performance measures in the six studies included Berg Balance Scale (BBS), Dynamic Gait Index (DGI), Mini Balance Evaluation Systems Test (MiniBEST), dynamic posturography, and reaction time testing.

Conclusions: The samples examined in the reviewed studies consistently had a marked increase on the VASF after the 6MWT, indicating an increase in the amount of perceived fatigue. Significant declines in physical performance were found after the 6MWT in BBS, DGI, and MiniBEST which indicate a decline in clinical measures of balance when in a fatigued state. Declines were also found after the 6MWT in reaction time testing and in measures of dynamic posturography.

Clinical Relevance: People with MS are susceptible to increasing fatigue and poorer performance on physical performance tests after bouts of relatively short activity such as the 6MWT. These may be the result of primary (i.e. MS-related) disease sequelae such as lassitude or diminished cortical activation, or secondary sequelae such as deconditioning. The physical therapist (PT) must consider whether the patient with MS is in a rested or fatigued state when conducting tests and measures as performance varies between these conditions. We suggest that the PT should conduct some tests and measures in both rested and fatigued conditions to gain a comprehensive understanding of each patient's abilities in varied conditions. Using a standardized work bout, such as the 6MWT, will enable the PT to identify the impact of fatiguing activity on physical performance in a reproducible way.
Purpose: Delirium is common among hospitalized older (>65 years) patients (pts) with prevalence rates as high as 70-84% in critical care units. Research shows that 13-48% of older pts hospitalized due to CVA develop delirium. Delirium is associated with longer hospital stay, higher mortality, the development of dementia, and functional decline. The purpose of this report is to increase delirium awareness among acute care therapists working in the neurological setting.

Description: Delirium is an acute confusional state characterized by inattention and altered consciousness. CVA is a clinical syndrome of sudden onset of neurological impairment of presumed vascular origin. Studies show delirium may be associated with specific types of CVAs, in particular intracerebral hemorrhage rather than brainstem or cerebellar CVAs. It may be difficult to differentiate between CVA and delirium since symptoms may overlap. Impaired consciousness could be due to a disturbance in neurotransmission or reduced perfusion; however the acute change may be delirium due to a medical complication such as infection, hypoxia, pain, dehydration or immobility. Delirium is a trigger to staff that the pt has a change in medical status which could impede recovery or even survival. The Confusion Assessment Method (CAM) or CAM-ICU (for non-verbal pts) is the most widely used screening tool for delirium across inpatient settings. The CAM assesses 4 realms: 1-acute change in cognition from baseline, 2-inattention, 3-disorganized thinking and 4-altered consciousness. To test positive, the pt must demonstrate 1 and 2 plus either 3 and/or 4. To accurately score a pt with CVA, a post-CVA cognitive baseline is established to determine if the observed cognitive/behavioral change is acute. If delirium is detected early, the team can address the medical causes thereby decreasing morbidity and allowing for full participation in physical therapy.

Summary of Use: The treatment team should routinely screen for delirium in older, high risk pts via the CAM/CAM-ICU. Pts with CVA should not be excluded from delirium screening. Instead a new cognitive baseline should be established to allow for accurate assessment. At NYULMC, older pts on the neurological units are screened via the CAM/CAM-ICU as part of each therapy session. This quick screening allows for efficient communication among team members. If a pt scores positive, the provider initiates a delirium workup while the therapy/nursing teams implement non-pharmacologic interventions such as: early mobility, frequent orientation/reassurance, enhancement of sleep-wake cycle and sensory deficit correction, especially of vision and hearing. Family involvement is encouraged as pts with delirium often benefit from familiar faces and the comforts of home such as music or photos.

Importance to Members: Delirium can have long-lasting negative outcomes including functional decline, dementia and early death. Pts post CVA are not immune to delirium. Routine use of the CAM can alert staff to changes in medical and cognitive status that are not necessarily related to CVA.
Purpose/Hypothesis: Falls are the leading cause of death from unintentional injury among older adults. To make accurate decisions about fall risk and prevention, it is critical that physical therapists use appropriate balance assessment tools. The Timed Up and Go (TUG) is a widely used performance-based balance outcome measure. However, evidence supporting the instrument’s ability to predict falls is controversial. The purpose of this study was to evaluate the TUG’s ability to predict future falls in a sample of community dwelling older adults. Another purpose was to determine whether there was a significant interaction in the number of falls over time in subjects classified at high versus low risk of falling. The published 14-second threshold score was used to classify fall risk.

Number of Subjects: Forty-five community dwelling older adults aged 65 and older (x=84 years) participated in this study. All subjects lived independently and were able to walk inside their homes with or without an assistive device, but without help from another person.

Materials/Methods: Subjects performed the TUG, and those who scored ≥14 seconds were classified at high risk of falling, while subjects who scored <14 seconds were classified at low risk of falling. Following balance testing, telephone interviews were conducted every 3 months for one year to determine the number of falls experienced at 3, 6, and 12 months. Subjects who reported at least one fall were classified as fallers at the 3, 6, and 12-month time point. Subjects who had not fallen were classified as non-fallers. Chi-square and mixed ANOVA with Least Significant Difference post hoc analyses were calculated using SPSS v 23.

Results: Subjects at high risk of falling were more likely to be fallers 3 months (χ²=9.61, p<0.01), 6 months (χ²=13.60, p<0.01), and 12 months (χ²=7.87, p<0.01) after testing. Results of the mixed ANOVA revealed a significant within-subjects main effect for time (F=4.74, p=0.03). Post hoc analysis revealed a significantly greater number of falls from 3 months (m=0.27, SE=0.06) to 12 months (m=0.40, SE=0.07; p=0.02). A significant between-subjects main effect existed for fall risk (F=13.59, p<0.01), with subjects at high risk having a significantly greater number of falls (m=0.53, SE=0.09) than those at low risk (m=0.12, SE=0.07). The two-way interaction between time (number of falls at 3, 6, 12 months) and fall risk (low risk versus high risk) was not statistically significant.

Conclusions: The TUG’s 14-second fall risk classification score appropriately predicted fallers and non-fallers prospectively for 12 months. In addition, subjects classified at high risk of falling had a significantly greater number of falls 3, 6, and 12 months after performing the TUG.

Clinical Relevance: Findings benefit the physical therapy community by providing evidence that the TUG, a commonly used balance measure, can be used to prospectively predict fallers versus non-fallers in community dwelling older adults.
TITLE: Relationship between Exercise and Fatigue Level in People with Parkinson’s Disease

AUTHORS/INSTITUTIONS: T. Ronck, R. Sanft, R.P. Eason, R. Bliss, R. Xia, Doctor of Physical Therapy, University of Saint Mary, Leavenworth, Kansas, UNITED STATES| R.L. Silvey, Mathematics, University of Saint Mary, Leavenworth, Kansas, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Parkinson’s disease (PD) is a chronic neurodegenerative disease that is characterized by both motor and non-motor symptoms such as bradykinesia, rigidity, fatigue and cognitive dysfunction [1-3]. Fatigue is frequently reported as one of the most debilitating symptoms and voted as the leading symptom in need of research by patients with PD [3-4]. However, there is no effective medication regime for PD-related fatigue which has equivocal responses to dopamine-replacement therapy [5]. Accumulating evidence suggests that exercises are potentially beneficial in the management of PD fatigue [6-8]. Therefore, we sought to examine the relationship between exercise and fatigue level in individuals with PD. Further, the impact of clinical depression and disease history on the severity of fatigue was also investigated by comparing the difference in fatigue between two sub-groups stratified according to the disease history and to the status of depression.

Number of Subjects: 131 subjects

Materials/Methods: The participants were asked to complete the Parkinson’s Fatigue Scale, a 16-item assessment tool self-reported by individuals with PD, and to provide information about their weekly duration of exercise, when being diagnosed with PD, and absence/presence of a clinical depression. Pearson correlation analysis was applied to examine the relationship between the inverse of weekly exercise duration (expressed in 1/minute) and patients’ self-reported level of fatigue. In addition, T-tests were performed to identify whether there was any significant difference in fatigue level between subjects diagnosed with depression and those without depression as well as between subjects at the early and the advanced stages of PD (≤ 6-year disease history vs. > 6-year). An alpha level of 0.05 was used for all statistical tests.

Results: Results showed that there was a statistically significant correlation between the inversed weekly exercise duration (1/minute) and self-reported fatigue level (r = 0.267; P = 0.02). The higher fatigue levels were associated with the shorter durations of weekly exercise, and the lower levels with the longer durations. Further, subjects who were clinically depressed reported a significantly higher level of fatigue than those who were not (3.65 ± 0.80 cf. 3.14 ± 0.99, P = 0.02). There was no significant difference in fatigue level between the early and the advanced PD groups (P = 0.23).

Conclusions: The findings obtained from this study suggest that the therapeutic exercise program may be an effective treatment for PD-related fatigue. Future research should focus on investigations of efficacy of therapeutic exercise programs on PD-related fatigue through experimental studies.

Clinical Relevance: Findings of this study add support for further development of evidence-based therapeutic exercise programs in clinical management of PD-related fatigue and other symptoms in order to improve the quality of life in patients with PD.
Purpose/Hypothesis: Wearable consumer-level activity monitors have become popular amongst the public as a way to quantify physical activity. Since data provides feedback regarding number of steps walked across days, weeks and months, individuals may be more likely to increase their level of physical activity. The accuracy of various consumer-level activity monitors has typically been tested in healthy individuals. However, minimal research has been conducted on the accuracy of consumer-level activity monitors for persons with gait disorders, such as Parkinson Disease (PD). Due to the shuffling gait of individuals with PD, step counts may not be as accurate with consumer grade devices. Establishing the accuracy of step count monitors for persons with PD would create the opportunity to use the devices as a form of intervention to increase physical activity levels.

Number of Subjects: 33

Materials/Methods: 33 persons with PD (stage Hoehn & Yahr 1-3) with a mean walking speed of 1.26 m/s completed four walking tasks. The walking tasks consisted of two, 2-minute walk tests, one at a comfortable and one at a fast speed, as well as simulated household and community obstacle courses. Participants donned four models of activity monitors at the wrist and waist, (Fitbit Surge, Jawbone Up 2, Fitbit Zip, Jawbone Up Move). Each model was worn on the right and left side of the body for a total of eight activity monitors. Participants were videotaped during each of the walking tasks. The step count from each device was compared to the actual steps taken, as counted from the video. Accuracy of the activity monitors was examined using intraclass correlation coefficients (ICC [2,1]).

Results: The accuracy of the monitors across the four conditions varied widely ICC [2,1] 0-.903. The Jawbone Up Move was most accurate on the 2-minute walk test at a comfortable speed with an ICC of .903. However, the Jawbone Up Move was least accurate during the household obstacle course with an ICC of 0. All activity monitors were more accurate for continuous walking as compared to simulated obstacle course walking. In general, activity monitors worn on the waist were more accurate than activity monitors worn on the wrist. Lastly, monitors worn on the more affected and less affected side performed similarly.

Conclusions: The activity monitors were reasonably accurate in determining number of steps in persons with PD during continuous bouts of walking. Activity monitors were less accurate with respect to discontinuous simulated household or community level walking with frequent changes in direction and/or stopping.

Clinical Relevance: Commercially available activity monitors may be beneficial for increasing physical activity in persons with PD especially in community dwelling individuals. These activity trackers may be less useful for persons with PD who are primarily limited to the household as the monitors have higher variability and less accuracy in these settings.
**TITLE:** The JFK BIG Study: The Impact of LSVT-BIG on Fall Risk in Persons with Parkinson’s disease

**AUTHORS/INSTITUTIONS:** S. Isaacson, G.G. Fluet, Rehabilitation and Movement Sciences, Rutgers The State University of New Jersey, Iselin, New Jersey, UNITED STATES| J. Lazaro, L.M. Moore, A.E. O'Brien, A. Ray, P. Duttaroy, JFK Medical Center, Edison, New Jersey, UNITED STATES

**ABSTRACT BODY:**

**Purpose/Hypothesis:** Fall risk increases with age in all persons due to age related musculoskeletal and sensory issues. Parkinson’s disease (PD) causes perceptual impairments and movement disorders that increase the incidence of falls and subsequent injuries, resulting in a substantial negative impact on the lives of persons with PD. LSVT- BIG is an exercise and self-cuing based treatment designed to decrease the impact of disordered perception and movement caused by PD. This study will examine the impact of LSVT- BIG treatment on the functional mobility of a group of persons identified as being at risk for falls using the Functional Gait Assessment (FGA). We hypothesized that LSVT- BIG treatment would have an impact on the mobility related fall risk of the subjects studied.

**Number of Subjects:** 33

**Materials/Methods:** The records of 140 patients diagnosed with PD, admitted to the outpatient rehabilitation department of a suburban hospital were reviewed. Demographics and data for 8 different outcome measures were extracted for all subjects that completed at least 14 of 16 scheduled sessions of LSVT- BIG treatment (n=126). Data was analyzed for all subjects with a pre-test score greater than or equal to fifteen out of thirty on the FGA, the cut-off score for increased fall risk.

**Results:** 33 patients fulfilled the inclusion criteria. Mean age of subjects was 70.3 years (sd=9.6) and Mean disease duration was 5.2 years (sd=4.2). 33% (n=11) subjects reported at least one fall in the three months prior to treatment and 6% (n=2) reported a fall resulting in injury. 26 subjects were also identified as being at an increased fall risk based on five time sit to stand (5STS) scores and 25 demonstrated timed up and go (TUG) scores slower than the 20 second fall risk cutoff. After LSVT-BIG treatment, subjects as a group demonstrated significant (p<.001) improvements in FGA (mean = 7 sd =1.8), STS5 (mean 11.1 sec, sd=5.6) and TUG (mean 4.7 sec, sd=3.4). Importantly, this resulted in 26 subjects scoring above the FGA cutoff, 13 of 26 at risk subjects decreasing their STS5 time to faster than the cutoff, and 6 of 25 at risk subjects decreasing their TUG time to faster than the cutoff. Only one subject reported a fall during their treatment period.

**Conclusions:** These findings are consistent with our hypothesis that LSVT BIG treatment would have a substantial impact on the mobility performance of this at risk population. Prior to intervention this cohort demonstrated substantially lower scores on the three measured outcomes than the published intervention studies of LSVT-BIG, suggesting it may be effective for more impaired subjects. Definitive conclusions cannot be generated by this study due to the lack of control or retention data.

**Clinical Relevance:** This study suggests that LSVT-BIG treatment may have a positive impact on the mobility of persons at risk for falls due to Parkinson’s disease.
TITLE: Acute response to vibrotactile feedback on postural control in persons with Parkinson’s disease

AUTHORS/INSTITUTIONS: H. McHugh, C. High, S. Mills, S. VallabhaJosula, J. Freund, Physical Therapy, Elon University, Burlington, North Carolina, UNITED STATES| S. Amano, Ohio University, Akron, Ohio, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Common characteristics of Parkinson’s disease (PD) include gait abnormalities and postural instability. The role of vibrotactile feedback training in persons with PD (PwPD) has proven effective at reducing sway in quiet stance and improving balance. However, its immediate effect is unknown. We investigated the immediate effect of providing vibrotactile feedback to the trunk on static postural control in PwPD.

Number of Subjects: Ten healthy older adults (O), 76 ± 7 years; 9 PwPD, 69 ± 10 years, with a 25/132 UPDRS motor score.

Materials/Methods: Quiet standing for 30s each under the following conditions: feet together on firm surface eyes open (C1), eyes closed (C2); feet together on foam surface eyes open (C3), eyes closed (C4), and tandem stance on firm surface eyes open (C5), eyes open on firm surface that tilted less (C6) /more (C7). Conditions C1-C5 were performed on a force platform, while conditions C6-C7 were performed on a Biodex balance system. During each condition, there were two consecutive trials with and without vibrotactile feedback (randomized within each condition). Direction specific vibrotactile feedback was provided when the participant swayed beyond a set threshold. Path length, sway area, and velocity of center of pressure were calculated. A 2x2 mixed ANOVA was performed for conditions C1, C2, C3, C5, and C6. Conditions C4 and C7 was omitted, as many participants with PD could not complete the task.

Results: For C6, PwPD had significantly lesser path length (PwPD: 36.1 ± 7.6 cm; O: 58.1 ± 6.8 cm; P = 0.046) and velocity (PwPD: 1.2 ± 0.3 cm/s; O: 1.9 ± 0.2 cm/s; P = 0.046) both with and without feedback. There were no significant interaction or main effects for other conditions.

Conclusions: During C6, where there was less tilt, PwPD appeared to hold their posture more rigidly, compared to the healthy older adults. This may be due to co-contraction of muscles in the lower extremity. For conditions C1-C5, the groups behaved similarly with or without vibrotactile feedback. This leads us to conclude that there is no acute effect of vibration on postural control. Future studies may aim to explore the effects of directed instructions on how to specifically respond to vibrotactile feedback. The younger age of PwPD group, compared to the healthy older adult group might have influenced these results. Whether these results hold true for PwPD who have more impaired postural control (reflected by higher UPDRS score) is unknown.

Clinical Relevance: Clinical Relevance: PwPD have impaired postural control and participate in physical therapy to improve balance. While new modalities like vibration feedback are being explored as ways to enhance postural control in PwPD, the current study provides evidence that vibrotactile feedback to the trunk showed no immediate effect on static postural control. Lack of immediate benefit from vibrotactile feedback from the current study combined with positive findings from previous studies about long-term effects of vibrotactile feedback will help guide clinicians to appropriately use this form of feedback for PwPD.
TITLE: Hand-held dynamometry and other clinical strength tests for the lower extremities and trunk in people with multiple sclerosis

AUTHORS/INSTITUTIONS: M.M. Manago, M. Schenkman, Physical Medicine & Rehabilitation, University Of Colorado Denver, Aurora, Colorado, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Strength training in people with multiple sclerosis (MS) has been shown to increase strength and have an effect on mobility, quality of life, and participation. For the rehabilitation clinician, there are numerous clinically feasible measures available to assess change in activity and participation, but it can be challenging to quantify strength accurately and reliably, particularly in the trunk, where very few measures have been studied. This investigation sought to determine the discriminant validity, test-retest reliability, and response stability of a clinically feasible strength testing protocol using both hand-held dynamometry (HHD) and other objective, quantifiable clinical assessments for the lower extremities and trunk in people with MS.

Number of Subjects: 25 participants with MS, mean age 45.0 ± 12.3, median Expanded Disability Status Scale (EDSS) score 3.5 (1.5 to 5.0); and 25 age and sex comparable controls.

Materials/Methods: This cross-sectional study measured strength in participants with MS during two sessions, one week apart, and in healthy controls during one session. HHD measured ankle dorsiflexion (DF); knee flexion and extension; hip flexion, extension, abduction and adduction; and trunk lateral flexion. Trunk extension was tested by a prone endurance test, trunk flexion by a timed curl-up test, and ankle plantarflexion (PF) by a single leg heel raise protocol. Disability was defined as low (EDSS 0-3.5) or moderate (4.0-5.5).

Results: The strength assessment protocol discriminated between participants with MS and healthy controls for all muscles tested (p = <0.001 to 0.003). The protocol also discriminated between low (n=13) and moderate (n=12) disability groups (p = 0.001 to 0.046) for 80% of muscles tested. Test-retest reliability Interclass Correlation Coefficient (ICC) values were statistically significant and high for all muscles (ICC = 0.81 to 0.97). Minimal detectable change as a percentage of the mean was 13% to 36% for 85% of muscles tested.

Conclusions: The results of this study demonstrate that this clinically feasible strength assessment protocol detected strength deficits in people with MS compared to healthy controls, and between low and moderate disability groups in people with MS. Reliability was high in all muscles groups, and response stability was adequate for the majority of muscle groups. The strength assessment protocol described in this study is a potentially useful outcome for clinicians working with people who have MS.

Clinical Relevance: Results of this study provide evidence for a clinically feasible, valid, reliable, and responsive strength assessment protocol. Accurately measuring and detecting strength changes over time is crucial to identifying impairment, optimizing treatments, tracking change, and ultimately improving outcomes for individuals with MS.
Use of Robotic Assisted Gait Training for Recovery of Ambulation after Acquired Brain Injury with Ataxia: a Case Study

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Background & Purpose: Ataxia after central neurologic injury is a confounding variable to a person regaining independence in mobility and ambulation. Common methods of treating ataxia include family training, functional mobility and attempting to reduce ataxic movements by decreasing degrees of freedom. Use of robotic assisted gait training (RAGT) has been studied after stroke, spinal cord and multiple sclerosis, but has not been studied in the individual with ataxia. This is the case of one individual treated with RAGT that resulted in improvement in ambulation with U step walker from maximal assistance to minimal assistance.

Case Description: This case report describes a 55 year old male with ataxia as a result of a cerebrovascular accident (CVA) with basilar thrombosis of the left vertebral artery, rated as moderate on the NIH Stroke Scale (initial score 13). He attended outpatient therapy at TIRR Memorial Hermann with participation in RAGT twice a week and land based therapy once a week for 15 weeks, followed by RAGT once a week and land based twice a week for two weeks. Rehabilitation progressed from RAGT to body weight supported treadmill training and over ground training as need for assistance and support decreased. He participated in 24 RAGT sessions out of 66 total visits.

Outcomes: At discharge from acute care to skilled nursing facility, he required total assistance for all bed mobility, transfers, and was non-ambulatory. Prior to initiating RAGT on 7/24/14, he required maximal assistance to ambulate with U step walker with Scale for Assessment and Rating of Ataxia (SARA) score of 37/40. On 10/20/14, he progressed to requiring minimal assistance with U step walker over 15 minutes of walking. His over ground training continued to be challenged with increased level of open environments, such as 90° and 180° turns, navigating through crowded rooms, and increased time spent ambulating. By discharge on 12/29/14, he was able to navigate these open environments with supervision to minimal assistance with U step walker with SARA score of 29/40.

Discussion: One of the limiting factors of RAGT is the amount of assistance provided and reduced errors allowed. Motor control and motor learning principles recommend allowance of error in order to achieve the best learning environment for those with neurologic involvement. However, RAGT can be beneficial because those with cerebellar involvement and ataxia are unable to incorporate an error rich environment. As the person’s motor control improves, the parameters of the robotic assistance can be modified to introduce errors to the gait training sessions as well as progress the person outside of the use of the device into treadmill and over ground gait training sessions.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.
TITLE: Clinical outcome measures for pusher behavior after stroke: a systematic review of the literature

AUTHORS/INSTITUTIONS: R. Koter, S.E. Regan, C.M. Clark, V. Huang, M. Mosley, E. Wyant, C.E. Cook, J.M. Hoder, Orthopedics, Duke University, Durham, North Carolina, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Pusher behavior (PB) can lead to increased hospital length of stay, increased healthcare costs, and negative functional outcomes in stroke patients. The purpose of this updated systematic review was to identify scales used to classify PB in order to investigate literature that addresses clinimetric properties of scales previously identified and to create a valuable resource for clinicians containing recommendations for use of these tools in clinical practice.

Number of Subjects: Individuals post-acute stroke (<1 year) suspected of displaying pusher behavior, evaluated using a PB-specific outcome measure.

Materials/Methods: PubMed, CINAHL, and Embase were searched. Authors independently performed a title screen and abstract review in databases to determine full articles to review. Authors then completed full-text reviews to determine their appropriateness for inclusion. Authors extracted relevant data and applied the Consensus-based Standards for the selection of health Measurement INstruments (COSMIN) checklist for methodological quality and quality criteria to all final articles.

Results: Seven studies that included a total of 323 patients were included. Four scales were identified: the Scale for Contraversive Pushing (SCP), the Modified Scale for Contraversive Pushing (M-SCP), the Burke Lateropulsion Scale (BLS), and the Swedish Scale for Contraversive Pushing (S-SCP). Psychometric property investigation was most robust for the SCP, which evaluated internal consistency, reliability, criterion validity, responsiveness, and content validity across multiple studies. The BLS examined all of these measurement properties with the exception of internal consistency. The M-SCP and S-SCP were each examined in one study only. Cross-cultural validity has not been fully investigated in scales used outside of their country of origin.

Conclusions: The SCP has been the most extensively studied. Implementation of the COSMIN checklist revealed ‘Poor’ quality ratings for most evaluated measurement properties secondary to small sample sizes. The BLS was found to be more responsive than the SCP, indicating that it may better detect small changes in presence of PB.

Clinical Relevance: Persistent pusher behavior interferes with motor recovery and has been shown to protract recovery time after stroke. There is a need for consistent use of a clinical outcome measure to standardize diagnosis, to rate severity, and to determine meaningful clinical changes that are supported by interventional research. The SCP has been more widely studied, however the authors recommend the BLS as the preferred outcome tool to evaluate PB in English-speaking countries due to its higher reported responsiveness and inclusion of dynamic postures not evaluated by the SCP. The BLS is the only scale originally published in English. Further study is warranted with larger, more heterogeneous patient populations to improve the quality of measurement property examination and to better recommend regular clinical use.
TITLE: Improving Over-ground Ambulation and Balance With an Exoskeleton As Gait Training Intervention For a Patient With Hereditary Spastic Paraplegia: A Case Report

AUTHORS/INSTITUTIONS: E. Koch, Spinal Cord Injury and Disorders Center, Minneapolis VA Health Care System, Minneapolis, Minnesota, UNITED STATES

ABSTRACT BODY:

Background & Purpose: Robotics and partial body-weight supported gait training research has shown to be beneficial in improving over-ground ambulation in patients with various neurologic disorders. Ekso Bionics™ Ekso GT is a wearable robotic exoskeleton device that is used as a dynamic gait training tool during physical therapy. The adjustability of the Ekso GT programming through gait parameters, step initiation modes, and swing assistance allows for the physical therapist to decide which areas of the gait cycle to address based on the patient’s needs and ability. The purpose of this case report is to describe the possible effects of gait training with Ekso GT on balance, activity tolerance, gait speed, fall risk and self-confidence in performing activities of daily living in a patient diagnosed with Hereditary Spastic Paraplegia (HSP).

Case Description: The patient was a 68 year old male with a diagnosis of HSP. The patient presented with impairments of weakness and impaired balance leading to functional limitations including difficulty with ambulation and falling two to three times per week. The patient completed gait training in Ekso GT over a ten week period, two to three sixty minute sessions per week.

Outcomes: After 22 sessions of gait training, the patient demonstrated increased over-ground gait speed and endurance, improved balance and a decreased risk of falling according to the Berg Balance Scale, Timed Up and Go, 6 Minute Walk Test and 10 Meter Walk Test. The patient maintained improvements above his baseline presentation and decreased his frequency of falling; however these improvements were not fully sustained over the six month follow up period without intervention.

Discussion: The variable assist programming of Ekso GT allowed the patient to maximize his strength and ability to actively initiate each step and complete a functional gait pattern with a low percentage of robotic assistance. This device is able to provide a high repetition gait session with motor learning in a near optimal gait pattern and minimal fatigue on the physical therapist. The initial positive changes the patient experienced may be attributed to the intensive gait training while the regression noted may be attributed to the progressive nature of the disease, and discontinuing high intensity gait training. Further research is needed to determine the optimal time after diagnosis of HSP to start gait training and for the recommended intensity, frequency and duration of physical therapy that would be beneficial. Patient populations with similar neurologic diagnoses with various degrees of lower extremity weakness may obtain positive results from this form of physical therapy intervention.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: Ditunno PL, Patrick M, Stineman M, Ditunno JF. Who wants to walk? Preferences for recovery after SCI: a longitudinal and cross-sectional study. Spinal Cord. 2008;46:500-506.


Field-Fote EC, Roach KE. Influence of locomotor training approach on walking speed and distance in people with


TITLE: Admission Ambulation Distance and Venous Thromboembolism Prophylaxis in Acute Ischemic Stroke

AUTHORS/INSTITUTIONS: C.M. McQuillan, Physical Therapy, Marianjoy Rehabilitation Hospital, Naperville, Illinois, UNITED STATES|A. Dietzen, A. Sayyad, Marianjoy Rehabilitation Hospital, Wheaton, Illinois, UNITED STATES|A. Pettit, Northwestern University, Evanston, Illinois, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: To evaluate the relationship between admission ambulation distance and anticoagulation VTE prophylaxis for inpatient rehabilitation patients following an acute ischemic stroke.

Number of Subjects: Consecutive patients admitted over one year were assessed for appropriateness. Inclusion criteria included ischemic stroke less than six weeks prior to admission and over 18 years of age. There were a total of 295 subjects that met the criteria. Ambulation data was missing for 4 subjects, therefore the analysis was completed on a total of 291 subjects.

Materials/Methods: The subjects were divided into two groups based on the ambulation distance at admission to acute inpatient rehabilitation. Group 1 (n=236) included patients who were ambulating less than 150 feet at admission to inpatient rehabilitation. Group 2 (n=55) included patients who were ambulating over 150 feet at admission to inpatient rehabilitation. Each patient record was retrospectively assessed for anticoagulation VTE prophylaxis as part of their medical treatment, presence of VTE, Functional Independence Measure (FIM) ambulation gains, and discharge destination from acute inpatient rehabilitation. Chi-square analysis was completed for the categorical variables and t-tests were completed for continuous variables to determine significance between groups.

Results: Group 1 had a mean age of 71.38 years (SD=13.77 years) and sex distribution was 49% male / 51% female. Group 2 had a mean age of 69.4 years (SD=14.2 years) and sex distribution was 53% male / 47% female. In Group 1, 64% (151/236) were on anticoagulation VTE prophylactic treatment as compared to Group 2 with 44% (24/55) on anticoagulation. The differences between the two groups were significant ($\chi^2=9.04, p=.01$). Incidence of VTE for Group 1 was 2.5% (6/236) and for Group 2 was 0%. The differences between the two groups was non-significant, $\chi^2=1.479 (p=.477)$. FIM gait gains for Group 1= 2.28 (SD=1.55) and Group 2=1.35 (SD=.77). The differences in FIM gait gains were significant ($t=6.401, p=.0001$). Discharge destination for Group 1 was 52.1% to home, 35.5% to skilled nursing facility, and 12.4% to acute care. The discharge destination for Group 2 was 90.7% to home, 7.4% to skilled nursing facility, and 1.9% to acute care. The differences were significant between groups ($\chi=1.9\%$).

Conclusions: These results suggest that, as expected, patients with lower mobility scores were more likely to be anticoagulated. Anticoagulation does not appear to negatively impact FIM ambulation gains. Ceiling effect on FIM ambulation gains in group 2 may explain greater gains in group 1. In spite of lower initial mobility, incidence of VTE was similar between the two groups.

Clinical Relevance: In this patient population sample, the use of anticoagulation treatment was not detrimental to the possibility FIM ambulation score improvement.
**TITLE:** Apogeotropic Posterior Canal Benign Paroxysmal Positional Vertigo: A Case Study  
**AUTHORS/INSTITUTIONS:** K. SMITH, Rehab, National Dizzy and Balance Center, Blaine, Minnesota, UNITED STATES  

**ABSTRACT BODY:**

**Background & Purpose:** Characteristic posterior canal benign paroxysmal positional vertigo (BPPV) is the most common form of BPPV which presents with a torsional nystagmus with a vertical upbeating component in Dix Hallpike (DH) position. Anterior canal BPPV, a more rare form of BPPV, presents with a torsional nystagmus with a down beating component. Positioning of the otoconia in the non ampullary arm may change the nystagmus pattern observed in the DH positions. Apogeotropic Posterior Canal BPPV presents with a torsional downbeating nystagmus in DH position on the opposite side of the affected ear. The torsional component is often more pronounced then the vertical. The purpose of this case study is to describe an effective treatment for apogeotropic posterior canal BPPV.

**Case Description:** Patient A presented with a subjective symptom report including dizziness, vertigo, lightheadedness, and imbalance for approximately 2 weeks. Dizziness was reported while laying and tilting her head back. Symptom duration was less than 1 minute. Upon evaluation the patient scored 29/30 on Functional Gait Assessment (FGA) and 18/100 on Dizziness Handicap Index (DHI). Patient A was tested in both DH and supine head positions. A robust left torsional upbeating nystagmus pattern was present in left DH position. Latency was 0 seconds and duration was 20 seconds. A similar pattern presented in supine head left position with a latency of 5 seconds and a duration of 10 seconds. Patient A was treated with the CRT for the left posterior canal BPPV. The patient required one additional treatment to clear the left posterior canal of all debris.

Patient A returned to the clinic 1 week later with similar symptoms but decreased intensity. Examiner observed right torsional downbeating nystagmus pattern in right DH position. Mild left beating nystagmus was present in left DH position. Patient A was initially treated for right anterior canal canalithiasis. The patient returned with no change in symptoms or nystagmus pattern. Patient A was then treated for apogeotropic left posterior canal BPPV using quick liberatory rotation maneuver (QLR) and 5 repetitions of Demi Semont CRT. The patient was issued Demi Semont CRT for daily performance at home.

**Outcomes:** After completing clinic treatment and Demi Semont for home CRT, Patient A returned to the clinic 6 days later with no reported symptoms. The patient scored 29/30 on FGA. No continued symptoms with position changes were reported. Patient A did not return to the clinic for further treatment.

**Discussion:** QLR and Demi Semont CRTs are effective for treating apogeotropic posterior canal BPPV. If a patient who has recently been treated for posterior canal BPPV returns with a nystagmus pattern consistent with opposite ear anterior canal consideration of apogeotropic posterior canal BPPV treatment may be appropriate. Movement of otoconia to the non-ampullary arm may change nystagmus pattern and reported symptoms. Additional use of CRTs independently will better support effectiveness of treatments.

**References:** Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.:


TITLE: Effects of a Five-Week Multimodal Wellness Program on the Quality of Life and Functional Mobility of Individuals with Multiple Sclerosis: A Pilot Study

AUTHORS/INSTITUTIONS: D.D. Lykins, B. Anderson, S. Jung, A. Pittenger, R.A. English, Rehabilitation Sciences, University of Kentucky, Lexington, Kentucky, UNITED STATES

ABSTRACT BODY:

Purpose/Hypothesis: Previous research has demonstrated that engaging in various forms of exercise results in improved quality of life and physical function in individuals with multiple sclerosis (MS). However, there is a lack of research regarding the effects of participation in a multimodal exercise program. Thus, the purpose of this study was to assess the effects of a five-week multimodal wellness program on health-related quality of life and functional mobility of individuals with MS. It was hypothesized that both quality of life and functional mobility would be improved following the five-week program.

Number of Subjects: nine

Materials/Methods: Nine participants (male, n = 1; female, n = 8) with MS (relapsing-remitting, n = 8; secondary-progressive, n = 1) were evaluated using the Timed 25-Foot Walk (T25-FW), the 9-Hole Peg Test (9-HPT), the Berg Balance Scale (BBS), and the Multiple Sclerosis Impact Scale (MSIS-29). These objective measures were taken immediately before (week 0) and immediately after (week 5) a five-week multimodal wellness program. This program included a walking program, Pilates training, circuit training, yoga, and tai chi for a weekly, hour-long wellness session.

Results: A dependent paired-samples t-test revealed significant improvements for the MSIS-29 and the 9-HPT for the dominant hand. The 9-HPT for the non-dominant hand showed improvements, but they were not statistically significant. The BBS and T25-FW resulted in slight improvement, but no statistically significant changes between week 0 and week 5 were observed.

Conclusions: This study revealed significant improvement in dominant hand dexterity and increased health-related quality of life immediately following a five-week wellness program. Therefore, as supported by the hypothesis, individuals with MS—specifically those who are female and with relapsing-remitting MS—benefit from a multimodal wellness program that incorporates education and exercise. Further research is warranted to assess long-term benefits and to determine the most effective multidisciplinary wellness approach for individuals with MS.

Clinical Relevance: These results contribute to the emerging evidence regarding the benefits of physical activity in individuals with MS. Physical activity and education are shown to have a positive impact on quality of life and dominant hand dexterity. A larger scale study may demonstrate more significant positive effects in walking speed and balance. An advantage of a multimodal program is that it introduces people to a variety of activities which may help maintain interest in an ongoing program.
**TITLE:** The Effect of Armrest Use with the Five Times Sit to Stand Test

**AUTHORS/INSTITUTIONS:** J.F. Greany, J. Budzien, K.A. Greany, Health Professions/Physical Therapy, University of Wisconsin - La Crosse, La Crosse, Wisconsin, UNITED STATES

**ABSTRACT BODY:**

**Purpose/Hypothesis:** The purpose of this study was to evaluate the effect of armrest use in the Five Times Sit to Stand (5xSTS) test for adults with neurological disorders.

**Number of Subjects:** 12 females and 26 males (68.9 ± 12.3 years; BMI 27.8 ± 5.9 kg/m²) with Parkinson’s disease, Multiple Sclerosis or other neurological disorders participated in the study.

**Materials/Methods:** Participants attended a 1-hour physical activity program including balance, strength and aerobic components twice per week for 12 weeks. Timed Up and Go, 6 Minute Walk test, Functional Gait Assessment, and 2 trials of 5xSTS were measured prior to and following the 12 week program. The first 5xSTS trial was completed without the use of armrests and second trial was conducted using armrests. Data were analyzed using a 2-way ANOVA within-group comparison and correlations with other functional assessments.

**Results:** Effect of time (F(1,37) = 31.6; p<0.001) and use of arms (F(1,37) = 11.1; p=.002) were found to be statistically significant. The interaction of the two variables was not significant (p=0.25). Subjects had a mean improvement on the 5xSTS of 2.8 sec when not using armrests and 2.3 sec while using the armrests. Both values support or surpass the known MDIC of 2.3 sec. The correlations between 5xSTS and TUG, 6MWT, and FGA were 0.59, -0.71, -0.57, respectively, with no arms and 0.71, -0.76, -0.57 with arms.

**Conclusions:** The use of the armrests with the 5xSTS does not significantly influence the outcome if the same procedure is used consistently. Both variations of 5xSTS demonstrate a strong correlation 6MWT, FGA and TUG, and have similar MDIC values.

**Clinical Relevance:** The 5xSTS is used as a measure of lower extremity strength. In a population of adults with neurological impairment, it can be used either with or without arms to evaluate improvements.
Title: Intensive, functional training leads to optimal outcomes in a young woman post brain stem hemorrhage due to cerebral cavernous malformation

Authors/Institutions: K. Mattern-Baxter, K.R. Thompson, Physical Therapy, California State University, Sacramento, Sacramento, California, UNITED STATES

Abstract Body:

Background & Purpose: Cerebral cavernous malformation (CCM) accounts for 8-15% of all occult intracranial malformations and is defined by abnormal clusters of thin-walled blood vessels throughout the brain. About 30% of patients develop hemorrhage due to rupture of blood vessels, with 5-20% occurring in the brainstem. This case illustrates how a high dosage of physical therapy (PT) intervention administered at a critical time period optimized neurological recovery in a young woman after brainstem hemorrhage due to CCM.

Case Description: The patient was a 29-year old female with an uneventful medical history. Six weeks prior to the episode of care, she suffered a spontaneous rupture of unknown CCM in the brain stem. The patient reported initial symptoms of headache, dizziness, double vision, and sensitivity to light. Over the next days, symptoms progressed from weakness in her left upper and lower extremities to severe hemiparesis and inability to walk. After one week in the intensive care unit and corticosteroid treatment, she was discharged home to once-weekly outpatient PT. Six weeks later, she reported to a University outpatient clinic. She presented with severe left hemiparesis and walked with a front-wheeled walker (FWW), having experienced only minimal neurological recovery. Physical therapy treatment was administered 2/week for 6 weeks and consisted of functional, task-specific strengthening and endurance training using the overload principle. A daily home exercise program was adhered to.

Outcomes: Initial evaluation was conducted at week 6 post-hemorrhage and discharge evaluation at week 12. The 6-minute walk test (6mWT) was used to assess cardiovascular endurance, the 10-meter walk test (10MWT) for walking speed, the Fugl Meyer Upper Extremity Subscale (FMUES) for motor recovery, the 9-Hole Peg Test (9HPT) for finger dexterity, and the Functional Gait Assessment (FGA) for balance. The patient improved her 6mWT from 296 meters (m) with a FWW to 488 m of independent walking. Self-selected walking speed increased from 0.58 meters/second (m/s) to 1.25m/s and fast walking speed from 0.78m/s to 1.6m/s. Her FMUES progressed from 23/66 to 64/66 indicating a recovered upper extremity. She was unable to complete the 9HPT at initial evaluation. At discharge, her score exceeded that of the non-involved right upper extremity. Her FGA score improved from 15/30 to 30/30. The patient returned to all activities including riding a bicycle and bimanual typing.

Discussion: There is a paucity of literature on the effect of physical therapy on patients with CCM. This case study adds to the literature and demonstrates how a high dosage of PT intervention, administered at a critical time to optimize neurological recovery, led to better than expected outcomes in a young woman 6 weeks after brain stem hemorrhage due to CCM. Patients with similar clinical presentation might benefit from this high-intensity, functional treatment approach.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.: Li D1, Hao SY, Jia GJ, Wu Z, Zhang LW, Zhang JT. Hemorrhage risks and functional outcomes of untreated brainstem cavernous malformations. J Neurosurg. 2014;121(1):32-41


The Relationship between Fear of Heights and Balance

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Purpose/Hypothesis: Fear of heights (FOH) is one of the most common fears in humans, but its causes are not fully understood. Evidence suggests that dysfunction of 1 or more of the balance subsystems may contribute to FOH, however, the role balance system deficits play in causing FOH has not been widely explored. The purpose of this study was to identify if a causal relationship exists between visual, vestibular and/or somatosensory dysfunction and FOH. The hypotheses are: (1) participants with a self-reported FOH will demonstrate deficits in one or more of the sensory systems (2) participants with high Acrophobia Questionnaire (AQ) Anxiety scores will demonstrate greater deficits in one or more of the sensory systems than participants with low anxiety scores (3) participants with high AQ avoidance scores will demonstrate greater deficits in one or more of the sensory systems than participants with low avoidance scores.

Number of Subjects: 43

Materials/Methods: Forty-three participants, 31 females and 12 males, mean age 39 (± 15.46) were recruited. Participants completed 1 data collection session. Informed consent was obtained and basic demographic information was recorded. Participants were asked to complete the AQ. Next, timed single leg standing with head turns (SLSHT) was completed to examine stimulation of the vestibular system. Participants then completed the Sensory Organization Test (SOT) using the Natus EquiTest. SOT was performed in order from condition 1-6 with 3 trials collected per condition AQ Anxiety and Avoidance scores were compared to SLSHT time, average equilibrium scores (ES) for SOT Conditions 1-6, and the composite score using Pearson product moment correlation coefficient. Independent t-tests were used to determine if between-group differences existed for high vs. low AQ Anxiety scores and high vs. low AQ Avoidance scores related to SOT ES and SLSHT. Alpha level was set at .05.

Results: Fair correlation (r=-.335, p=.028) was found for AQ Anxiety Score and SOT Condition 1 (standing with eyes open) and a trend toward significance for the AQ Avoidance Score and SOT Condition 1 (r=-.289; p=.060). When the AQ Anxiety Score was compared to SOT Condition 2, there was a trend towards significance (p=.062) with a fair correlation (r=-.287).

Conclusions: Subjects with a self-reported FOH demonstrated a balance deficit when standing on a stationary surface with their eyes open. This finding corroborates the results of previous studies.

Clinical Relevance: The findings indicate that balance deficits are linked to FOH. Given this information, physical therapy interventions may be helpful in the treatment of this clinical condition.
TITLE: Afferent Electrical Stimulation with Mirror Therapy for Improving Ankle movement, Balance, and Gait of Stroke Survivors

AUTHORS/INSTITUTIONS: G. Lee, Physical Therapy, Kyungnam University, Changwon, Gyeongsangnam-do, KOREA (THE REPUBLIC OF)|D. Lee, Physical Therapy, Graduate School of Kyungnam University, Changwon, Gyeongsangnam-do, KOREA (THE REPUBLIC OF)

ABSTRACT BODY:

Purpose/Hypothesis: Balance and gait dysfunction is accompanied by motor impairments such as muscle weakness, abnormal muscle tone, and sensory loss of the affected side [1]. In particular, ineffective ankle dorsiflexion during the swing phase and failure to achieve heel strike at initial contact by the lowered foot may result in an abnormal gait pattern [2].

Mirror therapy (MT), is a cognitive intervention in which the movement of the less affected side, reflected in mirrors, indicates the direction for improved movement of the more affected side through a visual illusion created by overlap of the more affected side [3]. A few studies suggested that physical training through electrical stimulation combined with MT as cognitive intervention can accelerate motor recovery [4].

Recently, a study using Afferent Electrical Stimulation (AES) with MT for rehabilitation of upper extremities of stroke patients has been reported [5]. However, no applied this intervention to the lower extremities, especially for ankle movement. Therefore, this study applied AES combined with MT for the improvement of ankle movement of hemiplegic stroke survivors to investigate its effects on ankle dorsiflexor strength, balance, and gait.

Number of Subjects: 30 hemiplegic stroke survivors

Materials/Methods: The study was a randomized controlled trial. Thirty hemiplegic stroke survivors were randomly allocated to either the experimental group or the sham group. Subjects in the experimental group had ankle movement training using AES with MT for 30 minutes, following gait training for 30 minutes. Subjects of the sham group had ankle movement training using sham AES with MT for 30 minutes, following gait training for 30 minutes. All interventions were performed 5 times a week for 4 weeks. At the baseline and after 4 weeks of intervention, ankle dorsiflexors strength (Hand-held dynamometry), balance (Berg Balance Scale), and gait (GAITRite) were examined.

Results: After the intervention, compared to baseline the experimental group showed significant differences in ankle dorsiflexors strength, BBS, and gait parameters in the velocity, cadence, step length, stride length, and double support time (p<.05). Also, statistically significant differences between the two groups were in ankle dorsiflexors strength, BBS, gait velocity, step length, and stride length (p<.05).

Conclusions: AES with MT may effectively improve ankle dorsiflexors strength, balance, and gait of hemiplegic stroke survivors. The result of this study suggests that AES with MT for improving ankle movement, balance, and gait warrant consideration in stroke rehabilitation. Further studies will be necessary to demonstrate brain reorganization after AES with MT.

Clinical Relevance: The results of this study show the potential for the use of AES with MT in the rehabilitation of post-stroke survivors. AES with MT can be easily implemented in clinical settings. In addition, training using AES with MT may be particularly suitable given the recent trend towards moving rehabilitation out of the hospital environment.
TITLE: Benign Paroxysmal Positional Vertigo in a Person with Multiple Sclerosis in a Skilled Nursing Facility

AUTHORS/INSTITUTIONS: K.C. Gammons, J. Freund, Physical Therapy, Elon University, Chapel Hill, North Carolina, UNITED STATES|B. Robinson, Physical Therapy, Pettigrew Rehabilitation, Durham, North Carolina, UNITED STATES|

ABSTRACT BODY:
Background & Purpose: Multiple Sclerosis (MS) is an autoimmune disease causing demyelination in the central nervous system. Although persons with MS may have central vertigo, benign paroxysmal positional vertigo (BPPV) is also common. Vertigo has been linked to increased levels of fatigue, anxiety, and negatively impacts gait and balance. The purpose of this case report is to describe the diagnosis and treatment of BPPV in a person with MS in a skilled nursing facility.

Case Description: The patient was a 62 year old woman with lumbar compression fractures and a right ischial fracture secondary to falling. The patient’s medical history included multiple sclerosis with visual deficits, hearing loss and vertigo. Evaluation showed decreased gait speed, low back pain, lower extremity weakness, limited mobility, and vertigo with left side lying position. Hallpike-Dix testing confirmed left posterior canal BPPV. Physical therapy consisted of 8 sessions over 13 days including examination, canalith repositioning maneuver, balance and gait training, and lower extremity strengthening.

Outcomes: At discharge the patient improved her functional ambulation category from 2/5 to 5/5, increased gait speed from 0.5 to 0.8m/s and increased maximum distance walked from 200 to 1000 ft all with a rolling walker. She also reported no vertigo or low back pain. She made a clinically important change in gait speed progressing to community level.

Discussion: BPPV should be considered in the differential diagnosis of vertigo in persons with MS. The diagnosis and treatment of BPPV may help avoid unnecessary medications, speed recovery and improve mobility in those affected.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.


TITLE: A high-intensity, periodic model of traditional and robotic therapy for an adolescent with left hemispherectomy: A case report.

AUTHORS/INSTITUTIONS: T.A. Bisson, Program in Physical Therapy, University of Minnesota, Roseville, Minnesota, UNITED STATES; S. Kiseljak-Dusenbury, W.E. Alvarenga, Rancho Los Amigos National Rehabilitation Center, Downey, California, UNITED STATES

ABSTRACT BODY:
Background & Purpose: Research is limited in evaluating the effectiveness of robotic based gait training and high intensity balance exercises in adolescents with hemispherectomy. The purpose of this study is to evaluate the effectiveness of robotic based gait training and high intensity balance exercises using an alternative care model for an adolescent with hemispherectomy.

Case Description: Subject was a 13-year-old female adolescent who presented to outpatient physical therapy with apparent gait abnormalities, history of falls, and decreased walking speed. Patient was diagnosed with seizure disorder at three months old. She underwent three surgeries for correction of seizures and currently has diagnosis of right hemispherectomy with left sided weakness.

Outcomes: Pre-test velocity was measured with 10 m walk test. Pre-test velocity, cadence, and step length were measured with GAITRite, and postural control was assessed with mCTSIB on SMART EquiTest. Subject received 90 minute sessions of individualized therapy over 5 consecutive days. Individual session consisted of robotic gait training on Lokomat, orthotic adjustment and training, and balance training. Subject returned in seven weeks and completed another 5 days of consecutive therapy and then completed immediate follow-up testing. Subject was then seen in 15 weeks for the long-term follow up testing only. She showed substantial meaningful change in 10 m walk test from pre-test and immediate follow-up testing. Her gains in walking speed were sustained at the long term follow up testing (0.11m/s). Subject showed minimal detectable change (MDC) for mCTSIB of 1.2 deg/sec from pre-test and immediate follow-up testing. Her gains in sensory balance were sustained at the long term follow up testing (0.2 deg/sec).

Discussion: Gait speed and balance improved and the subject maintained gains after 15 weeks of completing the alternative care model of high intensive traditional and robotic therapy. Subject had no self-reported falls after immediate follow-up. The results of this case study suggest that a high-intensity, periodic model of balance and robotic based gait training may be a preferred treatment for adolescents with diagnosis of hemispherectomy. Randomized control studies need to be conducted for further evaluation.

References: Limit to only those materials that ensure that the content is evidence-based; minimum 5 references, no more than 10 years old.
