Abstracts

Neurology Section Poster Presentations
TITLE: Effects on episodic vertigo intensity of plantar somatosensory input via direct pressure vs. TENS in patients with benign paroxysmal positional vertigo.


ABSTRACT BODY:

Purpose/Hypothesis: The purpose of this study was to investigate the influence of plantar somatosensory stimulation delivered via direct pressure and TENS on the intensity of vertigo episodes in patients with benign paroxysmal positional vertigo (BPPV).

Number of Subjects: This study was a within-subjects design involving 17 patients (age 27-67 years) with BPPV who had previously undergone canalith repositioning without complete vertigo resolution.

Materials/Methods: Participants completed six treatment sessions during which three episodes of vertigo were induced. Immediately following each induction, the participant was provided one of three plantar stimulation treatments; direct pressure, TENS, or placebo. Treatment order was changed at each session so that after six sessions, each participant had experienced all treatment order permutations. After each vertigo episode, participants rated intensity on a visual analog scale. Treatment responses were compared with repeated measures ANOVA followed by multiple contrast analysis.

Results: While not significantly different in effectiveness from each other, passive plantar TENS and active plantar pressure significantly reduced vertigo intensity over “subsensory stimulation” placebo (p = 0.037). Patients subjectively reported a preference for direct pressure over the other conditions. Six patients expressed feasibility concerns over implementing a plantar stimulation strategy when experiencing episodic vertigo outside the clinic setting.

Conclusions: Based on the results of this investigation it appears that plantar somatosensory stimulation has the potential to attenuate the intensity of episodic vertigo in individuals with BPPV. While the intensity of experimentally induced vertigo in normal subjects has been reduced via plantar somatosensory stimulation, the findings of this study indicate that it may also reduce intensity of vertigo due to vestibular pathology.

Clinical Relevance: Recent literature reports that plantar somatosensory stimulation, via direct pressure, reduces some aspects of vertigo. Neuroanatomical theory postulates that plantar stimulation may partially override input from the vestibular organs at the brainstem’s vestibular nuclei, thus diminishing the perception of vertigo. A current study found that passive application of plantar transcutaneous electrical nerve stimulation (TENS) was as effective as active direct plantar pressure for lowering the intensity of vertigo in normal subjects, based on subjective self-reports of intensity of vertigo and objectively measured intensity of nystagmus. Various methods of plantar stimulation appear to reduce vertigo intensity in normals when it is externally induced calorically, yet the question remains as to whether plantar stimulation will reduce the severity of vertigo episodes in patients with vestibular pathologies.
Purpose/Hypothesis: The purpose of this study was to investigate whether limiting trunk rotation would have an effect on dynamic balance.

Number of Subjects: Fifty subjects between the ages of 20-88 years were recruited from the general population to participate in this study.

Materials/Methods: A goniometric measurement of trunk rotation was taken and the subjects performed the Timed Up and Go test (TUG). A splinting device which limits trunk rotation was applied to the subjects. Afterwards, an additional goniometric measurement was taken and the TUG test was repeated.

Results: The regression analysis showed that both age and gender had an effect on rotation. The Wilcoxon Signed Rank test results indicated that when the device was applied it restricted rotation and increased the TUG scores.

Conclusions: Results indicated that our device was effective in limiting trunk rotation. In our study we hypothesized that there would be a correlation between the application of the device and an increase in TUG scores. We expected there to be a correlation between age and ROM as indicated by our literature review. However, we did not expect a difference between left and right trunk rotation with regards to gender. We were anticipating a correlation between gender and TUG scores.

Clinical Relevance: Balance assessments and interventions are often a component of rehabilitation. Trunk rotation affects balance which ultimately affects the efficiency of gait. Therapists need to be aware of factors affecting balance, such as, age, gender, Parkinson's disease, and other pathological conditions. Our research indicates that when treating patients with balance impairments, trunk rotation should be assessed. If limitations are found, trunk rotation interventions should be included in the rehabilitation process.
**TITLE:** A Systematic Review of the Effectiveness of Body-Weight Supported Treadmill Training vs. Conventional Over-Ground Training for Patients with Incomplete Spinal Cord Injury

**AUTHORS/INSTITUTIONS:** K. Ferraro, M. Dickson, H. Hermansader, S. Rosa, D. Haladay, Physical Therapy, University of Scranton, Scranton, PA;

**ABSTRACT BODY:**

**Purpose/Hypothesis:** The purpose of this systematic review was to determine if body weight supported treadmill training (BWSTT) provided greater improvement in functional walking versus conventional over-ground training (COGT) in patients with incomplete spinal cord injury.

**Number of Subjects:** N/A

**Materials/Methods:** Search:
Four authors completed a search of CINAHL, Cochrane Library, ProQuest, PubMed and Physical Therapy Journal, which was conducted from February 26, 2008 to March 30, 2008. Inclusion criteria consisted of age greater than 7 years, ASIA Scores B-D (incomplete), and ambulation and/or functional outcome measures, while exclusion criteria included non peer-reviewed articles, ASIA Scores A or E and animal studies.

**Results:** Following a detailed appraisal, 12 studies fulfilled the inclusion criteria for this systematic review. Quality assessment scores (PEDro) ranged from 1 to 7/10 with an average of 3.3 points.

**Conclusions:** This systematic review demonstrates that both COGT and BWSTT are beneficial to patients with acute and chronic incomplete SCI. Additionally, both are effective in improving ambulation and functional outcome measures, but neither is superior. However, BWSTT is less physically demanding on the therapist allowing for longer, more productive treatment sessions. Due to the number of low level study designs and lack of homogeneity, further well designed RCTs need to be conducted to help determine which treatment approach is superior in improving gait parameters with this population.

**Clinical Relevance:** In the last decade, BWSTT has shown promise as a means of enhancing and restoring gait recovery in individuals with incomplete spinal cord injury. It has emerged as a potential and successful rehabilitation intervention for these individuals.
ABSTRACT BODY:
Background & Purpose: Finding novel and cost-effective ways to improve walking and fitness in patients with stroke is an important goal of rehabilitation professionals. This report describes the use of a commercially available elliptical trainer for gait and endurance training in 3 patients with chronic stroke. The primary objectives of this case series were to evaluate the feasibility of using an elliptical machine in patients with chronic stroke and to measure changes in gait speed, walking endurance and balance.

Case Description: The patients were 3 men with chronic stroke aged 65 to 73 years. All patients could walk without physical assistance on level surfaces using a single-point cane and orthosis if needed. The patients performed elliptical training 2-3 times per week for 8 weeks. Patients followed a progressive training program with a goal of achieving 20 minutes of uninterrupted activity while maintaining predetermined exercise parameters.

Outcomes: The following outcome measures were tested: habitual and fast gait speed, 6-minute walk test (6MWT), Berg Balance Scale (BBS) and Timed “Up & Go” (TUG). All 3 patients had little to no change in walking speed. Patients 1 and 2 had no change in 6MWT performance while patient 3 showed a 25% improvement. All 3 patients demonstrated improved BBS (28%, 11% and 9%) and TUG performance (5%, 15% and 15%).

Discussion: Elliptical training may be a feasible exercise alternative for ambulatory chronic stroke patients. However, clinicians and researchers should carefully consider equipment design and principles of motor learning and exercise prescription when providing elliptical training.
TITLE: Upper Extremity Changes Following a Dynamic Orthosis Exercise Session in Individuals with Chronic Stroke: A Pilot Study

AUTHORS/INSTITUTIONS: J.G. Barry, J. Deering, K. Terry, N. Silver, L. Amling, C. Araniecke, Physical Therapy, Maryville University, St. Louis, MO;

ABSTRACT BODY:

Purpose/Hypothesis: Stroke is a leading cause of disability in the United States. There is a need to study upper extremity potential in individuals with stroke, especially for those with more severe hemiparesis. The specific aims for the study were to look for changes in functional grasp, passive range (PROM), spasticity and grip strength immediately, 30 minutes, and one hour following SaeboFlex® training. It was hypothesized that there would be immediate improvement in measures with a decline at the 30 minute and 60 minute post measures.

Number of Subjects: 8 participants; Ages=41-73 years (mean 58). Time since stroke=1-12 years (mean 4). Inclusion Criteria: ≥ 18 years old, hemiparesis secondary to stroke occurring ≥ 6 months prior, owned a Saeboflex®

Materials/Methods: Outcome measures included the Box and Block test (B&B) for grasp, goniometry for wrist extension PROM, Tardieu Scale for wrist flexor spasticity (looking at both the difference between R₁ and R₂ and the muscle catch angle for R₃), and dynamometry for grip strength. Measurements were taken before donning the orthosis, immediately, 30 minutes and 60 minutes following the exercise program in the SaeboFlex®. Training protocol: each participant completed a one hour exercise program focusing on grasp and release activities with the number of repetitions counted. For normally distributed data, an analysis of variance (ANOVA) and post-hoc tests were used. For non-normally distributed data, a Friedman’s ANOVA and Wilcoxin Signed Rank Test was used. Significance level was set at p<.05.

Results: The B&B test was not significantly different for time, p=.121. The Wilcoxin Signed Rank for the B&B showed a significant improvement from the pre measure to the immediate post measure (post1) with p=.045. PROM was significantly different, F=12.085 and p=.010. The post-hoc (paired t-tests) revealed that there was an increase from pre to post1, p=.05. The Modified Tardieu difference score was not significantly different, F=2.764, p=0.140. The muscle catch angle at R₁ was significantly different, F=15.994, p=0.005. A post-hoc between Pre and Post1 revealed p=0.014 and between Pre and Post3 p=0.002. Grip strength was not significant, F=1.020, p=0.346. The average repetitions of grasp and release in one hour was 226 (range = 66-437).

Conclusions: Gains were made in grasp and wrist extension PROM following a 60 minute SaeboFlex® exercise program, but these changes gradually declined. There were significant gains in the Tardieu R₄ muscle catch angle, showing a decrease in spasticity, which was sustained for one hour following the intervention. Grip strength failed to show statistically significant changes as a result of the training session.

Clinical Relevance: Based on the findings of this pilot study, the SaeboFlex® may be useful in temporarily improving grasp and PROM in this chronic stroke population. It also allows over 200 repetitions of grasp/release in an hour, whereas 6 out of the 8 subjects were not able to grasp without the device. More studies with larger numbers and more varied participants are needed.
TITLE: Predicting home and community ambulatory activity after stroke.

AUTHORS/INSTITUTIONS: C. Reynolds, G.D. Fulk, Physical Therapy, Clarkson University, Potsdam, NY; S. Mondal, Mathematics, Clarkson University, Potsdam, NY;

ABSTRACT BODY:

Purpose/Hypothesis: To examine which measures of body structure/function and activity level can best predict home and community walking activity in individuals after a stroke, and to compare walking activity between subjects with a stroke and age-matched healthy individuals.

Number of Subjects: 20 subjects with stroke (Functional Ambulation Category ≥4, >6 months post stroke, mean age 65.3±11.71) and 13 healthy, age matched individuals (mean age 65.3±8.50).

Materials/Methods: Fugl Meyer Lower Extremity Motor score (FMLE), Berg Balance Scale (BBS), self-selected gait speed, and the 6 Minute Walk test (6MWT) were collected for each subject. Home and community walking activity was measured with a StepWatch Activity Monitor (SAM, OrthoCare Innovations), which the subjects wore for 5-7 days. A correlation analysis was performed to explore the strength of the linear relationship between measures of body structure/function and activity and ambulatory activity in the community. A best subsets regression analysis was performed to determine which body structure/function and activity level outcome measures could best predict home and community walking activity. An independent t-test was used to compare ambulatory activity between subjects with stroke and healthy subjects.

Results: Subjects with stroke had significantly lower scores on measures of body structure/function and activity than healthy subjects (BBS 48.4±8.31 vs. 56±0.0, gait speed 0.98 m/s ±0.34 vs. 1.36 m/s ±0.17, 6MWT 337.05 m ±149.30 vs. 560.23 m ±67.59). The 6MWT (r=0.703), gait speed (r=0.677), and BBS (r=0.586) were moderately correlated with mean steps taken per day. Based on the best subsets regression analysis, a model with the 6MWT alone was the strongest predictor of home and community ambulatory activity, mean steps/day=583 + 9.32 (6MWT), (RSq adj=46.6, SE coef=2.22, p=0.001). Subjects with stroke (3723±1979) took significantly less steps/day than healthy subjects (6289±1773), (t(27)=-3.88, p=0.001).

Conclusions: Measures of body structure/function and level of activity are moderately related to home and community walking activity in people with stroke. The 6MWT was the strongest predictor of real world walking activity. Individuals with stroke took significantly less steps/day than age matched healthy individuals and would be classified as sedentary based on Center for Disease Control guidelines.

Clinical Relevance: Regaining functional mobility in their home and community is an important goal in post-stroke rehabilitation. The 6MWT can be used in the clinic to predict how much walking activity an individual performs in their home and community following a stroke. It is important to note that individuals with stroke who may appear to be high functioning (gait speed >0.80 m/s) walk significantly less in their home and community than healthy individuals.
TITLE: Minimal Clinically Important Difference in Gait Speed in People with a Stroke

AUTHORS/INSTITUTIONS: G.D. Fulk, Physical Therapy, Clarkson University, Potsdam, NY; M. Ludwig, S. Golden, Good Shepherd Rehabilitation Hospital, Allentown, PA; K. Dunning, , Drake Center, Cincinnati, OH; P. Boyne, Rehabilitation Sciences, University of Cincinnati, Cincinnati, OH;

ABSTRACT BODY:

Purpose/Hypothesis: Gait speed is commonly used in the clinic and research to quantify walking ability in people undergoing rehabilitation after a stroke. Because gait speed is a widely used outcome measure it is important to know how much change in gait speed people with a stroke consider important. The purpose of this study was to determine the Minimal Clinically Important Difference (MCID) in gait speed in subjects participating in outpatient physical therapy (PT) after a stroke.

Number of Subjects: 37 subjects (23 with subacute stroke and 14 with chronic stroke) undergoing outpatient rehabilitation were recruited.

Materials/Methods: During the first week and last week of outpatient PT self-selected gait speed was measured. Three different anchors were used to dichotomize patients as improved or stable: patients’ perception of change in walking ability rated on a Global Rating of Change (GROC) scale, physical therapists’ perception of their patient’s change in walking ability on a GROC scale and transitioning from one functional walking classification to another. Functional walking classifications were based on work by Perry et al where <0.40 m/s is household ambulation, between 0.40 and 0.80 m/s is limited community ambulation, and >0.80 m/s is unlimited community ambulation. A Receiver Operator Curve (ROC) was created to determine the most sensitive and specific change in gait speed that could distinguish between patients with significant change and minimal to no change.

Results: Initial gait speed (0.60 m/s) was significantly less than gait speed on discharge (0.80 m/s), p<0.000. Using patients’ perception of change as the anchor, the area under the curve (AUC) was 0.724 (95% CI 0.509-0.939) and the MCID was 0.11 m/s with a sensitivity of 0.708 and a specificity of 0.625. Using clinicians’ perception of change as the anchor, the AUC was 0.724 (95% CI 0.545-0.904) and the MCID was 0.11 m/s with a sensitivity of 0.731 and specificity of 0.778. Using change in functional walking classification as the anchor, the AUC was 0.935 (95% CI 0.845-1.025) and the MCID was 0.13 m/s with a sensitivity of 0.917 and a specificity of 0.714.

Conclusions: A change in self-selected gait speed of 0.11-0.13 m/s was considered an important change in walking ability in this cohort of subjects with stroke. The MCID of gait speed was similar using 3 different anchors (patients’ and clinicians’ perception of change and transitioning from one gait speed category to another). Further research is planned with a larger sample size and to determine MCID of gait speed within different subgroups of people with stroke.

Clinical Relevance: Gait speed is related to a variety of body structure/function, activity level and social participation level measures and is commonly used in the clinic and research. Clinicians and researchers can use the MCID value of 0.11-0.13 m/s to identify important change in walking ability in patients and subjects with stroke undergoing outpatient rehabilitation.
ABSTRACT BODY:

Background & Purpose: West Nile Virus has increased in prevalence in the United States since it reached New York City in 1999. This flavivirus has been associated with encephalitis, viral meningitis, acute flaccid paralysis and acute respiratory failure. Advanced age is a key risk factor for these severe neurologic sequelae. As the population ages and the incidence of West Nile Virus continues to rise, the physical therapist must be prepared to treat this unique and relatively new patient population. The purpose of this case report is to review the incidence of West Nile Virus, discuss key prognostic indicators of functional recovery and present a case description with rehabilitation outcomes and therapeutic exercise recommendations.

Case Description: The client is a 74 year old male who was admitted to the hospital with fever and a persistent cough. He was diagnosed with West Nile Virus and developed encephalitis as well as aseptic meningitis. After two weeks the client was admitted to inpatient rehabilitation with mental status changes, lower extremity weakness, neuropathic pain, and impaired balance. He required moderate assistance for transfers and his ambulation was limited to 5 feet with a rolling walker. An EMG study revealed demyelination of motor and sensory nerves of the lower extremities, acute axon loss proximally greater than distally and anterior horn cell involvement. He remained in the rehabilitation hospital for three weeks and received transfer training, gait training and sub-maximal therapeutic exercise. The outcomes measured include the Berg Balance Scale, Functional Independence Measure and SF-36 Health Survey. Repeated measures of the client's lower extremity strength were also recorded with a hand held dynamometer.

Outcomes: While the client in this case did not demonstrate significant improvement in his lower extremity strength, he did show functional gains during his rehab stay. His total FIM score improved from 56 at admission to 83 at discharge. Specifically, his FIM score for transfers improved from 3 to 5, ambulation improved from 1 to 4, wheelchair propulsion from 1 to 2 and elevations from 0 to 2. His Berg Balance scale increased from 24 to 29 and he remained at high risk for falls upon discharge. The only significant change in his SF-36 responses was an improvement in bodily pain rating from extreme to moderate.

Discussion: Key prognostic indicators of functional recovery following West Nile Virus infection are age at onset, the presence of medical co-morbidities and EMG study results. Since acute flaccid paralysis has been associated with anterior horn cell involvement, the post polio literature was used to determine exercise intensity for this client. Submaximal exercise has been proven to be beneficial without causing overwork weakness in the post-polio population. When encountering future clients with West Nile Virus, the physical therapist must be aware of the EMG results and design an exercise program appropriate to the findings.
TITLE: The combined interventions of body weight support treadmill training and TheraBand: A case study of the effects on a person with hemiparetic gait.

AUTHORS/INSTITUTIONS: D. Veneri, Physical Therapy, University of Hartford, West Hartford, CT;

ABSTRACT BODY:
Background & Purpose: Body weight support treadmill training (BWSTT) is a fairly contemporary task-specific therapy for persons requiring gait retraining and has demonstrated clinically measured benefits. For this project, Thera-Band was configured around the hemiparetic leg to replace the subject’s AFO. The purpose of this single subject case study was to explore the effects of the combined interventions of BWSTT and Thera-Band on an individual with hemiparetic gait.

Case Description: Inclusion and exclusion criteria were identified. The subject was an independent ambulator on level with a LBQC, custom AFO and arm sling. She required supervision with showers and elevations and minimal assist with car transfers and ambulation over uneven ground. Informed consent was obtained, following approval by the University of Hartford’s Human Subjects Committee. The subject participated in three-10 minute training sessions three times a week for ten weeks. Thera-Band was configured around the hemiparetic leg figure –eight style and attached to the Biodex LiteGait Trainer harness. The subject performed TT at a self-selected speed with a five-minute rest period between each session. Vitals signs were monitored at all times.

Data was collected during weeks one, five and ten and eighteen and consisted of the 10 Meter Walk Test, the Tinnetti Balance Test and physiological cost index (PCI). Lower extremity (LE) function of the hemiparetic limb was assessed using hand-held dynamometry, and the LE portion of the Fugl-Meyer. The SF-36 identified the subject’s perception of stroke.

Outcomes: Overall improvements in gait speed, average step cycle, average step length and percentage of right and left leg distributions occurred. BWS decreased from 30% to 20% at week seven. The ambulation index, a parameter index generated by the Biodex LiteGait Trainer, is a composite score relative to 100 based on foot to foot time distribution ratio and average step cycle. The subject’s ambulation index increased from eleven to seventy-three over the course of the training protocol. Gait speed over ground with the AFO improved from 34.53 sec to 29.01 sec over time. The Tinetti Balance scores improved from 16 to 19/21 and the Fugl-Meyer from 13 to 19/34. Hand held dynamometry of the hemiparetic LE revealed statistically significant improvements using the Two Standard Deviation Band Method.

Discussion: Limitations were identified. Suggestions for future research include increasing the number of subjects, moving the study from an academic to clinical setting and perhaps reassessing some of the data collection tools. This single subject case study resulted in positive results with gains noted in strength, balance, and gait parameters following a training protocol combining the interventions of Thera-Band and BWSTT. Furthermore, these combined interventions required one therapist to supervise a subject utilizing BWSTT without their gait/orthotic devices – a potential advantage in today’s cost-conscious arena of healthcare.
ABSTRACT BODY:

**Background & Purpose:** An acupuncture point stimulator can be used to reduce the pain of migraine headaches. However, in this clinical case study, an acupuncture point stimulator was used to prevent migraine headaches.

**Case Description:** Two college age female students who are in a doctoral program in physical therapy suffered from migraine headaches. One of the students had two to three headaches/month. During her headaches she stayed at home at least 24 hours to recover. The second student had a migraine headache every day. She stayed in class, but her concentration was severely impaired. The students' headaches were compromising their ability to complete the physical therapy program. Each student was shown how to find and stimulate acupuncture points with an acupuncture point stimulator. They were instructed to stimulate 5 acupuncture points for migraine headaches (GV 7, LU7, ST8, GB 5 & 20) bilaterally in the morning and at night every day. Each point was to be stimulated for 30 seconds. The frequency of pulses was 4/sec and the intensity of the stimulation was as high as tolerated at each point. Both students were told to continue to use any prescribed medication.

**Outcomes:** The student with migraines occurring three times/month did not have another headache during the semester she used the stimulator (4 months). She stopped using the stimulator for the next semester and had only one headache occurring at the end of that semester. She began using the stimulator again and has had no more headaches. The second student stopped having daily headaches after three days of stimulation. She has used the stimulator for a full semester and reported only one headache during midterm exams.

**Discussion:** The students’ prescribed medications were failing to control their headaches. The faculty was very concerned for these students. In an effort to help them, this experimental protocol of acupuncture point stimulation was tried. Stimulation of acupuncture points is typically associated with relieving ongoing symptoms of pain. However, electrical stimulation of acupuncture points was discovered to be useful prophylactically for the pain of migraine headaches. Prevention of a migraine headache is superior to trying to reduce the pain of an ongoing headache. The total time required per day for stimulation of the selected acupuncture points is less than 15 minutes. The cost of an acupuncture point stimulator is low. If this protocol is successful with other people who suffer migraines, it could be a useful addition to the treatment of migraines.
Purpose/Hypothesis: Falling is a common occurrence and the leading cause of accidental death in people over the age of 65 years. The cost of treatment for injuries sustained in falls exceeded $20 billion in 2000. Individuals with Parkinson’s disease are nine times more likely to fall than healthy adults of the same age due to a number of factors including: loss of balance, decrease in strength and endurance, delayed reaction time, deficits in vision, impaired attention, and lack of confidence. Studies on treadmill training, dance, and traditional therapy have shown some positive results including increases in balance and self-confidence. An issue is that these interventions tend to target only one or two modifiable risk factors and often have not indicated long-term benefits to subjects. A multimodal intervention that is effective in addressing multiple impairments simultaneously would be beneficial to the patient and cost effective. We piloted a novel training program using an off-the-shelf dance video game, Dance Dance Revolution (DDR). The purpose of this study was to measure the efficacy of DDR training in reducing falling risks in Parkinson’s disease.

Number of Subjects: Two 78-year-old subjects: one subject with Parkinson’s disease (Hoehn and Yahr level 1) and one healthy age-matched control.

Materials/Methods: Subjects trained on Dance Dance Revolution for 24 sessions. Pre and post training, subjects were tested on a number of outcome measures for changes in functional performance, reaction time, balance, and health and well-being.

Results: Both subjects improved in all behavioral tests, including single and dual task reaction time step test, stair ascent and descent, five times sit to stand test, and balance. Additionally, subjects had 100% compliance and indicated enjoyment of the training.

Conclusions: The high level of compliance and improvement may be related to the real-time feedback of temporal and spatial accuracy of foot placement and knowledge of results about overall accuracy with game scores. Furthermore, behavioral improvements may be related to the external rhythmic cuing provided through the virtual environment of Dance Dance Revolution. External cuing strategies may encourage neuropasticity via cerebellar-thalamo-cortical circuits and thus bypass the defective basal ganglia.

Clinical Relevance: This research suggests that the complex interactive environment created by video games stimulates multiple senses and trains participants to coordinate effective sensory-motor responses that are relevant to the real world. Future research will conduct a randomized clinical trial with pre, post, and retention tests that include brain imagery.
Purpose/Hypothesis: The purpose of this study was to investigate the effect of a lighted tilted frame on symmetrical weight bearing individuals who have had a cerebral vascular accident (CVA).

Number of Subjects: 2 subjects, one who had a right CVA and the other had a left CVA.

Materials/Methods: Single-subject ABC design. Both subjects had 6 weeks of the intervention. The intervention consisted of standing for 15 minutes without visual stimulation during the A phase (control), standing with a lighted frame tilted towards the subject’s involved side for 15 minutes during the B phase and standing with a lighted frame tilted toward the subject’s uninvolved side for 15 minutes during the C phase. The subjects were examined transferring from sit to stand on the EquiTest System® before and after each intervention to determine their left/right symmetry in standing. Balance and gait assessments were performed before and after each phase. Acceleration line, mean level and two standard deviation band method were used to analyze the data.

Results: Both subjects had more weight on their uninvolved lower extremities during the A and B phases and had a more symmetrical stance during the C phase.

Conclusions: A lighted tilted frame, tilted towards the uninvolved side, improved weight bearing on the involved lower extremity of 2 subjects who had a CVA.

Clinical Relevance: These results may assist in providing visual stimulation to improve symmetrical standing in a clinical setting to patients who have had a CVA.
TITLE: Reliability and Validity of the Nintendo Wii Fit™


ABSTRACT BODY:

Purpose/Hypothesis: The aim of this study was to investigate the reliability of the Nintendo Wii Fit™ and concurrent validity by comparing it to the Neurocom EquiTest®. It is hypothesized that the Wii Fit™ will not be as precise or accurate as the EquiTest®.

Number of Subjects: 31 subjects (mean=22.6; range=18-25)

Materials/Methods: This was a reliability and concurrent validity study using a convenience sample. All participants completed two trials of the Body Test on the Wii Fit™, then two trials each of the EquiTest® Sensory Organization Test (Trial One) as well as the Weight Bearing Squat (Trial One). Outcome measures analyzed included center of gravity and left-right symmetry.

Results: The center of gravity and left-right symmetry measurements given by the Wii Fit™ were determined to not be reliable (ICC=.253; .270). There was no correlation found between the Wii Fit™ center of gravity measurements with those of the EquiTest®. The left-right symmetry measurements given by the Wii Fit were not correlated with those from the EquiTest® when the subjects stood without their feet properly aligned (r=.218). When the subject’s feet were lined up on the EquiTest®, the left-right symmetry measurements from the Wii Fit™ were shown to have a fair level of correlation (r=.532).

Conclusions: The Wii Fit™, though convenient and affordable, does not provide consistent, accurate results when compared to the EquiTest®.

Clinical Relevance: Caution should be used when interpreting the Body Test results of the Wii Fit™ since they were not reliable or valid when compared to the EquiTest®.
Background & Purpose: Over 10,000 people sustain a spinal cord injury (SCI) each year. Of these, between 16-59% of them will sustain some form of traumatic brain damage (TBI). A dual diagnosis of SCI and TBI can be a challenge not only for the patient and family but also for the medical team. Due to the cognitive deficits associated with TBI and the difficult rehabilitation process with SCI, adaptations must be made to the treatment program for a person with a dual diagnosis. The purpose of this case study is to describe physical therapy (PT) intervention for a patient with a dual diagnosis of SCI and TBI and to illustrate modifications that must be made for this unique patient population.

Case Description: The patient was a 30 year old Caucasian male with a dual diagnosis of severe TBI and complete T7 SCI following a motorcycle accident. He had an initial Glasgow Coma Scale of 3 and a Ranchos Los Amigos Level of IV. The patient received 5 weeks of PT in an inpatient hospital setting. Functional Independence Measure (FIM) scores and Agitated Behavior Scale (ABS) scores were collected. The patient’s cognitive and behavioral deficits from the TBI interfered with the SCI rehabilitation process. Inappropriate behavior along with inability to carry-over information and sequence tasks hindered the patient from learning novel tasks needed for SCI rehab such as sliding board transfers. Behavior modification techniques were critical to employ before any functional gains could be accomplished.

Outcomes: After 5 weeks, the patient progressed from initial FIM scores of 2 in wheelchair mobility and 1 in transfers to scores of 4 and 2, respectfully. These slow FIM score changes help illustrate the impact of a TBI on SCI rehabilitation. As ABS scores decreased, improved functional ability was noted. Despite the impact of the TBI on the rehabilitation process, the patient was able to show improvements in balance, strength, endurance, bed mobility, transfers and wheelchair propulsion through PT interventions that had been adapted to meet the needs of the dual diagnosis. Goals and plan of care also had to be adapted to meet the needs of this unique patient.

Discussion: Implications for physical therapy practice related to individuals with dual diagnosis: 1) goals must be modified to encompass both impairments, 2) behavior modification becomes a critical aspect of rehab, and 3) FIM scores may not reflect improvements which may impact reimbursement from third party payors. Future research should focus on determining the exact impact of dual diagnosis on FIM score changes in order to support continued physical therapy and to support reimbursement.
Purpose/Hypothesis: Current guidelines for acute inpatient stroke care recommend early mobilization and assessment by rehabilitation professionals as soon as possible. Population-based data were examined to determine the extent to which physical therapy (PT) is used in the acute care of stroke and whether demographic, socioeconomic, and geographic disparities exist in its use.

Number of Subjects: 243,515 adults >44 years of age (mean age 73 yrs; 52% female; 78% White) who were admitted to a short-term, acute care hospital with a primary diagnosis of stroke (identified via ICD-9-CM codes).

Materials/Methods: Analysis of two years (2005-2006) of hospital discharge data from all short-term, acute care hospitals (N=447) in four geographically and demographically diverse states (AZ, FL, NJ, WI). Data from other sources (e.g., US Census, Area Resource file, American Hospital Association database) were merged with the hospital discharge data. Records with PT charges were identified and converted to costs (adjusted for hospital characteristics & location). Descriptive statistics were generated to describe PT use and the clinical and demographic characteristics of individuals who received PT. Bivariate and multivariate analyses were conducted to identify factors associated with the receipt of and intensity of PT services, defined as adjusted PT costs/length of stay.

Results: 56% of the sample received PT. For individuals who received PT, the median total PT charges and median PT charges/day were $482 and $111 respectively. On average, PT charges were 2.4 percent of total hospital charges. In bivariate analyses, individuals who received PT were more likely to be older, female, African-American, and to live in a metropolitan area. Individuals who received PT also had greater stroke severity, more comorbidities, and longer lengths of stay (mean of 8 days vs 4 days). The proportion of individuals who received PT varied across states (range 53-59%) and across hospitals (range 0–95%). In bivariate analyses, individuals who received PT were more likely to be treated at not-for-profit hospitals. Other hospital characteristics such as bed size, volume of stroke patients, physical therapist FTEs, CARF accreditation, and medical school affiliation were not associated with receipt of PT, but were associated with intensity of PT services for those receiving PT. In preliminary multivariate analyses, receipt and intensity of PT use were associated with demographic, socioeconomic, hospital-related, and geographic characteristics, even after controlling for illness severity.

Conclusions: Only about one-half of individuals admitted to acute care hospitals for stroke receive PT. Factors beyond illness severity and need appear to determine whether and the amount of PT individuals receive. Understanding these factors is the first step in improving access to and quality of care.

Clinical Relevance: Based on current guidelines, PT in the acute care setting appears to be underused in some instances. We have identified potential areas for improving access to and quality of PT for the acute care of stroke.
Clinical Measure of Gait Rhythm: Reliability of The Audio Switch

A. McBroom, M. McCarthy, M. Spencer, R. Di Fabio, Program in Physical Therapy, University of Minnesota, Minneapolis, MN

Purpose/Hypothesis: Gait rhythm abnormalities are commonly seen in patients with High Level Gait Disorders and community dwelling elderly persons. It has been shown that disorders of gait rhythm are predictive of a decline in function and mobility. To measure stride time variability, previous studies have used computerized walkways, force sensitive heel switches, and motion analysis software. However, these methodologies are expensive to implement and have limited clinical application. The purpose of this study was to determine if a small wireless microphone can be used clinically as a reliable and inexpensive way to measure gait rhythm.

Number of Subjects: 6 naive non-impaired subjects (4 females, 2 males: age range 23-33 years) participated in this walkway study.

Materials/Methods: A wireless microphone (RevoLabs xTag) was used as an audio footswitch and was attached to the right heel to measure each subject’s stride time (the time between consecutive heel strikes of the same foot). At a self-selected preferred cadence, while being video taped, subjects walked 15 meters, paused, turned and returned to starting position. Praat voice analysis software was used to collect the unfiltered microphone recording in an audio wave file, where the peak of pulse bursts corresponded to consecutive right foot strikes. The video and audio wave files were synchronized using Sony Vegas Studio to confirm that the peak burst viewed in the audio file directly corresponded to foot strike. Only the first 10 steps were analyzed. The coefficient of variation (CV) for the mean stride time was calculated for each rater based on the assessment of 6 subjects. The standard error of measure (SEM) for intra rater reliability (in milliseconds; ms) was derived from the square root of the error term in a one way repeated measures analysis of variance with step number as the main effect.

Results: Average CVs between raters varied from 5.21% to 6.63%. Inspection of the dot plots (score distribution by rater) showed a highly consistent pattern of stride time measurement across raters. The error associated with measuring stride time (SEM) varied from ±56 ms to ±83 ms.

Conclusions: Our findings show that using a wireless audio foot switch is a feasible way to measure stride time variability. With a low CVs and SEMs less than 84 ms, the audio foot switch has good reliability for individual clinicians performing these measurements. These results suggest that clinical measures of stride time may be repeatable in a clinical environment. Further adjustments in audio recording (e.g., the use of filtering) may enhance the correspondence of foot strike bursts to the reality of foot strike so that stride time measurements for subjects with ambiguous stepping patterns can be improved.

Clinical Relevance: The use of the audio foot switch to determine gait variability and rhythm is a reliable tool that can be used easily in a clinical setting to compliment fall risk assessment.
TITLE: Auditory Discrimination Training at Preferred Cadence Improves Walking Coordination

AUTHORS/INSTITUTIONS: M. Martinson, J. Moen, E. Mraz, R. Di Fabio, Program in Physical Therapy, University of Minnesota, Minneapolis, MN;

ABSTRACT BODY:

Purpose/Hypothesis: Previous research demonstrates that perceptual learning through auditory discrimination training may transfer to improvements in the timing of motor tasks. It is not known if perceptual training can improve timing in a functional, weight-bearing motor task. The purpose of this preliminary study was to determine whether improvements in auditory discrimination training transfers to improvement in rhythmic stepping.

Number of Subjects: 6 non-impaired (4 females, 2 males; age range 23-33 years) participated in the study.

Materials/Methods: Subjects performed a motor pre-test on a platform with foot pedals that involved stepping in time with the rhythm of their preferred cadence. At first, subjects heard beeps through headphones corresponding to their preferred cadence (the “synchronization phase”). The beeps then disappeared during the “continuation phase” as subjects continued to step rhythmically from memory. Twenty blocks of 12 steps were performed. A computer program collected the step interval during the continuation phase. Cognitive Training: Subjects then underwent auditory discrimination training involving 6 sets of 60 trials for 5 days. In the task, subjects sat in front of a computer screen wearing noise-cancelling headphones as they heard auditory tones separated by an interval equal to their preferred cadence followed by a test interval. They pressed a designated key on the keyboard to indicate which interval was longer. A mean discrimination threshold was calculated in Matlab. Subjects then returned for a step-in-place post-test, and comparisons were made between pre and post-test step accuracy and variability.

Results: Repeated measures analysis of variance confirmed a discrimination learning effect from training day 1 (9% of threshold) to training day 5 (6% of threshold; p<0.05). Lower values indicate a closer approximation to the target interval. Each subject showed improvement in auditory discrimination ability from day 1 to day 5. Wilcoxin Signed Ranked test showed that stepping accuracy improved (median pre = 2.02% of target to median post =1.37% of target; p<0.05). Stepping consistency, however, was not significantly altered following discrimination training (median of 4% at pre and post-test).

Conclusions: Auditory discrimination training at the subject’s preferred cadence improved walking coordination, suggesting that the subject’s “internal clock” was modified. Our findings extend the work of Meegan et al. (2000) who demonstrated improved finger tapping accuracy following auditory discrimination training. The variability of stepping behavior in non-impaired subjects was already low at baseline and this may have contributed to the lack of further improvement in stepping consistency.

Clinical Relevance: Enhancing walking coordination through auditory discrimination training might be a treatment method that will benefit patients with gait dysfunction, including those with Parkinson’s disease. This type of training will be tested in a clinical environment to determine if the protocol is effective.
Incorporating the Use of the Nintendo Wii to Achieve Functional Outcomes in a Patient with a Brain Injury: A Case Report

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Background & Purpose: Virtual reality has been effective in improving impairments and functional limitations in patients with brain injury. However, positive results have been established using systems that are not commercially available and are generally very expensive. With the quickly evolving nature of technology, there has been a transition in recent years to incorporate commercially available gaming consoles into conventional therapy sessions, namely the Sony PlayStation II and the Nintendo Wii. While the popularity of these two gaming platforms continues to grow, research struggles to catch up to demonstrate sufficient evidence of their efficacy. For instance, there are no published reports at this time of using the Wii for rehabilitation in the brain injury population. Thus, the purpose of this case report is to describe an example of such a protocol.

Case Description: A 20-year old male, with motor and cognitive deficits after an anoxic brain injury, received 11 training sessions within an inpatient sub-acute facility. The 60-minute long sessions were divided to equally incorporate conventional physical therapy (PT) techniques and the use of Nintendo Wii Sports and Wii Fit games. The combination of the two approaches was chosen to uniquely challenge and improve the patient’s impairments (decreased balance, coordination, reaction time, visual-spatial skills, and strength) while providing an environment that was both interesting and fun for the patient. Ten individual games were selected for use, based upon patient choice and the different motor and perceptual demands presented by each game.

Outcomes: The patient made considerable improvement in balance, postural control, and functional mobility: Berg Balance Scale: 38/56 pre-, 56/56 post-; Dynamic Gait Index: 18/24 pre-, 24/24 post-. The patient was further assessed using the High-Level Mobility Assessment Tool (30/54 post-) to better represent the improvements made in higher-level motor skills. Cognitive function, more specifically in areas of orientation, attention, and recall (Mini-Mental State Exam: 17/30 pre-, 24/30 post-) also improved. Finally, in the post-intervention survey, the patient indicated that he enjoyed using the Wii, found the games sufficiently challenging, and conveyed that he would continue home use of a Wii gaming system if available.

Discussion: The combination of conventional PT interventions and the Nintendo Wii appears to have positively influenced this patient’s functional mobility, balance, and cognition. The Wii has much to offer in the rehabilitation setting. While it is not believed that it can take the place of skilled therapy, it can be considered as a supplementary tool. It has the potential to encourage patient motivation and it offers a feasible option, being both commercially available and relatively low-cost, for continued rehabilitation of possible life-long functional limitations, in this case as a result of a brain injury.
TITLE: Sit-to-Stand Phase Failure in Three Adults with Acute Traumatic Brain Injury

AUTHORS/INSTITUTIONS: S.B. Perry, Physical Therapy Program, Chatham University, Pittsburgh, PA; S. Little, Physical Therapy Department, HealthSouth Harmarville Rehabilitation Hospital, Pittsburgh, PA;

ABSTRACT BODY:

Background & Purpose: Sit-to-stand (STS) has rarely been studied in persons with acute disability who require physical assistance. Major influences on the normal ability to stand are: seat height, foot placement, armrest use, and leg force, especially knee extension. Sit-to-stand consists of 3 phases: 1. initiation to seat-off (SO); 2. SO to max ankle dorsiflexion (DF); and 3. max DF to erect stance. The hypothesized cause of Phase 1 failure is a deficit in momentum generation, Phase 2 failure balance impairment, and Phase 3 failure inadequate leg extensor force.

Persons with a traumatic brain injury (TBI) commonly have impairments that impact STS. Linking impairments to STS phase failure could help therapists best target interventions that reduce STS dependence. This multiple-case report cites the STS phase during which subjects with TBI required assistance and describes impairments which may be associated with the need for assistance.

Case Description: Three subjects with TBI ranging 1.5 to 5 months duration were ages 40, 20, and 20 years. All were inpatients, required assistance for STS, and were unable to stand unsupported. All subjects had adequate DF PROM to place feet flat on the floor while sitting. Compared with gender-specific published dynamometry values for the closest ages available (50-59 years), average quadriceps strength for subject 1 was 33% of the age group mean; subject 2 was 33%; and subject 3 was 17%. Forward reach in sitting ranged from 6.3 to 6.6" while the mean is 16.1" in healthy adults. Each subject was videotaped for 4 to 5 trials while standing from a seat set to 100% of knee joint height. Separate switches under the subject’s hips and attached to the therapist’s hand activated lights to indicate SO and the moment of assistance respectively. Digital video analysis was used to discern the STS phase during which the subject required assistance.

Outcomes: Across the 3 subjects, the need for manual assistance occurred simultaneously with SO in 10/14 total trials. Assistance was needed within 0.5 seconds prior to SO in the other 4 trials.

Discussion: These individuals required assistance during phases of momentum generation or postural instability. Leg weakness in the current subjects may have interfered with Phase 3 of STS, but assistance was required prior to Phase 3 in every trial. While normal subjects exhibit peak knee torque at SO, the leg muscle force required during STS is far less than their maximal strength measures. Phase 1 of STS is used to generate horizontal momentum that shifts center of mass (COM) forward over the feet. Sitting balance impairment may have reduced subjects’ ability to produce adequate momentum for SO. A large and rapid upper body rotation may have been destabilizing, resulting in the need for external support. Clinicians often attribute STS failure to leg weakness, but the present cases suggest that an inability to displace COM far enough and fast enough may have added to the need for assistance. Interventions which focus on these deficits may reduce dependence in STS, and this avenue is recommended for future research.
TITLE: Recovery of Meaningful Function 17 Years Post-Spinal Cord Injury Using Activity Based Restorative Therapy

AUTHORS/INSTITUTIONS: C.E. Felter, International Center for Spinal Cord Injury, Kennedy Krieger Institute, Baltimore, MD; D. Becker, Department of Neurology, Johns Hopkins School of Medicine, Baltimore, MD;

ABSTRACT BODY:

Background & Purpose: Activity Based Restorative Therapy (ABRT) combines the principles of massed practice, forced use, functional electric stimulation (FES), functional bracing and positioning, therapeutic handling, and motor relearning to re-establish the neural pathways using patterned and non-patterned activities following spinal cord injury (SCI). ABRT encourages the functional use of all major muscle groups in addition to providing intense sensory input to retrain activities of daily living.

Case Description: A 34 year old woman who sustained a traumatic SCI and concussion secondary to a motor vehicle accident. She was initially ventilator dependent and participated in four months of traditional, non-ABRT inpatient rehabilitation. In the years that followed, she received limited therapeutic intervention; however, she continued to notice isolated positive changes over time including functional motor control of her left shoulder and bicep, sufficient to operate a power wheelchair with the use of a goalpost style joystick. Seventeen years post-injury, she made a self-referral to an ABRT program. Upon admission, the following relevant secondary complications of SCI were noted: shoulder subluxation, neuropathic pain, scoliosis, disuse atrophy in all extremities, spasticity, and a chronic, stage II sacral decubitus ulcer. At that time, her injury was classified as C4 ASIA impairment scale B. Therapies were initiated which included 6 hours per week of physical therapy and 4 hours per week of occupational therapy for 6 months. Therapeutic interventions included use of a dynamic stander-glider, sitting balance, reaching, stretching, respiratory strategies, FES assisted upper and lower extremity cycling, therapeutic taping combined with FES of the shoulder, and FES to facilitate grasp and wrist extension.

Outcomes: Shoulder pain resolved from a self reported average of 9/10 at admission to 0/10 at discharge. Improvements were noted in trunk balance and upper extremity control including the ability to turn her wheelchair off and on without assistance allowing independent negotiation of her environment, brushing her teeth with minimal assistance and use of a wrist splint, and self feeding with minimal assistance after set-up and a wrist splint. Improvement was objectively noted on the Capabilities of the Upper Extremity Questionnaire (46/224 to 64/224) and on the American Spinal Injury Association Exam (light touch 16/112 to 21/112, pin prick 12/112 to 13/112, motor 6/100 to 9/100).

Discussion: Despite the limited changes that occurred in the first 17 years post-injury, the patient noted an enhanced rate of recovery during the ABRT intervention period. Following intervention, the patient demonstrated a level of functional independence that was better than expected for individuals with her level and severity of injury. It is evident based on the findings described above, that meaningful changes in functional status can occur many years after the initial onset of injury, and that these changes may be enhanced with the use of ABRT.
TITLE: Canal Plane Characterization and Adaptation of the aVOR following Traumatic Brain Injury

AUTHORS/INSTITUTIONS: M. Scherer, Physical Therapy and Rehabilitation Science, University of Maryland School of Medicine, Baltimore, MD; M. Schubert, Otolaryngology Head and Neck Surgery, The Johns Hopkins University School of Medicine, Baltimore, MD;

ABSTRACT BODY:

Background & Purpose: Recent findings in a U.S. Army Brigade Combat Team report that dizziness and imbalance both ranked among the top three symptoms for military Service Members (SM) who sustained traumatic brain injury (TBI) while deployed to Iraq. Despite the prevalence of vestibular-like complaints in this patient population, underlying pathology for these symptoms has not yet been established. We have initiated an independent line of research to characterize angular vestibulo-ocular reflex (aVOR) gain (eye velocity/head velocity) in blast exposed SMs with TBI. In this pilot work, we characterized aVOR function to rapid head impulses in each semicircular canal (horizontal, posterior, and superior) and aVOR gain adaptation in a 56-year-old patient with a moderate TBI (RLA 8). We compared these findings with an age-matched control subject with no vestibular deficit.

Case Description: In December of 2008, the patient subject sustained an industrial accident that resulted in severe and complex left facial and orbital fractures with a significant left subarachnoid hemorrhage over the frontal and squamous portions of the temporal lobe. Post injury sequelae included: neurocognitive deficits, dizziness, gaze instability, and sleep disorders. After a prolonged course in neurorehabilitation, the subject presented for re-evaluation and management of positional vertigo and dizziness.

Outcomes: Monocular scleral search coil recordings were used to establish function in the semicircular canals to passive head impulses. The subject with TBI demonstrated elevated aVOR gains relative to the age-matched control (p < 0.05) in both posterior canals (1.05 vs. 0.97; 0.93 vs. 0.79) and to leftward impulses (horizontal canal, 0.90 vs. 0.82). Following passive assessment, each subject was exposed to a paradigm that progressively increased the aVOR gain with active (subject generated) head movements. aVOR adaptation was evident in all training trials for the patient subject (p < 0.05, Tukey’s HSD) and was retained for passive (p < 0.05) but not subsequent active impulse testing (p > 0.05). In contrast, the control subject demonstrated significant aVOR gain adaptation during 7 of 10 training trials (p < 0.05), which was preserved to both active and passive assessment (p < 0.05).

Discussion: Our results in a single subject with moderate TBI demonstrate abnormally high aVOR gains relative to an age-matched control. These findings are consistent with reports of elevated gains in other patient populations with CNS pathology (i.e. cerebellum lesions). Additionally, aVOR gain adaptation does not appear as robust in patients with TBI as that seen in those without head injury. Diminished retention of aVOR adaptation in patients with TBI could have significant implications for vestibular rehabilitation programs commonly prescribed to SMs with vestibular deficits following blast exposure.
TITLE: Quality of Movement in People with Stroke: Clinical Application of the Essential Movement Component Evaluation

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ABSTRACT BODY:

Purpose/Hypothesis: The Essential Movement Component Evaluation was previously proved to be a feasible and reliable clinical method to assess quality of movement post-stroke. The purpose of this study was to further explore if this method can distinguish atypical movement patterns observed in people with stroke. The hypothesis was that preservation of essential movement components depends on severity of stroke.

Number of Subjects: Fifty participants were randomly selected from four completed Constraint Induced Movement Therapy studies. Three groups were included in this experiment based on their upper-extremity Fugl-Meyer (UEFM) motor scores: participants without stroke (normal group; n= 10; 53.74 ± 21.83 y/o; 3M/7F), high-functioning participants with stroke (n= 20; UEFM > 33; 60.55 ± 15.99 y/o; 13M/7F) and low-functioning participants with stroke (n= 20; UEFM ≤ 33; 69.8 ± 9.55 y/o; 12M/8F).

Materials/Methods: The task selected for this study was the “Lift Basket (LB)” task of the Wolf Motor Function Test. The LB task is regarded as a complex task that demands efforts from multiple body systems, such as muscle strength, dynamic/standing balance, and inter-limb coordination. The subject’s movement progression was videotaped. Participants’ video tapes were then converted to DVD in digital format for further EMCE analyses. One-way ANOVA was used to determine if there were any statistically significant differences in essential-movement component composite scores, compensatory movement composite scores and movement magnitude of three essential-movement components between three groups. The significant level was set at .05. In addition, the Scheffe post-hoc multiple comparison analysis was used to determine pair-wise significance. The prevalence for each essential movement component and compensatory movement was reported in percentage.

Results: All p values of the dependent variables were <.001, including the essential movement component total score, the compensatory movement total score, and the movement magnitude of the three essential movement components. Most of the Scheffe post-hoc multiple comparison analyses were statistically significant. The percentage of every essential movement components observed from the three groups decreased as impairment level increased. Percentages of observed compensatory movement increased as impairment level increased.

Conclusions: EMCE for the LB task was able to effectively distinguish the differences between normal individuals and the two different stroke groups. Statistically significant differences in quality of movement were found between normal individuals and people with stroke. The percentage of essential movement component observed from the two stroke groups decreased as impairment level increased. Compensatory movements increased as impairment level increased.

Clinical Relevance: Underutilized movement components and dominance of compensatory movements can provide therapists useful information on developing tailored therapeutic programs to restore disrupted movement patterns in the stroke population.
Background & Purpose: Following traumatic brain injury, complaints of dizziness frequently occur as a result of damage to various structures of the brain, cervical spine, or peripheral components of the vestibular system. Dizziness may also be attributed to psychological factors such as anxiety, a possible sequelae of mild traumatic brain injury (mild TBI). This report discusses a case with multiple causes of dizziness subsequent to sustaining a mild TBI and examines the differential diagnosis of associated symptoms.

Case Description: The patient is a 29-year-old woman who suffered a mild TBI after sustaining a fall. A CT scan of the head showed a right subarachnoid hematoma and she was hospitalized in acute care for 11 days before being discharged to home. She presented to outpatient physical therapy 5 weeks post injury with complaints of dizziness, cervical pain, headache, irritability, poor short-term memory, photophobia, phonophobia and anxiety. As a result of her symptoms, activity limitations included bending, dressing, walking long distances, lifting and riding in a car. Her participation restrictions included inability to work, drive or care for her 3-year-old daughter. Seven weeks into treatment, the patient complained of a new onset of “pressure release” in her left ear as well as tinnitus, hissing and dizziness with position changes. Perilymphatic fistula or superior canal dehiscence were suspected at this time by physical therapy and the patient was referred to ENT and neurology.

Outcomes: The patient presented to physical therapy with signs and symptoms consistent with bilateral benign paroxysmal positional vertigo (BPPV), right unilateral vestibular hypofunction and cervical whiplash injury. Initially she was treated with canalith repositioning maneuvers for bilateral BPPV with good results. A vestibular rehabilitation program was initiated, consisting of gaze stabilization exercises, balance training, brain injury education, moist heat and stretching to cervical spine. The patient’s initial posturography was significantly impaired revealing poor use of vestibular and visual cues. She demonstrated normal scores within 6 weeks of treatment and was able to resume working part time, driving and caring for her child. Following the onset of new symptoms, an audiology evaluation was performed and revealed no hearing loss, an atypical presentation for a suspected superior canal dehiscence or perilymphatic fistula. More than 4 months post injury, CT scan of the temporal bone revealed bilateral temporal bone fractures and probable superior canal dehiscence.

Discussion: Examination and management of a patient who has sustained a mild traumatic brain injury should include consideration of musculoskeletal, neurological and psychosocial aspects of the patient post injury. A thorough examination should be performed including the differential diagnosis of all possible contributing factors of vestibular dysfunction.
**TITLE:** Vestibular rehabilitation outcomes after concussion in children

**AUTHORS/INSTITUTIONS:** B.A. Alsalaheen, S.L. Whitney, P.J. Sparto, Physical Therapy, University Of Pittsburgh, Pittsburgh, PA; A. Mucha, Vestibular Rehabilitation Clinic, Centers for Rehab Services, Pittsburgh, PA; J.M. Furman, Otolaryngology, University of Pittsburgh, Pittsburgh, PA; C. Camiolo-Reddy, Physical Medicine and Rehabilitation, University of Pittsburgh, Pittsburgh, PA; M. Collins, M. Lovell, Orthopaedic Surgery, University of Pittsburgh, Pittsburgh, PA;

**ABSTRACT BODY:**

**Purpose/Hypothesis:** Dizziness and imbalance complaints are commonly reported after concussion. The purpose of this study was to examine the outcomes of children referred to vestibular rehabilitation after concussion.

**Number of Subjects:** A retrospective chart review of 48 patients between 8 and 18 years old (M = 15, SD = 2), who underwent vestibular therapy at a tertiary care balance center with a diagnosis of post concussion syndrome (PCS).

**Materials/Methods:** At initial evaluation, subjects completed the Activities-Specific Balance Confidence Scale (ABC) and the Dizziness Handicap Inventory (DHI) self-report measures. Subjects reported the current, best and worst dizziness severity over the past week using a verbal analog scale (0-100). The Dynamic Gait Index (DGI), Timed Up & Go (TUG), Five Times Sit-to-Stand (FTSTS) Test, gait speed, and Sensory Organization Test (SOT) performance measures were rated by the physical therapist. For the discharge scores, all measures were recorded from the most recent performance relative to their discharge date. A paired t-test was used to examine if the outcome measures improved at discharge compared with initial evaluation.

**Results:** Subjects received a custom designed vestibular rehabilitation program for a mean of 4 visits over an average of 39 days. There was significant improvement at discharge on the dizziness severity rating, ABC, DHI, DGI, gait speed, TUG, FTSTS and the overall composite score of the SOT (p < 0.01). The amount of improvement in the outcome measures was 20 (s.d. 22) for the dizziness severity, 21 (23) for the ABC, 18 (19) for the DHI, 3 (4) for the DGI, 0.31 (0.25) m/s for gait speed, 2.4 (2.5) s for the TUG, 2.8 (3.1) s for the FTSTS, and 19 (34) for the SOT composite score.

**Conclusions:** Children who were referred for vestibular rehabilitation after concussion improved in self-report and functional balance measures.

**Clinical Relevance:** Vestibular rehabilitation may be an important adjunctive therapy in the management of dizziness and balance functional limitations subsequent to concussion in children. The results observed here indicate the need for a clinical trial to further examine the benefit of vestibular rehabilitation for this population. Future research should also examine if other factors (e.g. concussion history, neurocognitive function, headache history) are predictive of the amount of improvement in outcomes.
**TITLE:** Which type of dual task best reveals symptoms of early PD?

**AUTHORS/INSTITUTIONS:** B.G. Farley, N. Denipah, G. Koshland, Physiology, University of Arizona, Tucson, AZ;

**ABSTRACT BODY:**

**Purpose/Hypothesis:** Persons with Parkinson disease (PD) exhibit more dual task interference than healthy age-gender matched peers (HC). However, it is not known if dual task interference is task-specific and which type of dual task would best discriminate deficits in early PD from HC. The present study compares the amount of dual task interference for different types of dual tasks involving motor-motor vs. motor-cognitive combinations during gait or upper extremity (UE) tapping tasks across three groups of subjects.

**Number of Subjects:** 50 subjects: 13 PD subjects (Hoehn and Yahr Stage 1-2); 13 age-gender matched healthy subjects (HC); 24 young subjects (YC)

**Materials/Methods:** The following single task protocols were performed. 1) Preferred Walking (Gait) - Subjects walked continuously over an electronic carpet. 2) Whole arm tapping (WAT) - Subjects tapped with their whole arm "as fast and accurately as possible" between two targets 39 cm apart on a keyboard. 3) Repetitive Alternating Finger Tapping (RAFT) - Subjects tapped alternatively two adjacent keys using their index and middle fingers "as fast and as accurately as possible." 4) Cognitive Listening (CL) - Subjects listened to an audio story via headphones and were then asked how many times the word "I" was used and three questions regarding the content of the story. These single tasks were combined into the following three types of dual tasks. (1) WAT+CL, (2) WAT+RAFT, (3) Gait+CL. Variables for both gait and UE tasks (WAT & RAFT) included cycle time (CT), variability of cycle time (COV), accuracy. Variables for CL included accuracy of counting I's and answering questions. For each variable, the percent change from dual to single task was calculated. For each task, the percent change of multiple variables was averaged and then summed for both tasks to compute the composite dual task interference. Differences between types of dual tasks and groups were tested with a repeated measure ANOVA (task X group).

**Results:** The WAT+RAFT (an upper limb motor-motor dual task) exhibited the greatest composite interference for all subjects, whereas the Gait+CL dual task elicited the least interference (task-specific main effect p< .01 ; e.g, for YC, WAT+RAFT = 53%, WAT+CL = 14%, Gait+CL = 3%). Differences also occurred between groups (group main effect p< .01), and the amount of interference was PD > HC > YC (e.g, PD -212%, HC -98%, YC -53% for one task WAT+RAFT). Post-hoc analysis showed that PD were significantly different from HC & YC for composite dual task interference. The same pattern of differences across tasks and groups was apparent for individual performance variables (e.g, cycle time) for single and dual tasks.

**Conclusions:** Findings suggest dual tasks that involve dual UE tapping movements are of sufficient difficulty to discriminate across PD and HC. Future studies may need to explore other types of LE tasks with high difficulty.

**Clinical Relevance:** Dual task protocols may reveal subtle manifestations of early PD and provide a clinical tool to measure improvement or slowing of motor deterioration following early exercise intervention.
TITLE: Morphological Adaptations in Lower Extremity Tendons Following Spinal Cord Injury

AUTHORS/INSTITUTIONS: J.M. Burnfield, Institute for Rehabilitation Science & Engineering, Madonna Rehabilitation Hospital, Lincoln, NE; M. Rawat, K. Kulig, Jacquelin Perry Musculoskeletal Biomechanics Research Laboratory, University of Southern California, Los Angeles, CA; P. Song, G.R. Bashford, Department of Biological Systems Engineering, University of Nebraska - Lincoln, Lincoln, NE; S. Arya, University of North Carolina – Chapel Hill, Chapel Hill, NC;

ABSTRACT BODY:

Purpose/Hypothesis: Tendon’s structural properties are altered by the mechanical demand habitually experienced. Reduced lower extremity loading arising from chronic spinal cord injury (SCI) paralysis would be expected to alter lower limb tendon morphology. This study compared Achilles and Patellar tendon macro- and micro-morphology in individuals with chronic SCIs to controls.

Number of Subjects: Ten males with a history of SCI (4 paraplegia, 6 tetraplegia; 6 complete; 9 non-ambulatory) and 10 males without known lower extremity orthopedic or neurologic pathology participated.

Materials/Methods: Transverse plane gray scale ultrasound images of Achilles and Patellar tendons were recorded (Sonoline Antares, Siemens Medical Solutions) and analyzed (Image J software and MATLAB). Measurements of anterior-posterior (AP) and medio-lateral (ML) thickness and transverse cross sectional area (CSA) were calculated to determine impact of reduced load on macro-morphology. To enable comparison between individuals of different height and weight, macro-morphology measurements were normalized to body mass index and expressed as normalized units (NU). Micro-morphology was assessed by extracting two spatial frequency parameters [peak spatial frequency radius (PSFR) and spectral axis ratio (AR)] from 2mm² kernels within a manually selected region of interest (ROI) to quantify measures of tendon fibril organization.

Results: Macro-morphology: Achilles tendon dimensions did not vary significantly between controls and SCI for AP (0.18 vs. 0.19), ML (0.47 vs. 0.48), or CSA (2.48 vs. 2.23). Although Patellar tendon dimensions did not vary significantly between controls and SCI for AP (0.12 vs. 0.13), significant differences were identified for ML (0.62 vs. 0.97; p=0.004) and CSA (2.31 vs. 3.28; p=0.007). Micro-morphology: PSFR did not vary significantly between groups for either tendon. AR was significantly smaller for controls than SCI for only the Achilles tendon (1.398 vs. 1.466; p=0.019).

Conclusions: Despite reduced ambulatory capacity in the individuals with chronic SCI, Patellar tendon dimensions were notably increased for both ML (56%) and CSA (42%) compared to controls, suggesting a possible adaptation in those with SCI to prolonged sitting with flexed knees. The higher Achilles tendon AR in individuals with SCI suggests the lack of stimulus to the tendon over time permitted a purer parallel-fibril structure. In contrast, control participants had slight disorganization due to normal variations in tendon loading, leading to a less ellipsoidal spectrum.

Clinical Relevance: Lacking, to date, has been an understanding of how key extensor tendons at the ankle and knee respond at a macro- and micro-morphology level to altered loading arising from chronic SCI. Expanded access to technology enabling individuals with SCI to load their lower extremities more fully and for a longer duration (e.g., robotic gait therapy and partial body weight support treadmill training) makes it essential for clinicians to understand the physiological capacity of tissues that will be challenged.
TITLE: Is Physical Therapy Treatment Effective in Reducing the Incidence of Falls in Stroke Survivors?

AUTHORS/INSTITUTIONS: K. Goodlow, Alexian Rehabilitation Hospital, Elk Grove Village, IL; T. Steffen, Physical Therapy Programs, Concordia University- Wisconsin, Mequon, WI;

ABSTRACT BODY:

Purpose: A systematic review of the literature was performed to evaluate the effectiveness of physical therapy intervention to reduce the incidence of falls in individuals who had suffered stroke.

Description: Falls are a common problem after stroke, with a reported 46-73% of individuals falling in the first six months after stroke. Falls can result in many complications, including soft tissue injury, fracture, rehospitalization, social isolation and depression. Physical therapists are often utilized to reduce falls and improve postural stability after stroke. The literature was searched for evidence to support the use of physical therapy in the reduction of falls after stroke.

Summary of Use: A search of relevant literature was performed using internet databases. Key search terms included physical therapy, stroke or cerebrovascular accident, and falls. A modified method of the American Academy of Cerebral Palsy and Developmental Medicine was used to systematically grade the level of evidence in each article. Six studies met search criteria and were reviewed, including five randomized control trials and one non-randomized study. Studies varied in the type of intervention applied, time frame of intervention and in the setting therapy was delivered. Two studies treated subjects within 5-7 days after stroke, two studies recruited subjects 2-4 months after stroke, and the remaining two studies investigated intervention more than one year after stroke.

Importance to Members: There is limited evidence that physical therapy interventions, such as the Balance Master® or standing postural training, can help reduce falls in individuals 2-4 months after stroke. There is no evidence that home therapy is any more or less effective than inpatient therapy immediately after stroke. There is no evidence that physical therapy intervention is effective in reducing falls more than one year after stroke. There is a paucity of research related to the effectiveness of physical therapy to reduce the incidence of falls after stroke, using falls as a primary outcome measure. Further research is needed to support physical therapy interventions capable to reduce the incidence of falls, a common and costly problem in stroke survivors.
Managing shoulder pain with a tele-exercise program after spinal cord injuries

AUTHORS/INSTITUTIONS: J. Jaramillo, M. Hong, K. Manring, J. Kiratli, VA Palo Alto HCS, Palo Alto, CA;

ABSTRACT BODY:

Purpose/Hypothesis: Shoulder dysfunction resulting from inherent stresses during wheeling and transfers is a common problem in people with spinal cord injury (SCI). Treating shoulder pain is a challenge in this population as they are unable to rest the joint without giving up significant mobility. Thus, it is difficult to manage their pain while encouraging active rehabilitation. Home exercise programs (HEP) are essential in preventing pain and maintaining healthy shoulders, but adherence to HEPs is often inadequate. Our purpose was to evaluate the potential for a novel tele-health approach to increase adherence and improve HEP outcomes.

Number of Subjects: Five participants (1 female, 4 males; 51 ± 7.9 years) with chronic SCI and shoulder pain.

Materials/Methods: We utilized the Health Buddy (HB) tele-messaging system with specific HEP-related content developed by us based on input from focus groups of patients and clinicians. The HB connects via a phone line to a messaging center to download daily responses and upload new content; study coordinators log onto a secure website and monitor participant responses and adherence. After a physical therapy evaluation, participants were prescribed a HEP, given a HB unit, and asked to use HB daily for 6 months. Assessments were made at baseline, 6, and 12 months and included maximal force during wheelchair propulsion, and, pain, subjective evaluation of the program, and adherence. A repeated measures ANOVA was performed to compare effect of treatment on maximal force and pain over time. A Holm-Sidak method was used for post-hoc comparisons.

Results: There was a statistically significant effect of treatment over time (p=0.008). Mean maximum force was 141 ft/lbs at baseline, increased to 209 ft/lbs at 6 months (p=0.03), and further increased to 252 ft/lbs at 12 months (p=0.002). Pain was significantly reduced from a baseline of 7 to 3.4 both at 6 and 12 months (p=0.05). Mean compliance was 70% at the start and dropped to 35% at 6 months, remaining at this level for the duration of the study. In answering overall how helpful had HB been as part of their program, only 13% answered “very” helpful at 6 months, but 63% felt this way at 12 months. When asked whether they would continue to use HB if they could, 50% stated they would both at 6 and 12 months.

Conclusions: Although the use of HB declined after three months, most participants reported that they enjoyed their HB experience and showed improved shoulder health as evidenced by greater force production and decreased shoulder pain.

Clinical Relevance: Our findings are indicative of a role for telehealth technology in home rehabilitation. Clinicians and researchers should “front-load” the important content, so that the most important information is delivered in the earliest timeframe when adherence is highest. Participants appear to retain what is learned and use this information beyond defined time frames; individuals adapt and integrate the new knowledge to effectively improve their health status.
Purpose/Hypothesis: Balance deficits are common post central nervous system insult. While numerous therapeutic techniques are used in balance rehabilitation, no single type of intervention has proven to be most effective. The purpose of this pilot study is to examine the feasibility of using a mechanized balance system in conjunction with computer gaming to provide large quantities of repetitive task practice specifically to improve anticipatory balance, and to assess the intervention's effectiveness across disability domains.

Number of Subjects: A heterogeneous group of seven adults (54 to 84 yo) with hemiparesis, who were at least one year post stroke (6) or traumatic brain injury (1) participated. All participants could ambulate at the minimal assist level or higher, and had pre-intervention Berg Balance Scale (BBS) scores ranging from 21 to 53.

Materials/Methods: Pre- and post assessment included the BBS, Chedoke-McMaster (CM) Stroke Assessment, the Modified Falls Efficacy Scale (MFES), the Stroke-Adapted Sickness Impact Profile (SA-SIP), and three dimensional gait analysis including EMG and force data. Data were analyzed both visually by individual case and using the Wilcoxon Signed-Ranks Test. Participants trained for between 12 to 25 sessions using a mechanized tilting balance platform. Platform rotations were set at a predictable velocity, direction, and magnitude of motion for four-minute increments, at which time the training parameters were varied. Participants played Wii games during the platform perturbations.

Results: Standing on the mobile platform was feasible for all participants, although one was unable to game concurrently. Repetitions of practice (platform tilt) ranged from 14,000 to 49,000 repetitions per participant, with total practice times ranging from 4.2 to 16.3 hours. All participants improved on the BBS (P=0.017), from a baseline mean of 39.3 (SD=12.4) to 46.6 (SD=8.4). Hip power generation (H1) during early stance phase also improved (P=0.044) from a baseline of 0.60 W/Kg (SD=0.39) to 0.97 W/Kg (SD=0.64). There was a trend toward improvement in CM trunk scores (P=0.083), MFES (P=0.066), and SA-SAP (P=0.066). Variable changes were seen in other gait kinematic and kinetic data, as well as in lower extremity EMG.

Conclusions: This practice environment was feasible and allowed for a large number of practice repetitions. Balance and hip power generation in walking improved, and there was carryover to other improvements in gait and quality of life for some participants.

Clinical Relevance: Concurrent computer gaming resulted in a high degree of engagement during the predictable platform movements and provided an implicit learning environment for anticipatory balance responses. The BBS improved the most in the individuals with initial scores below 45, which is the level placing them at risks for falls, all improving more than six points, the minimal clinically significant level of change identified for the BBS. Hip power generation improved more in the higher functioning individuals.
TITLE: A new measurement tool for vestibular hypofunction: validity of the Emory Clinical Vestibular Chair Test

AUTHORS/INSTITUTIONS: C.D. Hall, Rehabilitation Research and Development, Atlanta VAMC, Atlanta, GA; J. Hoover, M. Jacobs, R. Lieberman, K. Mihevc, S.J. Herdman, Rehabilitation Medicine, Emory University, Atlanta, GA; R.J. Tusa, Neurology, Emory University, Atlanta, GA;

ABSTRACT BODY:

Purpose/Hypothesis : Proper diagnosis is critical to determine treatment. Computerized rotary chair testing is the gold standard for identifying bilateral vestibular hypofunction, but is prohibitively expensive. The Emory Clinical Vestibular Chair Test (ECVCT) was developed as a reliable and cost-effective alternative to the computerized test. The purpose of this study was to determine the validity of the ECVCT to distinguish unilateral (UVH) and bilateral (BVH) vestibular hypofunction from non-vestibular causes of dizziness.

Number of Subjects : Healthy participants with normal vestibular function (n=22) and individuals with UVH (n=11) and BVH (n=7) based on computerized rotary chair.

Materials/Methods : Emory University IRB approved the protocol and informed consent was obtained. Participants sat in a high-backed chair with head pitched forward 30 degrees and eyes closed. The chair was manually rotated 180 degrees/second for one minute. After the chair was stopped, infra-red goggles were positioned and then participants opened their eyes. Post-rotary nystagmus in the dark (PRNT-dark) was timed until nystagmus stopped. The test was repeated, rotating the chair in the opposite direction. Subject characteristics were compared using t-tests (p<.05). A receiver operating characteristic (ROC) curve analysis was performed to determine the cut-off value for PRNT-dark that would optimize sensitivity and specificity.

Results : Healthy participants were significantly younger than the vestibular group (p<0.01), but there were no differences in height or weight. ROC curve analysis identified the optimal PRNT-dark cut off as 31 seconds. Comparison of patients with vestibular hypofunction versus healthy participants yielded sensitivity of 83% and specificity of 64%; that of patients with BVH versus healthy participants yielded sensitivity of 71% and specificity of 88% and that of UVH versus healthy participants yielded a sensitivity of 50% and specificity of 70%.

Conclusions : ECVCT is a valid tool that distinguishes between participants with and without vestibular hypofunction. In comparison, computerized chair testing has sensitivity of 71% and specificity of 54%. One potential problem with the ECVCT is the ability of a 'spinner' to avoid accelerating/decelerating chair rotation during testing. Thus, establishing reliability of test performance is essential. Individuals >75 years old have shorter responses to computerized chair testing than younger individuals. Further research is needed to determine if age also shortens PRNT-dark.

Clinical Relevance : The Emory Clinical Vestibular Chair Test is a valid, cost-effective, and readily available tool for distinguishing between healthy participants and those with vestibular hypofunction. The ECVCT does not distinguish well between patients with UVH and BVH. Thus, it is best to arrive at a diagnosis using the ECVCT in conjunction with other tests (e.g.head impulse test and the head-shaking nystagmus test) to determine diagnosis.
TITLE: Spring-loaded devices to facilitate locomotor training in people with incomplete SCI

AUTHORS/INSTITUTIONS: J.H. Kahn, Sensory Motor Performance Program, RIC, Chicago, IL; G. Hornby, School of Applied Health Sciences, University of Illinois at Chicago, Chicago, IL;

ABSTRACT BODY:

Purpose/Hypothesis: Locomotor training (LT) performed on a treadmill or over ground can enhance functional ambulation following incomplete spinal cord injury (SCI); however, the labor-intensive demands on therapists limit its practice in the rehabilitation setting. Several robotic devices have been developed to assist patients during ambulation on a treadmill, although the costs of these devices are prohibitive for most facilities. There is a need to enhance the delivery of LT to those with potential to recover walking ability while minimizing equipment costs and relieving demands on therapists. Low-cost assistive devices used during LT on a treadmill will enhance the duration of gait rehabilitation while minimizing demands on the therapists.

Hypothesis: LT on a treadmill with the assistance of spring loaded devices will improve walking performance.

Number of Subjects: Part 1: Five subjects with chronic motor incomplete SCI (ASIA C or D) completed same day testing of treadmill stepping under 3 conditions: 1) no assistance, 2) therapist assistance, and 3) assistance of a spring loaded device. Part 2: Two of the above subjects completed 12 weeks of LT with the spring loaded device.

Materials/Methods: Subjects performed a graded treadmill test under 3 conditions. Therapist assistance consisted of 1 therapist. Spring assist consisted of the use of commercially available constant force springs that were attached to a rack and an extension was then attached to the individual’s knee and/or ankle to assist with swing during gait. Subjects began walking at a baseline speed of .5 or 1.0 kmph and speed was increased every 3 minutes as tolerated by .5 or .1 kmph increments. Primary outcome measures include peak treadmill speed, cadence, and stride length. Clinical measures were collected for the 2 subjects who completed 12 weeks of LT with the spring device and included TUG, gait velocity, 6min walk, and lower extremity ASIA motor scores (LEMS). Subjects participated in 36 sessions of LT with assistance as needed at the knee and ankle to achieve clearance in swing. The LT utilized the constant force springs as well as another low cost device consisting of elastic tubing attached to pulleys that were then attached to the individual’s knee and/or ankle providing assistance during swing.

Results: Walking on a treadmill with spring loaded devices improves walking performance as compared to walking without a device. Peak treadmill velocity without assist was 1.4 kmph increasing to 2.34 kmph and 2.04 kmph with therapist- and spring-assist, respectively, with changes in both stride length and cadence. Two subjects completed 12 weeks of LT with varying outcomes. Subject 1 improved 6 min walk distance by 50m, gait speed by .17 m/s, TUG by 13.26s, and 7 points on LEMS. Peak treadmill velocity improved by 1.5kmph. Subject 2 did not improve.

Conclusions: Low cost devices may improve locomotor performance, although more experimentation is required.

Clinical Relevance: Such low cost devices can enhance delivery of gait training to individuals with SCI and be applied in a clinical setting.
Learning and memory deficits are common sequelae following traumatic brain injury, often resulting in significant functional consequences and providing a challenge to the treatment team. This presentation will explore the practical application of errorless learning and procedural learning strategies in a patient with a traumatic brain injury and significant learning, memory, and sensory impairments. TJ is a 24 year old Iraq war veteran who sustained a traumatic brain injury from a gunshot wound to the head. He suffered bifrontal brain injury requiring extensive bifrontal craniectomy for acute neurosurgical management. The penetrating injury left TJ totally blind and with severe learning and memory deficits, unable to generate any conscious recall of new information. Additionally, TJ presented with profoundly impaired initiation, a lack of environmental interaction, decreased spatial orientation, and an inability to divide attention. TJ demonstrated no insight into these deficits. While each of these impairments on its own could result in significant functional deficits, this combination was devastating. This case report will examine the decision making process in determining the treatment plan for this patient, with consideration of the best available evidence as well as clinical experience. Initiation and learning were facilitated through an interdisciplinary approach using repetitive, errorless learning and procedural learning methods which involved all team members using the same verbal and tactile cues, as well as auditory cues. Additional interventions included graded hand over hand facilitation of interaction with his peripersonal space, followed by progression to extrapersonal space and functional tasks. Lastly, spatial orientation drills were executed for TJ's awareness of himself in relation to the environment, and as well as facilitation and graded cuing for use of a white cane for mobility. Through these selected interventions, TJ demonstrated procedural learning of the trained skills and retained new information during his rehabilitation stay. Despite the equivocal literature regarding errorless learning, this approach, combined with other select interventions, and provided by an interdisciplinary treatment team, resulted in learning and carryover in a patient with severe memory impairment.
TITLE: Effects of the Wii and Wii Fit on Outcomes in an Individual with Chronic Stroke

AUTHORS/INSTITUTIONS: J.C. Wang, Inpatient Rehabilitation Unit, Swedish Medical Center, Englewood, CO; B. Crowner, Program in Physical Therapy, Washington University, St. Louis, MO;

ABSTRACT BODY:

Background & Purpose: Use of virtual reality (VR) in rehabilitation of individuals with neurologic impairment is a promising tool for improving functional outcomes. With improvements in technology, simple virtual reality systems, such as the Nintendo Wii, are commercially available. The purpose of this case report is to describe the effects of using the Wii and Wii Fit as a VR system on functional outcomes in an individual with chronic stroke.

Case Description: The patient was a 53 year-old, right-handed male who was six months status post left lacunar cerebrovascular accident. At his initial visit, he reported: decreased right lower extremity strength, reduced gait speed, and gait instability. Upon examination, he ambulated modified independent with a straight cane and right AFO 76.2 and 30.5 meters on level and uneven surfaces respectively with reduced gait speed. He demonstrated right lower extremity circumduction and knee hyperextension after ambulating 76 meters. He had reduced strength throughout his right upper and lower extremity and hypertonicity in his right triceps, wrist and finger flexors, and posterior tibialis. He participated in 30 therapy sessions using only the Wii VR system over an 11 week period and was not receiving any other concurrent therapy. Treatment sessions occurred 2-3 times per week for 60 minutes each session. Training was performed using the Wii Sports (bowling, golf, tennis, and boxing) and Wii Fit (balance and aerobic) game software. All games were performed from a standing position. Over the course of the treatment, the dose of the intervention was increased in duration, repetition, and complexity based on his performance, posture and movement quality.

Outcomes: Following intervention, the patient improved in the following outcomes (pre-post) beyond the Minimal Detectable Change for the respective measure: Berg Balance Scale (50-56/56); Timed Up and Go (13.0.-10.4 sec.); 6 Minute Walk Test (146-268 meters), and three portions of the Stroke Impact Scale (Memory, Handicap, and Percent Recovery). Gait speed (0.41-0.75 m/sec) was markedly improved, and he was able to ambulate without his cane independently for 152 and 61 meters on level and uneven surfaces. Right lower extremity strength (pre-post) was: hip flexion (3+ to 4), hip extension (3 to 4), knee flexion (2- to 3), knee extension (4 to 5), and ankle dorsiflexion (3+ to 4).

Discussion: Use of the Nintendo Wii as a VR system was effective in improving all mobility centered outcome measures. Improvements noted in this patient exceeded those noted in other published case reports. It was an affordable and adaptable intervention that was challenging for the patient’s balance and mobility. It provided knowledge of results and performance feedback to the patient, enhancing motor learning. This case report supports the current virtual reality literature, showing benefits of this non-traditional treatment in the stroke population.
Title: Gait and balance training with the KineAssist®

Authors/Institutions: L. Weil Foster, M. Berkowitz, E. Roth, Rehabilitation Institute of Chicago, Chicago, IL; K. Goodlow, Alexian Rehabilitation Hospital, Elk Grove Village, IL; D. Brown, Physical Therapy and Human Movement Sciences, Northwestern University, Chicago, IL; E. Lewis, KineaDesign, Evanston, IL;

Abstract Body:

Background & Purpose: Reduced gait speed is observed in the majority of people post-stroke. This may be partly caused by poor balance and muscle weakness. Interventions that target balance, muscle strength and coordination can reduce functional deficits. Risks associated with balance and gait training requires the therapist to provide safety and support during challenging tasks. As a result, patients are not challenged to their limits and therapists put much physical effort into safety control. This case study examined an individual with slow gait speed and poor balance, secondary to hemiplegia. The participant worked with a PT using the KineAssist, a robotic balance and gait training system that allows full movement range during gait and balance tasks, yet provides safety with balance loss. She performed a set of nine different exercises, 3 days a week, over a 6 week period, that were designed to challenge her at high levels of effort while still providing safety and freedom of movement.

The purpose of this case study is to report the unique experience that this stroke survivor had while working on challenging gait and balance tasks using the KineAssist.

Case Description: The nine exercises, performed in the KineAssist, included: 10 meter sprints, sidestepping, 10 meter isokinetic walking, step-ups and step-downs, stepping onto/off foam, walking tandem on a 3 meter course, 10 meter backward walking sprints, dynamic squatting over 10 meters, and forward reaching.

Outcomes: Improvement, after 6 weeks, was noted on multiple measures. Comfortable walking speed increased from 0.12 to 0.20 m/sec. Fast walking speed improved from 0.16 to 0.24 meters/sec. 6 minute walk distance improved from 48.85 to 74.20 meters. Berg Balance score improved from 28 to 37/56. Lower Extremity Fugl-Meyer score increased from 11 to 15/34. The participant also exhibited improvements in performing the exercises. Her 10m sprint walking time decreased from 137.59 seconds to 49.24 seconds. She initially could not complete a set of foam or step exercises, she completed two sets of each by week 6. She could not perform 10 meters of sidestepping, but by week 6, she sidestepped to both the paretic and non-paretic side for 10 meters. Week 1 she could not walk backwards without losing her balance multiple times. Week 6, she was able to complete the 10 meters for two trials without loss of balance.

Discussion: Initially, the participant had losses of balance with activities. However, in the robotic device, she was able to learn how to correct her balance with challenging activities such as backward walking and tried novel activities such as sidestepping. The interventions performed with the assistance of the KineAssist were safe and potentially effective. As a result, she has increased endurance and confidence in the performance of the exercises. She reported improvement with performing activities at home: stair climbing and reaching. This case study illustrates the feasibility to expose individuals with poor balance and walking ability to highly challenging exercise tasks.
Abstract Body:

Purpose/Hypothesis: Walking speed is a major determinant of community ambulation post-stroke. One of the primary aims of therapy is to increase walking speed. Therapists often utilize Perry's classification to predict community status and try to progress post-stroke survivors from one speed category to another. However, not all individuals necessarily make the transition from one category to another and some of those who do are susceptible to losing balance during walking. It is therefore likely that while increasing walking speed individuals may also change other important factors of gait that are associated with balance. Spatial variability in gait has been associated with balance impairments and has been deterministic of walking speeds in different neurological populations. Therefore, the purpose of our study was to describe the association between spatial variability in gait and walking speed post-stroke.

Number of Subjects: Sixty eight community dwelling (M=44), chronic stroke survivors, age 53± 11years participated in the study.

Materials/Methods: All the data were collected and analyzed in the gait laboratories at the Rehabilitation Institute of Chicago. Each subject completed at least three walking trials at both self-selected (SS) and fastest comfortable (FC) walking speeds over the Gaitmat II or overground where their three dimensional data was captured using an eight-camera motion analysis system. The spatial parameters (step length and step width) were calculated using the GaitMat II software and OrthoTrak 6.2.4 version respectively. Standard deviation (SD) was used to quantify variability in the parameters.

Results: Mean step length increased with an increase in walking speed and mean step width remained unchanged. Only the group of individuals who could increase their walking speed more than 0.4 m/s on command had a significant increase in step length variability (r=0.51, P=0.015) and step width variability (r=0.54, P=0.017). Individuals who could not increase their walking speed did not demonstrate any change in step length (r=-0.002, P=0.981) or step width variability (r=-0.08, P=0.362).

Conclusions: Step length and step width variability have a direct relationship with gait speed in individuals post-stroke, and these variabilities are sensitive to changes in walking speed post-stroke compared to mean step length and step width.

Clinical Relevance: Examining step length and step width variability may be important in determining the appropriate therapeutic interventions for individuals post-stroke. Although walking faster may improve community ambulation status, it may not be an appropriate goal for all individuals post-stroke. Individuals who exhibit limited changes in walking speed and step length and step width variability may have limited benefits from training that focuses primarily on increasing walking speed.
Background & Purpose: Here we describe the outcome of early intensive inpatient and outpatient rehabilitation and the effect of treatment on functional mobility in a child presenting with acute paraplegia following a T6-T7 fracture dislocation. Activity-based restorative therapy has been shown to improve motor function in individuals following spinal cord injury (SCI). However, evidence in literature supporting intensive rehabilitation in the pediatric population is limited.

Case Description: A six year old boy was admitted for acute inpatient rehabilitation 11 days following T6 – T7 fracture dislocation resulting in T6 ASIA impairment scale A paraplegia. The patient received 25 hours per week of inpatient rehabilitation for 8 weeks, immediately followed by 15 hours per week of outpatient rehabilitation for 4 weeks. A multifactorial treatment approach was utilized during both the inpatient and outpatient stay. Physical therapy interventions included dynamic balance training, therapeutic exercise, developmental positioning, therapeutic activities, lower extremity functional electric stimulation ergometry, body-weight supported treadmill training (BWSTT), and over ground gait training.

Outcomes: We demonstrate a significant increase in functional mobility as measured by the Functional Independence Measure for Children (Wee FIM), Physical Abilities and Mobility Scale (PAMS), the Spinal Cord Independence Measure (SCIM) and the 66 item Gross Motor Functional Measure (GMFM-66).

Discussion: This study illustrates that intensive rehabilitation immediately following spinal cord injury in children can improve functional mobility. These results provide a basis for further studies on the effect of intensive rehabilitation in children with acute SCI.
TITLE: Head rotation influences reaching range of motion in individuals with chronic severe stroke: the asymmetric tonic neck reflex

AUTHORS/INSTITUTIONS: M.D. Ellis, J.P. Dewald, Physical Therapy and Human Movement Sciences, Northwestern University, Chicago, IL;

ABSTRACT BODY:

Purpose/Hypothesis: We have previously demonstrated that maximum isometric elbow flexion and extension strength is impacted by head rotation in adults with chronic severe hemiparetic stroke. More specifically, when an individual with severe stroke rotates the head toward the affected side, maximum elbow extension strength increases. This finding is consistent with the longstanding clinical observation of the re-emergence of the developmental reflex, asymmetric tonic neck reflex, following stroke. The impact of asymmetric tonic neck reflex on reaching function following stroke has not been quantified or studied rigorously. The ACT\textsuperscript{3D} is a robotic device and clinical tool that has been used to quantify total reaching range of motion (work area) and is well suited to quantify the impact of head rotation on reaching. In this study we employ the ACT\textsuperscript{3D} to quantify work area as a function of head rotation while controlling for shoulder abduction loading that is known to impact reaching range of motion in individuals with severe stroke. We hypothesize that work area will be greater when maintaining the head rotated toward the affected arm than when rotated away from the affected arm for all shoulder abduction loading levels and suggest that this is due to augmentation of elbow extension from the asymmetric tonic neck reflex.

Number of Subjects: Data from 7 individuals with severe stroke (Fugl-Meyer < 30/66) has been collected to date as part of an ongoing larger comparison group study (30 stroke, 30 control).

Materials/Methods: Work area was evaluated at 4 abduction-loading levels for two head rotation positions (toward and away). The first abduction-loading level was with the arm supported on a haptic horizontal surface while the other 3 levels required active elevation of the arm above the haptic surface at 50%, 100%, and 150% of limb weight.

Results: Work area increased 17%, 27%, 23%, and 32% respectively for each progressive loading level when the head was rotated toward the affected arm.

Conclusions: These results suggest the emergence of asymmetric tonic neck reflex, which is known to be mediated via motor nuclei in the reticular formation, implicating descending brainstem motor pathways as a contributor to upper extremity movement generation in this population. The influence of brainstem motor pathways has previously been associated with reduced reaching range of motion as a function of abduction loading. The combined evidence suggests that individuals with severe hemiparetic stroke have an increased contribution of descending brainstem motor pathways that greatly influence motor output following a stroke-induced loss of primary corticofugal motor pathways.

Clinical Relevance: Rehabilitation clinicians must consider factors such as head position and abduction loading when attempting to evaluate and treat distal upper extremity impairments and activity limitations in this patient population.
TITLE: Changes in motor performance associated with improved function following high-repetition upper extremity functional task training for people with chronic stroke

AUTHORS/INSTITUTIONS: S.L. DeJong, C.E. Lang, Program in Physical Therapy, Washington University School of Medicine, St. Louis, MO; R.L. Birkenmeier, Program in Occupational Therapy, Washington University School of Medicine, St. Louis, MO;

ABSTRACT BODY:
Purpose/Hypothesis: Studies of motor recovery after stroke in animal models have demonstrated neural adaptation and functional gains following hundreds of repetitions of task-specific upper extremity (UE) training. In a translational proof-of-concept study, we demonstrated improved UE function following similar intervention for people after stroke. The purpose of this companion study was to identify changes in motor performance that parallel functional improvement.

Number of Subjects: Five subjects with chronic UE paresis due to stroke participated.

Materials/Methods: Subjects underwent motion analysis before and after high-repetition UE functional task training for three 1-hour sessions per week for 6 weeks. During each training session, subjects were challenged to complete ≥300 repetitions of UE tasks, which were selected, graded, and progressed according to each subject’s goals and movement capabilities. Motor performance was evaluated using 10 trials for each of 2 tasks: 1) lifting a vertical cylinder onto a shelf with a palmar grasp, and 2) removing a large ring from between two shelves using a 2-finger grasp, moving it, and placing it over a slightly smaller disk. For each testing task, we measured duration of the reach, grasp, transport, and release phases, maximum distance between the thumb and index finger (peak aperture), smoothness/efficiency of finger movement, and grip force during transport. Changes in these motion analysis variables were compared to concurrent changes in UE function (Action Research Arm Test and 2 Stroke Impact Scale subtests).

Results: Four of the 5 subjects showed functional gains, and corresponding changes in motion analysis variables. One subject showed no functional improvement and no change in motor performance. Most subjects showed faster completion of most movement phases, less excessive grip force, and improved efficiency of finger movement. Changes in peak aperture were negligible. Specific changes in motor performance varied across subjects, according to their initial movement difficulties. For example, one subject dropped the ring in 6 of 10 trials initially, and only once after intervention. For that subject, only the grasp and release phases of movement were completed more quickly after intervention. Other subjects, who consistently completed both tasks, increased their speed across all movement phases.

Conclusions: These preliminary findings indicate that high-repetition functional task training may improve UE function in people with chronic paresis post stroke, and that functional gains may be associated with increased movement speed, more efficient finger movement, and improved modulation of grip force.

Clinical Relevance: This is the first attempt to translate high repetition intervention protocols used in animal motor recovery studies, to rehabilitation of people after stroke. The aspects of motor performance that contribute to functional change may vary across individuals, as a function of their specific movement problems and training tasks.
Purpose/Hypothesis: We developed a new measure of functional walking for individuals with incomplete spinal cord injury (iSCI) – the Spinal Cord Injury Functional Ambulation Profile (SCI-FAP). The SCI-FAP involves the timed performance of nine walking tasks that are frequently encountered by able-bodied individuals\(^1\), such as walking and negotiating obstacles, doors and stairs. The measure accounts for manual assistance and walking aids used. The purpose of this study was to assess the inter-rater reliability, test-retest reliability, convergent validity and discriminative validity of the SCI-FAP.

Number of Subjects: Sixteen individuals with iSCI and 16 able-bodied individuals participated. Subjects with iSCI sustained the injury at least 1 year prior to study participation, and were able to walk 10 meters over-ground with braces, walking aids, and/or physical assistance of 1 person.

Materials/Methods: Subjects with iSCI attended 2 testing sessions separated by 1-2 weeks. At the first session subjects performed the SCI-FAP, the 10-meter walk test, the 6-minute walk test and the Walking Index for Spinal Cord Injury II (WISCI II). Three raters scored the subjects’ performances on the SCI-FAP to establish inter-rater reliability. To establish convergent validity, results obtained on the SCI-FAP were compared with scores on the 10-meter walk test, the 6-minute walk test and the WISCI II. At the second testing session subjects completed the SCI-FAP in order to assess test-retest reliability. Able-bodied subjects, age- and gender-matched to the subjects with iSCI, attended 1 testing session to complete the SCI-FAP. To establish discriminative validity, scores on the SCI-FAP were compared between the 2 groups.

Results: Inter-rater reliability (intraclass correlation coefficient (ICC) = 0.99) and test-retest reliability (ICC = 0.98) were high. Total scores on the SCI-FAP were moderately correlated with the results from the 10-meter walk test (r = -0.82), the 6-minute walk test (r = -0.83), and the WISCI II (r = -0.84). Performance on the SCI-FAP was significantly poorer among subjects with iSCI compared with their able-bodied counterparts (p<0.05).

Conclusions: The SCI-FAP is a valid and reliable measure of walking skill for individuals with iSCI.

Clinical Relevance: Adequate assessments of functional walking for the iSCI population are lacking.\(^2\) Researchers and clinicians will benefit from a measure that includes the evaluation of walking skills relevant to daily life.

Purpose/Hypothesis: Gait abnormalities and associated balance dysfunction have been shown to be prevalent in individuals with Parkinson’s disease (PD). Research has shown that external cueing, especially auditory cueing, can improve components of gait in individuals with PD. Most of the studies have used a single session of training with auditory cues and have not assessed the long-term carryover of such training. However, few studies have been conducted to analyze both temporal and spatial aspects of gait at once. Therefore, the purpose of our single subject case study was to determine the effects of gait training with an auditory cueing device (metronome) on gait parameters and balance in an individual with PD during walking.

Number of Subjects: A seventy year old male individual who was diagnosed with PD eight and a half years ago volunteered for the study.

Materials/Methods: During the initial non-cued session, the participant was asked to walk 25 feet three times on the GAITRite in order to assess cadence along with other gait parameters. Balance was also assessed using the Berg Balance Scale (BBS). The participant was then allowed to walk fifteen minutes with the metronome set at ninety percent of baseline cadence with a researcher in order to acclimate to this cadence. The participant was also instructed to increase the frequency of the metronome up to 110% of the baseline cadence as tolerated in the next three weeks. After three weeks of this cued gait training, the individual’s gait was recorded on the GAITRite and balance score was recorded using the BBS. Both pre- and post-test values of gait parameters recorded from the GAITRite, as well as the BBS scores, were compared. The minimal detectable change (MDC) and the percentage change between pre- and post-test values were calculated.

Results: Double support time and stance time on both the left and right sides were decreased while swing time and single support time on both sides were increased after three weeks of use of auditory cueing when compared to the pre-test values. Step time differential, stride length differential, and cycle time differential were also decreased after three weeks when compared to pre-test values. Results also suggest that BBS score also increased to 19% from pre-test score.

Conclusions: Based on this case study, our findings indicate that gait training with a metronome has some beneficial effects in improving gait and balance in individual with PD. Decreased stride length differential, step time differential and cycle time differential following three weeks of gait training with metronome indicate possibilities of changing the gait in more symmetric pattern. In order to generalize these results, additional research using an increased number of participants is required.

Clinical Relevance: The outcomes of this case study provided information on whether cueing strategies can be used during ambulation training along with traditional physical therapy in order to improve gait abnormalities and balance in individuals with PD.
**ABSTRACT BODY:**

**Background & Purpose:** People post stroke often are left with residual effects, which include slow gait speed, slow cadence, asymmetrical gait pattern, and increased incidence of falls. Evidence is growing in support of body weight supported locomotor training (BWSLT) for improvement of gait speed, gait kinematics, balance and motor recovery for chronic stroke patients. In a few recent studies, it has been demonstrated as more effective in restoring normal movement patterns when combined with multichannel functional electric stimulation (FES) to the hemiparetic lower extremity. The purpose of this case study was to determine the changes in gait using a combination of these interventions for a community ambulator with chronic stroke.

**Case Description:** The patient is a 39 y.o. male 3 years post stroke who has received therapy in both the inpatient and outpatient settings. Prior to beginning treatment, he ambulated independently with a molded ankle-foot orthotic (MAFO) with numerous gait deviations. The patient's goal was to ambulate without the MAFO without increasing his risk for falls. He completed BWSLT plus FES to the gastrocnemius and peroneal muscles of the hemiparetic leg for 25 sessions. Body weight support and time spent with FES were gradually reduced as speed of the treadmill was increased. After each treadmill session, the patient performed overground walking and stair training without FES. Also included in the treatment program were exercises focusing on hemiparetic single leg balance, stretching and strength training. Outcome measures included 6 minute walk test, fast gait speed, Berg Balance Scale (BBS) and kinematic gait data. At the time of this abstract, locomotor training without FES was ongoing.

**Outcomes:** Fast walking speed increased from 1.29 to 2.3 m/s. 6 minute walk test improved from 367 to 584 m. During BWSLT, he was initially training at 1.18 m/s with FES; currently he is able to train at 2.24 m/s with FES and 1.79 m/s without FES. Step symmetry improved, hemiparetic leg stance time increased and step length increased bilaterally. Body weight support was initially 12% but by the 7th session was 0% support. BBS improved from 50/56 to 53/56 and is limited by right single leg stance time. All outcomes were measured without the MAFO. Intervention is ongoing at the time of this abstract. Follow up data one month post intervention is planned.

**Discussion:** BWSLT in combination with multi channel FES was effective at producing increases in gait speed and walking distance that exceeded accepted values of clinically important change in stroke (>0.15 m/s and >50 m). Although cause and effect cannot be established in a case report, we believe that the addition of FES to the treatment program helped to produce the large changes in overground gait speed observed because FES allowed faster speeds during BWSLT.
Purpose: Of the 420 counties that comprise Appalachia, the counties located in eastern Kentucky are some of the poorest. Approximately 80% of these Kentucky counties having a shortage of designated Health professionals and healthcare resources. This shortage is a particular burden to individuals with neurological impairment, who require a collaborative interprofessional approach in order to achieve long-term improvement in health outcomes and quality of life. The Kentucky Appalachian Rural Rehabilitation Network (KARRN) has been established as a collaborative team including individuals impacted by neurological impairments, providers who serve them, members of communities in which they live, advocates, and researchers who investigate these impairments. Our goal is to identify, develop and disseminate information and strategies, and maximize resources to improve outcomes and quality of life for individuals with neurological impairments living in rural Kentucky Appalachian counties.

Description: Determined Supports and Barriers to health care: A preliminary study was conducted that examined the health and quality of life related supports and challenges from the perspective of individuals with spinal cord injury (SCI) and their families and healthcare providers who treat these individuals. Multiple themes were established with respect to barriers and supports to healthcare in rural KY such as the lack of and need for connection among those with SCI living in this community, issues related to limited personal and systemic resources, a need for increased specialized SCI knowledge among rural health care providers, and finally a need for greater advocacy for and among this population.

Network Development: From the groups that participated in the initial study, as well as other key persons, a network was developed that formally met and conducted an assessment of available community assets (Asset Mapping). The asset mapping focused on the following areas: institution, organization, individuals, environment, and economic/political. In addition, a formalized shared mission for the network was developed.

Summary of Use: Results from the first studies were used to develop short-term and long-term goals for the group. Short term goals include developing mentor programs for individuals and for providers, developing a network website for information sharing, developing a data base of people impacted by SCI and identifying constituents we are missing. Longer term goals include developing a foundation for future programs and research projects for KARRN, advocacy, and ultimately improving the quality of life and health outcomes for people living with SCI in these counties. A second educational conference has been planned to address topics important for the long-term care of individuals with SCI and to provide a common language for the network partners.

Importance to Members: Physical therapists are key contact people for individuals living in their communities with neurological impairments and may serve as facilitators for such network development in their areas.
TITLE: Effects of external cues on walking performance during single and dual tasks in persons with Parkinson's disease

AUTHORS/INSTITUTIONS: Y. Fujii, Y. Chen, P. Trueblood, T. Tyner, Physical Therapy, California State University, Fresno, Fresno, CA;

ABSTRACT BODY:

Purpose/Hypothesis: The purpose of this study was to examine the immediate effects of visual cue (VC) and auditory cue (AC) on gait during single and dual tasks in persons with PD.

Number of Subjects: A total of 15 subjects with idiopathic PD (mean age of 66.7yrs) were recruited from a local Parkinson's Support Group. The subjects had an disease duration of 5.9 years (range 1-13yrs).

Materials/Methods: The subjects walked along a 12-foot walkway (GAITRite, CIR Systems, Inc. Havertown, PA) under 3 cues: no cue (NC), VC (tape placed transversely at 46cm intervals along the walkway), and AC (metronome with frequency set at 100 clicks/min). The subjects were asked to match step length to the tape for VC and to step with the beat for AC. They were tested during single task (ST; walking alone), dual cognitive task (DCT; walking while subtracting numbers) and dual motor task (DMT; walking while carrying a 5 lb grocery bag). Gait velocity, cadence, and step length were measured using GAITRite System.

Results: A significant task main effect was found. There were consistent decrease in gait velocity, cadence, and step length during DCT; however, DMT did not cause significant change in gait variables as compared to ST. A significant cues main effect (p< 0.05) was also found. Both the VC and the AC caused decrease in gait velocity, cadence, and step length as compared to ST. The VC caused greater decline in gait variables as compared to the AC.

Our findings were not consistent with others using external cues which might be due to 1) applying the same intervals in VC and AC, and 2) less severity of our participants as compared to other studies.

Conclusions: Our findings may suggest that external cues may have different effect according to the severity of PD and need to be individualized. Future studies will be needed to determine the most effective interval and frequency for the VC and the AC in people with PD.

Clinical Relevance: When using a fixed interval visual cue and auditory cue may not increase gait velocity, cadence, and step length in patients with mild to moderate PD.
TITLE: Cognitive and Physical Performance in Patients with Asymptomatic Carotid Artery Disease

AUTHORS/INSTITUTIONS: N.C. Landgraff, Physical Therapy, Youngstown State University, Boardman, OH; S.L. Whitney, Physical Therapy, University of Pittsburgh, Pittsburgh, PA; G. Kerns, Department of mathematics and Statistics, Youngstown State University, Youngstown, OH; H. Yonas, Neurosurgery, University of Pittsburgh, Pittsburgh, PA;

ABSTRACT BODY:

Purpose/Hypothesis: The purpose of this study was to determine if patients with asymptomatic carotid artery stenosis and occlusion demonstrate deficits in cognitive and physical performance. The relationship between cognitive measures and performance of instrumental activities of daily living was examined.

Number of Subjects: Seventy-nine patients with asymptomatic carotid artery stenosis of moderate and severe degrees, or occlusion were tested.

Materials/Methods: Cognition was assessed via the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) and the Executive Interview (EXIT). Then RBANS assesses five domains of cognitive function, immediate memory, visuospatial/constructional, language, attention and delayed memory. It also provides a total scale score. Physical performance was assessed via the Physical Performance Test (PPT), and the Lawton Instrumental Activities of Daily Living. Testing was done in one session.

Cognitive scores on the RBANS were compared to age-matched established normal scores via one-tailed t-tests. Mean scores on the EXIT, PPT and Lawton IADL were calculated and compared to cut-off scores that indicated problems in these areas.

Results: Deficits were found in all RBANS domains in moderately stenotic patients. In the severe stenosis and occluded subgroups, there were deficits in all domains except language and immediate memory respectively. There were no significant findings on the EXIT. Decreased performance on the PPT was identified in all 3 subgroups. The Lawton IADL did not identify any decrease in performance.

Conclusions: Deficits in cognitive and physical function were found in this observational study of patients with asymptomatic carotid artery stenosis and occlusion, indicating that asymptomatic patients may not be truly asymptomatic.

Clinical Relevance: These areas of function (cognition and physical function) and the potential change in their status needs to be considered when patients are being evaluated for interventions to manage their carotid artery disease and risk for stroke.
TITLE: Disability of the Stroke Survivor and Burden of the Spousal Caregiver

AUTHORS/INSTITUTIONS: K.M. Johnson, Doctor of Physical Therapy, San Diego, University of St. Augustine, San Marcos, CA; C. Kelley, School of Physical Therapy, Texas Woman's University-Houston Center, Houston, TX; S.K. Ostwald, Health Science Center at Houston, University of Texas, Houston, TX;

ABSTRACT BODY:

Purpose/Hypothesis: The purpose of this study was to examine the correlation between the stroke survivors’ disabilities, as measured by the Functional Independence Measure (FIM), and spousal caregiver burden, as measured by the Zarit Burden Interview (ZBI). The null hypothesis had four components: There will be no relationship between the spouse’s ZBI score and the stroke survivor’s total FIM, motor FIM (mFIM), cognitive FIM (cFIM), and continence-related FIM (cr-FIM) scores.

Number of Subjects: One hundred and nineteen male and forty female stroke survivors and their spousal caregivers were subjects for this study. The subjects were discharged to their homes and recruited from the Houston Veteran’s Administration Medical Center (VAMC), Memorial Hermann Continuing Care Hospital, Memorial Hermann Hospital Texas Medical Center, Memorial Hermann Home Health, Memorial Hermann Southwest Hospital, and TIRR Memorial Hermann-The Institute for Rehabilitation and Research Hospital and Out-Patient Therapy Services.

Materials/Methods: This research study is a secondary analysis of the National Institute of Nursing Research (NINR) sponsored grant entitled “Intervention for Stroke Survivors and Spousal Caregivers.” A Spearman Rank Correlation Test was performed between: 1. Total FIM score of the stroke survivor and ZBI score of the spouse, 2. mFIM sub-score of the stroke survivor and ZBI score of the spouse, 3. cFIM sub-score of the stroke survivor and ZBI score of the spouse, and 4. crFIM (includes bladder and bowel sphincter control, toileting, and toilet transfer) sub-score of the stroke survivor and ZBI score of the spouse.

Results: 1. FIM:ZBI, r = -.378, R2 = 14%, p <.001, 2. mFIM:ZBI, r = -.326, R2 = 10%, p <.001, 3. cFIM:ZBI, r = -.325, R2 = 10%, p <.001, 4. crFIM:ZBI, r = -.321, R2 = 10%, p <.001.

Conclusions: Low statistically significant relationships were found between the previously mentioned FIM score and sub-scores of the stroke survivors and the ZBI score of the spouse.

Clinical Relevance: Lower FIM scores of the stroke survivor represent lower function and more disability, and the higher ZBI score of the spouse indicates greater burden. The low statistical significance with these four correlations could be due to the fact that burden as perceived the caregiver and measured by the ZBI includes things missed by the FIM, but are still very real to the caregiver, such as financial situation, and less social and leisure activities. When measuring perceived burden in caregivers, more than one measure may be indicated to make an accurate assessment.
Background & Purpose: Lateral medullary syndrome (LMS) is a series of clinical manifestations uncovered by Adolf Wallenberg, resulting from vascular damage. Disruptions of the blood supply of the posterior inferior cerebellar artery (PICA), basilar artery and or vertebral artery damage the lateral medulla. Currently, no well-documented literature to support effective interventions of the deficits caused by LMS exists. However, evidence for rehabilitation of impairments resulting from stroke can be found. This case study seeks to determine efficacious rehabilitative means of treatment for LMS.

Case Description: A 77 year old female was admitted after 2 days of vertigo, nausea, vomiting, left arm clumsiness, and falling to left side with an inability to sit up straight. A diagnosis of a left lateral medullary and small left cerebellar stroke was confirmed by magnetic resonance imaging findings of occlusion of left vertebral artery and PICA. On examination presented with:
- Stroke deficits: distractibility, impulsivity, moderate left side functional neglect, aphasia, complaints of headaches, dizziness, periods in seconds of none responsiveness.
- Neuromuscular: combination of lateropropulsion and pushers, impaired midline orientation, Horner’s syndrome in left eye, left eye skew deviation, hypotropia, nystagmus in left eye-in middle horizontal plane (occurring before loss of balance, emesis and or complaints of dizziness).
- Musculoskeletal: right C curve scoliosis, thoracic rib hump (left>right), leg length discrepancy, PROM: limitations in bilateral shoulders, hip flexion, abduction, knee extension, ankle dorsiflexion and right hip extension.
- Cardiovascular: hypertension

Admission Functional Measures: Functional Independence Measure (FIM), The Stroke Rehabilitation Assessment of Movement (STREAM), BERG balance scale.

5 weeks treatment:
- Midline re-orientation: visual cuing of mirror and vertical structures, focus on letter “B”, mental practice, learning movements to align body to vertical, 6x/week, 20 minutes.
- Core stabilization: supine/sitting trunk rotations, sitting/standing perturbations, maintaining static positions in sitting/standing, progressing to reaching activities in positions, PNF D1/D2 rhythmic initiation, 3x/week, 20 minutes.
- Body weight support: Litegait over ground–normalize gait pattern, 1x/week, 30 minutes.
- Forced use of right lower extremity: sitting/standing weight shifting activities, step ups/downs, theraband application as tactile cue to prevent knee hyperextension, 6x/week, 20 minutes.
- Motor relearning for functional activities, 6x/week, 30 minutes.

Outcomes: Discharge-Improvement percentages: FIM score: Walk 29%, Stairs 4%, STREAM total score 11%, BERG 16%. Decline percentage: FIM score: Bed/chair/wheelchair (W/C) 16%.

Discussion: Selected dependent measures indicate an improvement in motor control and balance improving functional activities. Sole exception was bed/chair/W/C possibly due to later re-onset of dizziness from reaction to medications. Rehabilitation strategies for this case were effective in treating LMS impairments.
TITLE: Error Signals for aVOR Gain Adaptation

AUTHORS/INSTITUTIONS: M. Schubert, Otolaryngology Head and Neck Surgery, Johns Hopkins University, Baltimore, MD; M. Scherer, Physical Therapy and Rehabilitation Science, University of Maryland, Baltimore, MD;

ABSTRACT BODY:

Purpose/Hypothesis: Gaze stability refers to clear visual acuity during head rotation. The gain of the angular vestibulo-ocular reflex (aVOR) is a measure of gaze stability. While vestibular rehabilitation typically includes active head rotation exercises designed to increase aVOR gain and improve gaze stability, most attempts to study the aVOR have done so using passive, low velocity head rotations – atypical of those encountered in daily life. To improve gaze stability, the brain must be exposed to incongruent head and eye information - or error signals. Coupled with head motion, velocity error signals provide a continual image slip on the retina, while position error signals provide a still but new image location on the retina. We sought to determine the effects of velocity and position error signals for increasing aVOR gain during rapid head rotations in healthy controls and patients with vestibular hypofunction.

Number of Subjects: Eye and head rotations were measured with scleral search coil before, during, and after aVOR gain adaptation in twelve normal and eight subjects with vestibular hypofunction.

Materials/Methods: aVOR gain increases were compared using two means: error signals of position and velocity that were small and incremental (IVE or IPE) or large and constant (CVE or CPE). We hypothesized that small and gradual error signals would show better aVOR gain adaptation. Most subjects participated in either two velocity error or two position error experiments each, separated by one or two weeks. Subjects fixated visual targets during ~300 active, transient horizontal head impulses. Pre- and post-training aVOR gains were measured in complete darkness for active and passive head rotations. In the IVE paradigm, the target velocity progressed by increments of 10% of head velocity until the aVOR gain demand reached 2. For IPE, the target was progressed by 5% up to 15% greater than head amplitude. For CVE, target velocity was of equal magnitude but opposed head direction for a constant aVOR gain demand of 2. For CPE, the error signal was always 5% greater than the head amplitude. For CVE, target velocity was of equal magnitude but opposed head direction for a constant aVOR gain demand of 2. For CPE, the error signal was always 5% greater than the head amplitude.

Results: Active head accelerations (784 ± 311 d/s/s) were lower than passive head accelerations (3402 ± 527 d/s/s), p = 1.5x10-8. Both paradigms elicited increases in aVOR gain during the training. For velocity errors, the IVE paradigm was more effective than CVE: normals - active (mean 17.3 ± 4% vs. mean 7.1 ± 9%, p = 0.029) and passive (mean 14.2 ± 5% vs. 4.5 ± 8%, p = 0.018) head impulses: vestibular hypofunction - active head impulses (mean 18.2 ± 9.2% vs. mean -6 ± 3.8%, p = 0.003). aVOR adaptation to passive head impulses were less consistent in patient subjects. For position errors, the CPE paradigm was more effective (mean 7 ± 0.03% vs. 4 ± 3%).

Conclusions: Both velocity and position error signals increase aVOR gain, but gradually applied velocity error signals are superior.

Clinical Relevance: Gaze stability exercise programs should incorporate rapid head impulses that are progressed gradually.
TITLE: Postural adaptation implicitly occurs during upper extremity training in standing post stroke.

AUTHORS/INSTITUTIONS: S.A. McCombe Waller, M.G. Prettyman, Physical Therapy and Rehabilitation Science, University of Maryland, School of Medicine, Baltimore, MD;

ABSTRACT BODY:

Purpose/Hypothesis: To assess outcomes in biomechanical and clinical postural control measures at baseline and post upper extremity training in the standing position.

Number of Subjects: Nine subjects with chronic hemiparesis of moderate severity

Materials/Methods: Subjects received training approximately 1 hour, 3x/week for 6 weeks consisting of 5 upper extremity (UE) tasks involving grasp, reach and release assisted by a hand training orthosis. All training was completed in standing. Training instruction focused on completion of the upper extremity tasks with no explicit instructions provided regarding postural control, strategy, or adjustment. All subjects received testing with, 1. Neurocom Balance Master for dynamic weight shifts medial/lateral; anterior/posterior) and limits of stability, 2. Berg balance test and, 3. Activities-specific Balance Confidence Scale (ABC) at baseline and post training.

Results: At baseline, subjects showed limitations of movement initiation, directional control and movement extent during weight shift to a visual cue; both in the medial/lateral and anterior/posterior directions. For the limits of stability test, movement was constrained with marked reduction in movement extent, movement velocity and directional control to the paretic side. Observational findings were lack of visible ankle strategy to produce a transfer of center of pressure (COP) during weight shift in all directions especially posterior and to paretic side. These baseline findings demonstrate delays in movement onset that are indicative of motor planning and preparation deficits as well as problems with biomechanical control of weight shift of the COP through space suggesting a lack of appropriate anticipatory postural adjustments. After upper extremity training with no targeted postural control training, movement of the COP was achieved, now in all directions with improved velocity, directional control and movement extent offering support that UE training in standing is a whole body intervention that can facilitate implicit adaptation of biomechanical postural control. In addition, significant increases in the both the Berg (p<.01) and the ABC scale (p<.001) were demonstrated. All subjects reported increased levels of confidence in their ability to balance during the listed tasks with 7 of 9 subjects improving to a level that moved them into a higher confidence category.

Conclusions: This pilot study provides evidence of implicit postural adaptation in response to a focused upper extremity intervention performed in the standing position.

Clinical Relevance: Completing upper extremity training in standing provides a context relevant position for training patients post stroke that may improve arm function as well as postural adaptation.
**ABSTRACT BODY:**

**Background & Purpose:** Multiple sclerosis (MS) can produce body structure and function impairments in sensation, strength, balance, and motor control that can lead to deficits in locomotor ability. Little research exists to demonstrate if persons with MS can tolerate daily locomotor training and can improve walking performance from a brief, intense intervention period.

**Case Description:** Two persons with MS who have experienced multiple falls participated in this brief, intense intervention. Participant #1 (P1) was a 59 y.o. female with a 40-year history of MS who lives independently in the community, and does not use an assistive device. Participant #2 (P2) was a 53 y.o. female with a 30-year history of MS who lives independently in the community, and uses a single point cane or a rolling walking occasionally. Each participant underwent 10 sessions of locomotor training over a 2-week period. Training was performed in a bodyweight supported treadmill environment and overground. Total stepping time on the treadmill ranged from 20-32 min. Maximum treadmill speeds ranged from 1.27-2.01 m/s. Variations in the environment (carrying loads, head turns, lighting changes) were introduced to produce challenges. After the treadmill, 20-30 minutes of overground training occurred indoors and outdoors with emphasis on maintaining posture and kinematic corrections practiced on the treadmill. Difficulty was progressed by changing speed and direction rapidly, including head turns, carrying loads, varying terrain, and adding perturbations. Each session ended with the participant performing 2 sets of 50 single leg hops on a sled using elastic resistance to work on developing faster propulsive forces. Testing sessions occurred the week prior to the beginning of training and 2-3 days post-training. Follow-up test sessions will be conducted at 1- and 3-months post-training.

**Outcomes:** P1’s self-selected 10-m walking speed (SSWS) increased from 0.96 to 1.28 m/s, fast 10-m walking speed (FWS) increased from 1.27 to 1.64 m/s, Berg Balance Scale (BBS) did not change 55/56, 6-min walk test (6-MWT) increased from 372 to 456 m, Activities-specific Balance Confidence (ABC) Scale improved from 62.2 to 79.4/100%, and the MS Impact Scale (MSIS-29) improved from 70 to 45 (29 = least disability; 145 = maximum disability). P2’s SSWS increased from 1.07 to 1.26 m/s, FWS increased from 1.27 to 1.56 m/s, BBS improved from 53 to 54/56, 6-MWT increased from 379 to 439 m, ABC Scale improved from 60 to 76.3/100%, and MSIS-29 improved from 77 to 61.

**Discussion:** Improvements for both participants in walking speed, distance travelled, balance confidence, and perceived disability met or exceeded the minimal clinically important difference. Ten sessions of a locomotor training program within 14 days led to marked improvement in activity and self-perception of disability for these two individuals with MS who are community ambulators. No adverse events were reported by either participant. Long-term retention of benefits of this program are not known at this time.
TITLE: Core Strength & Balance: A Systematic Review of the Current Literature

AUTHORS/INSTITUTIONS: J. Thomas, T. Williams, B. McNeal, Physical Therapy, Southwest Baptist University, Bolivar, MO;

ABSTRACT BODY:

Purpose: Core strengthening is being used by many physical therapists as a part of their intervention for individuals with a variety of conditions, but the exact effects of core strengthening are unknown. In order to provide the best possible patient care, it is crucial to understand the effects of the many different types of core strengthening programs. The purpose of this systematic review was to determine if core strengthening improves balance.

Description: After searching multiple databases and setting limiting criteria, eight studies were found that directly measured balance after a core strengthening intervention. Two studies used Yoga, three used Tai Chi, two used the 6 Second Abs machine, and one used a core stability exercise. The methods used to measure balance included single leg stance (SLS) times, the Star Excursion Balance Test (SEBT), Berg Balance Scale (BBS), Tinetti Balance Scale, a heel-to-toe walking task, modified functional reach tests (FRT), and limits of stability (LOS) testing performed on computerized balance platforms. The included articles were evaluated using the 2004 American Academy for Cerebral Palsy and Developmental Medicine (AACPDM) methodology for systematic reviews of evidence.

Summary of Use: The limited current research on this topic provides indicative findings that core strengthening does improve balance. However, only two of the eight studies examined were randomized controlled trials, only one was strong in quality, and none had blinded assessors. In order to have a more definitive answer, higher quality research needs to be conducted including large randomized control trials that utilize blinded assessors.

Importance to Members: The use of core strengthening exercises has become more emphasized in the rehabilitation setting in recent years. Improving core strength - also referred to as core stability, trunk stability, and postural stability - has been claimed to reduce pain, maximize the force production of the extremities, and improve balance. However, the bulk of the literature produced thus far about core strengthening exercise focuses on its efficacy in treating low back pain or improving athletic function. Fairly weak evidence currently exists to support the use of core strengthening to improve balance. It is crucial to evidence-based practice that both the benefits and limitations of core strengthening are identified.

AUTHORS/INSTITUTIONS: D. Blankenship, K. MacDonald, K. Mortellite, M. Paulsen, T.L. Smolak, Department of Family and Community Medicine, Doctor of Physical Therapy Division, Duke University, Durham, NC;

ABSTRACT BODY:

Purpose: A spinal cord injury (SCI) is a traumatic event, which undoubtedly leads to significant lifestyle changes. During the early stages of recovery following an incomplete spinal cord injury (iSCI), patients often have a goal to return to ambulation. However, there is no comprehensive clinical guideline for developing a plan of care or prognosis for ambulation. Therefore the specific aims of this study were to: (1) Investigate current research for walking recovery; (2) Investigate current clinical practice through discussion with experienced clinicians; (3) Identify knowledge gaps between best evidence and current practice; (4) Identify what patient values are important during rehabilitation; (5) Identify barriers to implementation of best practice.

Description: To determine the best practice for regaining walking ability in an individual with an iSCI, a systematic evidence-based literature review was conducted. Selected literature included meta-analyses, systematic reviews, randomized controlled trials, cohort studies, case series or reports, as well as expert opinions regarding the full continuum of care. To supplement this search, a convenience sample of eight clinicians who attended a national meeting of the American Physical Therapy Association was selected to participate in a focus group. The clinicians were asked to respond to a series of questions based upon a case vignette. The questions were designed to evaluate assessments, interventions, goals and barriers to implementation of best practice. Additionally, an open forum, as well as informal interviews, were conducted with individuals with a SCI to address their preferences for rehabilitation. Literature was used to complement the knowledge gained through these discussions.

Summary of Use: Limited research exists that comprehensively evaluates walking recovery in the iSCI population. Clinicians need to be systematic throughout the continuum of care by addressing patient goals, identifying appropriate prognoses for ambulation and selecting strategies to accomplish a functional ambulatory status. Based on the findings of this study, the recommendation for the best physical therapy intervention for walking recovery is Body Weight Supported Treadmill Training followed by overground training.

Importance to Members: The level of evidence for locomotor training in the iSCI population is weak. Knowledge of which individuals would benefit most from a specific intervention has not been established. Existing studies are heterogeneous regarding characteristics of the participants as well as interventions, protocols and outcome measures used. Despite this, it is clear that these studied interventions may be of value to the plan of care. Unfortunately, several barriers pose challenges in translating this evidence into clinical practice. These barriers include patient and environmental factors, therapeutic limitations and third party influences. Furthermore, the patient perspective must be considered regarding medical, social, psychological and logistical domains of care.
Purpose/Hypothesis: The purpose of this study was to compile an evidence-based multidimensional fall risk screening tool that would be used to establish preliminary reference values for modifiable fall risk factors tested in independent community dwelling adults. The research hypotheses were investigated to determine if there would be significant differences in testing due to aging factors prior to the age of 65. A secondary objective sought to determine if age group, sex, and physical activity were predictive of total physical performance.

Number of Subjects: 190 subjects underwent screening.

Materials/Methods: Evidence-based compilation of a 16-component test multidimensional fall risk screen (MFRS) and subsequent community screenings of 190 adults aged 20-79 were carried out. Participants completed a health status questionnaire and underwent physical performance testing utilizing the MFRS. Test results provided fall risk stratification of each participant. This cross-sectional study utilized multivariate analysis and multiple regression to test the null hypotheses at p-values of <.01.

Results: The MFRS proved to be an efficient measure of modifiable fall risk factors. Fall risk stratification was determined for each participant. Component test reference values for the six age decades 20-79 were developed. Adults aged 20-79 demonstrated significant age-related differences in physical performance on most of the component tests and on the MFRS total score of impairment. Single Leg Stance tests, followed by Ankle Dorsiflexion ROM, Five Times Sit To Stand Test, Dynamic Visual Acuity, and Single Heel Rise Tests showed the greatest decline in performance at significant impairment levels at young and middle-aged adult decades. Sex and physical activity had a relationship to age-associated changes but not as primary predictors.

Conclusions: Community screening was able to identify fall risk and preclinical disability in young, middle-aged, and older adults.

Clinical Relevance: Fall risk stratification following routine multidimensional screening of modifiable physical fall risk factors can be used as a primary prevention strategy to provide the high-functioning adult with information and direction on how to minimize physical impairments, fall risk, and allow aging to occur at a healthier more independent level. The MFRS component test reference values will add to the existing fall risk stratification body of knowledge. The MFRS will be of immediate use in clinical and community practice.
TITLE: Postural Control in Older Adults with Subclinical Neck Impairments

AUTHORS/INSTITUTIONS: D.M. Wrisley, X. Shi, K. McNerney, Rehabilitation Sciences, University at Buffalo, Buffalo, NY; J. Quek, Singapore General Hospital, Singapore, SINGAPORE; J. Landahl, Exercise Sciences, University at Buffalo, Buffalo, NY; N.A. Kumar, Texas Tech University Health Sciences Center, Odessa, TX;

ABSTRACT BODY:

Purpose/Hypothesis: Although the contribution of cervical proprioceptive information to postural control has been demonstrated in animals, it is unknown how cervical range of motion and intervertebral segmental mobility effect postural control in humans. The purpose of this study was to investigate the relationship between total cervical range of motion, passive upper cervical intervertebral segment motion, and postural control in older adults with no history of neck pain or pathology.

Number of Subjects: Sixteen community dwelling older adults with no history of falls, neck pain, or pathology (age 73 ± 7 years; 6 F, 10 M) were recruited as part of a larger study on aging and postural control.

Materials/Methods: Each subject underwent passive upper cervical intervertebral segment motion testing (UCM), and kinematic analysis of active assisted total cervical range of motion (CROM) and upper cervical range of motion (UCROM). Subjects' kinematic and kinetic responses to 7 conditions of platform “sway referencing” (SR) were examined [Static, Anterior-Posterior (AP) and Medial-Lateral (ML) rotation, AP and ML translation, AP and ML Combined (AP and ML translation with either AP or ML rotation)]. Root Mean Square (RMS) and equilibrium scores (% sway relative to theoretical sway limits) (EQ) of the AP and ML Center of Pressure (CoP) and head sway were calculated for each SR condition. Subjects also completed the Timed “Up & Go”, Berg Balance Scale, and Functional Gait Assessment as measures of gait and balance. The Spearman correlation coefficient was used to calculate the correlation between UCM, CROM, UCROM and the CoP and head RMS and EQ scores during the 7 SR conditions and between UCM, CROM, UCROM and the clinical gait and balance measures. An ANOVA was performed to determine if there were differences in the head or CoP RMS and EQ scores during the SR conditions between subjects with and without limitations in CROM or UCROM.

Results: Moderate correlations (r = 0.54-0.67) were found between UCROM and gait and balance measures. Significant differences were found in the performance of gait and balance measures between subjects with and without UCROM limitations. Significant differences were found in RMS and EQ scores between subjects with and without UCROM limitations but only in the rotational SR conditions. Significant differences were found in RMS and EQ scores between subjects with and without CROM limitations but only during the translational SR conditions.

Conclusions: Subclinical impairments in neck mobility are associated with increased sway and impaired balance as measured by clinical gait and balance measures. Impairments in upper and lower cervical ROM impact postural sway differently depending whether the perturbation is translational or rotational and may reflect differences in the location and mechanism of integration of sensory information from the cervical spine.

Clinical Relevance: Cervical ROM and intersegmental mobility impairments should be investigated and addressed as possible sources of balance dysfunction and fall risk in older adults.

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Effect of the Loss of Funding for Exercise on Individuals with Disabilities

E.E. Simunds, N.A. Flinn, Medical Rehabilitation Services, Courage Center, Golden Valley, MN;

Purpose/Hypothesis: Individuals with physical disabilities who had been exercising regularly in a therapeutic Health and Wellness program found their coverage for fitness terminated by county agencies. This provided an opportunity to demonstrate the value of fitness programs for these consumers by measuring changes experienced after loss of support for exercise.

Number of Subjects: Termination of fitness services at our facilities occurred for 79 individuals. Forty-six were contacted by phone and 30 agreed to participate in the study.

Materials/Methods: We developed a phone interview based on the short form of the Secondary Conditions Surveillance Instrument (Ravesloot et al., 2006). The interview included questions about demographics, type of exercise, length of time since termination of financial support, presence of secondary conditions (SC), and efforts to continue exercising. Phone calls were attempted twice and the interview was scheduled if a consumer consented. Thirty participants consented, 17 females and 13 males, with an average age of 52 years (29-91 years). Over two-thirds of their diagnoses were neurological (stroke, TBI, seizures) and the remaining individuals had a variety of other chronic health conditions. These consumers exercised for an average of 19.52 months (3-36 months), and lost funding for exercise for an average of 6 months (1 to 13 months).

Results: The 30 participants reported an average of 3.00 secondary medical conditions prior to stopping exercise, but 5.63 secondary conditions at the time of the call. This change in number of SC was statistically significant using a Wilcoxon signed ranks test at p=.0001. Further, on a 0-3 scale of severity, they rated the conditions as an average of .73 prior to and 1.26 after stopping exercise. This difference was also statistically significant using a Wilcoxon signed ranks test at p = .0001. Examination of subgroups revealed that loss of funding for exercise resulted in a greater increase in number and severity of secondary conditions for older consumers, women, and consumers participating in aquatics than those participating in land-based exercise. The findings are less clear when the results are compared by mobility type as the use of a manual wheelchair may be somewhat protective of fitness level. Those secondary conditions that increased the most included decreased physical function, social isolation, mental health concerns, reduced endurance, and falls or fear of falling. The incidence of secondary conditions was consistent with the literature.

Conclusions: Regular exercise appears to help individuals with disabilities control the presence and severity of secondary conditions and the loss of this opportunity reverses the trend.

Clinical Relevance: The long term consequences of neurological disorders must be considered during rehabilitation. The thin margin of health of these clients makes regular exercise participation crucial to maintaining health. The need for accessible and assisted exercise opportunities beyond acute rehabilitation should be recognized by rehabilitation personnel and health plans.
Correlation of Gait and Balance Parameters to Self-Reported Functional Measurements in Community-Dwelling Subjects with CVA

K.L. Mercuris, S. Bradley-Diehl, R. Schider, Physical Therapy, Des Moines University, Des Moines, IA;

Purpose/Hypothesis: Individuals have varying degrees of impairments and disability following a stroke. Impairments, such as decreased postural control or balance, impact functional activities due to the increased risk of falls. Dynamic balance is critical for ambulation, and thus is an important consideration for physical therapy. However, there is limited research on the relationship between dynamic balance, gait velocity, and functional capacity in individuals with stroke. The purpose of this study is to determine the correlation between postural control, gait velocity and self-reported functional capacity, assessed by the Craig Handicap Assessment and Reporting Technique (CHART) and the Stroke Impact Scale (SIS). It was hypothesized that good postural control and high gait velocities would correspond to a higher level of independence at home and in the community.

Number of Subjects: Fifteen (7 males and 8 females) community ambulating CVA subjects (mean age= 62.4y) with mean of 5.0 years post-stroke, participated in the study.

Materials/Methods: Self-selected gait velocity was measured. The Four Square Step Test (FSST) time was used as a measure of dynamic balance with multi-directional stepping. All subjects completed the self-report CHART and SIS questionnaires which are reliable and valid tools to assess self-perceived function in the home and community. Both questionnaires include subscales for physical independence, mobility, strength, and social integration. Pearson’s correlation tests were done to assess the relationships between the different variables.

Results: Gait velocity and FSST time were strongly correlated. FSST and gait velocity moderately correlated to the SIS Total score. FSST moderately correlated to the Chart Total score. However, gait velocity was weakly correlated to Chart Total. Chart Total and SIS Total did not correlate.

Conclusions: The study showed that FSST better reflects patient’s self-perceived functional recovery as measured with the CHART and SIS than does gait velocity. CHART and SIS did not correlate even though each has been shown to be a reliable and valid tool in previous studies. Additional statistical analysis is in process to determine the predictive value of FSST to home function.

Clinical Relevance: Dynamic postural control, as measured via the FSST, may be an effective clinical assessment tool for the prediction of recovery of function in community ambulators following stroke. It appears the SIS and CHART may measure different functional outcomes in the stroke population. Further studies are needed to determine the relationship of balance interventions and gait training to the overall recovery and home/community function of individuals with stroke.
Lower-functioning participants with post-stroke hemiparesis show greater improvements with an intensive, high-dose, mobility training than higher-functioning participants.

**Authors/Institutions:** S.L. Fritz, E. Rivers, A. Merlo-Rains, Exercise Science, University of South Carolina, Columbia, SC;

**Abstract Body:**

**Purpose/Hypothesis:** This study investigated changes following an intensive, high-dose, intervention in a sample of individuals with chronic deficits of gait, balance, and mobility post stroke. This intervention was designed as a lower-extremity correlate to upper-extremity CIMT, using the principles of massed practice and intensive rehabilitation rather than restraint. The primary goal of this study was to determine if higher or lower functioning participants demonstrated greater improvements.

**Number of Subjects:** A convenience sample of 12 individuals with chronic stroke was divided into two groups. Eight lower functioning, defined as Berg less than 45 [av. Berg 31(9)], av. age 62 (21), av. time since stroke 2 year 10 months (2 years, 2 months)]; and 4 higher functioning [av. Berg 50 (3), av. age 62 (9), av. time since stroke 3 years, 6 months (3 year, 3 months)].

**Materials/Methods:** Both groups received intensive training, 3 hours per day for 10 consecutive weekdays (30 total hours). The sessions focused on encouraging the participants to use their more-affected lower-extremity in a massed practice schedule; activities selected were based on subject’s deficits and tailored to their level of functional ability using a task-oriented intervention approach, focusing on variability of practice, tasks directed at underlying impairments, and functional activities. Activities included items such as gait training, sit-to-stand, stair climbing, various balance and proprioceptive activities, and coordination tasks. Treatment outcomes were assessed at 4 different time points (baseline, pre, post, and 3-months) using 3-Meter Walk, Activities Balance Confidence Scale, Berg Balance Scale, Dynamic Gait Index, & Timed Up and Go.

**Results:** Participants, who were lower functioning, showed greater improvements across all outcome measures reported following the intensive intervention than the higher functioning participants. While some of this may be due to a ceiling effect in the outcome measures, the differences were quite large; the average effect size across all outcome measures was 0.89 and 0.26 respectively for the groups. For example the lower functioning participants improved an average of 12 points (3.3) on the Berg Balance Test, while the higher functioning participants only improved 1 point (2.2). Lower functioning participants improved on the Timed Up and Go by an average of 16 seconds (21), while the higher functioning group improved 0.5 seconds (1.2) on average.

**Conclusions:** This study investigates an intensive and novel therapeutic intervention that may be promising in decreasing chronic impairments and disabilities in those with stroke, primarily in those with Berg Balance Scores less than 45 points.

**Clinical Relevance:** If an appropriate intervention can be determined resulting in significant improvements with only a two-week, albeit intensive, intervention; then, it is important to identify what patients may benefit the most from the intervention.
TITLE: Association between lower limb corticospinal tract asymmetries and cortical motor thresholds in individuals with stroke

AUTHORS/INSTITUTIONS: S. Madhavan, J. Stinear, SMPP, Rehabilitation Institute of Chicago, Chicago, IL;

ABSTRACT BODY:

Purpose/Hypothesis: Magnetic resonance diffusion tensor imaging (DTI) and transcranial magnetic stimulation (TMS) have been used extensively to probe the structural integrity and conductivity, respectively, of the corticospinal motor system after stroke. However, little is known about lower limb motor corticospinal connectivity and it remains unknown if a quantitative relationship exists between corticospinal connectivity and conductivity (i.e.,) do more fibres mean greater conductivity? Hence, the purpose of this study was to examine the relationship between structural damage of the corticospinal tract (CST), corticospinal excitability, and motor function in chronic hemiparetic stroke patients.

Number of Subjects: 11 moderately impaired individuals with chronic sub-cortical stroke.

Materials/Methods: CST damage was quantified using structural magnetic resonance and diffusion weighted imaging. This permits calculation of fractional anisotropy (FA) to estimate the integrity of white matter tracts in a specified region of interest. We computed the FAs for the affected and unaffected lower limb motor cortices and calculated an index of FA asymmetry. Excitability and conduction of corticospinal projections to the lower limb were measured by estimating the active motor threshold of the corticomotor representation of the tibialis anterior (TA) muscle. Gait velocity and lower limb Fugl-Meyer scores were used to assess lower limb motor function.

Results: The FA asymmetry was positively correlated to paretic TA motor threshold (p = 0.02, R² = 0.42). Subjects with larger asymmetries (greater damage) had higher motor thresholds. FA asymmetry was negatively correlated with gait velocity (p = 0.05, R² = 0.23). Subjects with larger asymmetries had lower gait velocities.

Conclusions: Greater CST damage results in higher motor thresholds and lower gait velocities. To our knowledge, this is the first demonstration of a quantitative relationship between CST integrity, excitability and motor function in the lower limb of stroke patients.

Clinical Relevance: Understanding the relationships between corticospinal connectivity, conductivity and limb function is necessary to provide insights into the anatomical and physiological substrates driving walking recovery following stroke. Due to the recent emergence of numerous non-invasive brain stimulation techniques to manipulate cortical excitability to restore between-hemisphere symmetry post stroke, our findings will help guide the effective application of non-invasive brain stimulation. This is the first step towards individualizing brain stimulation rehabilitation interventions to maximize the effect of gait training.
Background & Purpose: Cerebrovascular accident (CVA) is one of the leading causes of disability in adults. Body-weight supported (BWS) gait training following CVA has been widely examined; however, few studies have examined patients with acute CVA (<6 weeks). Most recent studies on BWS gait training have utilized the treadmill as the main form of locomotion training, with positive results. The purpose of this case report is to describe the outcome after over-ground BWS gait training in a patient with an acute CVA.

Case Description: The patient was a 61 year-old homeless male who was found on the street by fire rescue with apparent CVA and severe disability. He was admitted to an acute care hospital for 11 days, followed by admission to an inpatient rehabilitation facility (IRF) for 9 days. The patient’s diagnosis upon admission was right hemiparesis due to left CVA. He also presented with altered mental status and aphasia. The patient was found to have bilateral carotid artery stenosis 80% to 90%. Due to this patient’s unusual socioeconomic status, he represents a high risk population for continued impairment and overall poor prognosis. In the IRF, the patient received traditional rehabilitation services including physical, occupational, and speech therapies. As a part of his physical therapy treatment, the patient received daily sessions of over-ground BWS gait training over seven days at 40% body support, ambulating a total of 4000 feet (400-600 ft/session).

Outcomes: To determine response to treatment, the following outcome measures were used: Functional Independence Measure (FIM) (bed mobility, transfers, stairs, and gait), Functional Ambulation Category (FAC), and Acute Care Index of Function (ACIF). At discharge, the patient improved in all functional categories assessed. The patient’s bed mobility progressed from supervision (FIM=5) to complete independence (FIM=7), while transfers improved from minimal assistance (FIM=4) to supervision (FIM=5). Both stairs and gait scores improved from total assist (FIM=1) to supervision (FIM =5). General ambulation also improved on the FAC scale. Initially, the patient required firm continuous support from one person who assisted with balance and upright stance (FAC = 1). At discharge, the patient only required verbal supervision or stand-by help from one person without physical contact (FAC = 3). The patient was discharged with an ACIF score of 89.3, a 33.3 point gain (admission score = 56), representing a marked improvement in overall patient function.

Discussion: The results of this case report are significant because they describe the benefits of BWS gait training on over-ground conditions in a patient with an acute CVA. This case report demonstrates that improvements in functional status are possible with early use of evidence-based interventions. Similar results were obtained with over-ground BWS gait training in this case when compared to previous treadmill studies. The patient’s unique social history adds to this report’s clinical importance on functional improvements for vulnerable patients with acute CVA.
THE EFFECTIVENESS OF A COMPUTERIZED BALANCE TRAINING PROGRAM IN INDIVIDUALS WITH PARKINSON'S DISEASE: A PILOT STUDY

G. Stern, American International College, Springfield, MA

ABSTRACT BODY:

Purpose/Hypothesis: The purpose of this study was to test the efficacy of a computerized functional balance training protocol in a population of individuals with Parkinson's disease (PD). Experimental group subjects practiced functional balance activities with computer generated visual cues and feedback utilizing the Balance Master System™ (BMS). The performance of an experimental group was compared to a control group receiving traditional rehabilitation training under non-visual cued, non-computerized conditions.

Number of Subjects: A sample of 20 community dwelling individuals with PD (Hoehn and Yahr stage I-II) volunteered to participate.

Materials/Methods: Subjects were randomly assigned to the experimental (BMS protocol) or control (traditional rehabilitation) group. All subjects were tested with the Timed Up and Go (TUG) test and the Functional Reach Test (FRT) prior to training, immediately upon completion of training and at one month post training. Subjects trained for a total of 10 sessions, 36 minutes of total activity per session, over a two week period. The BMS protocol included weight shifting and sit to stand activities. Experimental subjects received computerized rhythmic, externally paced visual cues during practice. The traditional rehabilitation protocol included stretching, balance and functional activities, practiced without visual or rhythmic cueing.

Results: There was a significant decrease in TUG scores over the three testing intervals in the experimental group as compared to the control group (F = 20.67, p = .0001). No significant difference was found in FRT scores (F = 3.46, p = .079).

Conclusions: Computerized balance training was effective over time in individuals with PD. While both groups practiced for the same amount of time and training sessions, the conditions of practice were different. Experimental subjects appeared to benefit from a computerized, intensive training protocol with externally paced visual cues. Experimental subjects were prompted to change their movement pattern with a pre-set, timed visual cue. Control subjects practiced under non-visual/auditory conditions with internally, self-paced activities. In addition, while the control subjects practiced for the same amount of sessions and time, they did not practice with the same intensity. The computer training appeared to be highly motivating to the experimental subjects as they potentially could practice sit to stand for up to 120 times. Control group subjects practiced sit to stand up to 20 times during the training period.

Clinical Relevance: Computerized psychomotor training supports learning through externally paced, repetitive, motivated, intensive practice. Externally paced cued practice may potentiate both a short term and long term effect on psychomotor learning. Learners may benefit from computerized training programs that meet the following conditions: programmable, timed externally paced visual cues; intensive practice schedule; engaging and appropriately challenging activities.
TITLE: Beneficial Effects of Exercise on Diabetic Neuropathy

AUTHORS/INSTITUTIONS: P. Kluding, R. Rupali, S. Jernigan, K. Farmer, J. Rucker, R. Moses, Physical Therapy and Rehabilitation Sciences, University of Kansas Medical Center, Kansas City, KS; M. Pasnoor, L. Herbelin, Neurology, University of Kansas Medical Center, Kansas City, KS; D. Wright, Anatomy and Cell Biology, University of Kansas Medical Center, Kansas City, KS;

ABSTRACT BODY:

Purpose/Hypothesis: Patients with diabetic peripheral neuropathy (DPN) can have both small nerve fiber damage, associated with pain and impaired temperature sensation, and large nerve fiber damage, associated with impaired tactile sensation and joint proprioception. Although exercise is universally recommended for people with diabetes, there is little information about how exercise influences neuropathy. The purpose of this study is to quantify the effects of exercise on nerve function and cutaneous innervation in people with DPN.

Number of Subjects: Subjects with DPN in the age range of 40-70 years participated in the exercise intervention in a pre-test post-test design. The results of 8 subjects (4 males/4 females, age 58.6±5.6, diabetes duration 8.7±10.6 years) who have completed the project to date are presented.

Materials/Methods: The intervention consisted of aerobic and strengthening exercise 3-4 days per week. Large fiber outcomes included vibration threshold, nerve conduction studies, and ankle proprioceptive error; small fiber outcomes include intraepidermal nerve fiber density (IENF, via proximal and distal skin biopsy), temperature sensory thresholds, and pain (10 cm visual analog scale).

Results: The results from the first 8 subjects to complete the intervention are described. Significant improvements were found in proprioceptive error following the 10-week intervention (Δ -2.8±1.3°) and proximal IENF (Δ +1.6. ± 4.2 fibers/mm). Non-significant improvements were noted in other large fiber outcomes, including vibration threshold (Δ -3.1±13.3 Hz) and sural nerve amplitude (Δ +1.0±3.3 µV); and small fiber outcomes, including distal IENF (Δ +0.86±3.1 fibers/mm) and self-reported pain (Δ -2.0±3.6 mm).

Conclusions: These results suggest that select large fiber and small fiber outcomes may be responsive to the exercise intervention. This preliminary analysis provides evidence of improved proprioceptive function and proximal epidermal innervation with exercise and a trend towards improvement of vibration threshold, sural amplitude, distal IENF and pain.

Clinical Relevance: Exercise may be an appropriate non-pharmacological intervention to manage both large and small nerve fiber symptoms resulting from diabetic peripheral neuropathy.
**TITLE:** Sensation is central to motor learning: Experiment 2-a study of rTMS-induced virtual lesions

**AUTHORS/INSTITUTIONS:** L. Boyd, Department of Physical Therapy, Univ. British Columbia, Vancouver, British Columbia, CANADA; N.E. Acerra, S. Meehan, Graduate Program in Rehabilitation Science, University of British Columbia, Vancouver, British Columbia, CANADA; E.D. Vidoni, Department of Physical Therapy and Rehabilitation Science, University of Kansas Medical Center, Kansas City, KS; E. Dao, Department of Psychology, University of British Columbia, Vancouver, British Columbia, CANADA;

**ABSTRACT BODY:**

**Purpose/Hypothesis:** The goal of this study was to further elucidate the role of sensation in forming internal models for movement. In past work (see Experiment 1) we discovered a strong relationship between proprioceptive loss and the ability to accurately learn a motor tracking task after stroke. However, motor control deficits resulting from stroke may mask improvements associated with motor learning. To eliminate the potential impact of altered motor control on learning, we induced a transient virtual lesion to primary sensory cortex (S1) in healthy controls using 1Hz inhibitory repetitive transcranial magnetic stimulation (rTMS). We hypothesized that across practice motor control would be disrupted by inhibitory rTMS to S1 but that at retention motor learning would be preserved.

**Number of Subjects:** Healthy participants were randomly assigned to either an experimental (n=10, 28.3 y/o) or sham (n=10, 23.8 y/o) group; all were naive to rTMS and blind to group assignment.

**Materials/Methods:** Each participant’s anatomic MRI was used with a stereotaxic system to verify rTMS coil placement over S1; marking S1 standardized rTMS delivery across days. Each participant practiced a continuous tracking task where a repeating sequence was presented along side random sequences (100 trials over 2 days); a no rTMS retention test occurred on day 3. For the experimental group, task practice was paired with inhibitory rTMS (90% of motor threshold, 1200 pulses). The sham group received inactive rTMS from a custom TMS coil that did not deliver stimulation. Repeated measures ANOVAs (Group (Exp/Sham) X Sequence (Repeated/Random)) indexed changes in tracking errors separately for practice and retention. The effects of rTMS on proprioception (limb-position matching) and cutaneous sensation (2-point discrimination) were indexed before and after rTMS on practice day 1.

**Results:** Proprioception and cutaneous sensation were significantly worse after 1 Hz rTMS to S1 (p=.05). Across practice the sham group made more change than the experimental group (Group X Block interaction p=.02). Contrary to our hypothesis group differences persisted at retention as the experimental group with virtual S1 lesions was not as accurate as the sham group (Group main effect p=.00). The magnitude of tracking error at the retention test correlated with both impairments in proprioception (r=.48) and cutaneous sensation (r=.49).

**Conclusions:** These data suggest that practice under conditions of altered sensation caused the development of a motor plan that continued to be less accurate even when sensation was restored at the no-rTMS retention test. Our results extend those from our first study "Somatosensation is central to motor learning: Experiment 1 - a study of focal stroke" and demonstrate that sensation is essential for forming a motor plan that facilitates accurate movement.

**Clinical Relevance:** Taken together our 2 experiments demonstrate the essential nature of accurate sensation in motor learning. This information should be considered when developing rehabilitation programs for individuals with brain damage.
Title: Power training improves elbow stretch reflex modulation in persons post-stroke

Authors/Institutions: M. Corti, Physical Therapy, University of Florida, Gainesville, FL; C. Patten, Brain Rehabilitation Research Center, Malcom Randall VA Medical Center, Gainesville, FL;

Abstract Body:

Purpose/Hypothesis: While spastic hypertonia is a well-recognized symptom of impaired motor control following stroke, its functional consequences remain elusive. Our previous work demonstrated that an intervention of combined upper-extremity functional task practice (FTP) and power training, consisting of dynamic, high-intensity resistance training (POWER), did not exacerbate spasticity. Indeed, the hybrid intervention revealed improvements in both hyperreflexic and hypertonic components of elbow stretch reflex responses. Here we investigate how POWER and FTP, performed separately, affect elbow stretch reflex modulation. We hypothesized that increased descending drive in response to POWER would reveal enhanced gating of afferent information and improved stretch reflex modulation.

Number of Subjects: 15 participants (14±6.6 mo post-stroke, 59.8±15.0 yrs, 3 female) were randomly assigned to 10 weeks (30 sessions) of FTP or POWER.

Materials/Methods: Following a 2-week washout they crossed-over to 10-weeks of the alternate treatment. Clinical assessments and elbow stretch reflex responses were conducted at: baseline, after each treatment and at 6 month follow-up. Clinical evaluations included: Upper-extremity Fugl-Meyer, Chedoke-McMaster and European Stroke Scale. Stretch reflex modulation was evaluated using surface EMG of biceps brachii during passive and preloaded (20% MVIC) ramp-and-hold stretches at 4 speeds ranging from 90 to 270 degrees/s. Reflex activity was evaluated by calculating EMG burst duration (BURST), onset position threshold (THRESH) and onset latency (LAT).

Results: Clinical assessment confirmed baseline equivalence of POWER and FTP groups (p >.05). Per clinical assessment, participants improved following both POWER and FTP (p<0.05) without differential treatment effects. Passive and preloaded stretch reflex responses revealed decreased BURST (POWER 50% & 38%; FTP 22% & 20%, respectively). The magnitude of these effects was greater following POWER (p <.001). All improvements were retained at 6 month follow up (p <.02). In the passive stretch condition, THRESH and LAT increased significantly following both POWER (36.5o & 286 ms, respectively) and FTP (15.3o & 104 ms) (p < .001). In the preloaded condition, POWER revealed significant improvements in THRESH (25.8o) (p <.001) that were partially retained at 6 months (p =.09) and incremental improvements in LAT (46.6 ms) that reached significance at 6 months (p <.02). No significant improvements in the THRESH or LAT during preload were associated with FTP (p >.05).

Conclusions: These results confirm and extend our previous findings. While functional outcomes appear similar between POWER and FTP, greater improvements in stretch reflex modulation occur in response to high-intensity activity. Differential responses to passive and preloaded stretches observed following POWER suggest this effect involves improved gating of afferent inputs mediated through supraspinal, pre-synaptic pathways.

Clinical Relevance: POWER is therefore an important intervention approach that appears to facilitate neuromotor control and modulation.
TITLE: Case Report: A Computerized Dynamic Posturography Program Performed in Sitting to Improve Balance and Mobility in an Adult with Severe Chronic Cerebellar Stroke

AUTHORS/INSTITUTIONS: R.M. Hakim, L. DeMark, E. Guobadia, Physical Therapy, University of Scranton, Scranton, PA;

ABSTRACT BODY:

Background & Purpose: A recent systematic review of effectiveness of physiotherapy for adults with cerebellar dysfunction (Martin et al., 2009) reported positive effects over a range of outcomes measured, in particular balance, gait and function. However, none of the studies trained persons with cerebellar stroke on a force platform system, particularly those with severe deficits and wheelchair dependence. The purpose of this case report was to describe use of a computerized dynamic posturography (CDP) system to train balance and improve mobility in a patient with severe, chronic cerebellar stroke.

Case Description: A 48 y/o female resident of an assisted living facility who was 3 years s/p cerebellar stroke with a recent history of falls and near falls presented as dependent with all mobility skills secondary to ataxia, imbalance and marked postural deviation. Examination of balance-related performance was conducted before and after the intervention. Outcome measures included: modified Sensory Organization Test (SOT) and Limits of Stability (LOS) tests in a seated position on the NeuroCom Equitest system, Berg Balance Scale (BBS), and Seated Functional Reach Test (FRT). She required moderate assist X 2 for transfers, maintained unsupported sitting with asymmetrical posture for < 20 seconds (with greater weight on right IT and right thoracic curvature), and used a power wheelchair for locomotion. She participated in 1 hour of computerized balance training sessions in a seated position, 2 times a week X 8 weeks. Her customized program included: use of visual feedback on the computer screen while sitting to improve alignment and weight distribution, eye/head movements, reaching, and dynamic weight shifting toward targets with a moving surround and/or support surface. Activities were progressed using the Equitest level, pacing, time and compliance scores for each activity.

Outcomes: Upon posttesting, she improved SOT composite score by 6 points and maximum excursion abilities by 41%-71% on the LOS test. She improved (from completing 2 of 8 directions with repeated near falls on pretest) to completing 7 of 8 directions with 1 near fall on the LOS posttest. Scores on the BBS increased from 1/56 to 4/56 indicating improved sitting balance and transfers (items 3 & 5), and seated FRT increased by 2 inches. She was able to transfer with min/mod assist X1 and sit unsupported for 10-15 minutes with mild asymmetry. Subjectively, she reported greater ease with sitting on the edge of her bed, improved posture, and use of only one caregiver to assist with her mobility/ADLs instead of 2.

Discussion: After an 8-week CDP intervention, the patient’s balance abilities in sitting generally improved with increased trunk stability and dynamic postural control as indicated by most outcome measures. This type of program shows promise as an effective, systematic and objective treatment method for improving sitting balance and mobility in a patient with severe, chronic cerebellar stroke.
TITLE: The Effect of Body Position on Upper Extremity Single and Multi-joint Strength in Individuals with Chronic Hemiparetic Stroke

AUTHORS/INSTITUTIONS: D.M. Krainak, K. Bury, S. Churchill, M. Gandhi, E. Pavlovics, L. Pearson, M.D. Ellis, J.P. Dewald, Northwestern University, Chicago, IL;

ABSTRACT BODY:

Purpose/Hypothesis: Individuals with severe chronic hemiparetic stroke have reduced reaching distances associated with abnormal coupling of shoulder abduction and elbow flexion. It has been suggested that the expression of this impairment is due to increased reliance on brainstem motor pathways following the loss of corticofugal pathways due to stroke. Additional evidence for brainstem contributions, specifically from the vestibulospinal pathway, to the voluntary control of the upper limb may be obtained by comparing the effect of body position on single and dual task isometric strength in individuals with and without stroke. Considering the expected contributions of vestibulospinal motor system, we hypothesize that 1) there will be a greater percent increase from supine to sitting in the individuals with stroke compared with the control group for maximum isometric elbow extension and shoulder flexion strength, and 2) individuals with stroke will produce greater elbow extension during sub-maximal shoulder abduction torque (50% of maximum) in sitting versus supine.

Number of Subjects: Eleven individuals with chronic stroke (>1 year) and moderate to severe upper extremity impairment (average Fugl-Meyer 22.9/66) participated in the study. Ten adults without stroke were used as a comparison group.

Materials/Methods: Subjects performed isometric maximum voluntary torques (MVT) in sitting and supine recorded via 6-degrees-of-freedom load cell in six single tasks: shoulder abduction (SAB), shoulder adduction (SAD), shoulder flexion (SF), shoulder extension (SE), elbow flexion (EF), and elbow extension (EE). Each participant also performed a dual task maximizing EE torque while sustaining a submaximal (50% of maximum) SAB torque.

Results: The percent increase MVT from supine to sitting was greater in individuals with stroke for SE and EF, but not for all other torque directions. Furthermore, within group analysis showed that both groups had greater SF and EE MVT in sitting compared to supine. For the dual task, there was no difference in maximum EE torque produced during 50% SAB across positions (sitting/supine) for both groups.

Conclusions: Body position increases arm extensor strength in sitting in both populations presumably due to an increase in vestibulospinal drive. Unique to the stroke population was the increase in flexor activity measured in the paretic limb in sitting. However, body position does not appear to affect the ability of individuals with stroke to work outside the flexion pattern in a dual task. Future research of other dual tasks within the abnormal torque coupling patterns is necessary to further explore this possibility.

Clinical Relevance: Clinicians should consider the effect of body position when evaluating reaching impairments in chronic stroke. Our results suggest that individuals with stroke may have altered single-joint strength and shoulder/elbow coordination in sitting that should be accounted for in evaluation and treatment planning.
TITLE: Differential Diagnosis in Vestibular Rehabilitation Using the Vestibular Diagnostic Matrix

AUTHORS/INSTITUTIONS: J. Hoder, R. DeWitt, B. Moore, J. Sager, J. Goodrich, S.J. Herdman, Department of Rehabilitation Medicine, Division of Physical Therapy, Emory University, Atlanta, GA;

ABSTRACT BODY:

Purpose/Hypothesis: The Vestibular Diagnostic Matrix (VDM) was created by Dr. Susan Herdman as a clinical guide for skilled physical therapists to assist in the differential diagnosis of patients with vestibular dysfunction. The purpose of this research study was to examine the accuracy of the VDM by comparing a physician’s diagnosis to the diagnosis arrived at using the decision-making matrix.

Number of Subjects: Over 400 medical charts were reviewed from clients who came to Emory’s Dizziness and Balance Clinic with primary complaints of vertigo and/or disequilibrium, between 2003-2007. 107 charts were selected based upon the following inclusion criterion: the presence of symptoms, histories, and testing results necessary to reach a diagnosis on the VDM.

Materials/Methods: Charts were categorized by the 5 diagnoses in the VDM: Unilateral Vestibular Hypofunction (UVH), Bilateral Vestibular Hypofunction (BVH), Benign Paroxysmal Positional Vertigo (BPPV), central vestibular disorder (CVD), and migraine/Meniere’s disease. Each category was reviewed for the inclusion criterion until either 20 charts of each diagnosis were found or the charts had been exhausted. A rater, blinded to the chart selection process and physician’s diagnosis, then tracked the client’s subjective complaints and provocation testing results through the VDM to arrive at a possible physical therapy diagnoses. Results were compared to the reference standard diagnosis given by one of two neurologists. 10 random charts were reevaluated by the rater for reliability testing.

Results: Overall, the VDM was found to be 60.7% accurate, demonstrating good sensitivity (61%) and specificity (90%). However, according to phi-squared (φ^2) values, the VDM as an aggregate demonstrated low agreement with the physician’s diagnosis (φ^2 = 0.23)(Strong association = φ^2 > 0.50). For individual diagnoses, only BVH showed a strong association(φ^2 = 0.68), followed by BPPV (φ^2 = 0.47), migraine/Meniere’s (φ^2 = 0.37) and UVH (φ^2 = 0.27). CVD was not reliable (P > 0.01). Intrarater reliability was 1.00.

Conclusions: The phi-squared values for the VDM as a whole and for all diagnostic categories, except BVH, were less than 50%, suggesting the need for structural changes. This suggests limited usefulness for the tool clinically as a diagnostic instrument in its current form; however, its usefulness as an educational tool is supported by sound theoretical construct.

Clinical Relevance: Diagnostic trees and flowcharts have been used in healthcare to streamline decision-making for efficiency. Classification systems have been recommended for physical therapists to implement effective interventions. The VDM was created as a clinical guide for skilled physical therapists trained in vestibular rehabilitation to assist in the differential diagnosis of patients presenting with possible vestibular dysfunction. The VDM has been published as a theoretical framework, but has yet to be validated as a clinical tool. There have been no previous research studies to validate a clinical decision-making matrix for vestibular rehabilitation.
Purpose/Hypothesis: To determine whether veterans with multiple sclerosis (MS) have more injurious falls than veterans without MS.

Number of Subjects: 3,187

Materials/Methods: Veterans with MS in the NW US region were identified from the VA diagnostic code database as those meeting at least one of the following criteria: two or more outpatient visits coded for a diagnosis of MS (ICD9 code 340); an inpatient diagnosis of MS; receiving specific MS disease modifying medication; service connected for MS; coded at least annually since 2000 for a diagnosis of MS. Injurious falls in 2007 were identified from the CHIPS database by the ICD9 diagnostic codes E88x.x. These codes are used to document a fall as a cause of injury. The odds of an injurious fall in the year 2007 for the veterans with MS was compared to the odds of an injurious fall for a randomly selected 3:1 cohort of veterans without MS. By logistic regression the effects of the potential confounders of age, gender and number of visits were also evaluated.

Results: The adjusted odds ratio for a fall as a cause of injury among veterans with MS compared to veterans without MS was 2.54 (95% confidence intervals 1.52 – 4.16, p < 0.001). The odds of a coded fall increased by about 4% for each additional year in age (p < 0.001) and by 0.05% with each additional visit (p < 0.001). Women were twice as likely to fall as men (p = 0.057).

Conclusions: Veterans with MS are more likely than veterans without MS to sustain an injurious fall. The odds of having an injurious fall recorded in the medical record in one year are approximately 2 ½ times higher for veterans with MS than for veterans without MS. The odds increase with age and number of visits and are greater for women. Further studies prospectively assessing fall frequency, evaluating the medical, social and economic consequences of falls, as well as evaluating interventions to prevent falls are recommended to improve the independence and quality of life of people with MS.

Clinical Relevance: Impairments in neurologic function caused by MS increase the risk for falls and loss of independence. Although prior studies have shown that falls are common in people with MS, this is the first report that clearly demonstrates that injurious falls are more frequent in people with MS than in people without MS. This study supports the need for further research into interventions to prevent falls and their sequelae in people with MS.
TITLE: The differences in self-efficacy, function, and participation between adults with C6 or C7 motor tetraplegia who use power or manual wheelchairs


ABSTRACT BODY:
Purpose/Hypothesis: The purpose of the current study is to explore the differences between, manual or power wheelchair users in terms of self-esteem, function and participation in persons with similar motor level of spinal cord injury. It was hypothesized that manual wheelchair users will show significantly greater self-efficacy, function, and participation than power wheelchair users, as measured by three outcome questionnaires.

Number of Subjects: 30 participants with C6 or C7 motor level tetraplegia. Eighteen were manual chair users and twelve were power chair users. There were no significant differences between manual or power chair users regarding age, time since injury, or length of initial rehabilitation stay.

Materials/Methods: This is a descriptive cross-sectional study with a single data collection. Participants were a convenience sample of adults with self-declared C6 and C7 tetraplegia due to spinal cord injury (SCI) who are two or more years post injury. Demographics and three outcome measures were collected: Rosenberg Self Esteem Scale (RSES) as a measure of Self-efficacy, Spinal Cord Independence Measure III (SCIM III) as a measure of function, and the Craig Handicap Assessment and Reporting Technique (CHART) as a measure of participation. Scores for each questionnaire were compared between groups of manual and power wheelchair users using a multivariate analysis of variance (MANOVA).

Results: Significant difference was seen between groups (F = 2.677, p = 0.038). Multivariate analysis showed the differences to be in the SCIM III (F = 11.088, p = 0.003), and CHART subcategories Physical (F = 7.402, p = 0.011), Mobility (F = 12.894, p = 0.001), and Occupation (F = 5.174, p = 0.031, p = 0.031).

Conclusions: Manual wheelchair users demonstrated better physical function, mobility, and had a higher employment rate than power wheelchair users based on the SCIM III and CHART in this sample of adults with C6 or C7 motor level tetraplegia.

Clinical Relevance: Spinal cord injury is a life-changing occurrence for many people which requires adjustments in all areas of their life. Researchers have broadly investigated the impact of SCI on how and how well such adjustments are made. However, the role of the wheelchair that a person uses, manual or power, had not previously been examined.
ABSTRACT

Purpose/Hypothesis: Current spinal cord injury (SCI) rehabilitation programs encourage utilization of compensatory strategies rather than focusing on recovery of function below the level of the lesion. In addition, individuals with a SCI may elect to undergo the Olfactory Mucosa Autograph (OMA) surgery. The purposes of this study were to 1) examine the effectiveness of an intense physical therapy intervention program in promoting recovery of mat mobility in individuals with SCI and 2) to compare magnitude and rate of recovery of mat mobility skills for persons who have undergone versus not undergone the OMA surgery.

Number of Subjects: Twenty-three subjects with SCI divided into three groups: OMA (n=7), Matched Control (MC) (n=6), and Other (n=10) (a sample of subjects in the therapy program but not meeting the OMA & MC inclusion criteria) participated in this study.

Materials/Methods: A newly-developed Basic Movement Skills Inventory (LBMSI) was used for assessment of mat mobility skills. Subjects were scored on their ability to assume, maintain, and perform closed-chain activities for 25 mat skills. A 7-point ordinal scale (based upon the Functional Independence Measurement scale) was used for assessment of physical assistance required during the performance of each skill. Total and sub-score LBMSI scores were obtained for each individual at initial examination (IE), every 30 days and at discharge exam (DC).

Results: All subjects demonstrated significant improvement (p=0.005) in total LBMSI scores from IE to DC. There were no significant differences between the OMA, MC and Other groups in the magnitude (p=0.58) or the rate of progression (p=0.97) of total LBMSI scores from IE to DC (ANCOVA). Similar results were found when examining the assume, maintain and closed-chain LBMSI sub-scores.

Conclusions: This study provides evidence that an intensive physical therapy program was effective in promoting recovery of mat mobility skills in patients with SCI. Preliminary results suggest that individuals who have undergone the OMA surgery did not progress at a faster rate or of a greater magnitude when compared to MC subjects; however, subjects may not have had enough time or sufficient therapy duration to allow surgical and/or therapy-related recovery to occur.

Clinical Relevance: Participation in an intense, relatively long duration physical therapy program requires a significant investment of both time and financial resources. This study provides some evidence to justify this investment particularly when considering the important implications for improvements in functional mat mobility skills.
TITLE: The Effectiveness of an Intensive Physical Therapy Program for Individuals with Spinal Cord Injury in Promoting Recovery of Dynamic Sitting Balance

AUTHORS/INSTITUTIONS: C.A. Larson, P. Denison, Center for Spinal Cord Injury Recovery, Rehabilitation Institute of Michigan, Detroit, MI; N.R. Bushong, C.L. Harvell, Physical Therapy Program, Oakland University, Rochester, MI;

ABSTRACT BODY:

Purpose/Hypothesis: Rehabilitation for persons with spinal cord injury (SCI) has focused on using compensatory movement strategies since the nervous system was previously believed to be irreparable due to its' complex inter-connections. New research provides evidence that recovery below the SCI is possible particularly in response to intensive rehabilitation. The purposes of this study were 1) to examine the effectiveness of an intense physical therapy intervention program in promoting recovery of dynamic sitting balance in individuals with SCI and 2) to determine if individuals with SCI who are participating in an intensive therapy program and have undergone the Olfactory Mucosa Autograph (OMA) surgery progress to a greater degree in dynamic sitting balance as compared to matched control (MC) subjects who have not had the OMA surgery.

Number of Subjects: Seventeen (4 OMA, 3 MC and 10 Other (non-surgical)) subjects participated in this study (mean age = 28.5 ± 9.7 years; time since injury = 5.2 ± 7.1 years; mean therapy duration = 5.1 ± 3.1 months).

Materials/Methods: The Multi-Directional Reach Test (MDRT) was performed in the anterior, right diagonal, right lateral, left diagonal, and left lateral directions in sitting at initial exam, every 30 days and at discharge exam. Directions were “Without moving your feet, reach as far as you can in the forward (diagonal or sideways) direction; you must return to upright independently.”

Results: From test 1 to test 3 (first 60 days), the entire group did not improve in the anterior (p=0.44), right lateral (p=0.64), left diagonal (p=0.27) or left lateral (p=0.07) directions. They did improve in the right diagonal reach (p=0.02) direction. However, from initial to discharge exam (regardless of therapy duration), the 17 subjects significantly improved in the MDRT anterior (p=0.05), right diagonal (p=0.006), left lateral (p=0.01), left diagonal (p=0.013) directions; they did not improve in the right lateral direction (p=0.44). There were no differences between the OMA, MC or Other groups in dynamic balance from test 1 to test 3 or between initial and discharge examination for all except the left diagonal direction from test 1 to test 3 (p=0.008).

Conclusions: The intense physical therapy program was effective in improving patients’ abilities to perform sitting dynamic balance when the patient has participated in the program greater than 60 days. Preliminary findings suggest that subjects who have undergone the OMA surgery did not progress more in their sitting dynamic balance capabilities as compared to those who have not undergone the OMA surgery. This could be attributed to the OMA group’s decreased therapy duration as compared to the MC group. Also, subjects post-OMA surgery may not have had enough time or sufficient therapy duration to allow surgical and/or therapy-related recovery to take place.

Clinical Relevance: The results of this study demonstrate the benefits of an intensive rehabilitation program in promoting recovery of dynamic sitting balance after SCI.
TITLE: Gait characteristics in persons with chronic stroke classified as limited and full community ambulators

AUTHORS/INSTITUTIONS: M. Schaeuble, J. Resatar, M. Dumit, J. Hartley, K. Schultz, P. Rundquist, M. Finley, Krannert School of Physical Therapy, University of Indianapolis, Indianapolis, IN;

ABSTRACT BODY:

Purpose/Hypothesis: Impaired motor function and activity limitations including reduced gait velocity and asymmetrical walking patterns are common after stroke. Classifications of gait following stroke have ranged from household ambulation to full community ambulation (Perry et al, 1995). Purposes of this study were to compare motor impairment and spatiotemporal gait variables in groups of persons with chronic stroke: limited and full community ambulators and to determine predictors of gait velocity in these individuals. It was hypothesized that differences would exist in motor impairment and spatiotemporal gait characteristics between limited community ambulators and community ambulators.

Number of Subjects: Fifteen individuals (7 males, 8 females, age range 44-80 years, stroke onset 64±9 months) with motor impairment from chronic stroke participated.

Materials/Methods: Fugl-Meyer Motor Assessment (FM) was performed to quantify motor impairment. Spatial and temporal measures of gait were measured by the GAITRite Portable Walkway System (CIR Systems, Inc., Havertown, PA). Participants walked at a comfortable pace across the 4.88 m walkway for 5 measurement trials. In order to ensure steady-state ambulation during data collection participants began and ended the measurement trials 5 feet beyond the walkway. Typical orthoses and assistive devices were permitted as needed for safety. Trials were averaged and temporal and spatial parameters of both limbs calculated. Individuals with gait velocity 0.4m/s to 0.8 m/sec were classified as limited community ambulators and those with velocity >0.8m/sec were considered full community ambulators. ANOVA (p≤0.05) compared groups across all variables. Pearson correlation coefficients were calculated for FM and gait variables. Significant correlates to gait velocity were entered into a forward stepwise regression model.

Results: No difference in FM (p=0.88, mean = 68.6±19.2) was found between the groups; however, significant differences in spatiotemporal variables existed. Global gait variables of velocity and cadence were higher in full community ambulators. Temporal variables of paretic step time and single support (expressed as percent cycle), non-paretic swing and stance (percent cycle), paretic and non-paretic stance time and double support (percent cycle) were found to be different between groups. Spatial differences in step length of paretic and non-paretic limbs existed. Across all participants it was determined that 99% of the variance in gait velocity could be predicted by non-paretic stride length, stance time and swing time (as percent cycle).

Conclusions: Persons with chronic stroke classified as limited vs. full community ambulators differed in spatiotemporal gait variables, although clinical measures of impairment did not show differences. Spatial and temporal characteristics of the nonparetic limb were determinants of gait performance.

Clinical Relevance: Functional measures of gait need to be assessed along with impairment measures, with attention to non-paretic function in persons with chronic stroke.
ABSTRACT BODY:

Background & Purpose: Stroke survivors may experience loss of somatosensory function. The neural substrates related to sensory loss post-stroke have not been well described. Here we present a three-case series of sensory impaired individuals post-stroke in which patterns of functional activation are related to white matter connectivity, stroke lesion volume and location.

Case Description: Three sensory-impaired chronic left stroke patients with heterogeneous lesions are described in this case series. Subjects were tested for haptic sensation ability, using the Hand Active Sensory Test (HASTe). A Phillips 3T scanner was used to acquire 3 types of magnetic resonance image data; functional MRI, diffusion tensor imaging, and stroke lesion volume. Functional MRI was used to evaluate cortical activation during sensory brushing on the right and left index finger under two conditions, perception and discrimination. For each condition, 4.6 minute functional scans were acquired using 21 second intervals in a boxcar design. Raw data were analyzed using Oxford Centre for Functional MRI of the Brain Software Library (FSL). Analysis was carried out using FSL’s FMRI Expert analysis Tool v. 5.4. Statistic images were threshold using clusters determined by Z>3.0 and a corrected cluster significance threshold of p=0.05. Diffusion tensor tractography (DTT) was used to recreate and quantify projections between the internal capsule and the somatosensory cortex. Data were processed on a 7T Achieva, Philips workstation. Stroke lesion volume was quantified using high resolution images and Medical image processing, analysis, and visualization software. Lesion location was determined using FSL view and visualization of anatomical structures.

Outcomes: All subjects had bilaterally impaired haptic sensation ability measured by the HASTe where unimpaired is ≥ 13/18. Subjects mean was 6/18 and 9/18 for involved and uninvolved hand respectively. Lesion volumes were 2.1, 3.0 and 55cm3 . Two subjects had subcortical lesions in the third the one the parietal cortex was involved. Sensory cortex functional activation patterns during brush texture discrimination, which are bilateral in healthy subjects, were primarily contralesional for both hands in these subjects. DTT showed 90%, 93% and 100% fewer lines recreated between the internal capsule and sensory cortex ipsilesionally.

Discussion: Left stroke resulted in impaired haptic sensation bilaterally. Regardless of lesion location or size, white matter connectivity is diminished ipsilesionally. In these three subjects there appears to be a relationship between somatosensory function, functional activation and structural connectivity.
ABSTRACT BODY:

**Purpose/Hypothesis:** Exercise programs have been shown to enhance physical function and quality of life (QOL) among people with mild to moderate Parkinson’s disease (PD). However, most studies have been conducted in clinical environments for brief periods and may not be applicable to community settings. The purpose of this study was to investigate the feasibility and effects of an ongoing community-based exercise program on physical function and QOL. The program was initiated by a community-based PD support group, conducted at a university fitness center, and supervised by university researchers and graduate students.

**Number of Subjects:** Twenty people with mild to moderate PD (Hoehn and Yahr stages I to III) participated in spring 2009, the third 10-week session within the ongoing program.

**Materials/Methods:** One-hour group classes were held twice weekly and included aerobic exercise, strength training, flexibility exercises and balance exercises. Each training session consisted of a warm-up period, floor exercises, strength training using a circuit training model with exercise machines, and a final cool-down period. Evaluations were done one week before and after the 10-week session. The severity of the PD signs and symptoms was measured using the motor section of the Unified Parkinson’s Disease Rating Scale (UPDRS). Physical function was assessed using a variety of measures including gait speed, the six-minute walk test, the Berg Balance Scale, the “Timed Up & Go” test, and grip strength as measured by a hand-held dynamometer. The Short Form 36 (SF-36) was used to assess QOL. Weight lifted during each class was also recorded.

**Results:** Seventeen participants completed the 10-week session with an average attendance rate of 79%; of these, thirteen had participated in previous 10-week session(s). Significant improvements (p < .01) were seen in grip strength, weight lifted during classes, and UPDRS-Motor scores. Trends toward improvement were observed for Berg Balance (p = .064) and the Physical Function scale from the SF-36 (p = .08). A trend was observed toward more fatigue for the Parkinson’s Fatigue Scale (p = .062). No significant effects were seen for the other variables.

**Conclusions:** Our results show that people with PD continue to participate in, and benefit from, an ongoing, community-based, exercise program. Future research should investigate which aspects of a community fitness program make the program most feasible and beneficial.

**Clinical Relevance:** This study suggests that an ongoing community-based exercise program for people with PD is feasible. Group exercise training is a promising intervention strategy to improve physical function and QOL in people with PD.
TITLE: Can standardized clinical assessments reliably predict the presence of motor evoked potentials in individuals post stroke being considered for research?

AUTHORS/INSTITUTIONS: H. Roth, S. Madhavan, J.W. Stinear, Rehabilitation Institute of Chicago, Chicago, IL;

ABSTRACT BODY:

Purpose/Hypothesis: Transcranial magnetic stimulation (TMS) is a non-invasive method of stimulating the motor cortex and inducing motor evoked potentials (MEPs) recorded from muscle electromyograms (EMG). A database of post stroke potential research participants was developed to aid with recruitment for research studies at the Rehabilitation Institute of Chicago. Data collection included demographic information, standardized clinical measures and the presence of MEPs in the biceps brachii (BB), first dorsal interosseous (FDI), vastus lateralis (VL) and tibialis anterior (TA) muscles of the paretic limb. The purpose of this study is to look at the utility of using clinical measures to determine the likelihood of being able to induce MEPs in an individual post stroke in order to more efficiently recruit an appropriate subject population. We hypothesize that the Fugl-Meyer (FM) scores for the upper (UE) and lower extremity (LE) predict the ability to induce MEPs with TMS.

Number of Subjects: 32 individuals post stroke

Materials/Methods: The presence of MEPs during weak voluntary muscle contraction of the FDI, BB, TA and VL was determined using a MagStim 200 unit with a 70mm focal coil for UE musculature and a double cone coil for LE musculature. EMG electrodes were placed bilaterally over the VL, TA, BB and FDI with ground electrodes placed over the wrist or patella accordingly. The coil was systematically moved over the individual’s contralateral scalp to establish if a MEP could be elicited. The site was identified over the non-lesioned cortex where MEPs were induced at low stimulus intensities (hot spot). The coil was centered over the homologous site on the lesioned side. TMS intensities were increased until either maximum stimulator output or the participant’s tolerance was exceeded. The presence or absence of a MEP was converted into a binary code for analysis. Standardized clinical assessments included the UE and LE Fugl-Meyer, 9 Hole Peg Test, and spatial-temporal characteristics of gait obtained from the Gait Mat II®. Logistic regression analyses were conducted using Stata Software to determine where the clinical score predicted an odds ratio (OR) of > 1 (greater than a 50:50 chance). ORs were rank ordered when the logistic model was significant.

Results: Model significance was obtained for relations between MEP presence in the FDI and UE FM, and TA for the LE FM scores.

Conclusions: Individuals post stroke that scored < 43 on the UE FM and < 19 on the LE FM had less than a 50% chance of MEP presence with TMS.

Clinical Relevance: Clinicians and researchers can use standardized clinical measures to predict with reasonable confidence if an individual post stroke is appropriate for studies utilizing TMS. Although some potential participants may be unnecessarily excluded using this approach (or inadvertently included), fewer screening procedures represent savings in cost and time.
Purpose/Hypothesis: To examine the relationship between cognition, physical function and independence in activities of daily living in early Alzheimer’s disease (AD). It was hypothesized that regional gray matter atrophy, including the medial frontal cortex, would be related to cognition, physical function and functional independence.

Number of Subjects: Fifty-six Individuals without dementia (n=56) and 58 individuals with early-stage AD.

Materials/Methods: Participants underwent MRI and a comprehensive cognitive and physical function evaluation. The relationship of measures of cognition, physical function, and independence performing complex daily activities was explored using correlation and mediation analysis. We followed this with a voxel-based morphometric global conjunction analysis of imaging data to identify neural substrates common to our function measures.

Results: Cognition, primarily executive function, had a strong direct effect on independence in complex daily activities (beta=0.52, p<0.001) and mediated the influence of physical function on independence for those with AD (Point Estimate 0.44; Lower CI=0.16). Imaging evidence revealed that in AD, regional gray matter atrophy measures in medial frontal and temporo-parietal areas were related to decreased cognition, physical function and independence.

Conclusions: Loss of independence in early AD is closely related to impaired cognition associated with performing complex behaviors. People with early AD may have decreased gray matter volume in the medial frontal cortex that is associated with loss of independence in activities of daily living. Medial frontal cortex has been linked to aspects of performance evaluation and self-awareness for behavior.

Clinical Relevance: Declining independence in performance of ADLs may be in part related to decreased motivation or awareness to evaluate present conditions or behaviors. Clinicians may wish to structure sessions to provide additional extrinsic reward and feedback regarding performance when developing a plan of care to maximize functional independence for those with early AD.
TITLE: The Effect of Video Game-Based Exercise on Dynamic Balance and Mobility in Individuals with Huntington’s Disease.

AUTHORS/INSTITUTIONS: D. Kegelmeyer, N. Fritz, A. Kloos, Physical Therapy, The Ohio State University, Columbus, OH; S. Kostyk, Department of Neurology, The Ohio State University, Columbus, OH;

ABSTRACT BODY:

Purpose/Hypothesis: Huntington’s disease (HD) is a hereditary neurodegenerative disease that affects physical, cognitive, and psychological functions. Balance and gait impairments inevitably develop placing individuals at high risk for injurious falls and lowering their quality of life. Purpose. This study is to examine the efficacy of an exercise program using the video game Dance Dance Revolution (DDR) to improve dynamic balance and mobility in individuals with HD.

Number of Subjects: Participants will be 20 adults with HD who can ambulate 10 feet without assistance.

Materials/Methods: A randomized, cross-over, control design is being utilized. Subjects are alternately assigned to experimental (n=10) and control (n=10) groups. After 6 weeks of usual care to establish a baseline, the experimental group performs DDR for 45 minutes 2x/week for 6 weeks in their homes with a researcher who provides instructions, selects songs to challenge balance, and ensures safety. The control group performs a handheld video game that controls for the effects of the attention and novelty of the DDR intervention. After completing the 12 week period the control group crosses over to the DDR intervention and the experimental group performs the handheld video game. Subjects are pre-tested when entering the study and immediately prior to the intervention, and post-tested after the DDR intervention. Compliance with the control phase and fall incidence is determined via weekly phone calls.

Procedure. All outcome measures including the Tinetti Mobility Test (TMT), the 4-square step test, the Activities-Specific Balance Confidence (ABC) scale, forward, backward and obstacle course spatiotemporal gait measures using the GaitRite walkway, and subjects’ reported perceptions of the video games are obtained by one of the researchers who is blinded to group assignment.

Results: Preliminary data analysis of subjects who have completed the study (n=7) shows a trend for improvements in balance measures such as the TMT, and performance on an obstacle course following the DDR intervention.

Conclusions: The majority of subjects report that the DDR game is fun, challenging, and highly motivating whereas the hand held games tend to be difficult and inconvenient to play.

Clinical Relevance: This is the first randomized controlled trial to test the efficacy of video game-based exercise to improve dynamic balance, gait, and fall risk in individuals with HD. The preliminary results indicate that DDR is well tolerated, and may improve dynamic balance in this population.
TITLE: Reliability of a Thoracic-Lumbar control scale for use in Spinal Cord Injury Research

AUTHORS/INSTITUTIONS: D. Atkinson, K. Atkinson, J. Hale, M. Kern, M. Feltz, TIRR Memorial Hermann, Houston, TX; D.E. Graves, Baylor College of Medicine, Houston, TX;

ABSTRACT BODY:

Purpose/Hypothesis: The thoracic-Lumbar control Scale was designed to measure voluntary control of the trunk musculature following Spinal Cord Injury (SCI). The purpose of this study is to obtain preliminary inter-rater and intra-rater reliability estimates of the Thoracic-Lumbar control scale. This investigation used a 14 item scale rating four manual muscle tests (trunk extension, trunk flexion, right and left trunk rotation, and right and left elevation of the pelvis), the clinical Beevor's sign, and five clinical maneuvers (sit to supine, supine to sit, sitting balance, standing balance and sitting posture). Each of these has clear guidelines for grading the patient’s ability.

Number of Subjects: For this study each of the six NeuroRecovery Network (NRN) centers had two individual raters evaluate each of three volunteers on two separate days to provide a total of 72 evaluations.

Materials/Methods: Prior to the study a short educational presentation of the evaluation procedure followed by a question and answer period. One able bodied volunteer was available for a practice test so that the therapists could observe the administration of the evaluation and the specific maneuvers involved.

Results: The internal structure of the 14 items as a whole is satisfactory. The Standardized Item Alpha is 0.919 for all 14 items. All items except the Beevor’s sign were significantly related to the total score (see Table 1). Intraclass correlation coefficients for intra-rater reliability between day one and day two was .943; inter-rater reliability for day one was ICC = .962 and for day two ICC = .978.

Conclusions: Given the complex innervations of the muscles of the thoracic and lumbar it is difficult to isolate a level from the pattern of muscle weakness found following injury. This scale is designed to estimate the extent to which the thoracic-lumbar musculature functions as a unit. The preliminary data suggests that the items that form this scale can be reliably rated on patients with SCI, although the need for revisions/clarification of some of the scoring criteria was identified. Further investigation is necessary to determine the extent to which the validity of this scale can be established.

Clinical Relevance: The preliminary data suggests that the Thoracic-Lumbar Control Scale can provide valuable information on gains made in the control of trunk musculature following spinal cord injury.
TITLE: Effect of repeated sessions of rTMS given during an “active motor state” in patients with focal hand dystonia

AUTHORS/INSTITUTIONS: E. Haberman, J.C. Smith, M. Borich, T.J. Kimberley, Program in Physical Therapy, University of Minnesota, Minneapolis, MN;

ABSTRACT BODY:

Purpose/Hypothesis: The purpose of this study is to extend our previous findings supporting the use of repetitive transcranial magnetic stimulation (rTMS) as an intervention for patients with focal hand dystonia (FHD).

Number of Subjects: Data analysis has been completed on 15 subjects (3F; age: 56.5 ± 8.74y) diagnosed with FHD (11 real rTMS, 4 sham rTMS).

Materials/Methods: Randomized, single-blinded, sham controlled design was used. Subjects received 30 minutes of low frequency (1 Hz) rTMS for 5 consecutive days. Measures of cortical excitability, handwriting performance (axial pen pressure and velocity) and subjective report of symptoms were measured both before and after rTMS treatment on days 1, 5, and at the 10-day follow-up. Preliminary analysis has been performed using repeated-measures ANOVAs to determine if there was a significant main effect between sessions for measures of cortical excitability and handwriting axial pen pressure and velocity.

Results: Single pulse measures of cortical excitability demonstrated a trend toward statistically significant decrease (p=0.06), in the real rTMS group from day 1 pretest to the 10-day follow-up. Measurements of axial pen pressure demonstrated a trend toward decreased axial pen pressure in the real rTMS group with the rTMS treatment. Eleven subjects reported mild to moderate symptom improvement.

Conclusions: Preliminary findings demonstrate encouraging results. Previous research using a similar protocol has shown significant changes in cortical excitability and handwriting performance lasting at least 10-days following treatment.

Clinical Relevance: The application of rTMS as a therapeutic intervention for patients with FHD may result in symptom reduction, altered neural activity, and improved motor performance.
TITLE: Content comparison of vestibular rehabilitation quality of life measures based on the International Classification of Functioning, Disability and Health (ICF).

AUTHORS/INSTITUTIONS: A.A. Alghwiri, S.L. Whitney, Physical Therapy, University of Pittsburgh, Pittsburgh, PA; G.F. Marchetti, Physical Therapy, Duquesne University, Pittsburgh, PA;

ABSTRACT BODY:
Purpose/Hypothesis: To identify and estimate inter-observer rating agreement of the content of clinical, quality of life (QOL) measures that are used in vestibular rehabilitation based on the International Classification of Functioning, Disability and Health (ICF).

Number of Subjects: Not applicable.

Materials/Methods: The following 8 quality of life measures that have been used in vestibular rehabilitation were identified: the Vestibular Rehabilitation Benefit Questionnaire (VRMQ), Prototype questionnaire, the Vestibular Disorders Activities of Daily Living Scale (VADL), the Activity of Daily Living Questionnaire (ADLQ), the UCLA Dizziness Questionnaire, the Activities-specific Balance Confidence (ABC) Scale, the Vertigo Handicap Questionnaire (VHQ), and the Dizziness Handicap Inventory (DHI). A total of 164 items from these questionnaires were rated as linked to the ICF categories by two trained health professionals according to the linking rules. Based on the linking, the content of these questionnaires was compared and the extent of activity and participation covered by these measures was explored. Inter-observer agreement between two raters on the first two ICF components classifications for each item was estimated with a kappa coefficient.

Results: In the 164 items of the 8 questionnaires, a total of 86 different ICF components were linked, 20 categories of the component “body functions”, 64 categories of the component “activity and participation”, and 2 categories of the component “environmental factors”. Thirteen items could not link to any of the ICF components. The estimated kappa coefficients for two raters on identification of the two most relevant component classifications ranged from .45 to .69.

Conclusions: The eight questionnaires are comparable, with their focus on the activity and participation components of the ICF. Moderate agreement was displayed by two experienced clinicians on quality of life content related to the ICF component categories. Factors affecting the psychometric properties of the ICF classifications in relation to existing quality of life measures for persons with balance and vestibular disorders should be further studied.

Clinical Relevance: Using the ICF as a gold reference was found to be useful for comparing the content of health-status questionnaires as well as exploring the focus of the measures currently in use. Therefore, linking tools to the ICF can be a useful method for selecting specific measures in clinical practice.
TITLE: fMRI during individuated finger movements

AUTHORS/INSTITUTIONS: E. Chapman, J. Glesne, K.A. Pickett, T.J. Kimberley, University of Minnesota, Minneapolis, MN;

ABSTRACT BODY:

Purpose/Hypothesis: Idiopathic focal hand dystonia (FHD) is a debilitating disorder that causes abnormal cramping postures of the affected hand. It is thought to be a disorder linked to an abnormal level of cortical inhibition which may result in aberrant somatopic organization of the primary motor cortex and related cortical regions. In order to investigate the pathological cortical organization and the extent to which the activation overlaps in individuals with FHD a definitive understanding of healthy cortical activation must first be established. The primary objective of this study was to isolate the location and quantify the amount of cortical activation in the primary motor cortex during individual finger movements in healthy subjects. We have also conducted a pilot analysis comparing the healthy subjects to individuals with FHD.

Number of Subjects: Ten healthy participants between 20 and 40 years of age and 2 individuals with FHD have participated thus far.

Materials/Methods: Prior to the fMRI data collection, participants were trained in an individuated finger tapping task on a custom MRI compatible keyboard. The task was self paced and controlled via a visual stimulus which pseudorandomly cued each of the 10 digits. Digit movements were monitored on the keyboard. Each trial consisted of 100 individual finger tapping cues each of 3 second duration. Data collection was completed on a 3T MRI unit with a 12-channel head RF coil. Brain Voyager and a custom made Matlab program were used for data analysis. Cortical activation of finger individuation was scored with a cued to non-cued digit ratio based on the blood oxygen level dependent signal. For each activated digit, a center of mass (COM) of activation and the cued to non-cued activation intensity ratio was determined for all individuals. These areas were graphed for qualitative analysis.

Results: The cued to non-cued digit ratios clearly indicated that fully individuated cortical activation patterns are not present in the healthy group; however, the healthy group does demonstrate a trend for greater ratio of cued digit movement. The healthy individuals demonstrated cortical activation patterns that were focused and demonstrated primarily contralateral activation and ipsilateral inhibition. Preliminary results from the FHD group indicate greater amounts of cortical dispersion and ipsilateral activation.

Conclusions: Preliminary analysis suggests that the cortical activation in healthy individuals is associated with a more localized area of the primary motor cortex as compared to the FHD group. Additionally, the individuals with FHD appear to have a greater amount of ipsilateral activation. These data may support the theory of decreased cortical inhibition and altered somatopy in FHD.

Clinical Relevance: FHD is a debilitating disease that currently does not have a fully understood etiology. Revealing the differences in individuated finger activation patterns in healthy subjects and determining the pathological patterns in FHD may allow for a clear understanding of the mechanism of the disorder and give a neural substrate for future interventions.
TITLE: Rehabilitation of a Man with Runner’s Dystonia

AUTHORS/INSTITUTIONS: C.R. Grove, L.A. Brody, Department of Orthopedics and Rehabilitation, University of Wisconsin Hospital and Clinics, Madison, WI; B. Heiderscheit, Department of Orthopedic Surgery, University of Wisconsin-Madison, Madison, WI;

ABSTRACT BODY:

Background & Purpose: Performing highly-skilled, over-learned, repetitive tasks (e.g. typing, playing an instrument, or running) can lead to the development of a task-specific dystonia. The purpose of this case report is to describe the physical therapy management of a former marathoner diagnosed with runner’s dystonia.

Case Description: A 56 year-old man developed right thigh weakness and difficulty running after logging 50,000 lifetime miles. His work up, including neurological examination, imaging, electromyography, and nerve conduction studies, was unremarkable. He did not benefit from musculoskeletal-based interventions or verbally-cued gait training. Additionally, medication trials and botulinum toxin injections did not produce lasting improvements. Thus, he declined over two years to the point he could no longer run more than one-quarter mile or walk without significant deviations. Consultation with a neurological clinical specialist was recommended to address his goal of improving walking ability. His examination revealed minor, asymmetrical reductions in proximal strength and hamstring length. Computerized measures of self-selected, casual and fast walking were also collected, including velocity (V), cadence (C), and step time (TD) and step length (LD) differential. Substantial gait asymmetries were present during both casual walking [V = 147.8 cm/s, C = 108.9 steps/min, TD = 0.06 s (right>left), LD = 10.49 cm (left>right)] and fast walking [V = 155.6 cm/s, C = 110.7 steps/min, TD = 0.05 s (right>left), LD = 9.53 cm (left>right)] that were inconsistent with the severity of his impairments. The patient was instructed in a customized, independent exercise regimen to be performed daily for 60 minutes. This regimen emphasized initiation and timing of gait and balance activities under altered environmental or task conditions. Activities included deep water walking with resistance fins, retro and sideways walking in shallow water, treadmill training (with a metronome for cadence cues), over-ground training for trunk and limb dissociation, as well as strength and flexibility exercises. Additionally, daily use of shoes designed with a 5 degree dorsiflexed last was recommended.

Outcomes: The patient reported excellent compliance and a 25% improvement in overall walking ability over 8 months. Re-evaluation of his gait revealed a 6% decrease in casual walking velocity with an 18% increase in fast walking velocity. Substantial improvements in gait symmetry during casual walking (TD decreased by 50% to 0.03 s and LD decreased by 98% to 0.25 cm) and fast walking (TD decreased by 100% to 0.00 s and LD decreased by 89% (1.02 cm) were observed.

Discussion: This report provides an initial description of physical therapy interventions and preliminary outcomes for a person with runner’s dystonia. This man was able to improve his gait at the impairment level despite a potentially progressive condition. Additional research should clarify the most effective intervention strategies. Furthermore, measures for determining meaningful change at the activities and participation level should be explored.
TITLE: Determining Appropriate Outcome Measures of Physical Functioning and Self-perceived Overall Health Status Following Surgery to Remove Primary Brain Tumor

AUTHORS/INSTITUTIONS: J. Krug, Physical Therapy, University of Missouri, Columbia, MO; N.S. Litofsky, Neurosurgery, University of Missouri Hospital & Clinics- School of Medicine, Columbia, MO;

ABSTRACT BODY:

Purpose/Hypothesis: Impaired functional abilities, especially ambulation and balance, are common sequelae of brain tumor (BT). Research regarding effectiveness of surgery to treat BT has typically measured survival time, recurrence rate, and amount of tumor removed. Objective measurements of function and quality of life (QoL) are important, yet inadequately studied, aspects of treatment. The purpose of this pilot study was to determine appropriate outcome measures for these domains.

Number of Subjects: 9 adults with primary BT

Materials/Methods: Subjects were assessed using Timed Up-and-Go (TUG), Tinetti Performance-Oriented Mobility Assessment (Tinetti) and Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36) prior to, immediately following, and 3 months after surgery.

Results: Spearman’s correlations were conducted on all measurements. Only the TUG and Tinetti correlated pre-surgery (r=0.992, p=0.00). All measures significantly correlated post-surgery. This included the two physical functioning measures (TUG and Tinetti) immediately post-surgery (r=-0.833, p=0.01) and 3 months post-surgery (r=-0.966, p=0.0). This was also true for QoL and physical functioning measures immediately post-surgery: SF-36 and TUG (r=-0.762, p=0.028) and SF-36 and Tinetti (r=0.883, p=0.002) and 3 months post-surgery: SF-36 and TUG (r=-0.845, p=0.004), and SF-36 and Tinetti (r=0.849, p=0.004).

Conclusions: Strong correlations were observed among the outcome measures in this study after surgery. The TUG and Tinetti are reliable and valid for use in the stroke population. The neurological and mobility deficits and pattern of recovery of BT and stroke patients are similar (Haut et al, 1991; Black, 1991). Therefore the use of the same measures for BT is suitable. No correlations were noted between the SF-36 and the TUG or Tinetti at baseline. This supports the differences between QoL and functional measures; these do not measure the same things. However, after surgery (immediately after and 3 months post-) significant correlations were noted among all measures. It can be concluded that as physical status changed, so did the subjects’ perception of their QoL. While there are many aspects to QoL, physical status appears to play a significant role. Correlation of the measures supports their in future BT research. As the SF-36 has been established an appropriate measure for the BT population, its correlation with the TUG and Tinetti further indicates that these are appropriate measures for the BT population. Summary of Conclusions: Physical functioning and self-perceived QoL are closely linked. It is recommended that future studies of surgery for BT use measures of physical functioning and OHS. The TUG, Tinetti, and SF-36 are appropriate for these purposes.

Clinical Relevance: The TUG, Tinetti, and SF-36 should be used in both future BT research; these items should also be used as clinical measures of change and outcome for mobility and quality of life with clients diagnosed or treated for brain tumor
TITLE: After-Effects of Slow Isokinetic Walk Speed Training on Self-selected Gait Velocity in Persons with Chronic Post-Stroke Hemiparesis


ABSTRACT BODY:

Purpose/Hypothesis: Reduced walking speed is associated with decreased function and fall risk in people post-stroke. Weakness and hyperreflexia can interfere with walking training, however isokinetic slow speed training may be able to counter the effects of speed and weakness. The purpose of this study was to examine the short term effects of isokinetic slow speed walking on self-selected gait velocity in persons with post-stroke unilateral hemiparesis. It was hypothesized that subjects would show increased self-selected gait velocity after isokinetic slow speed walking trials compared with their self-selected speed prior to training.

Number of Subjects: 13 subjects (10 males, 3 females) with post-stroke unilateral hemiparesis. The number of years post stroke ranged from 3 to 27 years and the mean age of the subjects was 62.8 years.

Materials/Methods: A marked 10 meter pathway with 1.5 meters marked on either end. Kineassist, a device which allows the therapist to safely interact with the subject during gait, to set isokinetic walking speeds, and to determine data from walking trials such as force output. Methods: Each subject’s self-selected walking speed (baseline) was assessed with a series of three 10 meter walk tests prior to use of the Kineassist. Their maximum 10 meter walk speed was also assessed. Next, the subject’s isokinetic training speed was determined by taking the average of 3 pre-test 10 meter walks while secured to the Kineassist and dividing this in half. Subjects then performed a series of twelve 10 meter walk trials while secured to the Kineassist. Odd-numbered trials consisted of either self-selected (control) or isokinetic (experimental) walks in randomized order, each of which was followed by a self-selected speed 10 meter walk in order to determine post-isokinetic effects on walking speed. After completing all trials in the Kineassist, subjects’ comfortable and maximum speeds were again measured with 10 meter walk post-tests (comfortable x 3 trials, maximum x 1).

Results: 10 out 13 subjects demonstrated greater increases in self-selected gait speed following isokinetic bouts compared to control bouts. Across all subjects and trials, there was a significant difference (p = 0.0039) between the mean change in speed after control bouts (0.05 m/s ± 0.014) and after isokinetic bouts (0.083 m/s ± 0.019). There was also a positive correlation (R²=0.478, p = 0.0004) between mean isokinetic force generated and change in gait speed.

Conclusions: The results of this study show that isokinetic walking training can be used as a method to induce temporary increases in comfortable velocity for persons with post-stroke unilateral hemiparesis.

Clinical Relevance: The induction of transient improvements in walking speed after slow speed isokinetic training suggests that longer duration training should be studied to test for more long-term effects on gait velocity.
Background & Purpose: Research over the past several years has demonstrated that both high frequency and intensity of therapy, including numerous repetitions, are critical for stroke recovery. However, insurance reimbursement often limits the ability of therapists to provide this vital intensity of therapy. The purpose of this case study is to demonstrate the efficacy of intense therapy compared to non-intense intervention in a community clinic.

Case Description: This 49 year old male patient experienced an ischemic stroke in February, 2008. After inpatient rehabilitation he participated in traditional therapy (45 minutes of PT and 45 minutes of OT 5 days/week for 7 months, and then 3 days per week for 6 months.) He was evaluated at SWAN Rehab in March of 2009, however, he continued with 45 minutes of PT and 45 minutes of OT 3 days per week until starting intense therapy at SWAN Rehab 4 weeks later. At this time he was re-tested, and found to have made minimal gains in the previous month. At SWAN Rehab, the patient received intensive whole-body therapy consisting of 6 hours per day, 5 days per week for 4 weeks and then re-evaluated. Treatment included gait training consisting of over ground and weight bearing supported treadmill training. Upper extremity intervention included task specific training for self feeding, repetitive task training, and establishment of functional grasp during reaching. Patient participated in modified constraint therapy for several hours per day during the last 2 weeks of therapy. Treatment also consisted of balance training and upper extremity, lower extremity and core strength training.

Outcomes: During the initial 4 week period of conventional therapy, the patient made the following gains: -9% on the 10 meter walk test, no gain on the 6-minute walk test, 2 point gain on the Berg balance test, and 1 point gain on the UE Fugl-Meyer UE motor score. In contrast, during the 4 week period of intensive therapy the patient made the following gains: 48% on the 10 meter walk test, 49% on the 6 minute walk test, 1 point on the Berg balance test, a 4 point gain on the Fugl-Meyer UE motor score, and 27% gain on the timed up and go.

Discussion: This case study demonstrates that: 1) Patient’s can make significant functional gains at times greater than a year after stroke and 2) Frequency and intensity of therapy impacts outcomes. Furthermore, this case study suggests that by delivering “conventional therapy” physical therapists may not be allowing our patients to reach their full recovery after stroke.
ABSTRACT BODY:

**Background & Purpose:** Following spinal cord injury (SCI), shoulder demands are radically altered as usage and weight bearing increase. Consequently, shoulder pain associated with impingement is common in individuals with paraplegia (40% prevalence). Although little is known regarding shoulder health and injury prevention following SCI, exercise including circuit-resistance training (CRT) is encouraged in rehabilitation and community settings to promote shoulder health. Ironically, positions inherent to CRT programs may increase shoulder impingement risk. In the able-bodied, impingement is associated with altered shoulder kinematics, including increased scapular anterior tilt (AT), downward rotation, internal rotation, and glenohumeral (GH) elevation. Consistent evidence supports scapular AT as a key detrimental motion. No studies have assessed shoulder kinematics during CRT for wheelchair users. The purpose of this case study was to identify upper limb resistance exercises during CRT that produce most and least favorable scapular and GH kinematic patterns with regard to impingement risk.

**Case Description:** A 55 year-old female with T12 ASIA C SCI and without shoulder pain participated. During the first session, the one repetition maximum (1-RM) was determined for five Cybex Total Access exercises. During the second session, three-dimensional (3D) shoulder kinematic data were collected using the Flock of Birds™ electromagnetic tracking system. At each station, the subject performed one paced set of ten repetitions at 50% 1-RM.

**Outcomes:** Shoulder kinematic patterns were assessed across humeral elevation angles between 60°-90°. Peak scapular AT was greatest for rickshaw (21°+ 3°) and chest press (20°+ 2°) and least for lat pull down (14°+ 2°). When assessed across the entire exercise, the mean scapular AT for the rickshaw (17°+ 2°) and chest press (18°+ 2°) remained consistently higher than the other CRT exercises.

**Discussion:** This is the first study to examine shoulder kinematics during CRT. The peak and sustained magnitudes of scapular AT during CRT may be detrimental with regard to impingement risk. In prior studies, loaded weight-relief raises caused increases in scapular AT with magnitudes similar to those found in this case study. The rickshaw is commonly prescribed as it mimics motion for critical activities such as weight-relief raises and transfers. However, the rickshaw is concerning because of similar scapular patterns found in able-bodied individuals with impingement. Future research will address modifications to these commonly prescribed exercises in an attempt to optimize shoulder kinematics and ultimately improve shoulder health.
ABSTRACT BODY:

**Purpose/Hypothesis**: Physical therapy treatments for cerebrovascular accidents (CVA) are generally aimed at compensatory strategies or normalization of movement or a combination of the two. This divergence can contribute to the breakdown of communication between patients and therapists regarding intervention goals and impact the success of the rehabilitation program. It is important to consider how therapy instruction fits patient goals and needs after returning home. Therefore, the purpose of this study was to explore the integration of therapy instruction into the home and community following acute CVA.

**Number of Subjects**: Three participant experiences of rehabilitation during and one month after discharge served as instrumental cases. Inclusion criterion was a recent CVA with unilateral hemiplegia. Exclusion criteria were any pre-existing disorders which limited the ability to engage in CVA-oriented interventions.

**Materials/Methods**: Data collection included semi-structured interviews and observations. Physical therapists, patients, and caregivers were interviewed. Therapist interviews took place the week of discharge and asked about choices regarding therapy instruction. Patient interviews were conducted one week and one month post-discharge and asked about experiences of rehabilitation and their ability to use what was learned in therapy. If there was a caregiver involved, those interviews were conducted at these same times. Additionally, one hour of participant observation was used as a form of data collection during one therapy session the week prior to discharge, during the first week home and then one month post-discharge. Researchers analyzed observations notes and transcribed interviews for categories of data and emergent themes. Lastly, participants were given a summary of the individual case results and, when possible, provided feedback about thematic interpretation.

**Results**: We found one overarching theme of the desire for a return to life prior to CVA for patients, caregivers and therapists alike. Three sub-themes of safety, support, and success versus failure emerged as contributing factors toward achieving this goal.

**Conclusions**: While it appears that normalcy is the primary goal, there are other factors that are considered when choosing movement strategies during therapy and after discharge. Patients, caregivers, and therapists made reference to safety as the primary consideration when choosing movement strategies that were either compensatory or as life prior to CVA. Patients who had strong support after discharge were more likely to challenge themselves to integrate therapy strategies as instructed. Finally, successes when attempting tasks were reinforcing, while failures led to strategy modification or compensation.

**Clinical Relevance**: Maximum success for normalization of movement and integration of therapy instruction requires facilitation of a highly trained support network of caregivers to ensure safety and positive reinforcement when attempting tasks.
**TITLE:** Pedometer-Determined Physical Activity and Correlations to Symptom Severity in Persons with Early Parkinson’s Disease

**AUTHORS/INSTITUTIONS:** J.O. Yip, B.E. Fisher, Biokinesiology and Physical Therapy, University of Southern California, Los Angeles, CA; Z. Chancer, J. Hui, G.M. Petzinger, Neurology, University of Southern California, Los Angeles, CA;

**ABSTRACT BODY:**

**Purpose/Hypothesis:** There is beginning evidence that physical therapy in early stage Parkinson’s disease (PD) may minimize disability and importantly modify the disease state. However, motor deficits present in early PD are often subtle, thus making it a challenge to monitor small changes in disease severity and/or response to intervention. The purpose of this study was to determine the relationship between physical activity (PA) and disease severity as determined by the Unified Parkinson’s Disease Rating Scale (UPDRS).

**Number of Subjects:** Fifteen individuals diagnosed with early PD (within 3 years of diagnosis) who are medically stable and also optimized on their PD medications.

**Materials/Methods:** Participants wore a pedometer during all waking hours over a span of 7 days. A movement disorders neurologist administered the UPDRS. Pedometer-determined PA was collected and related to symptom severity using the UPDRS, both the total score and motor subscore.

**Results:** The representative sample (n=15) took an average of 6418 steps per day. Females (n=5) averaged 7105 steps, whereas males (n=10) averaged 6074 steps per day (140% greater/15% less than the national average for gender matched healthy controls). Steps/day and motor score of the UPDRS were significantly negatively correlated for all participants (r= -.57, p=.03). There were significant negative correlations between steps/day and total UPDRS score for females (r= -.89, p=.04) and participants right side affected (n=7) (r= -.77, p=.04).

**Conclusions:** Physical activity (PA) as measured by steps/day relates to disease severity, thus providing an easy way to measure subtle changes in disease state and response to physical therapy intervention. Higher UPDRS motor subscores (greater symptom severity) were correlated with decreased pedometer-determined activity for all participants. Of interest, items measured in the total score were influenced by gender and side affected; total score correlated with steps for females and those with right side affected. This indicates the potential influence of gender in PA in persons with PD, which merits further investigation.

**Clinical Relevance:** Pedometer-determined activity is a simple low cost validated measure that can be used to monitor patients with early PD, and in future research, to better define the relationship between PA and symptom severity in patient populations such as PD.
TITLE: Gait training using walking poles to facilitate trunk rotation and reciprocal arm swing in a patient with a cerebellar tumor resection secondary to metastatic breast cancer.

AUTHORS/INSTITUTIONS: C. Frede, Duke University Hospital, Durham, NC; A. Sonnycalb, Elon University, Elon, NC;

ABSTRACT BODY:

Background & Purpose: The cerebellum monitors movement of a body segment, comparing the outcome to the original motor command and makes corrections as necessary. Ultimately, cerebellar insults have the potential to produce motor function deficits, balance impairments, and decreased muscle tone. These impairments may limit an individual's ability to fully function within their environment. Physical therapy interventions often aim to augment these deficits through the use of mobility aids. Unlike walkers and canes, walking poles facilitate reciprocal arm swing and trunk rotation similar to that found in an individual with an unimpaired gait pattern. The purpose of this case report is to describe the use of walking poles as part of an intervention program in a patient with balance deficits following a cerebellar tumor resection.

Case Description: The subject is a 51 year old female, who was referred for physical therapy 18 months following recovery from a cerebellar tumor resection. The subject presented with gait and balance impairments, as well as a high fear of falling and a low falls self efficacy. The intervention program consisted of eight treatment sessions over five weeks including evaluations at the initiation and conclusion of treatment. Sessions occurred twice per week for one hour each. Over these eight sessions, the interventions used included gait training with forearm crutches and walking poles, the Balance Master and functional balance activities, and a home exercise program (HEP) including ambulation with walking poles for 20 minutes a day three times a week. She was asked to keep an exercise log to assess adherence to the HEP. The investigators provided support during weekly phone calls with the patient. The subject was also re-evaluated 10 and 16 weeks following the cessation of twice weekly therapy sessions with the continuation of the home exercise program.

Outcomes: The subject demonstrated a significant improvement in her Berg Balance Scale score, ABC fear of falling scale score, and her comfortable gait speed with the walking poles. Though non-significant, this patient demonstrated an improvement of 38 feet on her 6MWT.

Discussion: The addition of walking poles may allow for further improvements in gait and balance deficits in patients following a cerebellar tumor resection. The support and confidence provided by gait and balance training with walking poles, along with reinforcement of normal gait mechanics, may allow patients to improve gait components such as arm swing and trunk rotation. This more normalized gait pattern allows for safe ambulation and facilitates improvements in static and dynamic balance.
TITLE: Modified control of elbow flexor synergists after tendon transfer in tetraplegia.


ABSTRACT BODY:

Purpose/Hypothesis: The biceps brachii (BB), brachialis (B), and brachioradialis (Br) muscles are synergists in elbow flexion. After cervical spinal cord injury (SCI) one procedure for restoring pinch strength is to surgically transfer the Br tendon, under voluntary control, to the paralyzed flexor pollicis longus muscle (FPL). The purpose of this pilot study was to investigate the control strategy used by the transferred Br in its new functional role. We hypothesized that tendon transfer recipients must learn to activate Br independently of BB and B to produce functional pinch.

Number of Subjects: 5 subjects; 3 non-impaired (NI), 2 with cervical SCI (SCI-1 and 2), 1 year post Br-FPL transfer; age 27-40 years, 3 males, 2 females.

Materials/Methods: The coordination between BB, B, and Br in pinch and elbow flexion was investigated with fine-wire electromyography (EMG). In the NI subjects inter-muscular coordination during sustained elbow flexion was assessed by analyzing recruitment and instantaneous firing rate data obtained by EMG signal decomposition. Isometric and ramp contractions were performed against light resistance in 3 forearm positions. In the SCI subjects, muscle activation during maximum effort pinch was assessed by measuring EMG amplitude normalized (%) to maximum elbow flexion. Pinch force was recorded by a force sensor and custom grip with the elbow flexed 60° and forearm in neutral rotation.

Results: The NI subjects, activated all 3 muscles during isometric elbow flexion. Individual motor unit (MU) firing patterns were correlated within the same muscle (mean cross-correlation 0.57) and less correlated between muscles (0.32). B was recruited first with the highest number of MU’s in all forearm positions. In supination BB increased activity and Br decreased activity, but the reverse was true in forearm pronation. In contrast the SCI subjects activated Br more strongly than BB and B during pinch effort with the elbow flexed and forearm in neutral. SCI-1 produced 22N pinch force by activating the transferred Br to 49%, while limiting BB activation to 6% and B activation to 23%. SCI-2 produced 2N pinch force by activating the transferred Br to 14%, BB to 9%, and B to 3%. Importantly, SCI-1 activated only the B and BB during elbow flexion with light resistance and only the transferred Br in pinch with light resistance. SCI-2 could not activate Br independently of B and BB.

Conclusions: In NI subjects B is the main elbow flexor in all forearm positions. BB, B, and Br are not perfect synergists in sustained elbow flexion and are further influenced by forearm rotation, an important factor during functional pinch tasks. Our findings suggest pinch force is improved after Br-FPL transfers if individuals learn to activate Br independently of B and BB.

Clinical Relevance: Muscle re-education after tendon transfer involving Br may be facilitated with task oriented activities that aim to modify the control of elbow flexor synergists in functional pinch postures. Tendon transfer is a useful model to study motor learning.
TITLE: The Effects of Intense Locomotor Training on Postural Control in Early Parkinson’s Disease

AUTHORS/INSTITUTIONS: J. Song, B.E. Fisher, J.O. Yip, G. Salem, Biokinesiology and Physical Therapy, University of Southern California, Los Angeles, CA; G.M. Petzinger, Neurology, Keck School of Medicine, University of Southern California, Los Angeles, CA; B.G. Farley, Department of Physiology, University of Arizona, Tucson, AZ;

ABSTRACT BODY:

Purpose/Hypothesis: Recent research suggests that intense exercise in persons with early stage Parkinson’s disease (EPD) may slow motor deterioration. This necessitates establishing outcomes that can detect change in motor performance in EPD. Our preliminary data suggests that persons with EPD demonstrate postural control deficits during a complex locomotor task (90 degree turns) compared to healthy control (HC) participants. The purpose of this pilot study was to investigate if intensive locomotor exercise would improve dynamic postural control (PC) during turning.

Number of Subjects: Eleven subjects with EPD (Hoehn and Yahr 1 & 2) completed 18 sessions of intensive locomotor training (1 hour/day, 3 days/week for 6 weeks).

Materials/Methods: Subjects walked 4 meters to a designated location and turned to the right at a 90° angle. We analyzed the step turn in which the change in direction is to the opposite side of the pivot foot. The turn includes three consecutive steps: the approach step, the turn step, and the acceleration step. Two phases of turning were considered; Phase 1 (from heel strike of the approach step to heel strike of the pivot step and Phase 2 (from heel strike of the pivot step to heel strike of the acceleration step). Three-dimensional kinematics and segment inertial parameters were used to calculate the whole body center of mass (COM). Center of pressure (COP) was determined from force plate measures. Three trials were averaged to quantify dynamic PC as the distance between the COP and extrapolated COM (eCOM) in the direction of initial forward progression (DIFP) and the direction of the turn (DOT). Paired t-tests were used to assess the differences between pre and post exercise assessments (P < 0.05).

Results: Baseline measures indicated that persons with EPD preferentially adopted a more cautious, stable PC strategy as evidenced by shorter COP - eCOM distance compared to HC subjects during both Phase 1 and 2 in the DIFP (0.33m/0.04m vs. 0.36m/0.07m, respectively) and DOT (0.03m/0.36m vs. 0.13m/0.45m, respectively). It has been observed that COP – COM distance establishes the necessary disequilibrium to produce a turn; with longer COP – COM distance creating a greater moment about the COM, resulting in greater momentum. However, after intense locomotor training, persons with EPD demonstrated COP – eCOM distances during step turns similar to HC subjects. For Phase1, COP – eCOM distances increased by 9% and 200% in the DIFP and DOT (P < 0.05). Moreover, although not statistically significant, there was a trend toward increased COP-eCOM distance (13.5%) during Phase2 in the DOT (P = 0.068).

Conclusions: Our data suggests that persons with EPD may increase their ability to manage the disequilibrium associated with step turning, following intense locomotor exercise.

Clinical Relevance: Individuals with EPD demonstrate subtle (if any) functional and motor deficits and as such are not seen in physical therapy. Our data suggests a change in current practice given that PC deficits appear early in the disease process and appear to be amenable to intense training.
TITLE: The Effects of Assistive Devices on Gait Measures in Individuals with Parkinson Disease

AUTHORS/INSTITUTIONS: A. Kloos, S. Parthasarathy, D. Kegelmeyer, Physical Therapy, The Ohio State University, Columbus, OH; K. Thomas, Department of Neurology, The Ohio State University, Columbus, OH;

ABSTRACT BODY:

Purpose/Hypothesis: Falls are frequent in individuals with Parkinson disease (PD) due to gait and balance impairments. Clinicians typically prescribe ambulatory assistive devices (ADs) to prevent falls, but there are presently insufficient guidelines as to which ADs most effectively reduce the incidence of falls and injuries in the PD population. Therefore, this study compared spatiotemporal characteristics of gait and ability to maneuver around two obstacles when using 7 commonly prescribed ADs to determine which devices produced the most efficient and safe gait patterns in individuals with PD.

Number of Subjects: Twenty seven individuals with PD (5 women, mean age = 69.7±1.3 years, mean UPDRS motor section score = 24.2 ±2.0) who could walk 10 meters without assistance participated in the study.

Materials/Methods: Spatiotemporal gait measures were collected by having subjects walk at a normal, comfortable pace across a GaitRite walkway for 4 trials without an AD, or using a: standard walker, two-wheeled walker (2WW), four-wheeled walker (4WW), standard cane, bilateral walking sticks, laser cane, and U shaped, 6-wheeled walker with a laser light (6WW). Subjects were also timed and observed for gait problems while walking in a figure of eight around two chairs placed four feet apart.

Results: The 4WW produced the most normal and efficient gait pattern (mean velocity=101 cm/s; stride length=119 cm; percent double support=26%) whereas the standard walker (mean velocity=63 cm/s; stride length=96 cm; percent double support=34%) and 2WW walker (velocity=80 cm/s; stride length=93 cm; percent double support= 34%) produced the least normal patterns. The 4WW produced the least variability in all gait measures, whereas variability was significantly increased when subjects used a 6WW and standard walker. During figure of eight maneuvers subjects moved significantly faster (p<.01) in the 4WW, and 6WW conditions and significantly slower (p<.01) with the standard walker and 2WW condition. Subjects also had fewer freezing episodes and losses of balance when utilizing a 4WW and 6WW compared to other conditions. Step length was not significantly improved using either a laser cane or 6WW with a laser compared to a standard cane or 4WW.

Conclusions: A 4WW produces the most efficient and safe gait patterns when walking in a straight path and maneuvering around obstacles. The use of laser lights on canes or walkers may not effectively increase step length in some people with PD.

Clinical Relevance: A 4WW may be the best assistive device for fall prevention for individuals in the early to middle stages of PD. This study also demonstrated that utilizing walking in a figure of eight around obstacles is a sensitive test of dynamic balance function.
TITLE: Use of the GaitRite Gait Mat to Describe Gait Adaptability in Patients Post-Stroke During Curb Approach and Ascent

AUTHORS/INSTITUTIONS: R. Wellmon, Institute for Physical Therapy Education, Widener University, Chester, PA; R. Myers, MossRehab Hospital, Elkins Park, PA; K. Volk, Adventist Rehabilitation Hospital of Maryland, Rockville, MD; A. Degano, Inova Rehabilitation Center, Alexandria, VA;

ABSTRACT BODY:

Purpose/Hypothesis: The purpose of this study was to use the GaitRite Gait Mat to examine changes in gait when patients with chronic stroke walk toward and step up onto a 6 inch (15cm) curb. Research on gait adaptability has focused mostly on obstacle avoidance, where the goal is to describe gait changes when stepping over an object appearing in the path of travel. From a functional perspective, understanding how gait is adapted to allow stepping up onto a raised surface in the path of travel is also important. Changes in motor planning and control arising from a central nervous system lesion can affect how gait is organized when approaching and stepping up onto a curb.

Number of Subjects: Sixteen participants with chronic stroke (mean age = 54.6 +/- 10.5 years; 10 males, 5 females) were selected based on being independent in ambulation either with or without using assistive devices or orthotics. Gait performance in the group was compared to an age and gender matched non-disabled group. Ten participants had a right hemispheric lesion.

Materials/Methods: Ambulating at their preferred self-selected pace, participants completed 5 trials each of level walking and walking toward and stepping up onto a 6 inch (15cm) curb. Between and within group differences in selected temporal and distance measures of gait for the two walking tasks were examined using the GaitRite Gait Mat. Curb height was factored into all distance measures. Changes in gait velocity, cadence, and number of steps taken to complete each walking task, along with alterations in step length and step, swing, and single stance times were examined using a MANOVA procedure.

Results: In comparing level walking performance to curb approach and ascent, the post-stroke group exhibited significant reductions (p<.001) in both gait velocity and cadence and took a greater (p<.001) number of steps to complete the task. The age-matched group by comparison did not demonstrate significant changes in velocity and cadence during curb approach and ascent. When examining the individual steps leading up the curb, both groups altered foot placement two steps in advance of contact with the curb. In the post-stroke group, all temporal indicators increased significantly (p<.003) when the leading limb was being placed onto the curb.

Conclusions: The findings demonstrate the effects of a unilateral stroke on gait adaptability. Both groups altered gait during the curb approach and ascent task. However, the post-stroke group used a more conservative strategy during curb approach that was characterized by decreased velocity and cadence. In addition, more time was taken when placing the leading limb onto the curb. Both groups altered their pattern of gait two steps in advance of contact with the curb.

Clinical Relevance: The GaitRite Gait Mat can provide researchers and clinicians with a way to examine patient performance for tasks other than level walking. The current study provides insight into strategies used by patients after a stroke to step up onto a raised surface located in the path of travel.
TITLE: Three-dimensional shoulder complex kinematics in individuals with upper extremity impairment from chronic stroke

AUTHORS/INSTITUTIONS: M. Dumit, J. Hartley, K. Schultz, J. Resatar, M. Schaeuble, M. Finley, P. Rundquist, Krannert School of Physical Therapy, University of Indianapolis, Indianapolis, IN;

ABSTRACT BODY:
Purpose/Hypothesis: Stroke is a common contributor to loss of range of motion in the affected upper extremity. Alterations in shoulder elevation and scapular upward rotation have been related to shoulder pain in persons with hemiparesis from stroke. Previous research has documented that a nonlinear relationship exists within scapulohumeral rhythm (McQuade, et al 1998). The purpose of this study was to compare shoulder complex kinematics in persons with chronic upper extremity (UE) impairments due to stroke to a clinical impairment measure (Fugl-Meyer Motor Assessment).

Number of Subjects: Sixteen individuals with chronic impairments from stroke participated in this study (age range=46-80 years, male=8, female = 8, onset since stroke=66±40 mos).

Materials/Methods: Participants performed the UE portion of the Fugl-Meyer Motor Assessment (FM_UE, max = 66) with the shoulder/elbow subscale (FM_se, max = 42) documented. Three-dimensional kinematics of the scapula, humerus, and trunk were collected with the Motion Monitor™ short range transmitter system (Innsport, Chicago, IL) with use of “mini-bird” sensors. Participants performed three repetitions of arm elevation in random order of frontal plane (defined at 0° plane), sagittal plane (defined at 90° plane), and a self-selected, preferred plane of motion. The third repetition was chosen for analysis. Pearson correlation coefficients were calculated to determine relationships among the three planes at peak elevation. Scapular and humeral kinematics were calculated for the self-selected plane as all planes of motion were highly correlated. Scapulohumeral rhythm was analyzed based on peak elevation. Backward stepwise regression analysis was performed to predict scapular and glenohumeral kinematic contributions to the FM_se.

Results: Mean FM_UE was 38.3 ±18.3 with the subscale FM_se mean =25.3 ±10.9. The range of peak humeral elevation was 45.6°-129.2° in the self-selected plane. Median peak elevation was 106.7°±27.6°. Scapulohumeral rhythm was 4.1:1 in participants' whose peak humeral elevation ranged from 45°-50°, 1.5:1 from 80°-95°, and 2.1:1 from 105°-130°. Humeral elevation, scapular upward rotation, and scapular internal rotation predicted 65.4% of the variability in the FM_se scores.

Conclusions: Persons with chronic upper extremity impairments from stroke demonstrated reduced peak elevation with altered scapulohumeral rhythm. Participants with a greater limitation in elevation demonstrated a larger scapular contribution in the scapulohumeral rhythm. Three major predictors of the FM_se were humeral elevation, scapular upward rotation, and scapular internal rotation.

Clinical Relevance: These findings support the need for further investigation of scapular mobility and its association to impairment and function in individuals with similar presentation. Additionally, it indicates there is a need for rehabilitation to address scapular mobility, as well as humeral motion, when treating individuals with chronic upper extremity impairments from stroke.
TITLE: Assistive devices alter motor control solutions for balance during walking in adults with incomplete SCI

AUTHORS/INSTITUTIONS: K.V. Day, Physical Therapy, University of Florida, Gainesville, FL; S. Kautz, A. Behrman, Brain Rehabilitation Research Center, Malcom G. Randall VA Medical Center, Gainesville, FL; S.P. Suter, , Shands Hospital at the University of Florida, Gainesville, FL;

ABSTRACT BODY:

Purpose/Hypothesis: After spinal cord injury (SCI), individuals lack balance control while walking. Clinicians introduce assistive devices (ADs) to compensate for balance deficits, but such externally-controlled stability may restrict the opportunity to relearn normal balance strategies. Alternatively, ADs may have a role in stabilizing the upper body to minimize head perturbations and acquire accurate visual and vestibular inputs for balance control. In healthy persons, head stabilization is a priority for the nervous system and occurs through attenuation of accelerations from the pelvis to head. Thus, this study examined the effect of ADs on head stability post-SCI. We hypothesized that ADs would increase head stability relative to the pelvis as a mechanism for balance compared to walking without ADs.

Number of Subjects: Seven persons with incomplete SCI, AIS D (43.4 ± 15.6 years, 5 males) participated in this study. Four walked with rolling walkers and three with straight canes.

Materials/Methods: Participants performed two 30-second walking trials at self-selected speeds on a split-belt treadmill: first with their usual ADs, then without. Motion analysis data were acquired continuously. Step-to-step 3D linear accelerations of the pelvis and head centers-of-mass were analyzed across conditions. Acceleration root mean squares were calculated and used to determine attenuation coefficients. Coefficients represent the ability to reduce accelerations from the pelvis to the head with larger, positive values indicating greater attenuation.

Results: All individuals exhibited severely compromised walking speeds ranging from 0.12 to 0.6 m/s. Attenuation coefficients across participants and 3D directions varied, ranging from -282% to 92% attenuation with ADs and -2% to 93% without ADs. However, contrary to our hypothesis, the majority of participants demonstrated greater head accelerations relative to the pelvis with ADs, regardless of device implemented. All persons consistently exhibited attenuated head accelerations, to different degrees, in the anteroposterior direction while walking without ADs.

Conclusions: The ability to reduce upper body accelerations and preserve head stability with and without ADs provides insight into the solutions the nervous system discovers to manage walking balance deficits. Although findings were variable, ADs do alter the pattern of stability as evidenced by changes in coefficients across conditions. Walking in the absence of ADs for most persons appeared to create an environment with greater potential to obtain precise visual and vestibular information.

Clinical Relevance: Walking evaluations without an AD allow for testing of an individual's neural control strategy in coping with his/her SCI-mediated deficits. The heterogeneity of head and pelvic movement strategies measured here manifest in uniquely observable walking patterns such as rigid, highly variable, or asymmetrical gait. Future work additionally should investigate predictors underlying the motor control solutions in a person’s attempt to recover balance. Supported by VA RR&D, NIH T32

AUTHORS/INSTITUTIONS: E.M. Ardolino, Locomotor Training Clinic, Magee Rehabilitation, Philadelphia, PA, PA; G. Zipp, Graduate Programs in Health Sciences, Seton Hall University, South Orange, NJ;

ABSTRACT BODY:

Purpose/Hypothesis: There are currently no outcome measures that have been developed and validated to specifically assess balance in the SCI population. Therefore, the purpose of this study was to generate items for a new clinical outcome measure, the ABLE scale, using expert consensus via a 2 round Delphi survey approach.

Number of Subjects: 24 experts in SCI rehabilitation participated in this study. The experts were physical therapists who had at least 5 years of physical therapist practice, at least 2 years of evaluating and treating patients with SCI, and at least 2 years of administering the Berg Balance Scale or the Tinetti Performance-Oriented Mobility Assessment. Experts were recruited anonymously from the 14 Model SCI Centers, the 7 NeuroRecovery Network (NRN) centers, and the NeuroPT listserv.

Materials/Methods: Approval for the study was obtained from the Institutional Review Board (IRB) of Seton Hall University. The current version of the ABLE scale, which was written by the primary investigator, was posted online via Seton Hall University's ASSET program. All experts recruited for the study were given instructions on how to access the survey via ASSET, and were given 2 weeks to complete the first round of the survey. The survey was designed such that each item of the ABLE scale was listed individually followed by several questions regarding that specific item. The questions included rating the importance of including the item in the scale, the clarity of the wording, the appropriateness of the scoring, and the feasibility of administering the item in a PT clinic. Experts were also provided with the opportunity to offer suggestions on improving each item's instructional wording and the scale as a whole. The results from the first round of the survey were used to remove or modify any items which did not reach 80% agreement. The revised version of the ABLE scale was then reposted online via the ASSET survey tool for a second review by the same experts. During the second round, the experts were presented with each item of the ABLE scale, and were asked to answer the survey questions following each item which had been modified. After a consensus was reached by the clinical experts in rounds 1 and 2, the results were presented to the NRN Balance Committee for a final review by balance experts in the area of SCI. The final version of the ABLE was also posted online via ASSET, and the members of the Balance Committee were asked to complete the survey to determine their agreement with the scale, again requiring 80% agreement.

Results: After 2 rounds of the Delphi Study, and 1 round of review by the NRN Balance Committee, the ABLE scale now consists of 28 items, across three domains of sitting, standing, and walking.

Conclusions: As the scale was developed through expert consensus, it has content validity. Further testing is required to determine the psychometric properties of the scale.

Clinical Relevance: Once psychometric testing is completed, the PT may consider using the ABLE scale to assess balance in individuals with SCI.
TITLE: Modulation of Cutaneous Reflexes Post-Stroke: Relationship to Walking Performance and Interlimb Coordination

AUTHORS/INSTITUTIONS: M. Bowden, S. Kautz, Brain Rehabilitation Research Center, Malcom Randall VA Medical Center, Gainesville, FL; M. Klimstra, P. Zehr, Centre for Biomedical Research, University of Victoria, Victoria, British Columbia, CANADA;

ABSTRACT BODY:

Purpose/Hypothesis: The purposes of this study were to: 1) examine the relationship between cutaneous reflex modulation and measures of behavioral recovery and functional performance in individuals post-stroke; and 2) investigate interlimb reflex responses by examining reflex modulation when stimuli are applied separately to the non-paretic (NP) and paretic (P) leg. We hypothesized that individuals post-stroke will demonstrate decreased modulation of cutaneous reflexes and that increased modulation will correlate with increased locomotor function.

Number of Subjects: Fourteen individuals with chronic stroke (greater than six months post-stroke) participated in this study.

Materials/Methods: Participants walked on a treadmill at self selected speeds (SS) while random trains of electrical stimulation were applied to the superficial peroneal nerve on the P and NP leg at two times the radiating threshold. EMG was collected from the paretic tibialis anterior (TA), soleus (SOL), rectus femoris (RF), and biceps femoris (BF). The following measures were collected on each participant: paretic propulsion (Pp), walking speed (SS), and the clinical analog of Pp (paretic step ratio, PSR). Pearson’s correlational analyses compared reflex modulation to walking performance measures and paired sample t-tests comparing P vs. NP reflex responses.

Results: Pp (deviation from symmetry) significantly correlated with SOL modulation during NP leg stimulation (r=-0.58, p=0.04) while SS was significantly correlated with TA during NP stimulation (r=-0.709, p=0.01). Stimulation of the P leg was not significantly correlated with any measure. When responses from all subjects were averaged together, the paretic TA showed strong inhibitory responses, regardless of which leg was stimulated. In contrast, the paretic SOL demonstrated inhibition with P leg stimulation and excitation with NP leg stimulation, and both of these responses were stronger in stance than swing. NP stimulation differed significantly from P stimulation during toe-off in the TA and during stance phase for the SOL (p<0.025).

Conclusions: The association between Pp deviation and the SOL modulation is consistent with the hypothesis that high degrees of walking impairment (large Pp deviation values) would be associated with decreased modulation. The relationship between walking speed and TA modulation, however, reflecting that those walking most quickly demonstrated the smallest modulation. Reflex responses depended on the side stimulated and may be due to the variation in activation of spinal level excitatory and inhibitory interneurons.

Clinical Relevance: Reflex responses demonstrate high variability in the hemiparetic population and differ from responses seen in healthy control samples. These responses need to be better understood before they can be used as a marker to examine the effect of activity dependent therapeutic programs on reflex amplitude, reflex modulation between excitation and inhibition, and reflex variability.
TITLE: Accuracy demands differentially modulate impaired anticipatory control of object tilt and force sharing patterns during multi-digit grasping in Parkinson disease

AUTHORS/INSTITUTIONS: T. McIsaac, Biobehavioral Sciences, Teachers College, Columbia University, New York, NY;

ABSTRACT BODY:
Purpose/Hypothesis: To examine the effect of increased task accuracy demands on the coordination of multi-digit grasping forces during object grasping and lifting.

Anticipatory control of multi-digit grasping forces has been shown to be impaired in patients with Parkinson disease (PD). Focused attention on the accuracy of a task improves performance measures in healthy adults. We hypothesized that constraining the accuracy of a multi-digit grasping task would mediate the impaired anticipatory grasping control seen in PD.

Number of Subjects: Ten subjects with Parkinson disease (PD; OFF medication) and ten healthy age-matched control subjects.

Materials/Methods: Subjects lifted a manipulandum that measured normal and tangential grasping forces at each digit and object position. The accuracy of maintaining the object upright was either constrained with a behavioral consequence to error (high demand) or unconstrained (low demand) and the object’s center of mass (CM) was changed from trial to trial in either a predictable (blocked) or unpredictable (random) order. The pattern of shared forces among the five digits relative to the CM location, rate of individual digit force generation, and degree of object tilt were evaluated as indicators of multi-digit grasp control.

Results: Repeated measures ANOVAs [within-group factors of Digit (5), CM location (5), Predictability (2) and Accuracy (2)] reveal all subjects modulated individual fingertip forces to CM location throughout the Force Rise, Lift and Hold phases. However, subjects with PD OFF medication exhibited an impaired ability to use anticipatory mechanisms (modulation of forces prior to Lift) resulting in less differentiated scaling of individual finger forces to CM location, slower rate of early force generation, and overall lower grasping forces. These between-group differences in force modulation were similar regardless of the accuracy demands. Conversely, subjects with PD OFF medication minimized erroneous tilt of the object to a greater degree than healthy controls when accuracy demands were low and normalized their control of object tilt during high accuracy demands. These tilt corrections occurred as quickly with most CM locations for PD OFF subjects as healthy controls.

Conclusions: These findings in subjects with PD indicate that: (a) inaccurate scaling of fingertip force amplitude and sharing patterns before object lift is unaltered by increased demands of task accuracy; (b) however, control of object tilt is normalized when the accuracy demands are constrained and (c) the temporal recovery of erroneous object tilt is unimpaired in PD.

Clinical Relevance: While tasks with higher accuracy demands may lead to minimal improvements in the control of grasping forces in PD, such tasks that require increased attention with a functional consequence to errors may elicit greater achievement of the task goal without added time.
TITLE: Outcome measures of migraine associated dizziness, including balance and function, both pre- and post-manual therapy; Activities Specific Balance Confidence Scale, Dizziness Handicap Inventory, Dynamic Gait Index and Composite Score.

AUTHORS/INSTITUTIONS: B.J. Baker, B. Kinne, L. Arnst, D. Shoskey, C. Olgine, Physical Therapy, Grand valley State University, Grand Rapids, MI;

ABSTRACT BODY:
Purpose/Hypothesis: The purpose of this study was to investigate Migraine Associated Dizziness (MAD), including balance and function, both pre- and post-manual physical therapy.

Number of Subjects: A total of 20 subjects consented to participate in this study. Ten were excluded because of no dizziness or no diagnosed history of migraine. After the initial evaluation, two subjects dropped out of the study. Therefore there were eight total subjects who participated in the entire study.

Number of Subjects: A total of 20 subjects consented to participate in this study. Ten were excluded because of no dizziness or no diagnosed history of migraine. After the initial evaluation, two subjects dropped out of the study. Therefore there were eight total subjects who participated in the entire study.

Materials/Methods: A non-randomized, convenience sample was used. All subjects presented with an IHS diagnosis of migraine and a self reported history of dizziness associated with the migraine. The Activities Specific Balance Scale (ABC), the Dizziness Handicap Scale and the Dynamic Gait Assessment were administered by the same physical therapist (PT) during the initial evaluation and during the discharge evaluation. A composite score (CS), used first by Whitney et al, was also determined. Each subject received an individualized PT program designed by a PT with 15 years of experience. The treatment program consisted of manual therapy techniques.

Results: Results and conclusions: The ABC and DGI scores between initial and discharge were statistically significantly different with a P value of .012 and .017, respectively. The physical subscale of the DHI was statistically significant with a P value of .047. However the total DHI was marginally statistically significant with a P value of .092. The CS was found to be statistically significant with P value of .012. Overall, subjects demonstrated significant increases in balance confidence during daily activities (ABC), improved gait adaptability (DGI) and decreased physical symptoms of dizziness (DHI) following manual PT interventions.

Conclusions: Because of the small convenience sample and the lack of randomization, results can not be generalized to all people with MAD. However, it can be suggested that manual PT was an effective treatment for MAD in the population sampled, and that further research should include a larger sample size and randomization to increase the generalizability of results.

Clinical Relevance: Migraines affect about 16% of the adult population at some period in their lifetime. Dizziness accompanies the migraine in about 30% of migraine sufferers. Therefore MAD is a significant clinical problem, and should be addressed by PTs. This study investigates whether manual PT techniques are helpful in reducing MAD and the functional symptoms accompanying it.
Purpose/Hypothesis: Carbohydrate supplementation (CS) has been shown to help subjects sustain higher levels of physiologic performance during prolonged aerobic exercise. In contrast, little is known about the effects of CS on measures relating to gross motor control (GMC) or neuromuscular coordination. Greater understanding of this topic has implications for prevention of injury and rehabilitation of patients recovering from injuries to the neurological system. Stationary cycling is a discrete serial motor task which can be used to assess GMC in the lower extremities. The purpose of this study was to examine the impact of CS on measures of GMC during prolonged stationary cycling.

Number of Subjects: Twelve highly fit cyclists (29.92 ± 7.88 yr, 180.34 ± 5.86 cm, 79.03 ± 9.67 kg, 54.00 ± 4.13 ml/kg/min VO2 max) completed this study. Selection criteria were set to include participants with high fitness levels and exclude those with any type of pathology which would, by itself, alter GMC.

Materials/Methods: On two separate occasions, each subject completed a 2-hour exercise trial at a workload equivalent to 50% of VO2 max. Subjects received a total 216 g CS given out over regular intervals during one trial and received a placebo for the other, using a randomized, double-blind design. Each subject rode his own bicycle, mounted to an electronically braked load generator. Conditions were controlled by computer, and measure of workload (Watts) and GMC (SpinScan^TM^ and average torque angle (ATA) for 360° of pedal travel) were assessed by application software. Measures of workload, GMC and rating of perceived exertion (RPE) were collected at fifteen minute intervals during each trial. A two-way within-subjects ANOVA was used to assess the effect of CS upon dependent variables.

Results: Subjects showed a slight, non-significant (p = .721) decrease in workload over time under both conditions, and this decrement was less in the CS condition. RPE rose significantly (p = .041) and measures of GMC declined significantly (SpinScan^TM^, p = .002, and ATA, p = .042) over time in both conditions. Although not statistically significant, all measures of GMC declined less in the CS condition compared to the placebo condition.

Conclusions: CS not only helped subjects maintain higher workloads throughout the test period, it also helped maintain higher levels of GMC. These results support previous reports that CS lessens the decrement in physiological markers seen during prolonged aerobic exercise. But the findings also suggest that CS may help maintain GMC in spite of physiological fatigue.

Clinical Relevance: The smaller decline seen in GMC during the CS condition likely has clinical importance, as low fit individuals typically fatigue more quickly than the highly fit subjects who completed this study. If CS can help maintain GMC despite physiological fatigue, patients engaged in neurological rehabilitation could theoretically benefit from being able to maintain higher levels of neuromuscular control through more repetitions of therapeutic exercise.
TITLE: Effects of Carbohydrate Supplementation on Cognitive Measures during Prolonged Aerobic Exercise

AUTHORS/INSTITUTIONS: M. Wainscott, H. Rauch, G. Eichenberger, M. Crawford, D. Hoover, Physical Therapy Education, Rockhurst University, Kansas City, MO; W. Sturgill, Department of Psychology, Rockhurst University, Kansas City, MO;

ABSTRACT BODY:
Purpose/Hypothesis: Studies have shown that carbohydrate supplementation (CS) contributes to improved physical performance during prolonged aerobic exercise. Carbohydrates also play an important role within the central nervous system, yet few studies have addressed the impact of CS on measures of cognitive function (CF). More research on this topic may contribute to knowledge of cognition during exercise, and this has potential to aid in the rehabilitation of patients with brain injury. The purpose of this study was to explore the impact of CS on CF during prolonged aerobic exercise.

Number of Subjects: Twelve highly fit cyclists (29.92 ± 7.88 yr, 180.34 ± 5.86 cm, 79.03 ± 9.67 kg, 54.00 ± 4.13 ml/kg/min VO2 max) completed the study. Selection criteria were set to include participants with high fitness levels and exclude those with any pathology.

Materials/Methods: Each subject did a 2-hour exercise trial, on two occasions, at a workload equal to 50% of VO2 max. Subjects received a total 216 g CS given out over regular intervals during one trial and received a placebo for the other, using a randomized, double-blind design. Each subject rode his own bicycle, mounted to an electronically braked load generator. Conditions were controlled by computer and application software. Participants completed the Flanker Task (FT) at fifteen minute intervals throughout each trial. The FT is a computer-generated instrument with two components, compatible and incompatible figures, allowing for assessment of cognitive reaction time (RT) and response accuracy (RA). A two-way within-subjects ANOVA was used to assess the effect of CS upon RT and RA.

Results: Analysis showed participants were significantly slower (p < .001) in RT on the incompatible FT trials compared to the compatible trials across the 8 blocks. Differences in RT between conditions were not significant, nor were the interactions between conditions and FT mode. A t-test comparing FT mode on the placebo condition revealed that RT in compatible trials was significantly faster (p < .001) than RT in incompatible trials. In contrast, under the CS condition, compatible trials were 39.35 ms faster than the incompatible trials, but the difference was not significant. The SE was more than four times greater under CS than under the placebo condition.

Conclusions: Non-significant differences were found between conditions, whereas the speed and extraordinary uniformity of RT across blocks suggests that participants’ attentional control remained high throughout both conditions. This suggests that exercise itself had a larger impact on RT than did condition and begs further study. The greater variability seen with CS suggests that this condition affected attentional processing in a way that made it slower and more variable than when under the placebo condition. Such a response might present challenges clinically, particularly for individuals learning new tasks or performing tasks in new contexts.

Clinical Relevance: These results contradict previous findings that CS helps to improve function during prolonged aerobic exercise.
Purpose/Hypothesis: Rehabilitation clinics offer Body weight supported treadmill training (BWSTT) as a potential modality for gait training. It is uncertain, however, how empirical knowledge of BWSTT is being translated in the clinical environment. This study interviewed physical therapists to investigate the decision making processes used to guide therapist preferences for gait training.

Number of Subjects: Sixteen subjects from 3 physical therapy settings were interviewed.

Materials/Methods: General topics covered in the interviews included: 1) demographic and background information about the therapist and the clinic; 2) beliefs about the efficacy of gait training methods, including BWSTT; and 3) decision making process used in prescribing locomotor retraining for their patient/clients. Audiotapes of the therapist interviews were transcribed and interviews were analyzed by content to develop themes. The themes in each interview were then compared with those in other interviews to create broader categories that linked themes across interviews. Interviews continued until the point where no new information was obtained (saturation).

Results: Three primary themes for decision making developed out of the interview process. First, use of a disablement model with focus on impairments of body structure and function. Decreased strength led to use of BWSTT, while impaired cognition or increased spasticity led to use of overground walking. There was very little mention of patient-centered care. Another theme was the level of assistance needed by the patient for ambulation. BWSTT was chosen for low level patients for safety, while overground walking with various methods for facilitation was used to progress patients after the max assist level. As the patient became more independent, the BWSTT was used for high level patients for motor learning and endurance effects. The final theme was the influence of the clinical site itself as a cultural entity. This was seen in terms of use of evidence, site protocols and algorithms, and the type of BWSTT and parameters for BWSTT usage. Many therapists felt limited by the amount of time and resources that the BWSTT intervention required.

Conclusions: Although many studies support BWSTT as an effective modality for locomotor training after stroke, the actual application of this knowledge varied across therapists and facilities. Therapists typically did not take advantage of all the information available for decision making for their patients. In some cases, failure to apply knowledge from evidence was based on restraints from the systems in which therapists worked.

Clinical Relevance: Scientific evidence is important for the progression of our profession. However, this evidence must be applied in a clinical setting for it to be relevant. Resources available in the research setting are not always available in the clinical setting. Further research investigating the effectiveness of BWSTT with fewer resources such as assistance and time will be important for the application of this intervention in the clinic on a standard basis.
TITLE: Subjective visual vertical after vestibular physical therapy intervention

AUTHORS/INSTITUTIONS: M. Mohammad, P.J. Sparto, S.L. Whitney, Physical Therapy, University of Pittsburgh, Pittsburgh, PA;

ABSTRACT BODY:

Purpose/Hypothesis: The purpose of this study was to investigate the change in the perception of vertical in patients with vestibular disorders following vestibular rehabilitation using standard vestibular rehabilitation or a virtual reality intervention.

Number of Subjects: Twenty-two subjects (mean age = 52 y, SD = 11, range 27 - 70), 4 males, underwent vestibular physical therapy at a tertiary care balance center. Diagnoses included: 19 patients with peripheral vestibular disorders, 2 patients with central vestibular disorders, and 1 patient with mixed central and peripheral dysfunction. Patients were randomly assigned to receive virtual reality physical therapy intervention (VR, n = 14) or customized vestibular physical therapy (VEST, n = 8). Patients were treated once per week for 6 weeks. The perception of vertical was measured using a computerized subjective visual vertical (SVV) test. The SVV assessment was performed before and within one month after the end of the physical therapy intervention.

Materials/Methods: For the SVV test, subjects used a joystick to align a fluorescent line to their perceived vertical in a darkened room. The line was initially tilted 40 degrees clockwise or counter clockwise off vertical. Four trials were performed at each of the following backgrounds: a square frame that was tilted 28 degrees clockwise or counter clockwise off vertical, a disc that displayed a pattern of fluorescent circles that rotated either clockwise or counter clockwise at a speed of 30 degrees per second, and no background. The SVV was recorded as the angle between the final position of the line and earth vertical. The VR physical therapy intervention required that patients ambulate on a treadmill while moving through a virtual grocery store projected onto 3 rear projected screens surrounding the treadmill. The speed of movement was adjusted according to the patient’s self-paced velocity on the treadmill. Customized vestibular physical therapy consisted of compensation, habituation, and adaptation exercises that is the standard treatment for people with vestibular disorders. Both interventions included a home exercise program to be performed daily.

Results: The SVV angles were significantly larger with the frame and the disc in the background compared to no background (p < 0.01). Our data indicate that patients’ perception of vertical did not change after the treatment (p = 0.71). The type of intervention did not have an effect on SVV (p = 0.53). Although not significantly different, the SVV angles were larger with the frame (mean = 9.0, SD = 8.3) than with the disc (mean = 7.5, SD = 3.1), before and after physical therapy intervention.

Conclusions: There is documented evidence that patients’ function and balance improve after physical therapy interventions for persons with vestibular disorders. However, this improvement did not translate into improved SVV scores.

Clinical Relevance: These results provide preliminary evidence that vestibular rehabilitation may not influence recovery of perception of vertical, and presumably the use of visual cues for spatial orientation.
TITLE: Robot-assisted active repetitive motion™ therapy combined with somatosensory electrical stimulation promotes recovery after stroke.


ABSTRACT BODY:

Purpose/Hypothesis: Current evidence supports the use of rehabilitative interventions such as constraint induced movement therapy, repetitive task practice, electrical stimulation, and robotics to promote the recovery of upper extremity function after stroke. While the evidence is strong for implementing each one of these interventions in isolation, much less is known about the effectiveness of using these treatments in combination. Therefore, the purpose of the current research study was to determine if simultaneous use of somatosensory electrical stimulation and robot-assisted active repetitive motion™ therapy using the Hand Mentor™ (Kinetic Muscles Inc. Tempe, AZ) improves upper extremity function, spasticity, and quality of life in chronic stroke survivors.

Number of Subjects: Four subjects met the inclusion criteria of 1) a diagnosis of CVA at least 1 year prior to the initial testing session, 2) trace to fair muscle strength in wrist and finger extensors on impaired side, 3) the ability to follow directions and use the Hand Mentor™, and 4) no contraindications to electrical stimulation.

Materials/Methods: The current study used an A-B-A single-subject design. All Participants underwent 3 baseline testing sessions over a two week period (A) followed by a three week intervention period (B). The intervention period was then followed by 3 more testing sessions over a 4 week withdrawal period (A). The intervention consisted of 14 or 15 one hour active repetitive motion therapy sessions using the Hand Mentor™ coupled with simultaneous somatosensory electrical stimulation delivered 5 days per week for 3 weeks. During both pre- and post testing periods, upper extremity function was measured using Wolf Motor Function Test and the Fugl-Meyer Assessment of Sensorimotor Recovery after Stroke (upper extremity motor component). Spasticity was measured using the Modified Ashworth Scale, and quality of life was measured using the Stroke Impact Scale (SIS). The data for each subject was analyzed individually using a two standard deviation band method, along with celeration lines to estimate the rate of change in the data.

Results: Three of the four subjects showed improvement in the Fugl-Meyer Upper Extremity total score. All subjects improved in the quality of motion component within the Wolf Motor Function Test. In addition, two of the four subjects showed improvements in spasticity and quality of life.

Conclusions: Combining robot-assisted active repetitive motion™ therapy with somatosensory electrical stimulation appears to promote recovery in chronic stroke survivors.

Clinical Relevance: Multifaceted treatment approaches involving robotic devices and electrical stimulation appear feasible and effective. Future research is warranted to validate and expand upon the results of this initial trial.
TITLE: Post-tetanic potentiation (PTP) of the H-reflex in spinal cord transected rats

AUTHORS/INSTITUTIONS: C. Yates, N. Reese, Physical Therapy, University of Central Arkansas, Conway, AR; R.D. Skinner, E. Garcia-Rill, Neurobiology and Developmental Science, University of Arkansas for Medical Sciences, Little Rock, AR; S. Mori, Physiology, National Institute Physiological Science, Okazaki, JAPAN;

ABSTRACT BODY:

Purpose/Hypothesis: The H-reflex, an electrical analogue of the deep tendon reflex is altered following spinal cord injury. Previous studies have demonstrated that high frequency stimulation of the L3-5 lumbar dorsal rootlets in control animals produced a significant increase in reflex amplitude (PTP) lasting ~250 sec (Thompson et al. 1998). Previous studies in our labs have shown that the hyperreflexia induced by mid-thoracic spinal transection (Tx) in the adult rat and measured by the loss of low frequency-dependent depression of the H-reflex, could be alleviated by passive exercise of the hindlimbs for 30 days (Reese et al. 2005). The purpose of this study was to investigate if PTP exists in spinal transected animals compared with control animals and also to determine if PTP changes occur in transected animals that have had passive exercise training.

Number of Subjects: Adult female Sprague-Dawley rats (260-300 gms) were divided into the following groups: control n=11, transected and tested 7 days later (Tx 7days) n=5, transected and tested 14 days later (Tx 14 days) n=5, transected and tested 30 days later (Tx 30 days) n=5, and transected and exercised for 30 days (Tx+Ex30D), n=6.

Materials/Methods: Animals in all groups except the control group underwent a complete transection at T10 and were provided with daily animal care including bladder expression until reflexive voiding occurred. Complete surgery and care methods are described in Reese et al. 2005. At 7, 14, or 30 days post Tx the tibial nerve beneath the calcaneal tendon was stimulated and the response recorded from plantar muscles using a subcutaneous electrode. After 60 seconds of recording at 0.3 Hz, tetanic stimuli of 100, 200, or 300 Hz were given for 10, 20, or 30 seconds. Post tetanic stimulation was at 0.3 Hz and recording of the H-wave was done for 310 seconds. The (Tx+Ex30D) group began passive exercise to the hindlimbs, provided by a motorized exercise bicycle, 7 days after Tx, for 5 days/week, 1 hour per day for 30 days.

Results: In Tx 7day group, 2/5 showed a small PTP at lower stimulus amplitudes and all showed suppression of the H-reflex at higher stimulus amplitudes. At 14 days, 3/5 rats had low PTP and 4/5 had H-reflex suppression at higher stimulus amplitudes. At 30 days, 2/5 showed a modest amount of PTP and 2/5 had suppression of the H-reflex at higher stimulation amplitudes. In contrast, all Tx rats (n=6) that were exercised for 30 days (Tx +Ex30D) had PTP of 20-50% and were similar to that in intact animals.

Conclusions: Following Tx, rats showed only modest PTP of the H-reflex at 7, 14, and 30 days. However, Tx rats that were exercised demonstrated PTP of the H-reflex similar to that of intact rats. Tx rats that had exercise training had restored PTP as in control rats.

Clinical Relevance: PTP can be used as an additional tool to examine interventions used in human and animal studies for spinal cord injury. The return of PTP after spinal cord injury can be used as a measure of recovery from hyperreflexivity.
Background & Purpose: Charcot-Marie-Tooth Disease (CMT) is the most frequently inherited peripheral neuropathy. CMT is known for its slowly progressive symmetrical weakness that begins distally creating concurrent functional losses. While CMT’s progression is documented, few studies have reported long term effects of physical therapist (PT) interventions. Studies suggest strengthening and aerobic conditioning reduce fatigue and improve endurance in the short-term, yet few explore functional gains or long term impact of these efforts. The purpose of this case report is twofold: first, to describe a PT plan of care for a person with CMT that emphasized motor learning and control while incorporating surface electromyography (sEMG) for muscle contraction timing and sequencing, manual therapy, strengthening, and aerobic conditioning; second, to illustrate the PT’s role as primary care provider for a person with a chronic neuromuscular disability over a 4 year period.

Case Description: A 52 yo woman with CMT presented with bilateral distal weakness, imbalance, and inability to ambulate more than 50 ft with walking sticks. Her initial goals were to decrease fatigue, complete professorial responsibilities, walk independently from car to office (3000ft) and improve balance to reduce fall frequency (4 times over previous year). PT program addressed symptoms and patient goals.

Outcomes: The Patient Specific Functional Scale was used to progress goals. Muscle timing, sequencing and amplitudes improved recruitment in lower extremity muscles while other impairment measures of strength, balance, joint mobility and flexibility also improved. Her Physical Performance Test improved from 20/40 to 39/40, 5x sit to stand decreased by 33% and her walking prior to rest improved from 50 to 3000 ft. She completed a 10 k walk without walking sticks and learned to ski. Throughout this time, PT served as the primary care provider to educate, measure structural and functional progress, guide intervention priorities and address new symptoms and musculoskeletal complaints related to increasing activity levels and CMT disease progression.

Discussion: When referred to a PT, care plans typically address acute episodic events with short term interventions that demonstrate limited functional gains, challenging evidence for the long-term efficacy of PT. This case report illustrates the impact of a comprehensive 4 year PT-guided program that strategically prioritized problems during an extended follow-up period and resulted in significant gains across multiple functional outcomes. The primary focus of this care plan was to identify areas of deficit and to methodically improve trunk, hip and lower extremity recruitment patterns as they related to posture, balance and gait and secondarily to guide an aerobic conditioning program. The PT primary care provider managed the patient’s care and referred to her physicians as indicated. The authors encourage colleagues to combine evidence from both neuromuscular and musculoskeletal literature to offer best patient care outcomes for CMT.
TITLE: Exercise Initiation and Maintenance in Community-Dwelling Stroke Survivors

AUTHORS/INSTITUTIONS: L.D. Hedman, J. Baunetz, T. Crespin, A. Finendale, K. John, L. Matthysse, S. McCann, E. Purser, J.E. Sullivan, Dept of Physical Therapy and Human Movement Sciences, Northwestern University, Chicago, IL;

ABSTRACT BODY:

Purpose/Hypothesis: Despite the known benefits of exercise following stroke, most stroke survivors do not exercise regularly. We examined the process of initiation and maintenance of exercise in stroke survivors who exercise as part of their lifestyle. We were particularly interested in the influence of pre-morbid exercise habits, individuals’ perception of stroke severity and other internal factors.

Number of Subjects: 7 community-dwelling stroke survivors (2 female; 5 male) who exercised at least 3 times per week/20 minutes/6 months participated in the study. Ages ranged from 47-84 years and length of time post-stroke from 20 months-20 years.

Materials/Methods: Using a Grounded Theory framework, two semi-structured interviews were conducted with each subject; one in-person and one phone. The interview guide focused on the participants’ perception of the process he or she used to initiate and maintain exercise post-stroke, pre-morbid exercise habits and perception of stroke severity. Interviews were transcribed verbatim and coded. Codes were developed from emerging ideas from the interviews along with concepts from the social cognitive and social learning theories. Codes used included locus of control, outcome expectations, self-efficacy, health value, resources, and obstacles. A constant comparative method was used to discern common themes. A concept map was developed to illustrate the themes.

Results: 7 in-person and 5 phone interviews were analyzed. Following stroke, individuals experienced a decrease in functional self-efficacy. Internal locus of control was the main influence on the process of initiation and maintenance of exercise. An internal locus of control empowered individuals to take advantage of resources and overcome obstacles. Following exercise initiation, individuals experienced an increase in exercise self-efficacy and developed outcome expectations of improved function from exercise. These outcome expectations promoted exercise maintenance. As exercise was maintained, there was a shift in outcome expectations from improving function to avoiding functional decline. Pre-morbid exercise habits and perception of stroke severity were not significant factors in the initiation and maintenance of exercise. None of the participants identified general health benefits as a reason to exercise post-stroke.

Conclusions: Internal locus of control plays a significant role in the initiation and maintenance of exercise following stroke. Post-stroke exercise self-efficacy as well as outcome expectations and health values related to function strongly reinforce exercise. Neither pre-morbid exercise nor perception of stroke severity appeared to have a critical influence on post-stroke exercise adherence.

Clinical Relevance: Reinforcement of patients’ exercise self-efficacy as well as the functional gains resulting from exercise may help foster exercise adherence post-stroke. Education concerning the role of exercise in the prevention of stroke recurrence and health promotion is needed.
TITLE: The Movement Imagery Questionnaire-Revised, Second Edition (MIQ-RS) is a Reliable and Valid Tool for Evaluating Motor Imagery Ability in Stroke Populations

AUTHORS/INSTITUTIONS: A. Butler, J. Cazeaux, A. Fidler, J. Jansen, K. Easley, N. Shenvi, S.L. Wolf, Emory University, Atlanta, GA; M. Gregg, University of Winnipeg, Winnipeg, Manitoba, CANADA; C. Hall, University of Western Ontario, London, Ontario, CANADA;

ABSTRACT BODY:
Purpose/Hypothesis: To examine the test-retest reliability of the Movement Imagery Questionnaire-Revised, Second Edition (MIQ-RS), to examine the internal consistency of the individual items of the MIQ-RS, and to investigate the criterion validity of the MIQ-RS as compared to a previously validated instrument, the Kinesthetic and Visual Imagery Questionnaire-10 (KVIQ-10).

Number of Subjects: 46

Materials/Methods: The MIQ-RS and KVIQ-10 were administered twice by the same evaluator to twenty-three stroke survivors and twenty-three able bodied individuals over a two week interval.

Results: There was significant test-retest reliability (p > 0.05, ICC for average scores: 0.83-.99) and internal consistency (Cronbach α: 0.95-.98) of the visual and kinesthetic subscales in both groups. The two-factor structure of the MIQ-RS was supported by factor analysis, with the visual and kinesthetic components accounting for 88.6% and 83.4% of the total variance in the control and stroke groups respectively. There was also a significant correlation between the reported scores of the MIQ-RS and KVIQ-10 supporting the validity of the MIQ-RS in able-bodied (r=0.87 for visual, r=0.90 for kinesthetic; p < 0.05) and stroke (r=0.42 for visual, r=0.83 for kinesthetic; p < 0.05) populations.

Conclusions: The study shows that the MIQ-RS is a valid and reliable instrument in stroke and able bodied populations and therefore useful as an outcome measure for motor imagery ability.

Clinical Relevance: This study found that scores on the FMA and MMSE were not associated with performance on the MIQ-RS, indicating that the questionnaire may be used in the assessment of clients with a wide range of motor and cognitive impairments.
TITLE: Real world arm function and its relationship with kinematic evaluation of reaching in chronic stroke

AUTHORS/INSTITUTIONS: C. Carmona, M.D. Ellis, J.P. Dewald, Physical Therapy and Human Movement Sciences, Northwestern University, Chicago, IL;

ABSTRACT BODY:

Purpose/Hypothesis: Kinematic measurement of reaching range of motion (work area) during various abduction loading conditions has been demonstrated to be a reliable and valid impairment based measurement that quantifies the effect of abnormal joint torque coupling (flexion synergy) on functional reaching ability. This study sought to demonstrate that the quantitative measurement of reaching work area is related to both a direct measurement of upper extremity activities of daily living (Rancho los Amigos Functional Test for the Hemiparetic Upper Extremity, FTHUE) and a self reported measurement of real world arm use (Motor Activity Log, MAL).

Number of Subjects: Eleven individuals with chronic moderate to severe hemiparesis were included in the study.

Materials/Methods: Reaching work area was measured using the ACT3D, a robot device, which is able to measure reaching kinematics under specified abduction loading conditions. Work area was measured for two loading conditions including a “supported” condition where they glided along a virtual frictionless horizontal table and an “unsupported” condition where they were required to maintain the arm elevated above the same horizontal surface under normal gravitational loading conditions. Unsupported reaching work area was normalized to the work area while supported, to control for differences in limb length across individuals. Participants were also evaluated with the MAL and the FTHUE by a physical therapist who was blinded to the performance on the work area measurement.

Results: Correlations (Spearman rho) were calculated to determine the relationship between unsupported work area and both the MAL and FTHUE. There was a significant correlation between unsupported work area and the number of completed tasks of the FTHUE (r = 0.69, p < 0.05), the MAL QOM (quality of movement) scale (r = 0.59, p < 0.05), and the MAL AOU scale (amount of use) (r = 0.60, p < 0.05).

Conclusions: These findings suggest that total reaching range of motion against gravity is related not only to the ability of individuals to use the arm during activities of daily living but also to how much they actually chose to use the arm in the real world.

Clinical Relevance: Recent evidence suggests that individuals with moderate to severe stroke benefit from rigorous impairment-based interventions such as targeting abnormal joint torque coupling with progressive abduction loading during reaching practice with the ACT3D. The carryover of impairment reduction into functional abilities and real world arm use is more difficult to demonstrate in clinical research considering the requirement of large sample multi-site trials when utilizing qualitative assessments of activity and participation limitation. This study suggests that restoration of impairments, as detected by measurements such as work area, are likely representative of the restoration of function both directly and in the real world. These findings support the use of direct quantitative measures of movement impairment in small-scale early stage clinical research and ultimately in day-to-day clinical practice.
TITLE: Vestibular rehabilitation for persons with vestibular disorders using a virtual reality grocery store as an intervention

AUTHORS/INSTITUTIONS: K.A. Alahmari, S.L. Whitney, P.J. Sparto, Physical Therapy, University of Pittsburgh, Pittsburgh, PA; M. Redfern, Bioengineering, University of Pittsburgh, Pittsburgh, PA; J.M. Furman, Otolaryngology, University of Pittsburgh, Pittsburgh, PA;

ABSTRACT BODY:

Purpose/Hypothesis: To determine if using a virtual reality grocery store physical therapy intervention can improve nausea, headache, dizziness or visual blurring in persons with vestibular disorders.

Number of Subjects: Thirteen subjects with peripheral vestibular hypofunction agreed to participate. The mean age of the subjects was 52 ± 10 (range 26-59) with 10 women included.

Materials/Methods: Patients enrolled in the study were treated in a virtual reality grocery store environment. The grocery store consisted of three screens that reflected a grocery store environment with 16 different aisles. The patients ambulated on a treadmill with the speed of the treadmill controlled by the force applied to the grocery cart inside the virtual grocery store. Each subject was exposed to the virtual reality intervention for 6 visits (6 – four minute trials per treatment session). The complexity of the aisles was increased over the 6 visits according to each subject’s improvement and the investigator’s decision to increase the difficulty of the walking environments. Each patient was queried before and after each virtual reality intervention regarding any symptoms of nausea, headache, dizziness, or visual blurring using a visual analog scale. Each subject was also asked to complete the Simulator Sickness Questionnaire (SSQ) before and after each virtual reality session. Nonparametric statistics were used to test if the intervention significantly affected the symptoms within and between sessions.

Results: Nausea was significantly greater after the intervention compared with before the intervention during the first (p=.028) and third sessions (p=.026). However, the change in the nausea score was not different between the first session and the 6th session (p=.068). Headache was significantly increased within the first (p=.036) and the second sessions (p=.033). Dizziness was significantly increased within the first (p=.013), 3rd (p=.007), and 4th sessions (p=.009). Visual blurring was significantly increased within the first (p=.021), 2nd (p=.038), 3rd (p=.011), and 4th sessions (p=.028). The within-session increase in visual blurring did not differ between the 1st and 6th sessions (p=.061). The SSQ scores were significantly increased within all sessions (p<0.05)

Conclusions: Nausea, headache, dizziness, and visual blurring are significantly increased by the virtual reality intervention within early sessions, but not significantly stimulated during the last sessions. Symptoms of people with unilateral vestibular hypofunction, including nausea, headache, dizziness, and visual blurring lessened over the course of the treatment trial.

Clinical Relevance: Virtual reality intervention for patients with vestibular disorders appears to be a promising treatment modality.

Support: Eye and Ear Foundation and NIH DC05384 (slw)
TITLE: Constrained vertical vibration dose influences soleus motor neuron excitability in humans

AUTHORS/INSTITUTIONS: S. Chang, M.J. House, C. McHenry, J. Wu, R.K. Shields, Graduate Program in Physical Therapy and Rehabilitation Science, University of Iowa, Iowa City, IA;

ABSTRACT BODY:

Purpose/Hypothesis: To quantify the effects of various doses of vibratory input (g force and displacement) on soleus muscle excitability in individuals with and without spinal cord injury (SCI).

Number of Subjects: Ten

Materials/Methods: Subjects were seated with the hip and knee joints at 90 degrees and the foot secured on a servo-controlled vibration platform. We randomly introduced vertical vibration stimuli at 0.3, 0.6, 1.2, 3 and 5 g with displacements of 0.08, 0.17, 0.33, 0.83, 1.38 mm, respectively, for 20 seconds at a fixed 30 Hz frequency. Able-bodied subjects received the vibration with the limb at rest and with a 5% of MVC background contraction. Background muscle EMG was recorded during vibration and H-reflex and M-waves were elicited before and after each epoch of vibration to establish changes in excitability.

Results: Soleus RMS EMG in the vibrated limb remained unchanged during 0.3 and 0.6 g but increased at greater g forces (1.2, 3 and 5 g) in both tasks. During rest, post-vibration motor pool excitability was lowest at 0.6 g and unchanged at 5 g. Post-vibration H2/H1 ratio increases at all g forces indicating vibration reduced pre-synaptic inhibition. A similar reduction was not present in those with SCI. With 5% background muscle activity, post-vibration H-reflexes were reduced at all g forces. Furthermore, post-vibration H2/H1 ratio increased in all g forces indicating the pre-synaptic inhibition was reduced after a short bout of vibration.

Conclusions: These findings support that low g force vibration at 30 Hz induces minimal reflex muscle activity in individuals with and without spinal cord injury. In addition, certain g forces enhance motor neuron excitability through pre-synaptic mechanisms. The influence of g force on vibration induced motor neuron excitability provides a therapeutic method to understand the stresses placed on the musculoskeletal system in those with SCI.

Clinical Relevance: Whole body vibration (WBV) has been used in therapeutic settings and is purported to have a powerful influence on bone, muscle, and neuronal pool excitability in persons with and without spinal cord injury (SCI). However, WBV is not a feasible intervention in some cases of SCI. Improved understanding of the influence of vibratory dose on segmental limb motor neuron excitability is a necessary pre-requisite to understand the effects of vibratory stimulation on bone and muscle in persons with SCI.
TITLE: The Effects of Arm Position and Footwear on the Postural Control Response to Perturbed Stance.

AUTHORS/INSTITUTIONS: B. Albright, C.B. Horne, J. Bellis, East Carolina University, Greenville, NC;

ABSTRACT BODY:

Purpose/Hypothesis: To analyze the effects of different arm positions and footwear conditions on the postural control response to a perturbation during stance.

Number of Subjects: Twenty healthy young adults

Materials/Methods: Seven males and thirteen females ages 21-30 were used in this study. All subjects satisfied inclusion criteria. Subjects were tested while either wearing a control canvas shoe or barefoot and with arms held either across chest, on hips or down at sides. Arm positions and footwear conditions were presented randomly. Subjects stood on a dynamic force plate (NeuroCom) programmed to translate backward for a distance of 12.5 cm at a velocity of .23 m/sec. Consistent foot-placement was maintained. Force plate data was collected for five trials per footwear condition and arm positions resulting in a total of 30 trials per subject. MatLab programs and MANOVA (SPSS v16) with planned post-hoc comparisons using Bonferroni corrections were used to analyze center of mass (COM) and center of pressure (COP) for multiple sway variables. Level of significance was set at p<0.05. Sway variables included mean sway amplitude, sway variance, sway range, time to peak, and peak duration time.

Results: For the sway variables studied, there were significant main effects for footwear conditions and limited main effects for arm positions. The peak duration time was the only variable that showed an interaction between footwear and arm position. Though significance was not reached there was a trend toward a footwear – arm position interaction for COM and COP sway amplitude. Compared to the barefoot condition, subjects wearing the control shoe had a greater mean sway amplitude and variance for both the COM and COP with significant differences when arms where in the on-hips and across-chest positions. The control shoe condition also had a greater sway range indicating a greater peak anterior and posterior displacements of the COM and COP with significance between footwear conditions when arms where on-hips and across chest. Main arm effects were found only for COM and COP for the time to peak variable. The peak duration time COM was the only variable that showed an interaction between footwear and arm position.

Conclusions: Subjects wearing the control shoe had greater sway than when barefoot. The limited findings for arm positions and interactions may be the result of a slow perturbation velocity, allowing subject’s to compensate for any anticipated postural imbalance. It is reasonable that the main shoe effects may be attributed to: 1) an enhanced postural control due to an increase in plantar tactile input during the barefoot condition; 2) the comfort and confidence provided by a customary canvas shoe; or 3) a combination of both.

Clinical Relevance: This study showed that different footwear conditions should be considered when assessing balance and fall risk.
TITLE: Effect of Aerobic Exercise on Cortical Activity following Traumatic Brain Injury: A Pilot Study

AUTHORS/INSTITUTIONS: J. Lojovich, N. Rosene, B. Schomberg, M. Schultz, J. Carey, Prog in Physical Therapy, University of Minnesota, Minneapolis, MN;

ABSTRACT BODY:

Purpose/Hypothesis: Recent literature has suggested that aerobic exercise may be implicated in cortical changes affecting the memory system in both animal and human studies. Working memory is an attention-based, limited capacity system involved in the temporary storage and manipulation of information that is often significantly affected following traumatic brain injury (TBI). The purpose of this pilot study was to investigate changes in the intensity, volume, and location of brain activation in a subject with a severe TBI. The subject was tested during a progressively complex working memory tasks using functional magnetic resonance imaging (fMRI) both prior to and following a 6 week aerobic exercise protocol.

Number of Subjects: One male subject, age 28 with a severe, non-penetrating, traumatic brain injury via a motor vehicle accident, 6 yrs ago. The control subject group consisted of ten neurologically intact, right-handed adults (5 male, 5 female, mean age (SD) = 24.9 (3.98).

Materials/Methods: A 3T fMRI scanner was used to collect brain activation data during a visual fixation (control) condition and the 0-back and 2-back conditions of the N-back working memory task. fMRI data was collected on 3 separate days prior to and following participation in a supervised aerobic exercise program that met 3 times a week for 6 weeks. Brain Voyageur was used to analyze the location, volume, laterality and intensity of activation during each N-back task compared to the fixation condition and the activation patterns of the 0-back and 2-back conditions to each other. Comparisons of brain activation patterns in the TBI subject were made pre and post participation in the aerobic exercise program and also compared with the control group of neurologically intact subjects. The number of correct responses during the conditions were also recorded for each task and compared.

Results: The TBI subject demonstrated improvement in accuracy in both the 0-back and 2-back tasks following participation in a 6 week aerobic exercise program. Significant changes in cortical activation patterns, laterality, intensity and voxel count were also noted following participation in the aerobic exercise program.

Conclusions: Findings demonstrate changes in task accuracy and cortical activation patterns during different levels of cognitive difficulty following participation in an aerobic exercise program. This finding is consistent with recent available literature in well elderly populations.

Clinical Relevance: This pilot study is the one of the first to study changes in brain activity following aerobic exercise in a human, traumatically brain injured subject. Clinically, positive findings from a larger study could eventually lead to the prescription of aerobic exercise as an efficacious adjunct to cognitive rehabilitation following TBI.
TITLE: Operator-Induced Variability During Musculoskeletal Ultrasound of Subjects With and Without Spinal Cord Injury

AUTHORS/INSTITUTIONS: S. Dudley-Javoroski, T. McMullen, L.M. Peranich, R.K. Shields, PT and Rehabilitation Science, University of Iowa, Iowa City, IA; M.R. Mobily, Rehabilitation Therapies, University of Iowa Hospitals and Clinics, Iowa City, IA;

ABSTRACT BODY:
Purpose/Hypothesis: Preservation of muscle function and bone mineral density may equip paralyzed limbs to withstand the rigors of ambulation, should a cure for SCI emerge. Electrical stimulation training is a promising strategy to preserve the function and integrity of the paralyzed musculoskeletal system. As the linkage between the muscular and skeletal systems, tendon is a key player in muscle-bone loading scenarios. However, post-SCI tendon adaptations have received little attention. To facilitate future ultrasound studies of muscle and tendon adaptations to SCI, the purpose of the present study is to perform an analysis of repeated ultrasound images to establish the variation attributed to ultrasound operator technique.

Number of Subjects: 8 subjects with SCI and 10 healthy controls underwent sonographic imaging of the vastus lateralis, patellar tendon, soleus, and Achilles tendon. Scan position and operator technique were carefully controlled in order to minimize operator-induced error.

Materials/Methods: Two operators each captured 5 images for each anatomic location. Image dimensions were obtained using the ultrasound system's integrated tracing tools. Within-operator variation was expressed as %CV and intraclass correlation (ICC(3,1)) among repeated images. The variation due to image tracing was separately determined (ICC(3,1)). Between-operator variability was determined by ICC(2,1) for each anatomic site.

Results: Within-operator %CV ranged from 2.93% to 12.08%, depending on the anatomic location. ICCs (3,1) ranged from 0.58 to 0.95. Variability attributable to image tracing was low (ICC(3,1) 0.93 to 1.00). Between-operator concordance (ICC (2,1)) ranged from 0.62 to 0.74.

Conclusions: Relatively high between-operator variation supports the use of a single ultrasound operator for future studies. Variability during image processing (tracing) was considerably lower than variation contributed by operator technique during scan acquisition. Tissue adaptations in subjects with SCI add difficulty to image interpretation in this population.

Clinical Relevance: Future studies may use the measurement techniques developed in this report to judge the suitability of post-SCI muscle, tendon, and bone for high-load rehabilitation interventions. Likewise, the techniques presented here will serve as useful aids in quantifying adaptations that result from the reintroduction of physiologic loads during electrical muscle stimulation protocols.
Purpose/Hypothesis: Clonus, a sign associated with spastic hypertonia, is one of the most common and disabling complications affecting individuals with spinal cord injury (SCI). Approximately 70% of persons with SCI exhibit spastic hypertonia one year after injury. Clonus is rhythmic oscillatory motor behavior attributable to recurrent stretch reflexes and commonly occurs in the ankle joint after SCI. A quantitative assessment of ankle clonus in individuals with spinal cord injury (SCI) is needed as existing measures of spasticity lack validity, reliability and ability to detect change. The Ankle Clonus Drop Test appears to be a valid and reliable biomechanical test for assessing ankle clonus in individuals with SCI. The angle of muscle reaction (R1), defined by Tardieu, is the angle at which a velocity-dependent “catch” or clonus is felt during quick stretch of a muscle. Our objective was to explore the responsiveness to change of R1, elicited during the Drop Test, in individuals with SCI who participated in a 12-week locomotor training.

Number of Subjects: Eighteen individuals with SCI, varying degrees of ankle clonus, incomplete lesion at T10 or above, and ≥ 1 year post SCI were included.

Materials/Methods: The Drop Test simulates ankle clonus as it occurs in people with SCI during transfer activities when the bottom of the foot rapidly contacts the wheelchair footrest. During the test, the foot was dropped from a height of 10 centimeters onto a platform and related kinematic, kinetic and electromyographic (EMG) parameters were recorded. Kinematic data was collected using an eight-camera motion analysis system; joint angles were constructed from reflective markers placed at the fifth metatarsal head, lateral heel, lateral malleolus, lateral knee and greater trochanter. Concurrently, kinetic data was recorded with a force plate; ankle muscle EMG data was collected with an eight-channel recording system. Each participant was tested before and after 12 weeks of body weight supported locomotor training. A paired t-test analysis was conducted.

Results: The mean pre- and post-training angle of muscle reaction was 91.39° ± 12.73 and 87.53° ± 11.59, respectively. The mean change of 3.86° ± 9.03 (p = .087) showed a trend toward significance in the direction of increased dorsiflexion.

Conclusions: The Modified Tardieu Scale describes applying a quick stretch to a muscle at three different velocities relative to the limb falling under gravity; slower than (V1), equal to (V2), and faster than (V3) gravity. During the Drop Test, the limb falls at a rate equal to gravity (V2) and the angle of muscle reaction (R1) is kinematically measured. Our preliminary findings suggest that R1, as measured during the Drop Test, may be responsive to changes in plantar flexor spasticity in individuals with SCI.

Clinical Relevance: The ankle clonus drop test and angle of muscle reaction show promise as a valid, reliable and responsive measurement of plantar flexor spasticity in individuals with SCI and warrant further study.
TITLE: Is the scaling of reach kinematics to 3-D virtual targets preserved after stroke?

AUTHORS/INSTITUTIONS: J.C. Stewart, J. Gordon, C.J. Winstein, Division of Biokinesiology and Physical Therapy, University of Southern California, Los Angeles, CA;

ABSTRACT BODY:

Purpose/Hypothesis: Individuals post-stroke often demonstrate a decrease in the absolute values of peak acceleration and peak velocity when reaching but it is unknown whether they demonstrate a scaling of these variables based on target distance, a frequent finding in non-disabled adults that is indicative of anticipatory planning. The purpose of this study was to determine whether individuals post-stroke scale initial peak acceleration and initial peak velocity based on target distance for unconstrained reach actions to 3-D virtual targets.

Number of Subjects: Ten individuals at least 3 months post-stroke with mild to moderate motor impairment (UE Fugl-Meyer motor >35) and 10 age-matched, non-disabled adults.

Materials/Methods: Participants reached to 6 targets displayed in 2 directions (+45°,-45°) and 3 distances (8, 16, 24 cm) for a total of 120 trials with each arm while sitting at a virtual display unit. Vision of the target but not the arm was allowed while moving. Index finger position was sampled at 120 Hz. Mean kinematic variables by target were extracted for each arm in participants with stroke (paretic, nonparetic) and compared with the matched arm in controls.

Results: Participants with stroke had larger errors, longer movement times, and lower peaks of acceleration and velocity compared with the matched arm in controls. When reaching with the nonparetic arm, some participants increased initial peak acceleration (mean ranged from 500 to 1500 cm/sec²) as target distance increased while others did not, a finding similar to control participants. Initial peak velocity (30 to 120 cm/sec) consistently scaled across participants. Time to initial peak acceleration was consistent at 60±5 msec while time to initial peak velocity increased with increased target distance (90 to 250 msec). With the paretic arm, initial peak acceleration (250 to 400 cm/sec²) and initial peak velocity (20 to 70 cm/sec) did not consistently scale across target distances and were frequently followed by additional peaks. Time to initial peak acceleration was consistent and similar to the nonparetic arm (65±8 msec) while time to initial peak velocity (120 to 300 msec) was much more variable and did not consistently increase by target distance.

Conclusions: Scaling of initial peak acceleration and velocity based on target distance was preserved when reaching with the nonparetic but not the paretic arm. Participants used a combined pulse-height (scale peak acceleration)/pulse-width (scale time to peak velocity) strategy when reaching with the nonparetic arm that was similar to controls. No evidence of pulse-height control was seen when reaching with the paretic arm. Instead participants utilized a pulse-width strategy or demonstrated a strategy that relied heavily on feedback through multiple peaks of acceleration and velocity.

Clinical Relevance: Planning of unconstrained reach actions based on target distance after stroke was impaired with the paretic arm. Interventions to address planning may be warranted after stroke and should be investigated further.
TITLE: A recipe for disaster? Postural control and balance abilities of persons with Parkinson disease and peripheral neuropathy

AUTHORS/INSTITUTIONS: K.B. Foreman, O. Addison, R.L. Marcus, P. LaStayo, L. Dibble, Department of Physical Therapy, The University of Utah, Salt Lake City, UT;

ABSTRACT BODY:

Purpose/Hypothesis: Deficits in postural control in persons with idiopathic Parkinson disease (IPD) are well documented and place those persons at increased risk for falls and fall related injuries. Lower extremity peripheral neuropathy (PN) impairs the somatosensory components of normal postural control and increases fall risk. There are no reports in the literature documenting the effects of peripheral sensory deficits on persons with IPD. This case series documents the laboratory and clinical measures of postural control and balance of two persons with concurrent IPD and PN.

Number of Subjects: Two persons with IPD and PN are described here (PD1: Male, 76y, Hoehn and Yahr stage 3, UPDRS motor subsection on meds: 26; PD2: Female, 82y, Hoehn and Yahr stage 4, UPDRS motor subsection on meds: 28. Each with moderately impaired light touch and sharp dull sensibility inferior to bilateral malleoli).

Materials/Methods: Each person underwent laboratory kinematic and kinetic analysis of an anticipatory postural control task (gait initiation [GI]) and clinical exam of balance abilities (Timed up and go [TUG] and the Functional Gait Assessment [FGA]) in both on and off medication conditions.

Results: Both had histories of repetitive falls (> 10) over the past year. Regulation of center of pressure (COP) displacement during GI was profoundly hypometric off medications. On medications, their performance improved, however hypometric COP displacement persisted relative to COP displacements of persons with IPD reported in the literature (Martin et al., 2002; Dibble et al., 2004) (PD 1: Lateral COP and posterior COP displacement off/on meds: 16.9/26.9 mm; 6.7/10.3 mm, respectively; PD 2: Lateral COP and posterior COP displacement off/on meds: 11.5/10.6 mm; 6.2/14.6 mm, respectively). Performance on the TUG and FGA were affected in both on and off meds conditions (all TUG trials > 15 sec; all FGA scores <17/30). When considered relative to published cut-off scores of the TUG, performance of individuals with IPD/PN reflected a profound fall risk even when on medications.

Conclusions: The diagnosis of IPD generally is thought to carry an increased risk for falls and fall related injury. However, the postural performance of persons with IPD is generally heterogeneous and therefore it is unclear what characteristics amplify a persons fall risk. In this case series, we summarize the findings of two persons with combined IPD and PN. Such sensory and motor deficits appear to profoundly impair the ability to effectively displace their COP during GI as well as perform clinical balance tests. In addition, their clinical balance test performance indicated extremely high prospective fall risk.

Clinical Relevance: Physical therapists examining persons with concurrent IPD and PN should anticipate the potential for repetitive falls and plan treatment accordingly. Further research is needed to determine the effects of fall prevention interventions in these individuals.
Purpose/Hypothesis: Contractures are common in many neurologic conditions and treatment strategies vary greatly. There is limited evidence to support best practice with respect to contracture management. While there are many algorithms addressing the pharmacologic, medical or surgical management of spasticity and/or contractures, there is little current literature that describes a comprehensive decision making process for practicing physical therapy clinicians.

The aims of the current study were to (1) examine the clinical decision making process of expert clinicians when examining patients with contractures related to neurological impairments,(2) compare decision making processes of expert clinicians to an existing contracture management algorithm, and (3) modify the existing contracture management algorithm to reflect input from expert clinicians.

Number of Subjects: Nine "expert" clinicians in the area of contracture management consented for participation in the study. Characteristics of "expert" clinicians included the following: clinicians identified by their peers as experts in the target area, those that seek current evidence at least monthly, those that have attended continuing education on contracture/spasticity management and have greater than 2 years experience with contracture/spasticity management.

18 patient subjects were also recruited for participation in this study and included individuals presenting with a variety of contractures and neurological diagnoses.

Materials/Methods: A qualitative research design was used to identify key concepts and compare these concepts to the current algorithm.

The subjects (physical therapy staff clinicians) were identified following completion of a pre-study questionnaire and nomination process. During the study, subjects were asked to examine two patients identified by the research team as individuals with or at risk of a contracture due to a neurologic condition. Subjects were then asked to complete an examination of the patient with a focus on the joint of interest. Following the patient examination the subject underwent a guided interview process performed by one member of the research team. The examination process was repeated with a second patient.

All interviews were transcribed and the data coded into group themes followed by identification of concepts. The concepts identified were then compared to concepts already considered or missing from the treatment algorithm.

Results: A modified grounded theory approach was utilized for data analysis. The most common and important themes relevant to the goals of the study were identified and integrated into the existing algorithm.

Conclusions: Key concepts within the algorithm were validated by expert clinicians.

Clinical Relevance: While many interventions currently exist for management of contractures, novice clinicians often struggle with the proficient treatment of this impairment. An algorithm to assist with the clinical decision making of novice clinicians is a valuable clinical tool.
**ABSTRACT**

**Background & Purpose**: Restoration of walking function is a primary rehabilitation goal post-stroke. Locomotor training (LT) has emerged as a promising intervention aimed at improving locomotor function. However, to date its efficacy remains unclear in persons post-stroke. Gait speed remains the most commonly utilized outcome measure, however, it is a relatively global measure that provides little insight as to how underlying biomechanical mechanisms are influenced by LT. This single case design investigated: 1) the extent to which LT affects biomechanical parameters of hemiparetic locomotion, and 2) whether manual LT (MLT) vs. robotically-driven LT (RDL) reveal differential effects.

**Case Description**: A 67 year old male with chronic mild-moderate locomotor dysfunction following right-sided ischemic stroke participated in LT following an A-B-A study design (A-12 sessions of RDL; B-12 sessions of MLT) with 4-weeks of washout interspersed between training blocks. Training sessions involved 30 minutes of stepping at physiologic walking speeds (>1.0-1.3 m/s) with the goal of normalizing kinematics. 3-D biomotion assessments were conducted before and after each training epoch.

**Outcomes**: At study completion, spatiotemporal improvements were noted in self-selected and fast walking speeds (+.25 m/s,+.64 m/s, respectively). Kinematic improvements were noted in: paretic hip extension angle in terminal stance (+12.18°,+14.6°) and knee flexion during swing (+11.19°,+5.52°). The greatest improvements in walking speed were observed following MLT but were accompanied by aberrant kinematics including exaggerated hip extension in terminal stance (-15.26°,-14.18°). These non-physiologic kinematic patterns resolved following the washout and subsequent RDL block. Kinetic changes revealed disproportionate increases in hip (H3) and knee (K3&K4) power and decreased ankle power at both A1 (-.18W/kg,-.76W/kg) and A2 (-0.03W/kg,-0.74W/kg). Of note, decreased ankle power was observed in conjunction with altered kinematics that were characterized by tonic dorsiflexion (DF).

**Discussion**: These findings suggest differential effects of manual and robotic LT were revealed without clear indication as to which approach is more effective. Tonic DF in swing to improve toe clearance may inhibit the capacity to generate plantarflexion (PF) at terminal stance, impairing A2 and forward propulsion. Alternatively, the inability to generate effective PF power, even after 12 weeks of LT, may result from not specifically training the capacity to generate ankle power. Moreover, the range of walking speeds used for training may not have effectively reinforced appropriately timed PF activation, or alternatively, may have failed to offer sufficient intensity to induce appropriate biomechanical adaptations. Although LT appears to improve some locomotor outcomes, it does not appear to improve ankle power generation. Moreover, an apparent compensation for this lack of forward propulsion provided by the ankle was observed through the adoption of aberrant alterations at the hip and knee.
Purpose/Hypothesis: Hereditary spastic paraplegia (HSP) is a cluster of genetic disorders resulting in retrograde axial degeneration within the corticospinal and posterior column tracts of the spinal cord, leading to lower extremity paresis and spasticity. Recently, a new transgenic rat model of HSP was made using human mutation for the Non-imprinting Prader-Willi/Angelman syndrome locus 1 (NIPA1) gene; however, the functional consequences have not been identified.

Number of Subjects: Therefore, we examined 13 male Sprague-Dawley rats with and without the NIPA1 mutation to determine the similarity between the typical clinical presentation of HSP patients and a genetically engineered rat model.

Materials/Methods: Examiners masked to group assignment tested rats weekly for locomotion (BBB Scale), tactile (von Frey hair) and thermal sensation (Hargreaves), posture and reflexes (air righting, proprioceptive placing, limb position) and spasticity throughout the disease progression.

Results: Motor dysfunction occurred at 8-10 wks of age in the form of hindlimb hypermetria, trunk instability and impaired coordination during locomotion. Forelimb function remained intact over time. Evidence of corticospinal, vestibulospinal and propriospinal tract degeneration included loss of hindlimb extension, air righting and placing reflexes by 15 wks. No changes in thermal or tactile sensation occurred through 24 wks.

Conclusions: The NIPA1 mutant transgenic rats demonstrated early onset with slow progression of paresis similar to the clinical condition. Degeneration of multiple long motor and perhaps some proprioceptive sensory tracks appear to account for the deficits at least through 24 wks of age.

Clinical Relevance: Thus, the novel NIPA1 rat model closely mimics the clinical presentation of uncomplicated HSP and demonstrates the clinical usefulness of animal models in the study of HSP. Future studies will determine how NIPA1 gene mutation produces HSP so that effective treatments can be developed.
Background & Purpose: Patients with generalized dystonia are often treated medically with implantation of deep brain stimulators (DBS). However, there is very limited evidence for physical therapy interventions to improve functional mobility for these patients. Robotic assisted body-weight supported treadmill training (BWSTT) is emerging as a treatment for multiple neurologic diagnoses. The purpose of this case report is to describe the interventions and outcomes used, resulting in improved functional mobility for a patient with generalized dystonia.

Case Description: A 20 year old Venezuelan male, diagnosed seven years prior with generalized dystonia received skilled physical therapy intervention, including robotic assisted gait training on the Lokomat®, during three admissions to an outpatient therapy clinic over a one year period.

Outcomes: The patient participated in nine sessions of robotic assisted BWSTT during his first admit, 17 sessions during his second admit, and seven sessions during his third admit. Body weight support (BWS), guidance force (% of guidance provided by the Lokomat®), duration, and distance ambulated were monitored. Patient decreased BWS in kilograms (kg) from 30 kg-10 kg (69%-23% BWS) during the first admit, 10 kg-5 kg (23%-12% BWS) during the second admit, and 10 kg-5 kg (23%-12% BWS) during the third admit. Guidance force decreased from 100-60%, 85-70%, and 55-40% during the first, second, and third admits, respectively. Gait speed on the Lokomat® increased from 0.93-1.68 miles per hour, while distance ambulated ranged from 1,161-5,313 feet. Patient completed an average of 34.22 ± 7.93 minutes of BWSTT during each 60 minute therapy session. For outcomes originally, the patient could walk ten feet. During his third initial examination, he was able to ambulate 636 feet (six minute walk test). Additionally, he showed changes based on the Functional Independence Measure (FIM) by progressing from bilateral maximal hand hold assist, FIM level two, to requiring no assistive device or upper extremity support during ambulation, FIM level five.

Discussion: These data suggest robotic assisted BWSTT was a beneficial adjunctive physical therapy intervention to improve functional mobility in this patient. Limitations of this case report include modification by the physician of DBS settings during the first and second admit, and concurrent physical therapy balance training. Future research studies with this patient population could compare individuals receiving only robotic assisted BWSTT and conventional physical therapy. More research is warranted to determine the effectiveness of this intervention for other individuals with generalized dystonia.
TITLE: The Effect of Repetitive Transcranial Magnetic Stimulation on Bradykinesia in Parkinson Disease

AUTHORS/INSTITUTIONS: B.K. Randhawa, L. Boyd, Graduate Program in Rehabilitation Science, Univ. British Columbia, Vancouver, British Columbia, CANADA;

ABSTRACT BODY:
Purpose/Hypothesis: Anatomically the supplementary motor area (SMA) has direct connections with primary motor cortex through which voluntary movement is facilitated. In Parkinson’s disease (PD) the SMA receives reduced input from the basal ganglia causing bradykinesia. The main aim of this study was to determine whether enhancing activity in the SMA using 5 Hz excitatory repetitive transcranial magnetic stimulation (rTMS) would decrease bradykinesia as indexed by tests of motor function. Further, motor imagery is disrupted in individuals with PD as a result of under-activation of the SMA. Thus, a second hypothesis was that imagined movements would also be facilitated by excitatory rTMS.

Number of Subjects: To date we have tested the immediate effects of rTMS (pre-post) on two participants with PD (on-medication; Hohen & Yahr stags: 1; 63 and 67 y/o; right hand dominant and more affected) in a cross-over design.

Materials/Methods: Participant A received sham rTMS in session 1 and excitatory rTMS in session 2; the order of rTMS was reversed for participant B. Sessions 1 and 2 were performed 1 week apart. Before and immediately after rTMS a motor function test (handwriting) and a mental imagery task (Sirigu’s Break test) were performed. For the handwriting task participants wrote cursive “T”s in rectangular boxes of 2 cm height placed on digitizer tablet; scriptalyzer software was used to derive the kinematics of handwriting. In the Sirigu Break test participants separately mentally simulate and physically perform a continuous thumb-fingers opposition sequence to the sound of metronome until they are no longer able to keep up with imposed speed. Excitatory 5 Hz rTMS was delivered (110% motor threshold, 1200 pulses) to SMA. Stimulation location was standardized across participants and sessions using known Talairach coordinates of SMA, a stereotaxic system and anatomic MRIs from each participant.

Results: For both participants excitatory rTMS decreased bradykinesia during the handwriting task. Specifically, overall duration was shorter (Participant A: 10%, B: 15%), peak velocity was higher (A: 2%, B: 21%) and average velocity was faster (A: 12%, B: 18%). The Sirigu Break test also indexed diminished bradykinesia with physical break points 8% longer for participant A and 10% longer for B. However, results for the mental imagery portion of the Sirigu Break test were mixed, with one participant (B) improving 5% while the other did not (A: -9%). Data collection is ongoing to further and verify these results.

Conclusions: Our early results indicate that excitatory rTMS improved bradykinesia. However, the impact of rTMS on mental imagery in people with PD remains unclear.

Clinical Relevance: Our preliminary data illustrate that 5Hz excitatory rTMS over SMA in individuals with PD may reduce bradykinesia. These data suggest that excitatory rTMS may be a useful clinical adjunct to improve motor function during rehabilitation.
TITLE: The Effect of Incomplete Spinal Cord Injury on the Modular Control of Walking

AUTHORS/INSTITUTIONS: E.J. Fox, K.V. Day, Physical Therapy, University of Florida, Gainesville, FL; S. Kautz, D.J. Clark, A. Behrman, Brain Rehabilitation Research Center, Malcom Randall VA Medical Center, Gainesville, FL; S.P. Suter, Physical Therapy, Shands Hospital, Gainesville, FL;

ABSTRACT BODY:
Purpose/Hypothesis: Modular organization of walking control associates a single neural command with synergistic muscle activity to coordinate biomechanical subtasks. Healthy individuals walk using 4-5 modules. Individuals post-stroke use fewer modules in the paretic leg, which may be associated with greater walking disability and inability to activate discrete muscle synergies. The purpose of this study was to examine the effect of incomplete spinal cord injury (ISCI) on the modular control of walking. We hypothesized that persons with ISCI walk using fewer modules than healthy individuals.

Number of Subjects: Seven persons with ISCI (>6 months), classified according to the American Spinal Injury Association (ASIA) impairment scale (AIS) as C or D (5 males, 43.5 ± 22.5 years) participated in this study of walking control.

Materials/Methods: Subjects walked over-ground and on an instrumented split belt treadmill. Surface electromyography (EMG) was recorded in eight bilateral lower extremity (LE) muscles. Non-negative matrix factorization was applied to rectified and filtered EMG. The minimum number of modules required to explain ≥ 90% of EMG variability was determined and muscle activity relative to biomechanical subtasks was examined. The ASIA lower extremity motor score (LEMS) was used to examine motor function. Walking independence was assessed using the Walking Index for Spinal Cord Injury-II (WISCI-II).

Results: Individuals with ISCI walked over-ground at 0.18m/s to 0.80m/s. All had a LEMS ≥ 40/50, yet WISCI-II scores ranged from 8 to 17/20. Across the 14 LEs, an average of 2.8 modules (mode=2) explained the EMG during treadmill walking. In LEs using two modules (43%), the first module, active during the first period of double support, was dominated by extensor muscle co-activation. The second module activated the tibialis anterior and rectus femoris muscles during swing. Three LEs used four modules and demonstrated muscle activation patterns similar to healthy individuals.

Conclusions: Persons with ISCI relied on fewer modules compared to healthy individuals (2.8 vs. 4-5). Use of fewer modules suggests that SCI reduces the differential control of muscle activity to meet biomechanical task demands during waking. The ability to activate discrete modules may be indicative of more complex neural activation during walking and may therefore be associated with recovery after SCI.

Clinical Relevance: Following ISCI, examination of modular control may provide a framework for assessing the relationship between neural commands, muscle activation, and the biomechanical requirements of walking as well as the effect of rehabilitation on walking recovery.
Background & Purpose: Critical illness polyneuropathy (CIP) is a neuromuscular disorder that causes diffuse weakness in patients requiring prolonged intensive care unit stays. Patients with CIP have multiple impairments affecting multiple body functions and structures which results in a limited ability to participate in daily activities and life roles. This case report looks at the clinical decision making process for treatment of a patient with CIP and how treatment interventions effected outcomes. In addition, other treatment options and areas for future research will be discussed.

Case Description: Subject: The patient is a 32 year-old male who underwent a lengthened acute care hospital stay after he was originally admitted for acalculous cholecystitis and pancreatitis. During this 3 month time period in acute care he was diagnosed with critical illness polyneuropathy via electromyography study. Intervention: Upon discharge from acute care, the patient was admitted to an inpatient rehab setting. He participated in intensive therapy that included 2 hours of physical therapy, 1 hour of occupational therapy, and up to an hour of speech therapy per day. Physical therapy interventions included progressively resistive strength training, endurance training, functional activities, gait training, family instruction, and orthotic training and management. Outcomes: He spent 128 days at the inpatient rehab hospital except for one day where he was sent to the emergency department for sepsis. At initial evaluation his Functional Independence Measure (FIM) score total was 49. At discharge his FIM score total increased to 81. At initial evaluation his manual muscle test scores were 2-/5 for hip flexion, 1/5 for knee extension, 2/5 for knee flexion, and 3+/5 for plantarflexion and dorsiflexion bilaterally. Upon discharge home his manual muscle test scores increased to 4/5 for hip flexion, 2/5 for knee extension, 4/5 for knee flexion, and 4/5 for plantarflexion and dorsiflexion bilaterally. He was discharged to a wheelchair accessible apartment with his mother where his main form of mobility is in a manual wheelchair. We chose to provide him with a rolling walker and bilateral knee/ankle/foot orthosis (KAFO's) with offset knee joints. At the two week follow up, the patient has had no falls, continues to use the manual wheelchair for his primary mode of mobility, and ambulates with the rolling walker.

Discussion: Despite multiple contextual factors the patient was able to return home with support from family. This case study shows that an intensive rehabilitation program is beneficial in the treatment of a patient with CIP. The use of a multifaceted approach is necessary to see improvements in body function and structure in order to increase activity and participation in life roles. Further research is needed on determining the most effective treatment strategies as well as long term follow-up studies to better understand prognosis and outcomes.
Purpose/Hypothesis: Sleep has been demonstrated to enhance motor skill learning for young, healthy individuals. However, the role of sleep in promoting generalizability between similar tasks remains unknown.

Number of Subjects: Fifteen young, neurologically intact individuals (mean age: 25.7 y.o.) were pseudo-randomly assigned to either the sleep group or the no-sleep group.

Materials/Methods: The sleep group practiced a continuous tracking task in the evening and underwent retention and transfer testing the following morning; the no-sleep group practiced the tracking task in the morning and underwent retention and transfer testing in the evening.

Results: Both the sleep and the no-sleep groups demonstrated between session or “off-line” motor learning of the continuous tracking task (sleep group p=.044; no-sleep group p=.016). However, only the sleep group transferred learning of the task to the two transfer conditions (demonstrated by a lack of significant difference between retention testing and the transfer conditions; change of joystick gain p=.609 and change of task speed p=.070) whereas the no-sleep group failed to transfer learning of the task to the two transfer conditions (demonstrated by a significant difference between retention testing and the transfer conditions; change of joystick gain p=.031 and change of task speed p=.006).

Conclusions: These findings demonstrate that sleep promotes the transfer of motor skill learning to variations of the learned motor skill task for young, healthy individuals.

Clinical Relevance: Understanding the impact that sleep has on learning new skills and generalizing this learning to similar tasks may emphasize the need to encourage adequate sleep and address sleep issues in individuals undergoing rehabilitation.
Background & Purpose: Deep brain stimulation (DBS) has been found to be an effective treatment of advanced Parkinson Disease (PD), but can require several parameter adjustments to maximize symptom control and minimize adverse effects. Concurrently, persons with PD have also been shown to benefit from a multidisciplinary program in the inpatient rehabilitation setting. The purpose of this case report is to describe the multidisciplinary rehabilitation of a person with PD undergoing DBS programming.

Case Description: A 47 year old female with a 9 year history of PD participated in a multidisciplinary inpatient rehabilitation program in conjunction with initial programming of a left subthalamic nucleus deep brain stimulator. A variety of outcome measures were monitored including the Unified Parkinson Disease Rating Scale (UPDRS), Functional Independence Measure (FIM), and Berg Balance Scale (BBS).

Outcomes: At the end of a ten day inpatient rehabilitation stay, the patient's FIM score increased from 84/126 at admission to 104/126. Her BBS score increased from 40/56 to 55/56, and her UPDRS motor score decreased from 63/108 (DBS off and in “off state”) to 12/108 (1 month after programming). The patient's daily carbidopa/levadopa dosage decreased by approximately 2100 mg during her 10 day stay.

Discussion: Multidisciplinary inpatient rehabilitation proved to be an effective setting for programming and adjusting the DBS and tapering the carbidopa/levadopa dosage for this patient. One struggle for the rehabilitation team was capturing this patient’s true baseline functional status prior to the DBS being turned on and timing assessments accordingly. A more successful strategy in this area may have resulted in more significant improvements in outcome measure values. Further research is warranted to explore if inpatient rehabilitation in conjunction with DBS programming is as effective as the traditional outpatient model.
TITLE: Body Weight Supported Treadmill Training in a patient with MS: a case report.

AUTHORS/INSTITUTIONS: S. Weaver, Dept of Physical therapy, University of Michigan Health System, Ann Arbor, MI;

ABSTRACT BODY:

Background & Purpose: The purpose of this case report is to examine the use of robot assist body weight support treadmill training (Lokomat) in a patient with multiple sclerosis (MS) in order to increase endurance, gait velocity and quality of life and decrease fall risk.

Case Description: The patient is a 59-year old man with secondary progressive MS who was in the outpatient rehabilitation phase after a cardiac arrest secondary to a PE. The patient was motivated to participate in therapy with his goal to increase endurance, gait speed and quality during community and household ambulation. The rehabilitation strategy included the Lokomat along with traditional therapies in a total of 14 sessions over the course of 6 weeks followed by 3 weeks of only traditional therapy. During the 14 Lokomat session a variety of speeds, unloading weights, guidance force and walking times were used. The initial training parameters were set at a speed of 1.7 km/h, 61 kg unloaded, 75%-100% guidance force for 30 minutes and was progressed as tolerated by the patient. The Dynamic gait index, Berg Balance Scale, 10 Meter Walk test, MSIP were used to objectively assess the patient’s function prior to the onset of training, after 6 weeks of training and at 3 weeks post training.

Outcomes: During the 6 weeks, the patient progressed the Lokomat settings to be able to tolerate increased time (Initial=30 minutes, Final=47 minutes), speed (Initial=1.7 km/h, Final=2.3 km/h), decreased body weight support (Initial=61kg, Final=44kg) and decrease guidance force (Initial=80-100%, Final=45%). The Dynamic Gait Index remained relatively unchanged from a 12/24 initially to a 13/24 post Lokomat training and 13/24 at 3 weeks post training. The Berg Balance Scale improved from a pre training score of 38/56 to a post training score 45/56 and a 50/56 3 weeks post Lokomat training. The 10 Meter Walk improved during both comfortable (Initial=.16 m/s, Final=.22 m/s) and fast paced walking (Initial=.22 m/s, Final=.314 m/s). The MSIP was a score of 16 initially and 18 at the end of training.

Discussion: For this patient, Lokomat was well tolerated and was reluctant to discontinue therapy. It was a good option for an adjunct to therapy to progress this patients gait performance and endurance as well as decrease fall risk. The training demonstrated the most significant effect on static balance and gait velocity, but appeared to have little impact on higher level gait activities. The Lokomat is often criticized because it limits lower extremity movement to the sagittal plane, and therefore may not be effective in training higher level balance and gait skills, however, was shown to increase scores in the Berg Balance scale and gait velocities. The Lokomat gave an essential training environment for gait training at speeds and levels of effort greater than is possible in conventional gait training. The patients gait velocity increased however continued to correlate with safe household ambulation only. The reason for the negative change in the MSIP is unclear and warrants additional study.
**Background & Purpose:** Posterior Canal Benign Paroxysmal Positional Vertigo (PC - BPPV) was originally thought to constitute approximately 85-95% of BPPV cases. However, with the use of video-oculography recent literature suggests that of BPPV cases, 41-65% involve the PC, 21-33% the lateral canal (LC), 17% the anterior canal (AC), and 20% multi-canal BPPV. To date, research has focused on the evaluation and treatment of PC-BPPV. The positional tests and treatment maneuvers designed for the management of PC – BPPV are not sufficient for management of AC – BPPV due to the geometry of the ampullary segment of the AC. The purposes of this case report is to (1) discuss the clinical reasoning in the management of complex BPPV, (2) describe the rational for the interpretation of findings on positional tests for AC – BPPV, and (3) describe the treatment of AC – BPPV with new particle repositioning maneuvers designed to take into account the geometry of AC.

**Case Description:** This case report describes the clinical reasoning in the management of 1 patient who presented with complex, multi-canal BPPV and received a series of 4 particle repositioning maneuvers. Eye position traces of complex patterns of eye movements were recorded with video-oculography during positional testing and maneuvers. To determine the location of the debris within the canals, positional testing was performed prior to treatment. Interpretation of findings on positional testing suggested debris moved between canals within the 4 sessions. Once the canals involved were identified for each session, the appropriate particle repositioning maneuver was performed. The AC was treated with a new particle repositioning maneuver designed to accommodate the angle of its ampullary segment.

**Outcomes:** Multi-canal BPPV was successfully treated with 4 treatment sessions. Particle repositioning maneuvers designed to treat both the AC and PC were used. New particle repositioning maneuvers designed for the treatment of AC are effective.

**Discussion:** AC-BPPV may be identified and successfully treated with particle repositioning maneuvers designed to treat the AC. Two maneuvers are available to treat the AC. One requires identification of the side involved while the other treats both AC’s simultaneously. Further research needs to determine the effectiveness of the particle repositioning maneuvers in the treatment of AC-BPPV.

AUTHORS/INSTITUTIONS: G.T. Thielman, Physical Therapy, University Of The Sciences in Philadelphia, Philadelphia, PA; P. Bonsall, Occupational Therapy, Magee Rehabilitation Hospital, Philadelphia, PA;

ABSTRACT BODY:

Background & Purpose: Training in the virtual environment in post-stroke rehab is being established as a new approach for neurorehabilitation. ReoTherapy (REO) introduces virtual reality using an innovative robot-assisted program, based on the understanding that numerous repetitions of functionally oriented movements can stimulate cortical reorganization. The purpose is twofold; determine if training with a virtual reality system can yield favorable outcomes, and determine the appropriate patient selection for this technique. In order to properly assess this methodology, an established training methodology was used as a comparison; task-related training (TRT), the practice of goal-directed functional movements with a purpose of improving control strategies (that result from motor problems). Additionally, the appropriate level of patient to benefit from TRT has been defined in the literature.

Case Description: A 63 year old male, 3 years post onset of left-sided cerebrovascular accident (parietal lobe/basal ganglia) that led to right side (dominant) sensorimotor deficits. Four weeks of TRT was first completed, and then using a crossover design 4 weeks of REO was completed. Baseline data was collected at all intervals. TRT activities were performed at varied locations across the workspace, using the paretic upper-limb for reaching and grasping. The REO system involved the patient being securely constrained to the device that facilitated passive, active-assisted, and active movement while avoiding compensatory trunk movement. Reo training involved continuous reaching activity, with the arm placed in the device, while the patient follows a video monitor of the motion, as well as the perceived best path to achieve the desired motion. For both training methods, sensors provided bandwidth auditory feedback to encourage maintenance of the trunk against the chair back. All twelve rehabilitative sessions lasted between 50 and 65 minutes, with 175 to 225 repetitions per session. To counteract the effort differential between the two training methods, REO training used 10-20% more training trials per session.

Outcomes: Clinically relevant improvements for both techniques were found for the Motor Activity Log (MAL- patient's perception of function), the Wolf Motor Function Test (WMFT-total time score to complete a number of tasks), elbow extension active range of motion and the Reaching Performance Scale (RPS- measure of trunk movement used in reaching).

Discussion: Both protocols used environmental feedback, especially auditory, as a means to enhance motor learning. However, the degree of changes evident varied per protocol and may be due to the appropriateness of one technique for one level of patient, and the other technique for another level of patient. These criteria will be discussed. A randomized controlled trial would help establish why these differences were evident.
TITLE: Examining the effect of commercially available video game systems, the Nintendo Wii and Sony PlayStation 2, on balance and mobility in individuals with chronic stroke.

AUTHORS/INSTITUTIONS: S.L. Fritz, E. Rivers, A. Merlo-Rains, B.M. Duncan, University of South Carolina, Columbia, SC;

ABSTRACT BODY:
Purpose/Hypothesis: The purpose of this study was to examine the feasibility and effects of commercially available video game systems on balance and mobility in individuals with chronic motor and balance deficits from stroke.

Number of Subjects: Five individuals post stroke performed 20 hours of supervised interactive game play using the Nintendo Wii or Sony PlayStation 2 Eye-toy.

Materials/Methods: The subjects completed a 5-week intervention playing for one hour daily 4 times per week. Each hour session was split into two 30-minute sections. The first section was devoted to “fitness” based game play using Wii Fit or Eye-toy Kinetic, and the second section included “fun” based games utilizing Wii Sport or Eye-toy Play2. All gaming sessions were performed in standing and supervised by trainers. Outcomes were evaluated using standardized assessments for balance and mobility including the Berg Balance Scale, Dynamic Gait Index, Timed Up and Go, 6 Minute Walk and 3 Meter Walk velocity. These assessments were performed at pre- and post-intervention. Effect sizes were calculated for the outcome measures across individuals.

Results: This intervention was feasible for the participants. The individuals tolerated the duration of the intervention, and following training, were able to independently play the games including understanding set-up and interacting with the VR system. After the 20 hours of game play, small effect sizes were seen for balance and mobility with the exception of a moderate effect size for Dynamic Gait Index (ES=0.5).

Conclusions: Based on the small effect size seen in this sample, a small and limited change on mobility with slightly more effect on balance appears to have occurred following game play in these individuals. Despite the appearance of a small effect with this population, conclusions regarding the improvements cannot be directly contributed to game play due to the absence of a control group for ruling out confounding variables. A larger scale study with more participants needs to be performed to arrive at more sound conclusions. Future randomized trials should be conducted to evaluate the efficacy of the Wii and PlayStation Eye-toy for individuals with stroke. Further data collection is in process.

Clinical Relevance: Nearly 5.6 million Americans are living with chronic effects of stroke making stroke the leading cause of disability in the United States. Limited research exists to support effective interventions for chronic motor and balance impairments associated with stroke. A need exists for innovative and economically feasible interventions for individuals with chronic stroke. Virtual reality (VR) and interactive gaming have recently been introduced as low cost and effective adjunctive modalities for treatment in rehabilitation including neurological populations. However, minimal research currently exists supporting use of these systems as an adjunct to conventional rehabilitative strategies.
TITLE: Functional Outcomes after West Nile Neuroinvasive Disease: A case series.

AUTHORS/INSTITUTIONS: C. Swank, T. Fuller, T. Odom, J. Weakley, , Baylor Institute for Rehabilitation, Dallas, TX;

ABSTRACT BODY:

Background & Purpose: For individuals with West Nile Virus who develop West Nile Neuroinvasive Disease (WNND) symptoms of fatigue, muscle pain, muscle weakness persist >90 days. Recovery of physical health, cognitive health, and functional health is achieved in only one-third of individuals by 18 months. The characteristics of West Nile Virus infection may impact long term outcomes. Specifically, recovery potential varies between WNND subtypes: West Nile Meningitis (WN Meningitis), West Nile Encephalitis (WN Encephalitis), and West Nile Poliomyelitis (WN Poliomyelitis). Individuals with WN Meningitis generally have favorable outcomes, while those with WN Poliomyelitis tend to have considerable morbidity. Only one single subject case study was identified in the literature outlining progression of functional recovery through outpatient rehabilitation. However, no specific distinction was made of diagnosis subtype other than stating the individual had developed WNND. The recovery course in the case study may have been partially reflective of an undifferentiated diagnostic subtype. The purpose of this case series is to describe the functional outcomes for 7 individuals with various WNND clinical presentations.

Case Description: Of our 7 cases, 4 were diagnosed with WN Encephalitis, 1 with WN Meningitis, and 2 were undifferentiated WNND.

Outcomes: Those with WN Encephalitis continued to make slow functional gains for an average of nearly 22 months post-onset. Each progressed from primary use of a wheelchair to being a supervised or independent community ambulator. Two individuals resumed employment part-time at >40% premorbid levels. The individual with WN Meningitis returned to hobbies like golf at 4 months post-onset. Our two subjects with undifferentiated WNND infection had significant functional limitations requiring a wheelchair or an assistive device and orthosis for mobility. The limited recovery at 9 months post-onset appears to most closely resemble WN Poliomyelitis.

Discussion: Each of our subjects was either immunocompromised or of older age at the onset of West Nile Virus infection. For 6 cases, both pre-existing conditions were present. Initial medical management was marked by severe morbidity. Cognitive impairment experienced in three cases resolved by the end of inpatient rehabilitation and did not appear to adversely impact outpatient recovery. However, two cases with brainstem dysfunction had visual and vestibular impairment persist throughout the entire course of treatment. Rehabilitation for each individual was limited by profound muscle weakness and persistent fatigue despite slow progressive return of function. While inpatient rehabilitation length of stay was typically around 35 days, outpatient length of stay varied greatly according to WNND subtype. Impairments persisted post-rehabilitation limiting functional outcomes for each individual.
TITLE: Near-Infrared Treatment Decreases Symptoms Associated With Restless Legs Syndrome


ABSTRACT BODY:

Purpose/Hypothesis: Purpose: This study determined if monochromatic near-infrared light treatment is effective in decreasing symptoms associated with restless legs syndrome. Hypothesis: Treatment with near-infrared light will decrease symptoms associated with restless legs syndrome (RLS).

Number of Subjects: 34 volunteers with symptoms of restless legs syndrome were recruited for this study.

Materials/Methods: Subjects met International Restless Legs Syndrome Study Group (IRLSSG) criteria for the diagnosis of RLS in order to be admitted to the study. Subjects were randomly assigned to a treatment or placebo group. Their blood was drawn to check for serum ferritin and Vitamin B12 levels. The subjects underwent twelve 30-min treatments to their lower legs with near-infrared light. The placebo treatment did not deliver any light therapy. The RLS rating scale was used to assess and track patient symptoms. All patients filled out the RLS scale on seven occasions: just prior to treatment, at the end of each treatment week and at 1 and 3 weeks after cessation of treatment.

Results: After analyzing 18 patients (the data collection is slated to be completed by August 09), these patients reported improvement in symptoms and demonstrated a decrease in the RLS rating scale score.

Conclusions: Treatment with near-infrared light does decrease symptoms associated with RLS as demonstrated in lower RLS scale scores. This new, non-invasive and convenient method of treating this tormenting pathology might become a valuable new management option for restless legs syndrome sufferers. More research is needed to understand the exact mechanism behind infrared light treatment and this particular neurological disorder.

Clinical Relevance: Restless legs syndrome is characterized by a strong urge to move, accompanied or caused by uncomfortable, or even distressing paresthesia of the legs, described as a “creeping, tugging, pulling” feeling. The symptoms often become worse as the day progresses, leading to sleep disturbances or sleep deprivation and hence to strong fatigue, tiredness and low energy during the day time. There are only few treatment options in managing RLS, the most frequently used ones are dopaminergic drugs and exercise. New treatment options are highly sought after. Near-infrared light treatment is believed to facilitate the generation of nitric oxide from the endothelium and has been used in the treatment of neuropathy and to assist in wound healing. This study has shown that patients now have a new option to treat their RLS symptoms that is far less invasive and more convenient than most medication on the market.
**TITLE:** Improvements in outcome measures with addition of locomotor training with robot driven gait orthosis (Locomat) following over ground gait facilitation in a community ambulating patient with Intracerebral Hemorrhage.

**AUTHORS/INSTITUTIONS:** R.M. Harmon, Outpatient Physical Therapy, Moss Rehab, Media, PA; 

**ABSTRACT BODY:**

**Background & Purpose:** Body weight supported treadmill training (BWSTT) targets improvement in gait by improving symmetrical stance time and gait velocity. Walking practice with greater number of trained repetitions & normal walking velocity or faster results in improved gait speed and better function for patients with stroke. Advances in BWSTT have allowed development of a treadmill suspension system for gait training using synchronized robotic orthotic appendages. The purpose of this case study is to report effects of the addition of robot-driven locomotor treadmill training to the continuing rehabilitation of a patient with intracerebral hemorrhage.

**Case Description:** A 46y/o male with a cerebral vascular accident from intracerebral hemorrhage seen for physical therapy 2 times a week for 32 visits. Outcome tools were chosen based on functional status and prognosis. Modified Ashworth scales, ankle dorsiflexion range of motion, step length, stride length and gait pattern were measured. Activity based measures included gait speed, the 6 minute walk test, Timed up & go, Tinetti’s Performance Oriented Mobility Assessment and Berg Balance scale. Participation scales included the Stroke Impact Scale and Patient Specific Functional Scale (PSFS). Prior to the use of the Locomat, the treatment plan consisted of gait facilitation to promote a two-point reciprocal gait pattern incorporating motor relearning and NDT Bobath techniques. Robot driven locomotor treadmill training was initiated after one month of therapy. Beyond this point, the patient was only treated with the Locomat and established home exercise program.

**Outcomes:** Significant changes in most outcome measurements were noted showing a continuum of improvement throughout the course of care. Gait velocity showed the most drastic improvement. Preferred gait speed improved from 0.12m/s to 0.59m/s a 507% increase. All balance scores improved to levels of limited to falls risk. Endurance improved by a factor of four based on the six-minute walk test. Gait pattern became more normalized and clonus decreased with improved acceptance of weight onto involved lower extremity. PSFS increased from 26.6% to 90.0% indicating patient reported subjective improvement.

**Discussion:** Definitive conclusions on the effectiveness of the intervention cannot be made without a controlled study. With the time lapse of nearly 15 weeks from inpatient rehab to outpatient physical therapy, it is reasonable to conclude that the interventions facilitated a change in function. Robot-driven locomotor treadmill training allows for task-specific, long term, repetitive stepping training consistent with the principles of motor learning as a modality to maximize gait speed for patients with stroke. Utilization of this device combined with motor relearning and NDT Bobath interventions revealed a transition from barely a functional household ambulator to a near functional community ambulator.
TITLE: Utilizing the Wii Fit as Part of a Comprehensive Inpatient Physical Therapy Program to Treat Balance Dysfunction s/p Acoustic Neuroma Resection

AUTHORS/INSTITUTIONS: A. Esposito, Rusk Adult Inpatient Rehabilitation, NYU Langone Medical Center, New York, NY;

ABSTRACT BODY:
Background & Purpose: The purpose of the case study is to describe the feasibility and outcomes using the Wii Fit to treat balance s/p acoustic neuroma (AN). Advances in virtual reality (VR) make it a promising tool to treat vestibularly impaired patients, but VR is expensive and not readily available, whereas the Nintendo Wii is less expensive and commercially available.(1-2) The Wii Fit uses the forces applied by the player through their feet to measure changes in COM. Visual and auditory feedback informs the player about their position in space. Although the Wii Fit is not designed for therapeutic use, it shares qualities with expensive VR systems including repetition and feedback.

Case Description: The patient is a 51 yr old female s/p L AN resection. Upon admission, she demonstrated consistent LOB to the L during standing static and dynamic activities requiring mod A to correct. VOR was impaired with R head turns. Two hrs of PT per day 5-6 days/week focused on functional retraining, VOR exercises, balance and use of the Wii Fit. The goal was to utilize the Wii Fit for 15-20 minutes/day, 5 days/week. The protocol was established to allow time to practice functional tasks for safe discharge. Potential barriers impacting the feasibility of using the Wii Fit included patient tolerance, possible missed PT sessions and only one console available for use in the clinic.

Outcomes: Motor FIM: initial: 42; discharge: 57; Berg: initial 28/56; discharge: 48/56; LOS=20 days. The patient tolerated use of the Wii Fit 5 days/week 15-20 minutes/day for a total of 12 sessions. The Wii Fit interventions initially focused on activities that provided feedback on static standing balance and improving midline awareness. As the patient progressed, the difficulty of games increased including activities for anticipatory balance, weight shifting and unilateral stance. The patient reported a positive experience with the Wii Fit as part of her PT program. She was educated on a safe Wii Fit HEP as she owned her own console, and family training was provided to guard the patient when using the console.

Discussion: The feasibility of using the Wii Fit in the inpatient setting for a patient s/p AN resection is supported. Clinical and functional improvements were demonstrated using the FIM and Berg. Although it can not be determined whether the Wii Fit was specifically responsible for the improvements, it appears the Wii Fit is a therapeutic tool that can be utilized to address balance dysfunction while keeping the patient motivated and engaged. More research is necessary to determine whether the Wii Fit is more effective in treating balance dysfunction following AN resection compared to traditional interventions. 1.Cohen, HS. Disability and rehabilitation in the dizzy patient. Curr Opin Neurol. 2006; 19:49-54.