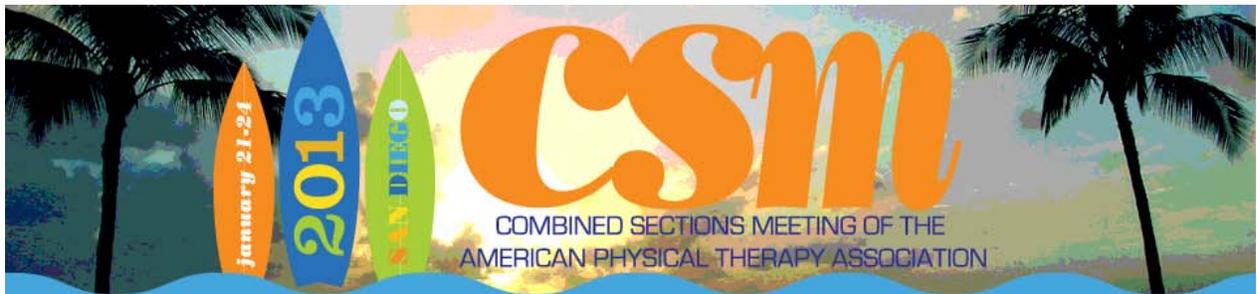


Abstracts



Neurology Section POSTER Presentations

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TITLE: The reliability and validity of the 'Sway Sled'®: a new clinical measure of stability limits.

AUTHORS/INSTITUTIONS: L.K. Allison, R. Shoaf, M. van der Linde, Physical Therapy, East Carolina Univ, Greenville, NC|

ABSTRACT BODY:

Purpose/Hypothesis : Decreased stability limits are a major risk factor for falls in older adults. Computerized forceplate testing (LOS) is the gold standard stability limits test, but is costly. The Multi-Directional Functional Reach (MDFR) test costs less, but may not be a valid measure. The new Sway Sled® (SS) is an inexpensive, easy clinical measure of stability limits that may offer better measures than the MDFR. The purpose(s) of this study are to test the reliability and validity of the Sway Sled® in young and older healthy adults, and compare these to the MDFR.

Number of Subjects : Subjects were healthy young (N=22; 12 F, mean age = 24.9 yrs, +7) and older adults (N=9; 2 F, mean age= 77.1 yrs, +26).

Materials/Methods : The SS is a lightweight, low-friction device placed on parallel bars with a height adjustable bar at the ASIS. Subjects slide the SS by weight-shifting. The distance between start and stop positions is measured. Subjects performed the SS first, then the LOS and MDFR in random order. For each group, maximum volitional sway excursion (ME) scores in all trials (3) in each direction (4; anterior, posterior, left, right) for each test (3) were compared using a RM-ANOVA ($p=0.05$) with post-hoc Paired t-tests ($p=0.0167$). Between-test comparisons included RM-ANOVA ($p= 0.05$) with post-hoc Paired t-tests ($p=0.0167$), and Pearson correlations ($p=0.05$).

Results : Reliability: For both groups, for all 3 tests in all 4 directions there was no significant difference in ME scores for Trials 2 & 3, with one exception for young adults [LOS; anterior]. In young adults, for Trials 1 & 2, SS ME scores were significantly different in only one direction (anterior), MDFR in 3 directions (anterior, right, left), and LOS in all 4 directions. In older adults, for Trials 1 & 2, ME scores for all tests in all directions were not significantly different, with one exception [LOS; left]. Validity: For both groups, SS ME scores were significantly highly correlated with the LOS in all 4 directions, with one exception for young adults (posterior). For both groups, the MDFR ME scores were significantly mildly correlated with the LOS in only one direction (young-right; older-anterior). In both groups, the SS ME scores were not significantly correlated with the MDFR in any direction, with one exception for young adults (right).

Conclusions : All 3 tests had good inter-trial reliability for both groups. First trial SS scores are accurate in both groups. First trial LOS and MDFR scores are accurate in healthy older adults; second trial scores should be used for young adults. SS scores are more reliable than MDFR scores laterally. This is important as medial-lateral COP control is a strong predictor of falls, and hip fractures occur most often with lateral falls. The SS had more frequent and higher correlations with the LOS for both age groups than the MDFR.

Clinical Relevance : The SS is a new clinical measure of stability limits with high inter-trial reliability and greater validity than the MDFR. It is useful in settings with parallel bars.

TITLE: Minimum Clinically Important Difference of the Functional Gait Assessment in Older Adults Based on Survey of Patients and Therapists

AUTHORS/INSTITUTIONS: M. Beninato, L. Plummer, Department of Physical Therapy, MGH Institute of Health Professions, Boston, MA|A. Fernandes, Physical Therapy, Brookline Heath Care Center, Brookline, MA|

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of this study was to determine the Minimal Clinically Important Difference (MCID) for the Functional Gait Assessment (FGA) in older community dwelling adults relative to patient and therapist estimates of change after physical therapy treatment of balance impairment and to determine the extent of agreement between patient and therapist (PT) estimates of change.

Number of Subjects : 94 community dwelling older adults undergoing physical therapy for balance retraining.

Materials/Methods : Patient demographics collected at the beginning of the episode of care. Estimates of change in "balance while walking" were solicited from patients and their PTs using a 15 point (-7 to +7 including a 0 point) Global Rating of Change (GROC) scale at the end of the episode of care. The FGA scores were collected at initial assessment and discharge.

Descriptive statistics were generated for demographic variables. The extent of agreement between patient and PT estimates of change was determined using weighted Kappa and Chi-square statistics. For agreement analysis, scores from the GROC were categorized as no change (scores of 0, 1, 2) minimal change (3 and 4) and moderate change (5, 6, 7). To determine the MCID for the FGA, we generated receiver operating characteristic (ROC) curves plotting the FGA change scores with the dichotomous outcome as having achieved important change (GROC score 3-7) or not (GROC score 0-2). Area under the curve (AUC), cutoff (CO) scores, sensitivity (SN), specificity (SP) and likelihood ratios (LR) were calculated. Separate analysis was performed based on therapists' ratings of change.

Results : The patients were 37.2% male with average age of 78.1+/- 6.9 and received on average 7.6 +/- 3.91 weeks of therapy. Median initial, discharge and change FGA scores were 18 (range 5-29), 23 (range 10-30) and 4 (range -2-4), respectively. Based on GROC scores, 90.4% of the patients reported important change had taken place versus 68.1% of the PTs. Poor agreement (weighted Kappa = 0.182; Chi Square = 17.89) was observed between PTs' and patients' estimates of change. Using PTs' ratings of change as the anchor, the MCID for the FGA was 5 points (AUC=.83; SN=.59; SP=.90; LR+=5.9; LR-=.46). The MCID for the FGA using patients' rating of change was also 5 points but this CO rendered lower accuracy (AUC=.59; SN=.46; SP=.78; LR+=2.09; LR-=.69).

Conclusions : A change score of 5 points may be used as an indicator of the MCID on the FGA. Poor agreement was found between patients' and PTs' estimates of change.

Clinical Relevance : PTs and their patients may be using different reference points for estimating important change in balance while walking implying a need for more explicit communication with patients relative to treatment goals consistent with patient centered care. PT ratings of change were more closely related to actual FGA change scores suggesting that PTs likely used observed performance as their anchor for rating change while patients may be using some other reference point for estimating change in balance.

TITLE: Use of the Wii Fit for Balance Rehabilitation: Establishing Parameters for Healthy Individuals, Preliminary Results

AUTHORS/INSTITUTIONS: M. Burns, K. Andeway, K. Ruroede, P. Eppenstein, Physical Therapy, Marianjoy Rehabilitation Hospital, Wheaton, IL|

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of this study is to establish balance parameters for the Wii Fit in a sample of healthy adults, for evaluation of balance measurement reproducibility.

Number of Subjects : The Wii Fit has been introduced as a cost-effective adjunct to balance training used in rehabilitation. There is scant literature on how to incorporate this technology into rehabilitation protocols using valid and reliable measurements. An IRB approved this prospective study of a healthy subject sample for analysis; 75 healthy subjects were approved for recruitment and planned to be evenly distributed across ages 21-65. The initial 73 participants' measurements are discussed here. Participants' had no history of neurological conditions or orthopedic injury that would limit study participation; body mass index below 35; self-reported to be physically active for moderate physical exertion and able to walk one mile; no self-reported history of seizures; normal blood pressure or under control with medication; female volunteers cannot be pregnant; normal or corrected to normal vision; and no previous experience with the Wii Fit.

Materials/Methods : All participants completed three trials of three balance activities on the Wii Fit, during a single session. The three activities, randomly ordered by the investigators, included: 1) Balance Bubble; 2) Body Fit/Center of Balance; and 3) Tight Rope Walking. All data were analyzed with the IBM SPSS Statistics 19.

Results : The 73 participants' age distribution were grouped into ranges; 21-35 (n = 24), 36-50 (n = 22), and 51-65 (n = 27). Descriptive statistics for distance and duration for the Bubble Balance and Tight Rope Walking were measured. Right and left Center of Balance distribution percentages were also measured across three trials. Bar graphs, line charts, and boxplots were generated to evaluate the distribution appearance and range of scores for each parameter. Detailed mean parameters are not reported given the partial sample; however, several general observations can be provided. Participants increased Balance Bubble distance and duration from the first trial to subsequent trials within the youngest and oldest group, while the middle age group did not demonstrate consistent performance across trials. Participants increased performance overall for the Tight Rope distance across trials and duration decreased from the first to subsequent trials across all age groups. Center of Balance distributed weight percentages were equal across trials on right and left sides.

Conclusions : More subjects need to complete the Wii Fit activities to evaluate a sample of healthy participants' parameters. Preliminary analysis suggests that the Wii Fit demonstrates promise as a potential tool to measure balance performance in healthy adults. Final results will be reported when testing is completed.

Clinical Relevance : To establish whether the cost effective Wii Fit can be used as a tool to measure and treat balance dysfunction in the clinical setting.

TITLE: Differences in Balance Performance and Fall Risk between Fallers and Non-fallers using Four Balance Tests

AUTHORS/INSTITUTIONS: K.K. Cleary, E. Skornyakov, K. Prescott, , Eastern Washington University, Spokane, WA

ABSTRACT BODY:

Purpose/Hypothesis : Falls in older adults can lead to serious injuries, functional declines, and death. Therefore, it is important to accurately identify those at risk for falling in order to utilize appropriate preventive interventions to decrease fall risk. Balance performance outcome measures are often used to predict an individual's risk for falling. The Berg Balance Scale (BBS), Tinetti Assessment Tool (Tinetti), Four Square Step Test (FSST) and Timed Up and Go (TUG) are four commonly used performance-based balance tests with well-established psychometric properties. The purpose of this study was to identify differences in balance performance and fall risk between fallers and non-fallers among a sample of community dwelling older adults. Specifically, the hypotheses were that (1) fallers would have poorer balance scores than non-fallers, and (2) instrument fall risk classifications would relate to fall history.

Number of Subjects : Forty-six people aged 65 and older from a senior living community participated in this study. Subjects had to be able to provide informed consent and walk independently within their living environment (with or without an assistive device) to be included in the study.

Materials/Methods : Subjects completed the four balance tests in varied order, and provided demographic data. They indicated whether they had fallen in the past year (yes/no), and were divided into "faller" and "non-faller" groups, respectively. Descriptive statistics, measures of association, and t-tests were calculated using SPSS v19.0.

Results : Of 46 subjects, 17 were fallers and 29 were non-fallers. There were no significant demographic differences between groups. Fallers performed worse on all 4 balance tests compared to non-fallers, but the only statistically significant difference between group means was on the BBS ($p=0.03$). Mean faller scores were worse than fall risk threshold scores on both the FSST and TUG. Only the FSST ($p=0.03$) and TUG ($p=0.04$) high fall risk categories were significantly associated with fall history. Of note, 13 subjects were unable to complete the FSST due to need for external support to maintain balance during the test.

Conclusions : The BBS was the only test to reveal statistically significant lower mean scores in fallers compared to non-fallers. The FSST and TUG were the only tests in which faller means were worse than fall risk threshold scores, and fall history was associated with instrument fall risk classification. Both hypotheses were partially accepted.

Clinical Relevance : The results of this study will benefit physical therapists (PTs) by describing balance performance of older adults (fallers and non-fallers) who live independently. Further, PTs may consider using the FSST or TUG fall risk classifications due to their significant relationships to fall history. More research on the FSST is warranted since many subjects were unable to complete the test despite their community dwelling status.

TITLE: Predicting Falls in Parkinson Disease: Is the Brief-BESTest as Good as the Mini-BESTest?

AUTHORS/INSTITUTIONS: R. Duncan, A.L. Leddy, G.M. Earhart, Program in Physical Therapy, Washington University, Saint Louis, MO|J. Cavanaugh, Department of Physical Therapy, University of New England, Portland, ME|L.E. Dibble, K. Foreman, Department of Physical Therapy, University of Utah, Salt Lake City, UT|T.D. Ellis, Department of Physical Therapy and Athletic Training, Boston University, Boston, MA|M.P. Ford, Department of Physical Therapy, University of Alabama at Birmingham School of Health Professions, Birmingham, AL|

ABSTRACT BODY:

Purpose/Hypothesis : Tools used to assess balance in people with Parkinson disease (PD) should be consistent in assessing the theoretical balance control systems, accurate in their ability to prospectively predict falls, and feasible and practical for clinical use. The Brief Balance Evaluation Systems Test (Brief-BESTest) is a new 6-item battery that includes items from each domain of the original BESTest. The purposes of this study were to: 1) describe balance performance of those with Parkinson disease (PD) using the Brief-BESTest, 2) determine relationships between the scores derived from three versions of the BESTest (i.e., Brief, Mini, and Full), and 3) compare the accuracy of the Brief-BESTest with that of the Mini-BESTest and BESTest in identifying fallers with PD. We hypothesized that the Brief-BESTest would be correlated with the Mini-BESTest and BESTest, and that the Brief-BESTest would be as accurate as, or more accurate than, the Mini-BESTest and full BESTest in identifying recent and future fallers.

Number of Subjects : 80 individuals (59% male; mean age 68.2 ± 9.3 ; mean Hoehn & Yahr stage 2.45 ± 0.64) with idiopathic PD.

Materials/Methods : Participants with PD ($n = 80$) completed the original 36-item BESTest at baseline while on anti-PD medication and reported their retrospective six-month fall history. Mini-BESTest items were scored concurrently with BESTest items. Brief-BESTest scores were later derived from BESTest values. Fall history also was recorded prospectively over the subsequent six-month ($n = 51$) and 12-month ($n = 40$) intervals.

Results : At baseline, participants had varying levels of balance impairment as evidenced by a mean Brief-BESTest score of $70.4\% \pm 16.7\%$. Brief-BESTest scores were significantly correlated with Mini-BESTest ($r = 0.94$; $p < 0.001$) and BESTest ($r = 0.95$; $p < 0.001$) scores. Six-month retrospective fall prediction accuracy of the Brief-BESTest at baseline was moderately high (area under the curve (AUC) = 0.82, sensitivity = 0.76; specificity = 0.84). Prospective fall prediction ability of the Brief-BESTest was similarly accurate for the six-month follow-up period (AUC = 0.88, sensitivity = 0.71, specificity = 0.87), but less sensitive over the 12-month period (AUC = 0.76, sensitivity = 0.53, specificity = 0.93). Fall prediction accuracy was similar to that of the Mini-BESTest and BESTest.

Conclusions : All three versions of the BESTest have reasonable ability to identify recent and future fallers, especially within six months before or after balance assessment.

Clinical Relevance : The Brief-BESTest is a simple and accurate tool for predicting falls among people with PD, particularly when time and equipment constraints are of concern, as the Brief-BESTest is shorter than the Mini-BESTest and full BESTest and has comparable predictive ability.

TITLE: Reliability and Validity of Measuring Gait Velocity and Step Times Using Laptop Mouse Entry

AUTHORS/INSTITUTIONS: D.W. Fell, J.C. Wall, M. Howell, A. Peterson, R. York, Dept of Physical Therapy, University of South Alabama, Mobile, AL|

ABSTRACT BODY:

Purpose/Hypothesis : Gait speed, a common objective measure, has a variety of measurement methods with varying efficacies. Therefore, it is important to identify the most accessible, efficient, and reliable methods of measuring gait velocity and other temporal measures. The aim of this study was to validate a computer software program which has been developed to analyze gait by using mouse clicks at key temporal events to calculate speed and step times during ten-meter walk trials, assessing inter-rater reliability and validity as compared to stopwatch measures.

Number of Subjects : A sample of 28 subjects was recruited (20 with no obvious gait deficits, and 8 with neurologic disability).

Materials/Methods : Subjects were videotaped during trials of a ten-meter walk test at self-selected comfortable, slow, and fast speeds. Two investigators collected data independently in real time from the central 6 meters of each trial using the computer program. The data calculated and used for analysis included total walking time and both left and right step times. Videotapes were reviewed at a later date for stopwatch measures by the same two investigators. Mean differences were calculated for each set of computer data, and compared to stopwatch measures, with 95% confidence intervals for each speed.

Results : The mean differences between all computer- and stopwatch-gathered step times at each speed were negligible for the entire sample and for the subset with disability. The mean differences of all computer-gathered step times between the two investigators were also negligible. The 95% confidence intervals showed small ranges between upper and lower limits, all included zero.

Conclusions : The computer software method is supported as both valid and reliable as a measurement tool for temporal gait parameters.

Clinical Relevance : Gait velocity and temporal measures are an essential functional measure in rehabilitation. This software makes the measures easy to accomplish in any clinical setting with a computer. Results are both valid and reliable for clinical measurement.

TITLE: The Use of the Mini-BESTest in the Diagnostic Evaluation of Patients with Suspected Normal Pressure Hydrocephalus

AUTHORS/INSTITUTIONS: M. Graham, G.K. Shumrak, , The Johns Hopkins Hospital, Baltimore, MD|

ABSTRACT BODY:

Background & Purpose : Normal pressure hydrocephalus (NPH) is characterized by an impairment of the flow and absorption of cerebrospinal fluid (CSF) causing ventriculomegaly, which leads to the following triad of symptoms: gait disturbance, cognitive dysfunction, and urinary incontinence. A method used to diagnose NPH is by a controlled CSF drainage trial via lumbar drain. Historically, physical therapists (PTs) have evaluated a patient's gait and balance pre and post drainage to determine the effects of CSF drainage on functional mobility. Literature has supported the use of the Tinetti POMA and the Timed Up and Go (TUG) for this assessment. Through a series of cases, we explore the use of the Mini-BESTest in addition to these standard outcome measures.

Case Description : 3 subjects with suspected NPH were admitted for a controlled CSF drainage trial. They underwent pre-drainage testing by a PT prior to admission. After removal of the lumbar drain and cessation of the drainage trial, all patients underwent post-drainage assessments by a different PT. Assessments included the Mini-BESTest, Tinetti, and TUG. No PT intervention was provided during the controlled drainage trial.

Outcomes : All 3 subjects demonstrated improvement in TUG, Tinetti, and Mini-BESTest scores post drainage. According to standards set by the The Johns Hopkins NPH team, these patients demonstrated a significant enough improvement in all 3 outcome measures to justify shunt placement.

Discussion : The Tinetti and TUG have been shown to be beneficial in diagnostic assessments of patients with suspected NPH. However, the Tinetti is known to have a ceiling effect on patients with minimal balance deficits. There is a need for an objective measure that can be used to demonstrate change in these higher level patients. It has been shown that dual task conditions reveal more gait impairments after CSF drainage than single-tasking in patients with suspected NPH. The Mini-BESTest has items that focus on these attention demanding tasks. Although there is no current research on the psychometric properties of the Mini- BESTest specific to the NPH population, it has been shown to be reliable and valid in other neurological disorders that have similar gait and balance impairments as NPH, particularly Parkinson's Disease. This case series demonstrates that the Mini-BESTest is feasible, efficient, inexpensive, and reactive to NPH monitoring. The Mini-BESTest has been added as a standard measure for the current NPH drainage protocol at The Johns Hopkins Hospital. Future research should focus on the psychometric properties of the Mini-BESTest in the NPH population and determining the meaningful change that would help to predict the success of shunt placement for the treatment of NPH.

TITLE: Case Report: Use Of The Xbox 360 Kinect Gaming System To Improve Balance In A Community-Dwelling Adult With A History of Recurrent Cerebellar Meningioma

AUTHORS/INSTITUTIONS: R.M. Hakim, J. Hindman, M. Horne, K. Kyle, Physical Therapy, University of Scranton, Scranton, PA, PA|

ABSTRACT BODY:

Background & Purpose : A recent systematic review (Martin et al., 2009) on the effectiveness of physical therapy (PT) for adults with cerebellar dysfunction revealed positive effects over a range of outcome measures, in particular balance and gait. However, the effectiveness of balance training using a gaming system has not been reported with this population. The purpose of this case report was to describe use of the XBox 360 Kinect to train balance in a community-dwelling adult s/p removal of a cerebellar meningioma.

Case Description : A 60 y/o male 3 months following post-op complications resulting from resection of a recurrent cerebellar meningioma presented with complaints of imbalance and recurrent near falls. PMHX included: hypercholesterolemia and prostate cancer. He lived with his wife in a two-story home and required contact guard for ambulation using a straight cane. Exam of balance-related performance was conducted before and after the intervention. Outcome measures included: Sensory Organization Test (SOT), Limits of Stability (LOS), Motor Control Test (MCT) and Adaptation test (ADT) on the NeuroCom Equitest system, Berg Balance Scale (BBS), Timed Up and Go (TUG), 30 Second Chair Stand Test (CST) and the Activities-Specific Balance Confidence (ABC) Scale. Upon initial testing, a systems review revealed problems with sensory integration, delayed motor responses, difficulty with dynamic visual acuity (DVA), eyes closed and narrow BOS activities, and decreased endurance and balance confidence. He participated in 1 hour of training on the XBox 360 Kinect 2 times a week X 6 weeks. His customized program included: body movement controlled games (e.g., soccer, bowling, reflex ridge) to improve alignment, gaze stability, and dynamic weight shifting/stepping. Activities were progressed using the level, time and rest periods.

Outcomes : Upon post-testing, SOT scores improved for conditions 1-4 (composite from 40 to 51 points), but remained below normal for 5 and 6. LOS maximum end point excursion improved by an average of 36%. MCT latency and amplitude remained WNLs. ADT improved for responses to upward platform rotation (from 2 to 0 falls), but remained unchanged/impaired for downward rotations. ABC score improved from 75.0% to 92.5%. Clinical balance tests improved as follows: BBS from 37/56 to 43/56; TUG from 14.2 to 12.2 seconds; CST from 8 to 10 reps; and DVA improved from unable to focus to maintaining focus with a drop of 2 lines during head turns. Subjectively, he reported greater ease with walking/ADLs (no longer using cane; supervision) and enjoyment of the Kinect games.

Discussion : After a 6-week XBox Kinect intervention, this individual's balance abilities generally improved with increased dynamic postural control, gaze stability and balance confidence as indicated by most outcome measures. This type of body-controlled gaming shows promise as an enjoyable, engaging adjunct to conventional PT for improving balance in community-dwelling adults with cerebellar dysfunction.

TITLE: Co-morbidities in Parkinson's disease; implications in screening for balance deficits

AUTHORS/INSTITUTIONS: L.A. King, K. Priest, F.B. Horak, , Oregon Health Sciences University, Portland, OR|D. Pierce, Biostatistics, OHSU, POrtland, OR|J. Wilhelm, A. Serdar, R. Blehm, Rehabilitation, OHSU, POrtland, OR|

ABSTRACT BODY:

Purpose/Hypothesis : Purpose: To determine the relationship between co-morbidity status and balance abilities in people with Parkinson's disease (PD).

Number of Subjects : Number of subjects: Forty-eight people with PD with a mean Unified Parkinson Rating Scale (UPDRS) score of 35 ± 11 and Hoehn and Yahr (H&Y) score of 2.4 ± 0.5 were included in this study.

Materials/Methods : Methods: All participants were screened over the phone using the Cumulative Illness Rating Scale-geriatrics (CIRS-g) and an overall co-morbidity score was calculated. All participants then came in for a clinical evaluation of their balance and disease severity using the miniBESTest and the UPDRS.

Results : Results: People with PD had high levels of comorbidity with 50 percent of all people reporting impairment in organs related to vision and hearing (90%), respiratory (64%), mental illness (62%), upper and lower GI (58%), musculoskeletal (75%) and genitourinary (54%). There was a significant correlation between co-morbidity score and balance ($r = -0.47$; $p = 0.0008$) but no relationship between co morbidity score and severity of PD ($r = 0.11$; $p = 0.46$). Balance score also related significantly to quality of life ($r = -.030$, $p = 0.04$) while disease severity did not ($r = 0.18$; $p = 0.23$).

Conclusions : Conclusion: Co-morbidities are common in people with PD and are significantly related to balance but not necessarily to disease severity.

Clinical Relevance : Clinical relevance: A phone screening of co-morbidities may alert nurses or physicians to people who should have a balance screening by a physical therapist.

TITLE: The effects of vibrotactile feedback on reaction times during dual-task balance performance in different age groups.

AUTHORS/INSTITUTIONS: C. Lin, S.L. Whitney, P. Sparto, Physical Therapy, University of Pittsburgh, Pittsburgh, PA|J.M. Furman, Otolaryngology, University of Pittsburgh, Pittsburgh, PA|P.J. Loughlin, M.S. Redfern, Bioengineering, University of Pittsburgh, Pittsburgh, PA|G.F. Marchetti, Physical Therapy, Duquesne University, Pittsburgh, PA|K. Sienko, Biomedical Engineering, University of Michigan, Ann Arbor, MI|

ABSTRACT BODY:

Purpose/Hypothesis : Vibrotactile feedback (VTF) has been shown to improve balance performance in a single-task laboratory environment. However, typical activities of daily living occur in a multi-tasking environment. Also, dual-task balance performance can degrade with aging. It is not known how well VTF can improve balance during dual-task conditions. The purpose of the study was to compare older adults with young adults in their ability to use VTF while performing an auditory choice reaction time (CRT) task concurrently with balance tasks.

Number of Subjects : 17 healthy young adults (mean: 25 ± 2 y) and 15 healthy older adults (mean: 75 ± 6 y) were recruited.

Materials/Methods : Participants completed the three-visit experimental protocol consisting of standing balance with a secondary auditory CRT task. During the first visit, subjects completed screening tests and were trained in the use of VTF during different standing balance task conditions and practiced auditory CRT tasks. The auditory CRT task required participants to push a button in their right or left hand as quickly as possible to discriminate between tones of different pitch. The standing balance task required subjects to stand for 120 s during 4 sensory organization test conditions: level (L) and sway-reference (SR) platform with eyes open (EO) and eyes closed (EC). The four conditions were performed with and without the auditory CRT, and with and without VTF. During the second and third visit, each of the 16 conditions (auditory CRT on/off * VTF on/off * Vision EO/EC * platform L/SR) were tested in random order after a short re-training. Reaction times (RT) were recorded in eight of the 16 conditions. The median RT for each condition across both sessions was calculated. A repeated measures ANOVA was conducted to test for between-subjects effects of age group and within-subjects effects of environmental conditions (VTF, Vision, and Platform) and all interaction effects. In particular, we were interested in the interactions between age group, VTF, Vision and Platform.

Results : The main effect of age group confirmed that older adults had longer RTs than young adults ($p < 0.001$). The within-subjects effects of VTF ($p < 0.001$), Vision ($p = 0.003$) and platform ($p < 0.001$) showed that those three factors influenced the RTs performance in older and young groups. Furthermore, there were significant interactions between Age * VTF ($p < 0.001$), Age * Platform ($p = 0.018$), and Age * VTF * Platform ($p = 0.008$), indicating that the older adults RTs were delayed by a greater extent compared with young adults when they were attending to VTF on SR platform.

Conclusions : The results suggest that the healthy subjects response to the information from VTF prior to the CRT task and attentional resources of older adults are compromised more than young adults when trying to utilize VTF.

Clinical Relevance : Using VTF as a balance aid depends on the person's ability to process the information in a meaningful and timely way. The research demonstrated that VTF requires additional allocation of attentional resources.

TITLE: Development and Validation of a Timed Version of the Dynamic Gait Index

AUTHORS/INSTITUTIONS: A. Shumway-Cook, P.N. Matsuda, C. Taylor, Rehabilitation Medicine, University of Washington, Seattle, WA|M. Studer, B. Whetten, , Northwest Rehabilitation Associates, Salem, OR|

ABSTRACT BODY:

Purpose/Hypothesis : The Dynamic Gait Index (DGI) measures the capacity to adapt gait to complex walking tasks (CWT) commonly encountered in daily life including: changes in gait speed, gait with horizontal head turns, gait with vertical head turns, gait with pivot turn, stepping over obstacles, stepping around obstacles, and stairs). Scores based on gait and need for assistance, range from 0, unable, to 3, normal, with a total score range from 0 (worst) to 24 (best function). The original DGI is widely used due to a low administrative burden and known psychometric properties. However, the sensitivity to change in is relatively limited because of its scoring system. This study developed a new scoring system based on the dimensions of assistance, gait, and time, and examined the psychometric properties of the new measure.

Number of Subjects : 969 participants (mean age 65.3; range 25-97 years), 138 controls and 831 mobility-impaired participants. Forty-three physical therapists collected data at 17 clinical sites throughout the US and 1 site in the United Kingdom.

Materials/Methods : PTs, recruited from clinical sites responding to the Neurology Section list serve, underwent video-based training on original and modified (time, level of assistance and gait pattern each scored separately) scoring systems. Data on original and new DGI was collected on patients receiving PT. Controls were recruited from volunteers in the Seattle area. A random sample was retested within one week. Descriptive statistics summarized sociodemographic data. Correlational analysis examined the relationship between original and new scoring systems. SPSS 16.0 was used to conduct an exploratory factor analysis with oblimin rotation. Item response theory examined the effectiveness of the new scoring system, test score dimensionality, and determined redundancy in the scale.

Results : Test-retest reliability for the new DGI total scores was high ($r = .90$); internal consistency was $\alpha = .94$. Correlation between old and new DGI gait pattern scores was high ($r = .98$). New DGI gait pattern scores were only moderately correlated with time ($r = -.62$) and level of assistance ($r = .58$) suggesting that time and level of assistance measure distinct but correlated constructs. Original DGI scores were moderately correlated with time ($r = -.62$) and level of assistance ($r = .60$) suggesting that time and assistance were not measured in the original DGI total score. Three correlated factors, gait pattern time and level of assistance, explained 78% of the total variance. Correlations among the factors ranged from .57 to .59.

Conclusions : The modified version of the DGI appears to be a reliable and more sensitive measure than the original DGI, with time and level of assistance providing distinct information beyond that of gait difficulty.

Clinical Relevance : Sensitive measures of locomotor performance, including the ability to adapt gait to complex walking conditions found in daily life, are an essential part of locomotor rehabilitation.

TITLE: The Accelerometer as a Valid Outcome Measure of Core Stability during Dynamic Activities

AUTHORS/INSTITUTIONS: T.L. Millard, D.M. Hayes, K. Bellamy, S. Brubaker, H. Dunn, J. Gurley, K. Kincaid, , North Georgia College & State University, Cumming, GA|

ABSTRACT BODY:

Purpose/Hypothesis : Falls resulting from balance loss are leading cause of head injury. Balance interventions aimed at fall incidence target core stability or postural control. The gold standards of postural stability are expensive with limited portability. Portable, easy to use tools are needed to assess postural control, balance and/or provide immediate feedback during interventions. While accelerometers have predominantly been used to measure energy expenditure, recent evidence demonstrates its use as a measure of static and dynamic balance. The objectives of this study were to examine accelerometer responses in moving and nonmoving environments and to investigate the reliability and validity of the accelerometer as a measure of core stability during dynamic activities as compared to the Biodex balance trainer.

Number of Subjects : 21 participants without impairment (21.4 ± 2.5 years; 52% female) were recruited.

Materials/Methods : In a quasi-experimental design, participants completed 2 sessions within one week consisting of Biodex testing, walking, and stabilizing on rolling platform while wearing an accelerometer. Intra-class correlation (ICC) was used to establish test-retest reliability. Concurrent criterion-related validity was established by comparing accelerometer data to Biodex testing and content validity by demonstrating differences in accelerometer counts between the two conditions.

Results : Fair to good ICC (3,1) values for accelerometer activity and AP counts were 0.59 ($p = .016$) and 0.84 ($p < .001$) respectively during Biodex postural stability testing. During dynamic activities AP accelerometer counts during walking and stabilizing on a rolling platform were significant (ICC (3,1) = 0.72, $p = .003$; ICC (3,1) = 0.49, $p = .045$). Activity and AP accelerometer counts during Biodex testing significantly correlated with postural stability AP score ($r = 0.89$, $p < .001$ and $r = 0.94$, $p < .001$) and with postural stability index score (0.90, $p < .001$ and 0.95, $p < .001$). As predicted accelerometer activity counts in all three axes during walking were significantly higher as compared to stabilizing on rolling platform (210.8 vs. 1.8; 52.1 vs. 7.1; 325.6 vs. 40.7).

Conclusions : Accelerometer AP axis counts had the strongest test-retest reliability during postural stability testing, moving activity, and stabilizing on a moving platform. Activity and AP counts were strongly correlated with Biodex for postural stability measurement. Concomitantly, the accelerometer differentiated a high activity condition (walking) as compared to a low activity or stabilizing activity (holding position on a rolling platform).

Clinical Relevance : The attributes of the accelerometer including portability, low cost, ease of use, high reliability and validity in a variety of environments make it clinically relevant for assessing balance deficits. Activity and AP counts potentially serve two purposes: 1) outcome measure of change in core stability and 2) clinical assessment identifying a patient's level of function to enhance goal setting and determination of effective exercise prescription parameters.

TITLE: Effectiveness of the Feldenkrais Method for balance systems and balance related disorders: a systematic review

AUTHORS/INSTITUTIONS: B.I. Richardson, M.D. Fenner, R.J. Allen, Physical Therapy, University of Puget Sound, Tacoma, WA

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of this systematic review was to investigate the efficacy of the Feldenkrais Method as an intervention for improving balance.

Number of Subjects : Eleven quantitative research studies from peer-reviewed research journals fit the inclusion/exclusion criteria for this systematic review. Each study included the Feldenkrais Method as a treatment intervention, and had at least one outcome measure relating to balance.

Materials/Methods : PubMed, CINAHL, SportDISCUS, and Health Source: Nursing & Academic Edition were searched on December 23, 2010 for "Feldenkrais". All subject ages and diagnoses were included, and all publication years preceding our search date were accepted. Experimental, quasi-experimental, and single group pre- post-test design studies were included. Articles were excluded if the full text was not available in English.

Results : Eleven articles fit our inclusion/exclusion criteria, and were evaluated with the PEDro scale. The articles were then organized by the following subject types: healthy young adults, people with musculoskeletal issues, stroke survivors, people with multiple sclerosis, and older adults.

Conclusions : Based on systematic review of available literature, it appears that the Feldenkrais Method may be effective for increasing trunk flexion and decreasing postural sway in young, healthy adults. There is also moderate support for the use of Feldenkrais for improving balance in people with multiple sclerosis. Evidence is strong for the use of Feldenkrais for improving balance in older adults. More research is needed to determine whether Feldenkrais is effective improving balance in stroke survivors, individuals with musculoskeletal disorders, and other populations.

Clinical Relevance : Balance is an issue commonly addressed as part of skilled physical therapy intervention, particularly in neurological populations and with older adults. It is a complex system that often necessitates innovative treatment approaches. When patients do not respond to standard interventions for balance deficits, there are some complementary approaches that can be utilized in conjunction with conventional treatment for optimal results. One such approach is the Feldenkrais Method. Feldenkrais is a method of somatic education that helps patients become more aware of how they move, and uses specific patterns of movement to redirect neuromuscular pathways and promote motor learning. If a patient has balance deficits that are not responding to standard physical therapy interventions, it may be worth considering the use of the Feldenkrais Method, particularly if the patient is over age 65 or has multiple sclerosis.

TITLE: Kinematic Analysis of Postural Response to Posterior Translation While Wearing Rocker Bottom Shoes in Younger and Older Adults

AUTHORS/INSTITUTIONS: D.R. Scott, E. Gullede, R. Bolena, B. Albright, Department of Physical Therapy, College of Allied Health Sciences, East Carolina University, Greenville, NC|

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of this study was to compare the kinematic differences of the postural response to a posterior surface translation between younger and older adults while wearing a control shoe and a rocker bottom shoe.

Number of Subjects : 15 healthy younger adults (ages: 20-35) and 14 healthy older adults (ages: 50-75)

Materials/Methods : Control and rocker bottom (sole rounded from metatarsal heads to toe) shoes were used in this study. Participants attended two research sessions. During Session 1, the below threshold stepping velocity (BTSV) was determined. The BTSV was defined as the fastest velocity at which the participant was able to maintain balance without stepping in three consecutive trials while wearing rocker bottom shoes. During Session 2, the kinematic data was collected. Participants stood on a dynamic force plate in a predetermined position. Data was collected for six trials (3 anterior, 3 posterior) in rocker bottom and control shoes. Data was analyzed for 3 s post perturbation for the posterior trials. Joint excursion, time to initial response, response time, and variability were calculated. Statistical analysis included paired t-tests to compare the effects of shoe type and two-sample t-tests to compare the effects of age.

Results : In rocker bottom shoes, both age groups exhibited a different kinematic postural response. Joint excursion was significantly increased while wearing rocker bottom shoes at the ankle and knee. While wearing rocker bottom shoes, time to initial response was significantly decreased at the ankle and significantly increased at the head. Response time was significantly increased in rocker bottom shoes at the ankle and hip. Variability was significantly increased while wearing rocker bottom shoes at the ankle, trunk, and head. Though no significance was found for the majority of kinematic variables between age groups, the mean BTSV of the older group was significantly slower than the younger group.

Conclusions : In both younger and older adults, a posterior surface perturbation while wearing shoes with rocker bottom soles resulted in distinct and significantly different kinematic responses when compared to control shoes. The kinematics of postural responses indicate that shoes with rocker bottom soles are potentially more destabilizing for both young and older adults. In addition to the kinematic differences found between shoe types, the mean BTSV of the older group while wearing rocker bottom shoes was significantly slower than the younger group. This finding further supports the conclusion that in healthy older adults and in populations at risk for falls, the use of rocker bottom or other unstable shoes increase the potential of falls when confronted with a standing perturbation such as a forceful slip or trip.

Clinical Relevance : These results raise concerns that shoes with rocker bottom soles may increase the risk of falls, particularly in older adults.

TITLE: Equilibrium of three dimensional spinal rotation differences in subjects with and without low back pain.

AUTHORS/INSTITUTIONS: P. Sung, J. Ryu, E. Jeong, P. Shrestha, , Korea University, Seoul, KOREA, REPUBLIC OF

ABSTRACT BODY:

Purpose/Hypothesis : Although a number of studies have evaluated postural adjustments based on kinematic changes, spinal rotation angles with relative holding time (RHT) and relative standstill time (RST) has not been carefully considered in subjects with low back pain (LBP). This study investigated three dimensional kinematic changes of spinal axes based on gender and dominance side difference in subjects with and without LBP while standing on one leg without visual feedback.

Number of Subjects : Subjects with (n=26; 9 men, 17 women) and without (n=28; 11 men, 17 women) recurrent low back pain (LBP) participated in this study.

Materials/Methods : All participants were asked to maintain the stork test position (standing on one leg with the contra lateral hip flexed 90 degrees) for 25 seconds. The outcome measures included rotational angles for the axes of the spine (Rx, Ry and Rz).

Results : The RHT was longer for both the core spine and lumbar spine axes for subjects without LBP than those from subjects with LBP. For the core axis of the trunk, significant differences between the two groups exhibited based on the main effect of visual feedback ($F = 7.07$, $p = 0.01$), trunk rotation ($F = 4.36$, $p = 0.04$), and both of these interactions ($F = 4.44$, $p = 0.04$). However, there was a lack of significant interaction with age for the lumbar and core spinal axes.

Conclusions : The stability index of the core spine significantly decreased in both RHT and RST, especially when visual feedback was blocked for subjects with LBP. The interaction between visual feedback and trunk rotation indicated that core spine stability is critical in coordinating balance control.

Clinical Relevance : A trunk muscle imbalance may contribute to unbalanced postural activity, which could prompt a decreased, uncoordinated bracing effect in subjects with LBP. As a result, kinematic rehabilitation training could be used in the prevention of postural instability in such subjects.

TITLE: Identification of Fall Risk in Community Dwelling Older Adults Using Non-linear Analysis of Head Sway

AUTHORS/INSTITUTIONS: M.H. Thompson, , ACTe One Consulting & Education, LLC, Vancouver, WA|D.M.

Wrisley, Department of Physical Therapy, Lynchburg College, Lynchburg, VA|J. Cavanaugh, Department of Physical Therapy, University of New England, Portland, ME|P.R. Trueblood, Department of Physical Therapy, California State University –Fresno, Fresno, CA|D. Umphred, Department of Physical Therapy, University of the Pacific, Stockton, CA|

ABSTRACT BODY:

Purpose/Hypothesis : The goal of this cross-sectional investigation was to discriminate fall-risk from non-fall risk healthy, community dwelling older adults (CDA) comparing linear and non-linear analyses of postural sway, specifically Approximate Entropy (ApEn) and the Largest Lyapunov Exponent (LyE).

Number of Subjects : The sample was comprised of 30 CDA (72.64 ± 7.84 years) without a history of falls, documented pathology, or body system impairment upon examination. The subjects scored 89.84 % (9.91) on the Activities Specific Balance Confidence (ABC) scale indicating high confidence in their balance abilities. The median Vestibular Activities of Daily Living (VADL) score for the subjects was 1.2 (0.68) indicating that they were highly functional.

Materials/Methods : The Functional Gait Assessment (FGA) was selected to classify the subjects as fall-risk and non fall-risk. Postural sway was measured during static and anterior/posterior (AP) sway-referenced surface testing conditions, recording both COP and head movement in the AP and medial/lateral directions. First, the ability of the measures of the CoP and head sway in STATIC and APROT test conditions to identify differences between CDA with fall risk and those without risk was determined using the independent t Test, with a significance set at <0.05 . Those measures found through independent t-test to identify a difference between the groups (fall risk, no fall risk) were selected for analysis of discriminative validity using the Receiver Operator Curve (ROC) and the Area under the Curve (AUC).

Results : Traditional linear analyses of COP or head sway data in either test condition or direction were unable to discriminate individuals at risk from those not at risk. However, using non-linear analyses of AP head sway, a cut-off ApEn value of 0.384 demonstrated the ability to identify the fall-risk group with a sensitivity of 100%, specificity of 59%, and a positive and negative LR of 2.45 and 0.41.

Conclusions : These results suggest that linear analysis of platform COP sway alone lacks the discriminate ability to identify fall risk in the healthy CDA population, but may be improved by the examination of head movement and the addition of non-linear analyses.

Clinical Relevance : Older adults have increased risk of falls and balance impairment is a key risk factor. Linear analyses of postural sway have shown variable ability to discriminate fallers from non-fallers in the healthy, community dwelling adult population.

TITLE: The Arabic Version of the Dynamic Gait Index: A Validation Study.

AUTHORS/INSTITUTIONS: A.A. Alghwiri, Physical Therapy, The University of Jordan, Amman, JORDAN|W.

Mahmoud, Physical Therapy, Jordan University Hospital, Amman, JORDAN|

ABSTRACT BODY:

Purpose/Hypothesis : To evaluate the inter- and intra-rater reliability of the Dynamic Gait Index (DGI) after translating it to Arabic.

Number of Subjects : A convenience sample of 47 patients with stroke (mean age 64 years, SD 12).

Materials/Methods : The DGI was translated according to the World Health Organization forward/backward translation protocol for translating assessment tools.

Participants were assessed using the Arabic version of the DGI twice with one week interval. Two physical therapists did the first assessment to test the inter-rater reliability and one physical therapist did the second assessment to test the intra-rater reliability.

The intraclass correlation coefficient (ICC), model (2,1), and the 95% confidence interval were used to estimate the inter- and intra-rater reliability of Arabic version of the DGI .

Results : The Arabic version of the DGI total score reflected high agreement for both inter-rater and intra-rater reliability (intraclass correlation coefficient =.98), (confidence interval =.97-.99).

Conclusions : The Arabic version of the DGI was developed and reflected high reliability of the total score in stroke population.

Clinical Relevance : The availability of a reliable Arabic version of the DGI facilitates its use among therapists from Arabic origins; consequently this will enrich the rehabilitation process in their clinical practice.

TITLE: Examination of sustained gait speed in individuals with chronic stroke deficits

AUTHORS/INSTITUTIONS: P. Altenburger, T.A. Dierks, K.K. Miller, Physical Therapy, University of Indiana, Indianapolis, IN|A.A. Schmid, Health Services Research and Development Center on Implementing Evidenced-Based Practice, Roudebush Veterans Administration, Indianapolis, IN|S.A. Combs, Krannert School of Physical Therapy, University of Indianapolis, Indianapolis, IN|M. Van Puymbroeck, Recreation, Parks, and Tourism Studies, Indiana University, Bloomington, IN|

ABSTRACT BODY:

Purpose/Hypothesis : Post stroke survivors suffer from an inability to achieve a walking speed that enables them to independently ambulate within the community. Sustained walking speed is often calculated from the distance achieved during the 6-minute walk. This calculation assumes individuals tested maintain a specific level of gait speed throughout the test. The aim of this study was to measure the change in real-time gait speed in a cohort of chronic stroke survivors during a 6 minute walk test (6MWT).

Number of Subjects : A convenience sample of 45 individuals with chronic stroke onset greater than 6 months ago. Criteria for inclusion were: completed all stroke related in-patient rehabilitation; had residual functional disability; score a >4 out of 6 on the short 6 item Mini-Mental State Examination; and were between the ages of 50-85. Individuals were excluded if they: were unable to verbally communicate; if their therapy referral was for sensory, cognitive, or speech deficits only; or if they had pre-morbid psychiatric histories which included inpatient stays.

Materials/Methods : The 6MWT was used to measure sustained gait speed. Participants were asked to walk back and forth along a 100 foot walkway at a comfortable pace covering as much ground as possible in six minutes. During the 6MWT each participant passed over an electronic gait mat (GaitRITE System) which captured their self-selected comfortable walking speed. Fast walking speed (FWS) was measured using the 10 meter walk test (10MWT).

Results : A significant reduction in gait speed was found when initial comfortable gait speed was compared to end gait speed during the 6-minute walk test (.88m/s vs. .80m/s, $p < .00001$). Subgroup assessment based upon ambulation classification (limited community = .4m/s - .8m/s, unlimited community = > .8m/s) revealed significant declines in speed for those classified as limited community (.61m/s vs. .53m/s, $p=.010$) and community ambulators (1.15m/s vs. 1.06m/s, $p=.0001$). Average maximum gait speed calculated during the 6MWT was significantly slower than the on-demand speed recorded during the 10MWT (.88m/s vs. 1.06m/s, $p < .00001$).

Conclusions : Our findings demonstrated a significant decline in gait speed during the 6MWT of .08m/s. Subgroup gait speed classifications revealed declining speeds for both the limited community and community ambulator categories. A speed calculation from the average distance walked would not have captured this change. Declines in sustainable gait speed could significantly impact patient confidence and quality of life.

Clinical Relevance : Common clinical practice is to measure fast and comfortable gait speed using the 10MWT while evaluations of gait endurance are assessed with the 6MWT. Applying this standardized approach to these individuals would not have identified an inability to maintain a sustained gait speed. Managing functional recovery of gait should include examination of real-time sustained gait speed with goals focusing on an individual's ability to maintain speeds for 6 minutes or longer.

TITLE: Task Analysis to Guide Intervention in a Person with Chronic Cerebellar Stroke

AUTHORS/INSTITUTIONS: A. Ash, E. Hussey, S.A. Meardon, Health Professions, UW-La Crosse, La Crosse, Wi,

ABSTRACT BODY:

Background & Purpose : Cerebellar strokes often lead to significant difficulties with recovery of motor coordination. Task-oriented approaches have the potential to support the repetition and specificity needed to improve functional mobility and have been reported to be beneficial for gait and to reduce falls risk. Hedman's task analysis model is often used to diagnose specific difficulties of movement control. However, application of this model to the development of a task-oriented circuit has not been demonstrated. Task analysis may be a useful method in determining coordination deficits in order to create an individualized intervention. The purpose of this case report was to describe the outcomes of a task analysis-based circuitry program on function and independence in a person with cerebellar stroke.

Case Description : A 29-year-old woman, two years after cerebellar stroke, demonstrated bilateral motor incoordination and lacked independent mobility. At baseline, task analysis (using videotape) of critical elements for sit to stand (STS) and walking were used to identify key movement deficits. Based on these deficits a task-oriented circuit of STS, walking, strength and balance was developed. Baseline measures included: Five Times Sit-to-Stand (FTSTS) from a standard and mobile chair, standard and dual task Timed Up and Go (TUG), 6-Minute Walk Test (6MWT), Dynamic Gait Index (DGI), Activities-specific Balance Confidence (ABC), and functional torque ratios at the knee. Outcomes were analyzed relative to minimum detectable change scores (MDC).

Outcomes : After 34 sessions, FTSTS improved ≥ 20 s during stable and mobile conditions (MDC=2.3s). TUG-standard remained unchanged ($\Delta=1$ s; MDC=2.9s), TUG with a carrying task improved ($\Delta=5$ s); TUG with a secondary cognitive task worsened ($\Delta=7$ s). Her ABC score improved 27.4% (MDC=13%). No meaningful change was observed for 6MWT, DGI, or functional torque ratios. Task analysis was repeated using videotaped assessment and provided qualitative indicators of improved coordination relative to the patient's adaptability to conditions during sit to stand transitions and forward walking.

Discussion : This case report demonstrates the use of systematic task-analysis to determine the priorities for task-oriented interventions in a patient with cerebellar stroke. Meaningful improvements were observed in functional outcome measures related to safety and independence, as well as self-perceptions of balance capability. Little impact was observed in standardized measures of gait. Qualitatively, the patient made gains in adaptive movement coordination and control during transfers and gait. While limited by the individual's capacity for change, repetition of specific tasks and task elements, identified through task analysis, appeared to translate into improved functional mobility and independence for this patient. Further methods to quantify the observed coordination changes would be beneficial.

TITLE: Predictors of functional outcomes (OASIS-C) for patients after stroke undergoing home-based rehabilitation.

AUTHORS/INSTITUTIONS: F.Y. Asiri, S.L. Whitney, , University of Pittsburgh, pittsburgh, PA|G.F. Marchetti, , Duquesne University, pittsburgh, PA|J. Ellis, L. Otis, , Gentiva Home Health Services , Atlanta, GA|

ABSTRACT BODY:

Purpose/Hypothesis : The literature on the impact of home-based rehabilitation on functional outcomes for patients after stroke is limited. The purpose of this study is to describe the outcomes of home-based rehabilitation on functional performance for patients after stroke and associated factors that contribute to better outcomes after an episode of care.

Number of Subjects : 182 (mean age 76.5 ± 9 years, 51% male) receiving home care services for late effect of cerebrovascular accident CVA (hemiplegia) after hospitalization for CVA.

Materials/Methods : Treatment records for patients receiving home-based rehabilitation in 2010 were reviewed at the start of care and discharge. Patients were selected based on ICD-9 codes with CVA on admission to home care. The primary outcome measure was a change in ADL performance between admission and discharge from home health care (HHC) services. Functional status items in the Outcome Assessment Information Set OASIS-C consist of nine activities of daily living (ADL) items. The composite score to calculate overall functional status was used. Data were retrieved from one home health agency database. It was hypothesized that the ADL score, gait speed, and cognitive function at the start of care would be significant predictors of improvement in functional performance over the course of the home care intervention. Mean change in ADL score and factors predictive of improvement were identified using analysis of covariance and multivariate linear models.

Results : Patients showed improvement in mean ADL scores after an episode of care (2.13 ± 1.28 points). After adjustment for ADL score at the start of care, discharge facility (acute versus rehab/long term care), gait speed (household versus community), memory function, and presence of confusion were significantly associated (all $p < .05$) with improvement in functional scores. The best multivariate model included cognitive function, speed of walking, discharge facility, memory deficits, and presence of confusion, which predicted 71% of the variance in ADL score changes over the course of intervention. In addition, patients who were ambulating at least 0.4 m/s (limited community) demonstrated significantly greater ADL change than those walking at slower speeds < 0.4 m/s (Household), $p = .031$.

Conclusions : There was a significant improvement in ADL function for patients with stroke after receiving home-based rehabilitation. Gait speed at the start of care had an influence on functional improvement. The interaction among the factors of discharge facility, confusion and cognitive function also predict functional change after an episode of care.

Clinical Relevance : Knowledge of which factors affect outcome in persons who have had a stroke and are undergoing treatment in the home could affect goal setting.

TITLE: Effectiveness of Body Weight Supported Treadmill Training on Gait Speed in the Stroke Population: A Systematic Review

AUTHORS/INSTITUTIONS: J. Baldwin, A. Hassan, E. Townsend, A. McCarthy-Jacobson, Department of Physical Therapy, MGH Institute of Health Professions, Boston, MA

ABSTRACT BODY:

Purpose/Hypothesis : To assess, the effect of Body Weight Supported Treadmill Training (BWSTT) versus overground gait training (OGT) on gait speed (GS) and to evaluate whether BWSTT versus OGT improves GS so that individuals achieve community ambulation (GS>0.8 m/sec).

Number of Subjects : Thirteen articles were included for evaluation with Sackett's level of evidence ranging from 1A-2B indicating that all articles were Randomized controlled trials.

Materials/Methods : The study design was a systematic review. Three electronic databases, CINAHL, PUBMED and PEDro were searched. Randomized controlled trials (RCTs) and crossover study designs were included that compared BWSTT to OGT. Studies that included electrical stimulation, biofeedback based on EMG, virtual reality or robotic devices were excluded. The quality of the articles retrieved was evaluated according to the PEDro scale.

Results : Thirteen articles were included for evaluation with Sackett's level of evidence ranging from 1A-2B indicating that all articles were RCTs. The PEDro scores for these studies were variable (Mean=5.8 [SD 1.14], range 4-8 out of 10). Inter-rater reliability for the scoring of these articles was excellent [ICC (3,1) of 0.92]. Of the 13 studies, 8 achieved minimally clinical important difference in gait speed (.16 m/sec) in both the BSWTT and OGT and conventional therapy groups as measured by the 10 meter walk test. Only 4 studies reported significant between-group effects where BWSTT led to higher gains in GS. None of the studies demonstrated achievement of community ambulation status. There was little to no consistent dosing of BWSTT or OGT/conventional therapy across studies.

Conclusions : Body Weight Supported Treadmill Training is not superior to overground gait training for the improvement of GS or to achieve community ambulation status. Variability in training protocols makes it difficult to identify optimal parameters for the maximal outcomes in GS and function. Further studies are needed to establish optimal dosing of either OGT or BWSTT to maximize the benefit of gait training in people with stroke.

Clinical Relevance : Considering the costs of BWSTT, OGT may be chosen as a comparably effective treatment modality.

TITLE: Effects of 6-months of Intensive Physical Therapy in Conjunction with Pharmacological Interventions on Chronic Stroke Outcomes: A Case Study

AUTHORS/INSTITUTIONS: E. Barakatt, B. Coleman-Salgado, M. McKeough, J. Gong, E. Mintz, J. Thatch, A. Vourakis, Department of Physical Therapy, California State University, Sacramento, Sacramento, CA|D. Mandeville, Department of Kinesiology and Health Science, California State University, Sacramento, Sacramento, CA|

ABSTRACT BODY:

Background & Purpose : This case report describes the effects of intensive physical therapy in conjunction with muscle relaxant and neurotoxin pharmacological interventions on gait and function outcomes for a patient with chronic impairments following a stroke.

Case Description : The 57 year-old male patient was 13-months post ischemic stroke with severe left hemiparesis and upper motor neuron syndrome in the left upper and lower extremities. Patient received oral baclofen throughout the treatment period to control hypertonicity. Two months into the course of treatment the patient received intramuscular onabotulinumtoxinA injections in select muscles of the left upper and lower extremities to target local areas of hypertonicity. The patient received physical therapy interventions consistently 4 to 5 times per week during 20 of the 25 weeks of the study period. Interventions included weight-supported treadmill training, over-ground training, endurance training, neuromuscular re-education and balance training.

Outcomes : At the end of the study period the patient demonstrated measurable changes in fastest gait velocity, gait endurance, balance (Berg Balance Scale), mobility (Timed Up and Go test), and motor functioning as measured by the Stroke Rehabilitation Assessment of Movement Measure. Kinematic measures of the lower extremity during gait also demonstrated clinically meaningful improvements in ankle and knee ROM during both stance and swing phases of gait.

Discussion : This case report demonstrates that improvements in body function and activity outcomes can occur in an individual with significant poststroke chronic impairments with intensive physical therapy in conjunction with selective pharmacologic interventions to control abnormal muscle performance.

The findings of this case report reveal the possibility that an individual more than 18 months following a stroke can make meaningful improvements in body function and activity outcomes. This report also reveals the possibility that intensive physical therapy in conjunction with appropriate pharmacological interventions provides an opportunity for motor control improvements in an individual with significant poststroke chronic impairments.

TITLE: Short-term Effects of Hyperresistance Exposure on Gait Velocity and Muscle Activation in Persons Post-Stroke

AUTHORS/INSTITUTIONS: A. Bauer, D. Dessecker, K. Everly, E. Percival, M. Wlodarski, J.H. Kahn, , Feinberg School of Medicine, Northwestern University, Chicago, IL|D. Brown, , University of Alabama at Birmingham, Birmingham, AL|

ABSTRACT BODY:

Purpose/Hypothesis : One functional complication of stroke is a decrease in walking speed, due to a combination of muscle weakness and inappropriate phasing of muscle activity. Potentially, slowing a person down and providing high resistance (hyperresistance) could assist in activating central mechanisms that increase force generation and could result in an immediate increase in gait speed. The purpose of this study was to investigate the immediate effects of hyperresistance walking exposure on gait speed in persons post-stroke.

We hypothesized that exposure to hyperresistance during walking would cause an immediate increase in gait speed whereas an increase in gait speed would not be observed after exposure of walking at a comfortable speed without resistance. We also expect that the amplitude of rectus femoris (RF) and medial gastrocnemius (MG) muscle activation in the paretic leg would increase following the hyperresistance exposure.

Number of Subjects : Participants were 13 individuals with chronic post-stroke hemiplegia (6 male, 7 female; 5 right-sided hemiplegia, 8 left-sided hemiplegia; mean age = 51 years 7 months; mean months post-stroke = 11 years 11 months).

Materials/Methods : We used the KineAssist Driven Treadmill (KdT), which can sense forces produced at the hip to drive the speed of the treadmill. Each participant performed two Overground Ten Meter Walk Tests (OG-10MWTs), then were given a short period to acclimate to walking in the KdT. Subjects underwent a control exposure that consisted of comfortable walking speed with no resistance, followed by an experimental exposure of hyperresistance walking. Our primary outcome was gait speed, measured using KdT-based Ten Meter Walk Tests (KdT-10MWTs). Averages of gait speed, step length, and cadence were calculated for each KdT-10MWT. KdT-10MWTs were performed pre-control, post-control/pre-experimental, and post-experimental. Additionally, KdT-10MWTs were performed at seven intervals during each exposure. EMG signals were collected bilaterally from RF and MG during each KdT-10MWT to determine the change in activation amplitude. Paired T-tests were performed to compare speed during the control exposure to speed during the experimental exposure, using a p-value of < 0.05 .

Results : We did not observe a statistically significance immediate increase in gait speed when comparing experimental to control. However, seven subjects (high-response group) had at least a small meaningful change (≥ 0.05 m/s) in gait speed, with an average increase of 0.13 m/s. There was a statistically significant increase in step length within the high-response group ($p = 0.025$). No significant changes in cadence or EMG were found.

Conclusions : Overall, hyperresistance exposure did not cause an immediate, significant increase in gait speed or muscle activation. However, a subgroup did show at least a small meaningful change in gait speed, which was due to an increase in step length.

Clinical Relevance : Hyperresistance training is a potentially viable option for increasing gait speed in stroke survivors.

TITLE: Clinician adherence to a standardized assessment battery across settings and disciplines in a post-stroke rehabilitation population

AUTHORS/INSTITUTIONS: M.D. Bland, C.E. Lang, Physical Therapy, Washington University School of Medicine, St. Louis, MO|R. Fucetola, T. Huskey, A. Carter, M. Corbetta, Neurology, Washington University School of Medicine, St. Louis, MO|A. Sturmoski, M. Kramper, , The Rehabilitation Institute of St. Louis, St. Louis, MO|M. Whitson, H. Harris, J. Edmiaston, , Barnes Jewish Hospital Rehabilitation Services, St. Louis, MO|L.T. Connor, Occupational Therapy, Washington University School of Medicine, St. Louis, MO|

ABSTRACT BODY:

Purpose/Hypothesis : Examine clinician adherence of the Brain Recovery Core standardized assessment battery across settings (acute hospital, inpatient rehabilitation facility (IRF), outpatient facility) and professional disciplines (physical therapy (PT), occupational therapy (OT), speech-language pathology (SLP)) in participants post-stroke. Evaluate which specific implementation events or processes affected adherence and for how long adherence was sustained.

Number of Subjects : 2194 participant records stored in the Brain Recovery Core database between August 2010 and December 2011.

Materials/Methods : All participants admitted to the acute hospital, IRF or outpatient services with stroke undergo standardized admission and discharge assessments. Each month, clinician-specific feedback is provided showing adherence to the required assessment battery. Various events (e.g. staff meetings, all service meetings) were held periodically throughout the 17 month time period. A repeated measures ANOVA was used to determine if adherence to the BRC assessment battery differed across settings and/or disciplines. Visual inspections of time-series data were conducted to see if the events increased adherence $\geq 5\%$ and if so, how long the increase lasted.

Results : Adherence ranged from 21-100% across all settings and professional disciplines. Of the 3 settings (main effect of setting, $p < .001$), the acute hospital had the highest adherence (82%), followed by the IRF (80%) and then the outpatient facility (62%). Of the three disciplines (main effect of discipline, $p < .001$), PT had the highest adherence (83%), followed by OT (74%) and SLP (66%). Of the 25 events conducted across settings and disciplines, 10 resulted in a $\geq 5\%$ increase in adherence the next month. Of these 10, 6 services maintained their increased adherence for at least one month.

Conclusions : Actual adherence to using a standardized assessment battery in rehabilitation clinical practice varied across settings and disciplines. Specific events increased adherence 40% of the time with these gains maintained in 60% of those services for greater than a month.

Clinical Relevance : Standardized clinical assessments can be implemented into practice across different settings and professional disciplines. Knowing actual adherence versus self-reported adherence to standardized assessment use will assist with future implementation efforts as well as future analysis of delivery of care.

TITLE: INVESTIGATING WHETHER DISCHARGE DESTINATION FROM A LONG TERM CARE HOSPITAL CAN BE PREDICTED USING ADMISSION/DISCHARGE FIM SCORES FOR PATIENTS POST CVA.

AUTHORS/INSTITUTIONS: J. Booth, C. Kerscher, K. Klauber, J. Popp, Physical Therapy, Quinnipiac University, Hamden, CT]

ABSTRACT BODY:

Purpose/Hypothesis : To investigate whether admission/discharge Functional Independence Measure (FIM) scores can predict discharge destination for patients post cerebral vascular accident (CVA). Secondly, to identify if age, gender, race, social support, type/side of CVA, length of stay (LOS) and number of comorbidities, influence discharge.

Number of Subjects : 390 patients with the impairment code "stroke" were selected. 19 were excluded based on admitting ICD-9 code unrelated to CVA, 39 were excluded based on discharge destination. Final sample population consisted of 332 subjects.

Materials/Methods : A retrospective chart review of patients admitted to a long-term acute care hospital was conducted. Inclusion: inpatient rehabilitation following first CVA. Exclusion: history of prior CVA, discharge resulting in hospital readmission. Chi squared analyses were performed on gender, race and marital status, while Spearman correlations were performed on age, admission/discharge FIM and LOS to identify correlations with discharge setting. A multifactorial regression analysis was performed utilizing factors with significant correlations. Receiver operating characteristic (ROC) curves were created to identify admission/discharge FIM cut scores for community discharge.

Results : Significant correlations were found between discharge destination and age ($p<0.01$), admission FIM ($p<0.01$), discharge FIM ($p<0.01$), LOS ($p<0.01$) and gender ($p<0.05$). Regression analysis found 56% of the variance was explained by these factors. ROC curves identified an admission/discharge FIM cut score of 43/85 respectively for community discharge.

Conclusions : Admission/discharge FIM scores help predict discharge destination post CVA; age, LOS and gender also influence destination. These factors only represent a small portion of the elements influencing discharge planning.

Clinical Relevance : The results from this study can aid the discharge planning team in determining the appropriate discharge setting early in the patient's rehabilitation phase. Early determination of discharge can allow the family enough time to make necessary arrangements and home modifications. Additionally, this study offers quantitative data surrounding discharge planning. The quantitative results obtained from this study can be useful for physical therapists and case managers when advocating for a specific discharge setting not authorized by insurance. Lastly, improving the discharge planning process can lead to a more optimal utilization of resources thus decreasing the health care costs associated with a CVA.

TITLE: Locomotor Rehabilitation of Individuals with Chronic Stroke: Difference between Responders and Non-Responders

AUTHORS/INSTITUTIONS: S.A. Kautz, Health Science and Research, Medical University of South Carolina, Charleston, SC|M.G. Bowden, C.M. Gregory, , Ralph H. Johnson VA Medical Center, Charleston, SC|A. Behrman, Physical Therapy, University of Florida, Gainesville, FL|R.R. Neptune, Mechanical Engineering, University of Texas, Austin, TX|

ABSTRACT BODY:

Purpose/Hypothesis : Despite multiple clinical trials, little is understood regarding the difference between those demonstrating minimal clinically important differences (MCID) in self-selected walking speed (SSWS) and those who achieved lesser gains with locomotor rehabilitation. The purpose of this study was to demonstrate how those who respond with at least a MCID in SSWS (defined as 0.16m/s) differ in specific outcome measures from those with smaller SSWS increases. We hypothesized that those with an MCID in SSWS (responders) would demonstrate significant increases in clinical gait, balance, and daily step activity outcome measures, and that changes in SSWS would be correlated with changes in other clinical outcome measures. Furthermore, we hypothesized that responders would demonstrate significant improvements in measures of walking-specific motor control, while non-responders (SSWS < 0.16m/s) would do so without significant gains in motor control measures.

Number of Subjects : 27

Materials/Methods : Twenty seven hemiparetic subjects (17 left hemiparesis; 19 men; age: 58.7 + 13.0 years; 22.7 + 16.4 months post-stroke) participated in a 12-week locomotor intervention incorporating training on a treadmill with body weight support (BWS) and manual trainers accompanied by training overground. Measures of motor control, balance, functional walking ability and endurance were collected at pre- and post-intervention assessments. Participants were stratified based on a SSWS change of greater than or less than 0.16m/s. Paired sample t-tests were run to assess changes in each group, and correlations were run between the change in each variable and change in SSWS.

Results : The overall group increased SSWS by 0.21m/s. 18 responders and 9 non-responders, only differed by age (responders=63.6 years, non-responders=49.0 years, $p=0.001$) and the lower extremity Fugl-Meyer (responders=24.7, non-responders=19.9, $p=0.003$). Responders demonstrated an average improvement in SSWS of 0.27m/s as well as significant gains in all variables except daily step activity. Conversely, the non-responders improved SSWS by a statistically significant but not clinically meaningful 0.10m/s and also significantly improved endurance (the distance walked in 6 minutes) by 96 feet. Change in SSWS was negatively correlated with changes in measures of motor control in the non-responder group, implying that gains in SSWS were accomplished via compensatory mechanisms.

Conclusions : This study investigated locomotor outcomes within the context of those who achieve clinically meaningful changes in SSWS. Responders demonstrate significant and clinically meaningful changes in a variety of clinical outcome measures suggesting some recovery of more normal motor control, while non-responders appeared to increase speed via compensation.

Clinical Relevance : This study is the first step towards discerning the underlying factors contributing to improved walking performance with the goal to develop adequate models for prescribing specific therapies or combinations of therapies.

TITLE: Outcomes Following Music-Based Treadmill Training on a Patient Three Months Post-Stroke: A Case Report
AUTHORS/INSTITUTIONS: C. Boyea, S. Ryer, Physical Therapy, Carroll University, Waukesha, WI|M. Patel, Physical Therapy, Clement J. Zablocki Medical Center, Milwaukee, WI

ABSTRACT BODY:

Background & Purpose : Stroke has a profound effect on functional ability and quality of life. Millions of Americans have had a stroke, with more individuals experiencing a stroke each day. Restoration of walking function is a primary rehabilitation goal post-stroke. The most common gait impairments include decreased gait speed, cadence, and step length, and overall asymmetry. Treadmill training alone and in conjunction with rhythmic auditory stimuli has been correlated with increased gait speed and cadence in this population. The purpose of this case report is to describe outcomes in relation to gait speed and cadence, gait pattern, and patient-rated disability score following an intervention involving treadmill training and tempo-matched music.

Case Description : A 64-year-old male with a left-sided ischemic stroke received physical therapy in the inpatient rehabilitation setting. He presented at 65 days post-stroke with right-sided hemiparesis with impaired strength, motor control, sensation, and balance, and required minimal assistance with all mobility tasks. The patient received 18 physical therapy treatments two times per day, with five of those treatments incorporating treadmill training with music auditory stimuli. Music tracts were selected based on tempo, in which treadmill speed (miles per hour) was converted to tempo (beats per minute). During treadmill training, the patient was instructed to 'step to the rhythm of the music'.

Outcomes : At study completion, the patient demonstrated significant improvements in preferred gait speed, gait pattern and disability-rating on the Stroke Impact Scale (SIS) and non-significant improvements in fast gait speed and functional mobility on the Functional Independence Measure (FIM) and Stroke Rehabilitation Assessment Measure (STREAM). The patient's preferred gait speed increased from 0.332 m/s to 0.515 m/s and fast gait speed increased from 0.410 m/s to 0.571 m/s. The 7-Item Berg Balance Scale total score decreased from 14 to 10, STREAM total score increased from 30 to 33, FIM increased from 24 to 31, and SIS decreased from 54.2 to 53.0.

Discussion : The use of treadmill training has shown growth in recent years for addressing gait impairments following stroke. At study completion, the patient demonstrated a significant improvement in gait speed as well as met the minimum speed necessary to cross an average crosswalk safely. Gait impairments, particularly gait speed, are components of mobility that limit an individual from returning to their home and community environments. This study diverges from current research by incorporating an individual in the subacute phase of stroke, utilizing music auditory stimuli, and employing slower treadmill speeds. Treadmill training in conjunction with music stimuli has the potential to facilitate improvements in the stroke population, and with this approach, additional research is necessary to determine the relationship between music stimuli and functional improvements.

TITLE: The Effect of Commercial Gaming Systems on Upper Extremity Function During Stroke Rehabilitation: A Systematic Review

AUTHORS/INSTITUTIONS: K. Curbow-Wilcox, M. Brown, T. Davis, H. Greer, L. Roberts, B. Tate, C. Walker, School of Health Related Professions, Department of Physical Therapy, University of Mississippi Medical Center , Jackson, MS|

ABSTRACT BODY:

Purpose/Hypothesis : Stroke is the fifth leading cause of disability with 55% to 75% of patients continuing to experience hemiparesis after stroke rehabilitation. Hemiparesis of the upper extremity affects the ability to perform motor activities, which has a direct effect on independence and activities of daily living. Incorporating commercial gaming into stroke rehabilitation may be beneficial to patient recovery. The purpose of this systematic review was to evaluate the effect of commercial gaming systems on function of the affected upper extremity during stroke rehabilitation.

Number of Subjects : 4

Materials/Methods : The PubMed database was searched through February 2012 for clinical trials that used commercial gaming systems to treat patients after stroke. Search terms related to stroke and commercial gaming systems. No electronic limitations or exclusion criteria were used. Inclusion criteria were as follows: 1) clinical trial, 2) primary outcome measures: upper extremity function scales, 3) patients: post-stroke with upper extremity involvement, and 4) commercial gaming systems. Studies that met all inclusion criteria were scored using the Physiotherapy Evidence Database (PEDro) and the 2011 Oxford Centre of Evidence Based Medicine (CEBM) level of evidence scale.

Results : The electronic search revealed 14 articles. The title screen reduced the articles to seven and the abstract screen further decreased the number of appropriate articles to six. Four articles remained following the application of inclusion criteria. The remaining four articles were scored using PEDro and CEBM levels. The average PEDro score of the articles was 6 with a range of 8 to 4. On the CEBM level of evidence scale, three articles were scored as Level IV and one article was Level II.

Conclusions : The results of this systematic review demonstrated that the use of commercial gaming systems during stroke rehabilitation may potentially be effective in improving function of the affected upper extremity. The available evidence was graded as a "C" because the studies in this systematic review were consistently weak with the majority of studies having a PEDro score of less than 6.

Clinical Relevance : Although significant improvements were seen in all studies reviewed, inconsistent results coupled with moderate internal validity scores reduces the clinical significance of this intervention. Additional research is needed to clearly demonstrate the efficacy of commercial gaming systems in improving function of the affected upper extremity in patients post stroke.

TITLE: 'Living with a ball and chain': The lived experience of stroke for individuals and caregivers in rural Appalachian Kentucky

AUTHORS/INSTITUTIONS: M. Danzl, S. Campbell, J. Kuperstein, K. Maddy, A.L. Harrison, Rehabilitation Sciences, University of Kentucky, Lexington, KY|E. Hunter, , Cardinal Hill Rehabilitation Hospital, Lexington, KY|V. Sylvia, , Appalachian Regional Healthcare, Hazard, KY|

ABSTRACT BODY:

Purpose/Hypothesis : Stroke is one of the most prevalent and disabling conditions for individuals in rural Appalachia. To identify barriers and supports needed for community reintegration and positive quality of life for these individuals, an understanding of their lived experience is paramount. The purpose of this study is to describe the experience of stroke onset, transition through the healthcare system, and attempted community reintegration for individuals and caregivers in rural Appalachian Kentucky.

Number of Subjects : 13 individuals with stroke, 11 caregivers

Materials/Methods : An interprofessional research team conducted a qualitative study with an interpretative phenomenological approach using purposeful, criterion sampling. Data collection (interviews) and analysis occurred concurrently. Through alternating immersion and crystallization as individual researchers and as a team, data were analyzed within- and across-cases to assess experiences unique to participants and shared patterns among participants. Strategies to establish trustworthiness included triangulation of interview data with field notes and reflective memos, dual coding, peer debriefing in team meetings, and the use of thick description.

Results : Participants' experience of stroke onset was 'when life changed'. The unexpected and sudden onset was a life-changing event that devastated life plans. The transition through the healthcare continuum was marked by minimal recollection of acute care, the realization of what happened and stroke severity in inpatient rehabilitation, and marked decreases in healthcare support once discharged home. In attempts for home and community reintegration, hope and optimism dissipated with the experience of slow recovery and diminished capacity to resume meaningful roles. Maintaining a sense of self was important in managing depression and improving quality of life. Challenges to maintaining this included an altered sense of home and lack of control of one's life. 'Living with stroke' was marked by social and emotional issues. Some had positive family/community support, especially from faith groups. Many, however, experienced a lack of care and compassion with deficits attributed to mental illness instead of stroke, community stigmatization, and altered social relationships. Caregiving was a new role for most caregivers. For many, it was all consuming and difficult to balance caregiving with other life roles. Both individuals with stroke and caregivers expressed a need for support from community and healthcare systems.

Conclusions : Participants experienced profound emotional and social issues in attempts to live with stroke. The findings identify a lack of sufficient community and healthcare support once people return to their Appalachian communities.

Clinical Relevance : The findings of this study provide valuable insight for healthcare providers and community leaders attempting to improve service provision, facilitate community reintegration and support a positive quality of life for individuals with stroke and caregivers living in rural settings.

TITLE: The lived experience of stroke across the continuum of care in rural Appalachia: Theoretical frameworks

AUTHORS/INSTITUTIONS: A.L. Harrison, J. Kuperstein, M. Danzl, S. Campbell, K. Maddy, Rehabilitation Sciences, University of Kentucky, Lexington, KY|E. Hunter, , Cardinal Hill Rehabilitation Hospital, Lexington, KY|V. Sylvia, , Appalachian Regional Healthcare, Hazard, KY|

ABSTRACT BODY:

Abstract Body : Individuals with stroke and caregivers in rural communities experience negative health disparities and a lack of available resources. Facilitating self-determination is an important mediating variable to overcome these barriers and achieve positive health behavior changes, community integration, and improved quality of life. Self-determination encompasses competence (one's ability to effectively handle situations and feel capable and competent to do so), relatedness (desire to interact and connect to others), and autonomy (being a causal agent in one's life).

Our research team conducted a qualitative study with 24 participants to investigate the experiences of individuals with stroke and caregivers in Appalachian Kentucky in their transition through the healthcare continuum and attempted community reintegration. The purpose of this theory report is to present the theoretical frameworks used to guide data analysis and present a new model for identifying assets and needs in rural communities with the goal of facilitating self-determination.

Ecological systems theory informed our data analysis. Using modified domains of the social ecological model, we identified social support assets and needs at the levels of the microsystem (individual with stroke and caregiver), exosystem (community at-large and healthcare), and mesosystem (the closer community, connecting the micro- and exosystems). Types of social support include emotional (empathy, encouragement, spiritual), appraisal (affirmation, feedback, social comparison), informational (advice, directives), instrumental (money, time, in-kind assistance), and environmental (built and social environment).

The mesosystem we propose has the potential to provide vital linkages between the microsystem and exosystem. Examples of mesosystem supports are the use of community health navigators, development and funding of local support groups both for individuals with stroke and for caregivers, community education campaigns (e.g. health literacy initiatives, obtaining basic health insurance coverage, development of medical power of attorney and living wills), development and provision of educational resources to rural communities (e.g. falls reduction, stroke prevention, stroke etiology, healthcare resources), and knowledge translation efforts to update rural healthcare providers about social support needs of individuals with stroke and caregivers.

There is a sharp decline in mesosystem support once individuals with stroke are discharged to their communities, a time when the need and readiness for learning appear to be at high levels and the individuals are starting to 'live with stroke'. Future research is needed to investigate how the development of the mesosystem may reduce medical costs and improve quality of life for individuals with stroke and caregivers in rural regions.

TITLE: Use of Video Feedback during Chronic Stroke Rehabilitation

AUTHORS/INSTITUTIONS: S.M. Deprey, R. Grafenauer, A. Hunt, J. Smith, Dept of Health and Human Movement Sciences, Carroll University, Waukesha, WI

ABSTRACT BODY:

Background & Purpose : Videofeedback (VF) has been used extensively in sports to improve motor performance; additionally it has also been used in rehabilitation with individuals with stroke and visual neglect. Due to visual, perceptual and sensation deficits found after stroke, external feedback, such as VF, may promote a motor learning advantage over internal or verbal feedback alone. Motor learning requires detection of errors through sensory feedback to judge future performances. Thus, the learner needs to determine how the movement felt and judge if the chosen movement was appropriate to meet task demands. Persons with neglect are often unable to correct left side deficits due to the inability to synthesize sensory information. When viewing a video, one's left side is viewed on the right side of the monitor, thus individuals may be more likely to acknowledge and identify their deficits. Therefore, the purpose of this study is to describe the functional outcomes after physical therapy that included VF during post stroke intervention.

Case Description : Four subjects participated, mean age =57 yrs (range 54-59 yrs). All experienced a right middle cerebral vascular accident with resultant left hemiparesis >2 years prior to the study. Subjects 1 and 3 were ♂. Subjects had a Mini Mental State Exam (MMSE) >29, except subject 3 who scored 26. All subjects received 75 minutes of standard post stroke intervention 2x/week; 1x/week a video of one functional task (e.g., sit to stand) was taken. Subjects would view the video immediately after the task for up to 3 viewings.

Outcomes : Outcomes were assessed pre-and 9 weeks post- intervention and at 8 week retention without intervention. All subjects' Timed Up & Go (TUG) scores improved, however only subjects 3 and 4's scores met the minimal detectable change (MDC) of 2.9 sec. All but subject 3 maintained TUG gains at 8 weeks. All subjects' Berg Balance Scale ↑'d and met MDC for chronic stroke of >2.5 points; gains were maintained 8 weeks later for subjects 1 and 2. Subjects 2 and 4 exceeded the MDC of 37m on the Six minute walk test. All subjects' walking speed was slower after 9 weeks of intervention and remained slower at the 8 week retention test. Survey to determine the perceived usefulness of VF revealed that while the videos helped gain a better understanding of what components of a task needed to improve, the 2 ♂ participants did not like to see how they looked and focused on how poorly they were performing the task. Subject 3 also had difficulty interpreting the VF.

Discussion : Balance demonstrated positive changes after VF. Male subjects demonstrated improvements in more of the outcomes. Subject 3 had less positive gains in outcome measures. She also demonstrated the lowest MMSE (26) and was not able to identify areas of deficits on the video. Results from this case report are inconclusive and suggest variables such as individual characteristics (e.g., cognition, abstract or mechanical thinking and self-efficacy) may make VF more or less useful.

TITLE: The Combined Use of Serial Casting and Functional Electrical Stimulation to Improve Walking Speed and Range of Motion in a Patient with Chronic Spastic Hemiplegia

AUTHORS/INSTITUTIONS: M. Eikenberry, F. White, , Mayo Clinic Hospital, Phoenix, AZ, AZ|

ABSTRACT BODY:

Background & Purpose : Serial casting is commonly used to reduce spasticity and improve range of motion (ROM) of the gastroc-soleus muscle complex in patients with chronic hemiplegia secondary to acquired brain injury. Functional Electrical Stimulation (FES) is another option to reduce spasticity and improve ROM in patients with stroke and brain injury. Little data exists investigating the use of serial casting on functional outcomes, such as walking speed, in patients with stroke. However, several studies have documented the known benefit of FES on improved walking speed in these patients. This case study will illustrate the combined use of serial casting and FES to improve ROM and walking speed in a patient with chronic stroke.

Case Description : A 48 year old female with chronic spastic right hemiplegia due to a left ischemic stroke obtained a Bioness L300 (FES) system 6 months prior to the case study. After a training period with outpatient physical therapy, the patient ambulated limited community distances, using the Bioness L300 system and a single point cane. Over the course of 6 months, the patient experienced worsening spasticity and subsequently developed a 10 degree plantar flexion (PF) contracture. Subsequently, the patient regressed to the use of a front wheeled walker for ambulation with the FES device. The patient received four sequential castings to the right ankle at progressive dorsiflexion (DF) ranges of motion for a total of 10 days in the casts. The following tests were completed immediately before and after casting interventions: measurement of right ankle DF, passive ROM (PROM) with knee extended and a 10 meter walk test (10MWT) at both self-selected and fast speeds using a single point cane with the FES device.

Outcomes : The patients PROM improved from a 10 degree PF contracture to 5 degrees of DF for a 15 degree improvement in DF ROM. Both the 10MWT self selected and 10MWT fast tests showed clinically meaningful changes. The 10MWT (self-selected) improved from a speed of 0.4 meters/second (m/s) to 0.54 m/s for a total improvement of 0.14 m/s. The 10MWT (fast) improved from 0.45 m/s to 0.58 m/s for a total improvement of 0.13 m/s.

Discussion : These findings suggest a benefit with using serial casting to improve ROM and walking speed for this patient. Clinically meaningful changes for both ROM and walking speed were found after the casting intervention. Functional electrical stimulation devices are optimal when they are able to move the affected extremity through the entire range of motion. With a PF contracture, patients using FES devices will not have optimal gait mechanics or ambulation speeds secondary to inability to adequately clear the involved foot. Clinicians contemplating FES prescription for patients with spastic hemiplegia and PF contractures, may find the use of serial casting helpful to optimize ROM and improve functional performance.

TITLE: The Impact of Shoulder Abduction Angle and Abduction Loading on Reaching Distance in Adults with Chronic Hemiparesis

AUTHORS/INSTITUTIONS: M.D. Ellis, K. Barczak, S. Chirillo, G. Costabile, G. Dunford, J. Snetselaar, J. Drogos, J.P. Dewald, Physical Therapy and Human Movement Sciences, Northwestern University, Chicago, IL

ABSTRACT BODY:

Purpose/Hypothesis : Prior studies have demonstrated that reaching distance decreases as a function of abduction loading due to abnormal co-activation of abductors/elbow flexors and subsequent loss of independent joint control in individuals with stroke. While previous investigations have fully described horizontal planar reaching at shoulder height (90° abduction), no attempts have been made to investigate the impact of reaching at greater degrees of abduction. The aim of this study was to determine the effect of shoulder abduction on reaching distance while controlling for the known effects of abduction loading on independent joint control.

Number of Subjects : 10 individuals (2 female, 8 male) with chronic stroke participated in the study.

Materials/Methods : Maximum voluntary shoulder abduction torque was measured with a 6-DOF load cell. Maximum reaching distance was then measured using the ACT3D robot during four loading conditions (supported on a haptic surface, 0%, 12.5%, and 25% of max abduction), three abduction angles (90°, 105°, and 120°), and two environmental conditions (real vs. simulated elevation for 105° and 120°) to a standardized target. Maximum reaching distance was obtained from the longest of 10 reaching trials for each condition and was normalized by the total distance to the target. Finally, a passive lift condition was implemented with the ACT3D robot in order to determine if passive and/or active resistance to abduction was present. In the passive lift protocol, EMG was collected for the vertical fibers of pectoralis major and the latissimus dorsi.

Results : Reaching distance decreased with increasing abduction load ($p=0.001$) and with increasing abduction angle ($p=0.005$). In a second comparison of real vs. simulated elevation, there was no effect on reaching distance ($p=0.12$). Finally, during the passive lift condition, adductor muscle activation was quiescent however there was a slight increase in passive resistance to abduction equivalent to 15% of limb weight.

Conclusions : For a given abduction load, reaching distance decreases with greater abduction angles in individuals with stroke. This is likely due to the presence of external joint moments imparted by gravity, or more specifically, the component parallel to the reaching plane, and not likely due to flexion synergy since abduction loading was controlled and identical in all conditions.

Clinical Relevance : Shoulder flexion and elbow extension that occur during planar reaching greater than 90° of abduction are limited by both abnormal co-activation of elbow flexors and the component of gravity parallel to the reaching plane that imparts shoulder extension and elbow flexion torques. Both factors contribute independently to impede functional overhead reaching. Passive resistance to abduction may also limit reaching distance. Although our comparison of real vs. simulated elevation didn't indicate this, the small resistance to abduction detected during the passive lift suggests that it should be considered at least in patients with limited abduction PROM.

TITLE: Recovery of gait following the resection of the primary motor cortex.

AUTHORS/INSTITUTIONS: M.D. Ellis, Physical Therapy and Human Movement Sciences, Northwestern University, Chicago, IL|M. Fasick, Rehabilitation Therapies, Advocate Lutheran General Hospital, Park Ridge, IL|D. Ronin, Physical Medicine and Rehabilitation, Advocate Lutheran General Hospital, Park Ridge, IL|

ABSTRACT BODY:

Background & Purpose : Severe loss of descending corticospinal pathways following stroke leaves few neural resources available for controlling the affected arm and leg. A case is presented here where an individual survived a stroke that resulted in the complete resection of the primary motor cortex and surrounding motor areas, yet through rehabilitation, he recovered the ability to walk. A neuroanatomical explanation is offered based on current evidence.

Case Description : A 64 year old suffered an ischemic MCA stroke. He was treated with tPA but had complications including intracerebral bleeding. The patient underwent hematoma evacuation and craniotomy. He was intubated and had a tracheostomy and G-tube placed and was transferred to a long-term acute care facility followed by a subacute facility and finally to an intensive inpatient rehabilitation facility 3 months following the onset of stroke. On presentation to the inpatient rehabilitation facility, motor performance on the left side was significant for flaccidity with emerging hypertonicity of the plantar flexors and inverters. Muscle strength was 0/5 throughout. The patient was able to achieve standing in the parallel bars with maximum assistance but pushed toward the paretic side and required knee blocking on the left. He was graded 1 to 2 out of 7 on all functional mobility components of the FIM and was unable to attempt ambulation. Specific to ambulation, treatment progressed from standing tolerance in the standing frame and with a KAFO in the parallel bars to recumbent cycle ergometry to body weight support gait training on a treadmill and over-ground.

Outcomes : At discharge the patient was able to stand upright unsupported for 10 seconds without an assistive device. He transferred with minimum assistance with a large-based quad cane and an AFO. He demonstrated a circumducted gait pattern with external rotation and hip hiking in swing and limited limb loading and time spent in stance on the paretic side. He was able to walk 60 feet at a speed of 0.1 m/s with a large-based quad cane and an AFO and required minimum assistance approximately every 10 feet to stabilize posture.

Discussion : The achievement of ambulation in the absence of primary and secondary motor cortices is remarkable. It begs the question of what remaining neural resources were responsible for the control of the paretic leg in our patient. Mounting evidence supports the takeover of contralesional motor cortex in the control of the paretic limbs. Contralesional descending cortical pathways have access to the affected leg via brainstem. Unfortunately, while allowing for strong activation of lower limb muscles, this comes at a severe cost to inter-joint coordination. This is due to the multi-segmental collateralization of brainstem pathways that results in co-activation of muscles across joints. This is the likely mechanism that allowed our patient to achieve ambulation albeit with his gait pattern reflecting synergistic hip, knee, and ankle joint coupling resultant from abnormal muscle co-activations.

TITLE: Pedometers to Augment The Health of Stroke Survivors – A Pilot Study

AUTHORS/INSTITUTIONS: L. Espe, A. Kelly, L. Vielbig, J.E. Sullivan, Department of Physical Therapy and Human Movement Sciences, Northwestern University , Chicago, IL|

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of this study was to examine the effect of a community-based, pedometer-monitored walking program on gait speed, walking distance, health-related quality of life, and balance self-efficacy in adults with chronic stroke.

Number of Subjects : Eleven subjects completed the study; 5 female, 6 male. Mean time since stroke 12.2 (1.5-25) years; mean age 60.4 (41-87) years; side of involvement 7 – left, 4 – right. Participants were community ambulating adults (≥ 21 years of age) with a diagnosis of chronic stroke (≥ 6 months).

Materials/Methods : Four primary outcome measures were administered at pre-test, post-test, and 3-month follow-up. These included the Activities-Specific Balance Confidence Scale (ABC), the Stroke Impact Scale (SIS), the 6-minute walk test (6MWT), and the 10-meter walk test (10MWT). Subjects were instructed on pedometer use, signs and symptoms warranting medical attention, use of the Rating of Perceived Exertion (RPE) scale, and step log use. Subjects wore pedometers daily for 6 weeks and recorded daily step counts. Researchers contacted subjects weekly by phone to discuss progress and record step counts. A decision algorithm was used to set walking goals for the following week.

Results : Results: All subjects completed the intervention without adverse events. There were no group mean statistically significant improvements on any of the outcome measures. Eight subjects demonstrated improved 6MWT scores across at least one time interval. All subjects improved on at least one outcome measure at post-test. Three subjects improved on multiple outcome measures data post-test and 3-month follow up. These subjects were slightly younger (mean age 57); had significantly more recent stroke onset than other subjects (4.5 years, $p=0.024$) and tended to have lower initial scores on 6MWT. Two of these subjects' improvement exceeded the MCID for the 6MWT.

Conclusions : A a community-based, pedometer-monitored walking program may improve walking endurance following stroke, however the small number and heterogeneous characteristics of subjects limit generalizability. Future research should explore optimal subject and intervention characteristics of pedometer-monitored walking programs.

Clinical Relevance : This study demonstrates that chronic stroke subjects can use pedometers safely in the community to monitor activity.

TITLE: "Mi Trial Es Su Trial": A Comprehensive, Interdisciplinary Approach to Overcome A Spanish Language Barrier for Inclusion in a Multi-Site, Behavioral, Randomized Controlled Rehabilitation Trial

AUTHORS/INSTITUTIONS: O. Gallardo, R. Lewthwaite, B. Wagenheim, , Rancho Los Amigos National Rehabilitation Center, Downey, CA|M. Nelsen, C. Lane, C.J. Winstein, Division of Biokinesiology and Physical Therapy at the Herman Ostrow School of Dentistry, University of Southern California, Los Angeles, CA|

ABSTRACT BODY:

Purpose : To make the ICARE clinical trial accessible to Spanish speaking individuals and increase Hispanic recruitment capacity while assuring validity of the data.

Description : Stroke is the leading cause of adult disability in the United States, impacting approximately 6 million individuals and their families annually. Incidence by ethnicity in the U.S. is 87% Non-Hispanic and 8.2% Hispanic. The Interdisciplinary Comprehensive Arm Rehabilitation Evaluation (ICARE) is a language intensive, NIH-funded phase III trial, based in 3 regionally distributed centers (Atlanta, Los Angeles, Washington DC). Analysis of early recruitment activity suggested that Non-English language was a sole reason for exclusion for a significant number of prospective participants across the 5 California sites. In California, 27% (50% at one site) met stroke diagnosis criteria and were excluded due only to language during Pre- Screening, as compared with 1% in Georgia and 2% in the District of Columbia. NIH policy mandates minority inclusion in Phase III clinical trials and requires that designs permit valid analysis. We determined that an important minority population, Spanish speakers, required inclusion.

Summary of Use : Only 3 of the 26 assessment tools needed were available in validated Spanish translations and we did not have the luxury of selecting alternative culturally-sensitive instruments to ease the inclusion of Spanish speaking individuals. Thus an interdisciplinary team initiated a strategic plan to translate the remaining assessment tools, therapy documents (14), and specific informed consent tools (4) into culturally equivalent Spanish language print materials, scripts and a parallel Spanish language data dictionary. Robust validity checks included multiple, ethnically-diverse reviewers; back translation; standardization competencies and comparison of data sets attained in English and Spanish interactions. The described plan and procedures for translation of all study documents was required to obtain Institutional Review Board approval for recruitment of Spanish speaking individuals

Importance to Members: Language need not be a barrier to inclusion in a complex trial involving a principle-based behavioral intervention. With a committed team of professionals, rigorous standards and validation testing, study protocols may be developed with equivalent psychosocial and psychomotor attributes in Spanish. Inclusion and development of cross-cultural measures and interventions are important to increase generalizability of trial results and reduce inequalities in health care

TITLE: Effects of the Application of a Weighted Gait Belt on Gait Parameters in Individuals with Hemiparesis Following a Stroke: A Pilot Study

AUTHORS/INSTITUTIONS: P. Ghosh, K. Goeke, B. Schmitt, A. Bertrand, C. Bouton, A. Buelow, , Maryville University, St. Louis, MO|

ABSTRACT BODY:

Purpose/Hypothesis : Asymmetric spatiotemporal gait characteristics have been shown to be prevalent in individuals following stroke with hemiparetic gait. No studies have been conducted to analyze the effects of a weighted gait belt on characteristics of gait during overground walking in individuals following stroke. Therefore, the purpose of our study was to investigate the effects of the application of additional weight on a gait belt to the hemiparetic side of the pelvis on gait parameters in individuals with chronic stroke.

Number of Subjects : Five female and five male individuals poststroke between the ages of 45 and 70 were recruited.

Materials/Methods : All ten participants satisfied the eligibility criteria and agreed to participate in a single session of the proposed intervention. Approximately three percent of their body weight was calculated after standing on a scale. Sand weight equal to three percent of body weight was applied to gait belt on the hemiparetic side of the pelvis and weight distribution on each side was assessed before and after addition of weight by using one scale under each foot. All participants ambulated 30 feet, six times on the GaitRite mat; three times with weight and three times without weight, alternating with each trial. Values of gait parameters recorded from the GaitRite were statistically analyzed using a MANOVA. In order to delineate more detailed association, a paired t-test was run to compare the step length differential, step time differential, weight distribution during static stance, and single limb support before and after the addition of weight.

Results : Our results indicate that the application of additional weight on a gait belt showed a significant decrease in both step time differential ($p<0.05$) and step length differential ($p<0.001$) when compared to the values obtained without application of weight. Our data also indicate that the use of additional weight on the affected side significantly increased weight bearing in the affected lower extremity ($p<0.002$) and decreased weight bearing in the unaffected lower extremity ($p<0.01$) when compared to the values obtained without the application of weight. The single leg support time on both affected and unaffected side did not show any significant differences but displayed a trend of an increase in the time spent in single leg support after addition of weight. The use of additional weight did not change the velocity and cadence.

Conclusions : Our findings indicate that the use of applied weight on a gait belt to the hemiparetic side of the pelvis can promote more symmetrical pattern of gait in individuals following stroke

Clinical Relevance : The outcome of our pilot study may help clinicians to consider using weighted gait belt during gait training of individual with hemiparesis following stroke.

TITLE: Differences in Motor Coordination between Adults Post Stroke with or without Sensory Loss

AUTHORS/INSTITUTIONS: K. Gutman, E. Donoso Brown, C. Moritz, D. Rios, T. Gilbertson, K.E. Miller, R. Price, S.W. McCoy, Rehabilitation Medicine, University of Washington, Seattle, WA|

ABSTRACT BODY:

Background & Purpose : Sensory impairments are reported in 53% of people after stroke, and greater numbers may be affected by impaired discriminative sensation.. Sensation loss can negatively impact the speed of completing motor tasks. However, there is little evidence of the relationship between sensation loss and the capacity to gain motor function if provided with motor training. The effect of sensation loss on the ability to improve muscle coordination through a motor task was evaluated using NeuroGame Therapy (NGT), a home surface electromyography (sEMG) biofeedback system connected to a video game which is controlled by active wrist extensor and flexor muscle activity.

Case Description : Participants were four adults (3 males), ranging in age from 53 to 68 years. Two of the participants had loss of protective sensation as measured by Semmes-Weinstein monofilaments on the 3rd digit, thumb pad, and palmar surface of the hemiplegic arm. Of the two participants without sensation loss, one had slightly diminished protective sensation on his 3rd digit and thumb pad, with the remaining upper extremity having normal sensation. Participants were assessed by sEMG measurements of maximum voluntary contraction (MVC) and co-contraction ratios (wrist extensor integrated sEMG/wrist flexor integrated sEMG and normalized using the sEMG MVCs) during active range of motion into wrist extension (AROM), and a reaching task. Measurements were taken twice before NGT, and twice after game play. NGT was conducted at home for approximately one month after completing four training sessions. Participants were asked to play the game five times a week for up to 45 minutes each session.

Outcomes : Based on descriptive analysis of MVC and normalized co-contraction ratios, the two participants who had sensory loss had lower MVCs and higher co-contractions ratios than the two participants without sensory loss. Changes due to NGT varied with the two participants with sensory loss demonstrating large co-contraction ratio increases on one of the two tasks and the two participants without sensory loss showing minimal to no change. Overall the subjects with sensory loss demonstrated more variable responses to NGT.

Discussion : It appears that those participants with sensory loss showed larger changes in co-contraction ratios whereas the participants without sensory loss showed larger MVCs. One of the participants with sensory loss was observed to play NGT with large arm movements and then showed increased co-contraction in the reaching task, whereas the other participant with sensory loss isolated his wrist movement more during NGT and showed increased co-contraction ratios during the AROM test. While these findings are interesting, these data are limited due to small sample size. A larger study should be conducted to better understand the effect of sensation loss on the capacity to change motor coordination.

TITLE: Association Between Performance in Clinical Balance Measures Requiring Reactive versus Voluntary Stepping in Community-Dwelling Individuals Post-Stroke

AUTHORS/INSTITUTIONS: L.D. Hedman, N. Jeewek, J. Lazzaro, K. Olyva, S. Sekanic, A. Story, K. Varchetto, K. Martinez, Department of Physical Therapy and Human Movement Sciences, Northwestern University Feinberg School of Medicine, Chicago, IL

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of this study was to examine the relationship between performance on the Lean Test (LT), a reactive balance measure, and measures that require rapid voluntary stepping in persons post-stroke. We hypothesized that there would be a moderate to excellent statistically significant correlation between the LT, and the Four Square Step Test (FSST) and the Step Test (ST).

Number of Subjects : Twenty-five community-dwelling stroke survivors >1 year post (mean = 96.38 months; range 27 - 231) participated in the study (19 males, 6 females). Thirteen individuals had right-sided weakness and 12 left-sided weakness. Mean age was 56.04 years (range 21 – 72 years).

Materials/Methods : The ST (uninvolved and involved legs), and FSST were administered in a randomized order followed by one trial of the LT in the forward and backward directions and to the uninvolved and involved sides. Number of steps for each limb were recorded for the ST. Time in seconds was recorded for the FSST. The LT uses an ordinal rating scale (0-3) that is based on number of steps taken and ability to stay upright. Side of first stepping leg was also noted. No assistive devices except ankle foot orthoses were used during testing. Data was analyzed using nonparametric statistical tests ($p < .05$).

Results : Median (range) scores for the LT were forward: 3 (1-3); backward: 2 (0-3); to uninvolved side: 2 (0-3); and to involved side: 2 (0-3). Subjects performed significantly better on forward LT as compared with backward LT ($p = .001$) and LT to involved side ($p = .003$). Subjects initiated stepping with the uninvolved leg in 68% of all LT trials: 82% of forward trials, 77 % of backward trials, 55 % of lateral trials to involved side and 59 % of lateral trials to uninvolved side. Median (range) score for involved leg ST was 7 steps (4-12) and for uninvolved leg was 9 steps (6-14) ($p = 0.001$). Median (range) score on the FSST was 17.7 seconds (11.25-51.3). Moderate, but non-significant correlations (Bonferroni correction $p < .006$) were found between the LT to uninvolved side and uninvolved leg ST ($r = 0.421$; $p = 0.023$), and the LT to involved side and FSST ($r = -0.407$; $p = 0.030$).

Conclusions : Subjects took more steps with their uninvolved leg compared to their involved leg in the LT, a reactive balance measure, as well as in the ST that requires voluntary stepping. Subjects were more likely to initiate recovery with their involved leg when leaning in the frontal compared to sagittal plane. The weak association between the results of the lateral LT with ST and FSST may reflect differences in task requirements as well as the limited scoring levels for the LT.

Clinical Relevance : Assessment of reactive stepping in both frontal and sagittal planes may be needed to reveal differences in use of the involved leg for balance recovery post-stroke. Training individuals with chronic stroke to step with their impaired leg may increase their stepping options for dynamic balance control.

TITLE: A Liangong-based exercise program helps improve balance in five subjects living with chronic effects of stroke: a case series

AUTHORS/INSTITUTIONS: R. Kaufman, K.A. Nowakowski, D.E. Roberts, Department of Physical Therapy, Springfield College, Springfield, MA|

ABSTRACT BODY:

Background & Purpose : This case series examined the effectiveness of a balance and exercise program for persons with chronic effects of stroke. Changes in balance, speed of walking, and confidence in mobility functions were measured before and after an 8-week training program of Liangong exercises with treadmill or recumbent elliptical training. Liangong is a Chinese internal healing art, similar to t'ai chi ch'uan. The exercises include a sequence of 18 standing movement forms designed to improve strength, flexibility and balance. The forms require shifting weight between the feet in conjunction with arm and head motions. They are practiced with a brief pause between each form.

Case Description : Three females and two males ranging in age from 60-83 years who had sustained a cerebrovascular accident between 4 and 13 years ago participated. All subjects had some degree of sensorimotor impairment involving lower and/or upper extremities. Each ambulated independently with or without assistive devices including ankle-foot orthoses and canes. Testing was conducted prior to and following training. Clinical tests of balance included the Berg Balance Scale and the Activities-Specific Balance Confidence scale. Fall Risk and Postural Stability Index scores were derived using the Biodex Balance System SD. Comfortable and fast walking speeds were determined using the 10-meter Walk Test. Training was conducted twice per week for 8 weeks and included two repetitions of an 18-form Liangong exercise series, for a total of 25 minutes of Liangong training per session. This training was immediately preceded or followed by treadmill walking or recumbent elliptical exercise at a self-selected intensity or speed for up to 10 minutes.

Outcomes : All subjects demonstrated improvement in BBS scores, with change scores ranging from 3-11 points. Four subjects improved on the ABC scale, with change scores of 3-29% of pre training values. Four subjects improved Postural Stability Index and Fall Risk Tests score with percent improvement ranging from 8-57%. There were no consistent trends in gait speed performance changes pre to post training.

Discussion : A training program that includes Liangong exercises appears to have helped improve balance in individuals with chronic sensorimotor impairment as a result of stroke. Four of five individual BBS change scores were equal to or greater than the minimal detectable change of 6 points reported in the literature. Scores on the ABC Scale appear to co-vary with the improvements on the BBS in four of the five subjects. The Fall Risk and Postural Stability scores also showed positive trends. The lack of improvement in gait speed is not surprising, as the training protocol did not target locomotor speed. The results of this case series suggest that further examination of the effectiveness of Liangong exercises as a balance training strategy for subjects with stroke and chronic sensorimotor limitations is warranted.

TITLE: Skin-Related Adverse Events during Robotic-Assisted Locomotor Training

AUTHORS/INSTITUTIONS: C.P. Kelley, School of Physical Therapy, Texas Woman's University, Houston, TX|J. Childress, E.A. Noser, Department of Neurology, University of Texas Health Science Center, Houston, TX|

ABSTRACT BODY:

Background & Purpose : Improving post-stroke walking ability is a commonly expressed goal. Frequently, these patients exhibit a range of gait deviations in addition to a deconditioned state which may limit gains. An active area of stroke rehabilitation is locomotor training that combines a robotic orthosis with a body weight support (BWS) treadmill system. Studies have documented skin-related adverse events (AEs) during robotic locomotor therapy; yet, no reports have described attempts to lessen the severity and frequency of such AEs. Maintenance of skin integrity is an integral component of the rehabilitation course, and the purpose of this report is to describe attempts at prevention of skin-related AEs and protection of the skin once breakdown occurred.

Case Description : This report describes a 75 year old man who sustained an ischemic infarction involving a partial distribution of the right middle cerebral artery. His body mass index was 28.5, and comorbidities included hypertension, hyperlipidemia, diabetes mellitus, status post bilateral total knee arthroplasties, and smoking. His lower extremity (LE) skin was thin, dry, flaky, tanned, and virtually hairless, but otherwise intact. Sensation to light touch and proprioception were diminished on his left LE and intact on the right LE. The study protocol included 1-hour training sessions 5 days a week for 8 weeks for a total of 40 sessions. He progressed without complication until session 5 when a skin tear appeared. A second instance occurred after session 7. Strips of a viscoelastic polymer, in addition to the standard padding for the robotic orthosis, were then placed between the cuffs and the participant's legs; however, the pre- and post-training locations of the strips differed due to the experienced friction and mechanical forces. Starting at session 12, modifications included the wrapping of his LEs with full polymer sheets secured with elastic wraps and limiting each session's locomotor training duration.

Outcomes : No further skin breakdown occurred after the use of the polymer sheets, and all AEs were fully healed by session 22. His 10 meter walk test velocity increased from baseline of 0.069 m/s, to post-intervention of 0.087 m/s, and 3-month follow-up of 0.073 m/s. His 6 minute walk distance increased from baseline of 23.74 m, to post-intervention of 27.89 m, and 3-month follow-up of 26.43 m. His FIM locomotion score increased from a 2 to a 6.

Discussion : The subject's skin breakdown likely occurred due to a combination of his risk factors for skin tears, his atypical gait pattern, and the friction and mechanical forces of the robotic therapy. Standard padding was clearly insufficient to prevent injury; however, after his LEs were encased with the polymer sheets, he was able to progress. Although his therapy was limited due to his skin-related AEs and crouched gait pattern, his outcome measures improved from baseline through follow-up. Though challenging, this report demonstrates that people at risk for skin breakdown can participate in locomotor training with a robotic-assisted BWS treadmill.

TITLE: Does one session of gait rehabilitation improve post-stroke walking performance?

AUTHORS/INSTITUTIONS: T.M. Kesar, Rehabilitation Medicine Department, Division of Physical Therapy, Emory University, Atlanta, GA|D. Reisman, S.A. Binder-Macleod, Physical Therapy Department, University of Delaware, Newark , DE|

ABSTRACT BODY:

Purpose/Hypothesis : Restoration of walking function is a critical goal of post-stroke rehabilitation. There have, therefore, been concerted efforts in recent research toward developing more effective gait rehabilitation interventions. However, while most interventions improve walking function after 6 or 12 weeks of gait training, how and when these gait changes evolve is unclear. Similar to pharmacological treatments, where the time course of the physiological responses to a treatment are well understood, it is essential to systematically understand the time course of within- and across-session changes underlying gait rehabilitation. Our current study is based on the premise that small within-session changes in performance are 'building blocks' of long-term improvements in walking function produced after 6 to 12-weeks of gait retraining. A systematic investigation of changes in gait that occur within each training session can elucidate mechanisms underlying rehabilitation. The purpose of this study was to ascertain whether one clinical gait retraining session can improve post-stroke gait performance.

Number of Subjects : Fourteen individuals with chronic post-stroke hemiparesis (age 61 ± 9 years, time post-stroke 29 ± 28 months, lower extremity Fugl-Meyer score 22 ± 6) were recruited for this study.

Materials/Methods : Subjects participated in 1 session of gait training comprising five 6-minute bouts of treadmill walking with rest breaks between bouts (total 30 minutes of walking). Subjects trained at the fastest walking speed they could maintain for 4-minutes. The training included alternating practice of walking with and without functional electrical stimulation delivered to ankle dorsi- and plantar-flexors at appropriate phases of gait, and over ground walking practice. An 8-camera motion analyses system was used to measure gait kinematics and kinetics before and after the training session at the subjects' self-selected walking speed. Paired t-tests were performed to compare gait variables targeted by training (push-off forces and swing phase knee flexion) before versus after the training session.

Results : We found significant improvements in push-off forces and swing phase knee flexion after one gait training session ($p < 0.05$). The magnitudes of within-session improvement were greater than the minimal detectable change values, showing that observed changes were outside the range of measurement errors or physiological variability.

Conclusions : For the first time, we showed that one session of post-stroke gait retraining is sufficient to produce significant improvements in walking biomechanics.

Clinical Relevance : Our findings support the clinical observation that patients demonstrate improvements within a session of focused, intensive physical therapy. If we can maximize the effectiveness of each session of gait rehabilitation, we can maximize the cumulative long-term benefits of the time spent during rehabilitation. This study is the 1st step in developing cost effective methods to explore dose-response relationships and motor learning mechanisms underlying post-stroke gait rehabilitation.

TITLE: Functional electrical stimulation increases tibialis anterior muscle activity for patients with neurological injury.

AUTHORS/INSTITUTIONS: C. Lairamore, Physical Therapy, University of Central Arkansas, Conway, AR|

ABSTRACT BODY:

Purpose/Hypothesis : Foot drop is a common disability that limits ambulation in individuals with stroke and brain injury. Functional electrical stimulation (FES) when used as a neuroprosthesis has been shown to improve gait for individuals with chronic stroke. However, little is known regarding the therapeutic effect of FES in regard to motor relearning and the restoration of gait for individuals with an acute neurological injury. This study investigated the use of FES for improving gait and tibialis anterior (TA) muscle activity in individuals with neurological injury who were enrolled in a rehabilitation program.

Number of Subjects : 26

Materials/Methods : Participants were included if they were 3 months or less post first stroke or brain injury with resulting foot drop. Participants were randomly assigned to a FES group or sham stimulation group and blind to treatment condition. FES or sham stimulation was provided using a Bioness™ L300 unit during gait training sessions three times a week for the duration of the individuals stay in a rehabilitation facility with the amount of gait training held constant across groups. Spatiotemporal gait parameters, FIM™ gait scores, and tibialis anterior muscle electromyography data were assessed at baseline and after training.

Results : EMG and spatiotemporal gait data were analyzed across groups using an independent sample T-test. FIM™ gait scores were analyzed using a Mann-Whitney test. An alpha level of <0.05 was considered significant for all testing. No significant differences existed between the FES and sham stimulation groups at baseline. After the intervention the FES group exhibited increased TA muscle activity during the swing phase of gait when compared to the sham stimulation group ($p=0.02$). Both groups achieved similar improvements in velocity, temporal gait parameters, and FIM™ gait scores by the end of the study.

Conclusions : Use of FES in an inpatient rehabilitation facility for individuals with neurological injury improved their ability to activate the TA muscle during gait. The increase in muscle activity was noted specifically during the swing phase of gait, which correlates to when the FES is administered during training. This is significant because the swing phase of gait is when the tibialis anterior muscle should be activated. It is important not only for the tibialis anterior muscle to increase in activity but to also contract at the appropriate times during gait so that foot drop is prevented and an optimal gait pattern is relearned. While FES-induced tibialis anterior muscle activation did not augment gait beyond physical therapy and spontaneous recovery, in the time frame for this study, further study of the amount and timing of FES and of its' long term therapeutic effects on gait are warranted.

Clinical Relevance : This study indicates that FES provided during inpatient rehabilitation can increase activity of the tibialis anterior muscle during gait for patients with foot drop secondary to a stroke or acquired brain injury.

TITLE: Changes in cardiopulmonary efficiency and gait economy following 8-weeks of high intensity locomotor speed and skill training in individuals post-stroke

AUTHORS/INSTITUTIONS: A.L. Leddy, C. Holleran, Sensory Motor Performance Program, Rehabilitation Institute of Chicago, Chicago, IL|K.A. Leech, J. Matsubara, Neuroscience, Northwestern University, Chicago, IL|K. Pasquinnell, G. Hornby, Physical Therapy, University of Illinois at Chicago, Chicago, IL|

ABSTRACT BODY:

Purpose/Hypothesis : The effects of high intensity gait or locomotor training on cardiopulmonary capacity and efficiency are variable. Selected studies have demonstrated improved cardiopulmonary capacity (peak oxygen consumption or VO₂) following up to 6 months of treadmill training with reduced VO₂ at matched speeds. Other studies have demonstrated improved gait economy (O₂ cost, ml/kg/m) overground following 4 weeks of training without improvements in peak VO₂. Improvement in O₂ cost could be due to simply improved velocity, as demonstrated previously. The purpose of this study was to evaluate changes in cardiopulmonary capacity and economy during treadmill and overground walking in individuals post-stroke following 8-week of high intensity gait training.

Number of Subjects : 21 individuals post-stroke

Materials/Methods : This study was a repeated measures design. Individuals post-stroke were tested pre- and post- an 8-week intensive gait training protocol. Testing included a graded intensity treadmill test and 6-minute walk test (6MWT, walking normal comfortable speed) while cardiopulmonary data was collected using an indirect calorimeter and heart rate monitor. Trainings included up to 40 minutes of ambulation in a 60 minute session, 4-5 days/week with a goal intensity of 70-80% heart rate reserve or Borg Scale rating of perceived exertion (RPE) of 15-17. Gait training included continuous stepping activities with a purposeful direction on the treadmill, overground, and stairs, progressing with ankle weights, obstacles, and decreased upper extremity use as possible. Repeated measures analysis of variance with Tukey-Kramer post-hoc tests was used.

Results : Following 8 weeks of intensive gait training, individuals showed significant improvements in peak treadmill speed (0.56 ± 0.37 to 0.95 ± 0.44 m/s, $p < .01$), peak VO₂ (13.3 ± 5.1 to 15.9 ± 5.78 ml/kg/min; $p < .01$), with increases in minute ventilation. Comparisons of cardiopulmonary measures from peak pre-training speed to matched speeds post-training revealed non-significant decreases in VO₂, with significant decreases in minute ventilation, ratings of perceived exertion, and heart rate. During overground testing, subjects improved their distance ambulated during 6MWT from 163 ± 87 to 281 ± 144 m, with a significant $31\pm 25\%$ improvement in gait economy. Comparison of O₂ cost during comparable treadmill speeds indicated that $14\pm 24\%$ of the improvements could be accounted for by changes in cardiopulmonary efficiency, where $17\pm 17\%$ were due to increased walking speed.

Conclusions : Substantial changes in cardiopulmonary capacity and efficiency were observed following 8 weeks of high intensity training. Improvements in gait economy (O₂ cost) overground were due to improved cardiopulmonary efficiency and increased gait speed.

Clinical Relevance : Focus on continuous high intensity training may contribute to improved gait speed and economy post-stroke, which may impact functional mobility measured in the clinical setting.

TITLE: Improvements in Stance Time Asymmetry From Step-By-Step Proprioceptive Feedback Transfers to Overground Gait

AUTHORS/INSTITUTIONS: M.D. Lewek, K. Rascoe, Division of Physical Therapy, University of North Carolina, Chapel Hill, NC|J. Feasel, Department of Computer Science, University of North Carolina, Chapel Hill, NC|

ABSTRACT BODY:

Purpose/Hypothesis : Spatiotemporal asymmetry is common following stroke, cerebral palsy, Parkinson's disease, and traumatic brain injury. To treat spatiotemporal gait asymmetry we have developed a responsive, 'closed loop' control system, using a split-belt 'instrumented' treadmill that continuously adjusts the difference in belt speeds to be proportional to the patient's current asymmetry. The algorithm is capable of augmenting or minimizing asymmetry on a step-by-step basis. Our prior work suggests that augmenting asymmetry during treadmill training results in more symmetric treadmill stepping immediately following the training compared to minimizing asymmetry. The purpose of this study is to determine the effect of step-by-step manipulation of spatiotemporal asymmetry on overground gait. It is hypothesized that augmenting errors will promote greater spatiotemporal symmetry during overground walking than a minimization or control conditions.

Number of Subjects : 14 unimpaired subjects (22±2 years old).

Materials/Methods : All subjects performed three randomly ordered, gait training sessions (error augmentation (EA); error minimization (EM); control) each separated by about 1 week. During each session, subjects walked for 15 min (2 min Baseline, 11 min Adaptation, 2 min Post-Adaptation) at 120% of their self-selected overground gait speed. We induced stance time asymmetry by applying cuff weights to the right mid-shank (10% body weight). Stance time asymmetry was assessed by having subjects walk across a GAITRite mat with cuff weights attached immediately prior to, and following each gait training session. Average stance time asymmetry ratio during overground walking was compared immediately prior to and following treadmill walking between conditions using a repeated measures ANOVA ($\alpha=0.05$).

Results : Across all conditions, there was a significant improvement in stance time asymmetry ratio following training ($p=0.007$). Although no interaction effect was noted ($p=0.374$), the augmentation condition was the only condition to demonstrate a significant improvement in stance time asymmetry ratio after training (pre: 1.10 ± 0.04 ; post 1.06 ± 0.05 ; $p=0.016$).

Conclusions : Despite a two minute wash-out period, improvements in overground gait were still evident following training. A single session of augmenting asymmetry produced significant improvements in stance time asymmetry, which has been particularly resistant to change. This provides further evidence which suggests that learning may be enhanced with error-based feedback, and that short term changes performed on the treadmill can be transferred to overground gait.

Clinical Relevance : Training with responsive feedback may provide important proprioceptive inputs that can be used to modify gait patterns. The modification of gait patterns appears to be most symmetric if feedback is used that augments errors.

TITLE: Learning by losing balance: Improvement with a step-up task in stroke survivors

AUTHORS/INSTITUTIONS: R. Lopez-Rosado, S.R. Duffey, I. Akingbade, N. Korda, Physical Therapy and Human Movement Sciences, Northwestern University, Chicago, IL|D. Brown, Physical Therapy, University of Alabama at Birmingham, Birmingham, AL|

ABSTRACT BODY:

Purpose/Hypothesis : The aim of this study was to investigate online (within session) and offline (between sessions) task performance of stroke survivors in a step-up training program for both their paretic and non-paretic lower extremities, using three different approaches (clinician guarded, high repetitions; robot-guarded, high repetitions; and robot-guarded, low repetitions with increased height difficulty).

We hypothesized that participants who received the robot-guarded, step-up training program while challenged by increasingly difficult heights would demonstrate greater online and offline gains in both extremities.

Number of Subjects : 31 stroke survivors, randomly assigned to one of 3 groups: 1) clinician guarded, high repetitions (N=9); 2) robot-guarded, high repetitions (N=12); and robot-guarded, low repetitions with increased height difficulty (N=10).

Materials/Methods : The KineAssist® Balance and Gait Training Robotic System was used to guard participants. Part of a larger scope balance training study, all participants practiced a 5 minute step-up and down repetitive practice task on wooden steps at different heights, leading with their paretic side, once a week over a six week period. Within the same session, participants practiced another bout of 5 minute step-up exercise leading with their non-paretic side. Step height, number of repetitions, and exercise load (# of reps x step height) for each height level was recorded.

Results : Improved online performance occurred during the sessions where participants were progressed to more difficult heights within the five minute practice period (robot-guarded, low repetitions with increased height difficulty). With respect to offline learning over the course of six weeks, on average all participants tested at higher height levels in all groups for both the nonparetic and paretic legs (offline learning gains). Both robot-guarded groups and the clinician-guarded group demonstrated very similar step heights during the last 3 weeks of the study for the non-paretic extremity. Exercise load did not change for the different groups in the paretic extremity; however, it showed a linear increase in the robot-guarded group with high repetitions.

Conclusions : Robot-guarded step-up training provides a suitable environment for stroke survivors to practice the step-up task. When the task is made increasingly difficult so that loss of balance occurs, the robot-guarded condition allows for better online learning. The linear increase in exercise load for the nonparetic practice group using the robot under high repetition conditions suggests a progression in effort over the six week period, whereas the non-changing exercise load value for all paretic leg practice groups suggests that, repetitions were decreased to maintain a consistent effort during the 5 minute training session.

Clinical Relevance : We have provided evidence that learning of an important balance task, step ups, can best occur when the client is challenged to succeed at heights that are beyond their initial capabilities. Funding for this study provided by DOE/NIDRR Grant # H133E070013.

TITLE: Home-based robot-assisted rehabilitation for the ankle in a chronic stroke survivor

AUTHORS/INSTITUTIONS: J. Lynskey, A. Jarzabek, Z. Hall, P.R. Bosch, Physical Therapy, A. T. Still University, Mesa, AZ|K. Wing, , Southwest Advanced Neurological Rehabilitation, Phoenix, AZ|

ABSTRACT BODY:

Purpose/Hypothesis : Stroke induced foot drop impairs locomotor function. Robot assisted repetitive task practice is one approach that has recently been shown to improve lower extremity function and locomotion in stroke survivors. Robotic training, however, is typically confined to large hospital-based clinics or research laboratories, to which few patients have access. The purpose of the current pilot study was to investigate the effects of home-based robot-assisted ankle rehabilitation on strength, locomotion, and quality of life in a chronic stroke survivor.

Number of Subjects : 1

Materials/Methods : This study used an A-B-A single subject design. Isometric dorsiflexion strength, locomotor function, and quality of life were assessed three times during a 2 week baseline period (A), twice during a 12 week intervention period (B), and twice during a 4 week retention period (A). The intervention consisted of three 60-minute robot assisted training sessions (Foot Mentor™, Kinetic Muscles Inc.) per week for 12 weeks. Use and performance data from the robotic device was monitored remotely and feedback was given weekly via telephone. Data was analyzed using the 2 standard deviation band method.

Results : The participant was a 57 year old male with left sided weakness who suffered a stroke 47 months prior to enrollment. The participant performed all 36 treatment sessions with no reports of problems or adverse events. The participant demonstrated significant improvements in maximal isometric dorsiflexion force production (> 24%), stride symmetry (>5%), and perception of quality of life (strength, ADL/IADL, mobility, and overall recovery subscales) at both post-intervention measurement sessions (weeks 12 and 16).

Conclusions : Home-based robot-assisted ankle rehabilitation is feasible and can improve strength, locomotor function, and quality of life in a chronic stroke survivor. These improvements persisted for 4 weeks after the cessation of treatment.

Clinical Relevance : In the changing landscape of health care it is important to investigate alternative methods for delivering physical therapy. Home-based robotic interventions are one such methodology. The results presented here provide preliminary evidence supporting the use of home-based robotics for the treatment of distal lower extremity dysfunction in stroke survivors.

TITLE: Effects of an Intense Week-long Exercise Program in Chronic CVA: A case series

AUTHORS/INSTITUTIONS: K.L. Mercuris, M.M. Frandsen, Doctor of Physical Therapy Program, Des Moines University, Des Moines, IA|

ABSTRACT BODY:

Background & Purpose : Exercise programs for those with chronic cerebral vascular accident (CVA) are an effective intervention method for improving motor function and gait. Few studies have evaluated the effects of an intense exercise program in chronic stroke patients. The purpose of this case series was to assess the effects of a one-week intensive exercise program on gait, motor, and balance performance in chronic stroke patients (> 1 year post-CVA). The week long Stroke Camp was administered by faculty and students in a doctor of physical therapy program and community based therapist volunteers.

Case Description : Six participants (36-73 years; mean age 55.5 years) with chronic stroke (1.3 - 6.6 years post-CVA) were recruited from the community to participate in a 5-day Stroke Camp. Each day included a 45-minute group exercise session, and three individualized 45-minute exercise sessions each for balance, gait, and the upper extremity. Each participant additionally received two Feldenkrais Method® lessons during the week. Pre and post testing on day 1 and day 5 of the camp included: Berg Balance Scale (BBS), Four Square Step Test (FSST), Dynamic Gait Index (DGI), Timed Up and Go (TUG), 6-Minute Walk Test, and the Wolf Motor Function Test (WMFT). The GAITRite® electronic walkway was used to obtain spatial/temporal gait parameters. Center of pressure and area of sway were measured using a force plate.

Outcomes : All six participants demonstrated post-intervention improvements in the BBS (7.69-51.52% change) and 5 of them exceeded the Minimal Detectable Change (MDC) criteria. Five of the six participants showed improvement on the FSST (0.36-30.31%). All six participants improved on the DGI (5.88-28.57% change) but only one met the MDC. Four of the six participants improved on the 6-Minute Walk Test (2.7-16.67%) with 2 exceeding the MDC. Fast gait speed increased beyond the MDC in five of the participants with two of them increasing in both preferred and fast velocity by more than 15%. MDC time on the WMFT was exceeded by 2 participants on the simple tasks and 5 participants on the complex tasks. None of the participants reached the MDC for the TUG, and no changes were evident in center of pressure or area of sway.

Discussion : A week-long individualized intensive exercise program may be beneficial for improving functional balance in chronic stroke patients. Changes were evident in gait speed and upper extremity function. It appears the participants with the greatest deficits made the most progress. Post-testing was performed on the 5th day of the camp and the participants verbally reported fatigue after a week of exercise. The subjects reported focusing upon the 'quality' of their movements during post testing which may have resulted in a decreased speed of some of the timed tests (TUG). Students subjectively commented on the positive learning experience the camp provided to their education.

TITLE: Evidence of neural coupling between muscles of the paretic upper extremity in chronic hemiparetic stroke
AUTHORS/INSTITUTIONS: L.C. Miller, Biomedical Engineering, Northwestern University, Chicago, IL|J.P. Dewald, Physical Therapy and Human Movement Sciences, Northwestern University, Chicago, IL|K. McGill, , Palo Alto, VA, Palo Alto, CA, CA|

ABSTRACT BODY:

Purpose : Abnormal muscle co-activation patterns emerge in the paretic upper limb following hemiparetic stroke that constrain voluntary movement. One of these patterns, the flexion synergy (FS), has been experimentally quantified using isometric measurement of EMG and joint torque coupling and robotic analysis of reaching. It has been shown that as shoulder abduction (SABD) torque increases, the expression of the FS at elbow, wrist and finger joints (i.e. involuntary flexion at all joints) is more pronounced, presumably because of an increased reliance on reticulospinal pathways.

The FS may be due to common modulation of neural inputs to the involved muscles via reticulospinal pathways. Time and frequency domain signal analyses have been used with healthy controls and in isolated muscles of stroke participants to characterize modulation of motor unit discharges within a muscle. These techniques may be useful when employed between muscles of the FS to determine whether correlated motor unit discharge would explain the observed abnormal coupling.

Description : This study calculated coherence (i.e. frequency domain correlation) and cross-correlation (time domain) between upper limb muscles using motor unit discharge during generation of various isometric SABD torques. We hypothesized that increases in SABD torque would lead to coherence at frequencies < 10 Hz and the presence of cross-correlation between in-synergy muscle pairs.

2 participants with chronic hemiparetic stroke and 1 control were included. The paretic forearms of seated participants were casted to a 6 degree-of-freedom load cell, and the hand was secured to a wrist/finger torque-sensing device. The limb was positioned in 75° SABD, 90° EF, 40° shoulder flexion. Intramuscular EMGs were placed into 8 upper limb muscles. Isometric maximum voluntary torques (MVTs) were generated in 8 directions. Participants then performed submaximal SABD at 16.67, 33.33, and 50% MVT. Coherence and cross-correlation were calculated between in-synergy and out-of-synergy motor unit discharges.

Summary of Use : Common fluctuations in motor unit instantaneous firing rates were observed in FS muscles. Average cross-correlation coefficients were 0.17 ± 0.06 between biceps (BIC) and flexor carpi radialis (FCR), 0.29 ± 0.09 within BIC, and 0.30 ± 0.12 within FCR. Significant coherence was found between BIC–FCR and FCR–flexor digitorum superficialis (FDS) below 10 Hz, and it increased as SABD torque increased. At 50% and 100% SABD MVT, significant coherence also emerged from 10-20 Hz between FCR–FDS. Low levels of coherence were seen at low frequencies for muscle pairs outside of the FS (wrist extensors, triceps), but the coherence did not change with SABD torque.

Importance to Members: These results provide insight into the etiology of the FS, suggesting that reticulospinal pathways with diffuse projections to upper extremity flexors may underlie common modulation of FS muscles. The study also offers a technique that may be useful in the control of neuroprosthetic assistive devices following stroke.

TITLE: Examination Measures Chosen by Expert Physical Therapists to Assess the Same Patient with a Chronic Stroke

AUTHORS/INSTITUTIONS: J. Mowder-Tinney, K. Butler, C. Koenig, E. Tierney, , Nazareth College, Rochester, NY|

ABSTRACT BODY:

Purpose/Hypothesis : The current literature has identified different areas of clinical assessment that is essential to assess patients with neurological disorders and states that examinations should be comprehensive and standardized. However, the literature is lacking evidence regarding which items physical therapists (PT) commonly include. This study compared examination measures chosen by licensed expert PTs after evaluating the same patient with a stroke. The researchers were interested in the amount of time spent on each test as well as which priority problems the PTs identified.

Number of Subjects : There were five total participants consisting of four licensed Neurology Certified Specialists and one patient diagnosed with a chronic stroke.

Materials/Methods : Each PT performed a one hour exam on the same patient post-stroke on different days. Each exam was videotaped to find the time spent on each test and measure.

Following the exam, the PT identified three priority problems.

Results : PTs spent between 50-60 minutes on the exam. The amount of time spent on each chosen test and measure varied between them. The major areas were divided into four categories with associated time ranges in minutes: interview (6.3-27.5), impairment (5.4-17.5), function (7.0-15.1), and standardized measures (0-3.3). The impairment category included items such as sensory (0-0.4), proprioception (0), and tone (0-1.2). There was a wide range of identified priority patient problems ranging from lower extremity range of motion, balance, endurance, motor control, strength, proprioception, risk of falls, sensation, and gait deviations. Of the above priority problems balance and motor control were the only ones identified by more than one PT.

Conclusions : The literature states an exam should be fairly consistent across all PTs. Our findings suggest that PTs were not consistent in tests chosen and varied greatly in time spent on each test. Some literature has found that sensory, proprioception, and tone are commonly assessed during the examination of neurological patients. Those same impairments were identified in this study as priority problems, however, the PTs did not assess them. It is unknown if expert PTs relied more on their observation skills during the exam. This may explain the disproportionate time spent on the chosen tests and resultant priority problems identified. The data collected was limited since the researchers only observed what the PTs performed and did not analyze their thought process. The small sample size of NCS PTs limits the generalizability of the results.

Clinical Relevance : While literature has recognized areas that should be assessed in every neurological exam, this study showed large variability between the tests and measures chosen by PTs. In addition, this study suggests that priority problems are being identified without any formal assessment. Future research should include how they decide which measures to perform during an exam and how much they use their observation skills to identify priority problems.

TITLE: Treatment Techniques Chosen by Expert Physical Therapists Based on the Evaluation of the Same Patient With a Chronic Stroke

AUTHORS/INSTITUTIONS: J. Mowder-Tinney, K. Kelleher, J. Poirier, , Nazareth College, Rochester, NY|

ABSTRACT BODY:

Purpose/Hypothesis : Depending on the site of injury after a stroke, a person can present with a variety of impairments and functional limitations including strength, motor function, somatosensory, balance and coordination. After identification of these problems by the physical therapist (PT), recent literature describing stroke rehabilitation suggests utilizing interventions that are patient-centered and task oriented emphasizing repetition and progression. However, there is a lack of knowledge of the current interventions PTs use based on the patient's identified problems. The purpose of this study is to describe treatment techniques expert PTs choose after evaluating the same patient with a chronic stroke.

Number of Subjects : A convenience sample of four PTs with Neurological Clinical Specialty (NCS) certification participated. The patient evaluated was a 71 year old female who had a left hemisphere stroke 3 years post, who had no cognitive or verbal deficits.

Materials/Methods : The design of this study is a descriptive research study describing categories of physical therapy interventions used by expert PTs to treat the same patient with a chronic stroke. Each PT had sixty minutes to perform an initial evaluation. After the evaluation, each PT completed three prepared documents with the following information in sequential order: plan of care, intervention planning for first physical therapy session, and rationale behind chosen interventions. The two researchers analyzed the three documents individually and systematically developed categories applying previous theories and frameworks. A third researcher confirmed the accuracy of the results.

Results : There was no clear consensus among the PTs regarding frequency and duration of treatment, which ranged from one to three sessions weekly and varied between thirty to sixty minutes. PTs identified different priority problems for the same patient, however impaired gait was listed by each of the four PTs. Of treatment interventions chosen, 79% were task-specific and 86% of interventions were categorized as remediation, focusing on enhancing skills or reversing priority problems. Results show that all PTs agreed that the patient had the capacity to improve function.

Conclusions : The findings of this study demonstrate the variability in the development of a plan of care by expert PTs, when evaluating the same patient with a chronic stroke. Task oriented interventions and remediation of tasks were a primary focus in the results, which have been found to increase neuroplasticity when linked with repetition and progression. Limitations of this study were NCS PTs were from the same city making it difficult to apply findings to all NCS PTs, and not all PTs were currently practicing in a neurological setting at the time of the study, which could have affected identification of problems and chosen interventions.

Clinical Relevance : Regardless of the amount of clinical experience, stroke rehabilitation continues to prove to be complex and requires further understanding of clinical application through research.

TITLE: Comparison of Intense Gait-Oriented Exercise Incorporating Principles of Motor Learning to Conventional Therapy on Gait Speed in Patients with Chronic Stroke:A Pilot Study.

AUTHORS/INSTITUTIONS: J. Mowder-Tinney, J. Brown, L. Minkel, T. Bergin, T. Murphy, , Nazareth College, Rochester, NY|

ABSTRACT BODY:

Purpose/Hypothesis : Providing optimal recovery through stroke rehabilitation is an ongoing challenge. Intensive gait-oriented exercise (IGOE) has been noted to improve functional walking speeds. Literature supports incorporating motor adaptation into functional ambulation and providing knowledge of results feedback. However, it is unknown the best way to facilitate functional improvement when utilizing combinational therapy. In addition, visits are limited due to reimbursement and assessing the effectiveness of therapy within each visit is warranted. The purpose of this pilot study was to explore IGOE incorporating principles of motor learning and its impact on gait speed compared to conventional therapy provided for patients with chronic stroke.

Number of Subjects : Four subjects with chronic stroke undergoing therapy with a mean age in years and standard deviation of 55.5 (8.1) and mean time since stroke of 27 months.

Materials/Methods : Subjects were recruited after receiving eight weeks of conventional therapy 1x/week consisting of function/impairment based treatments. Subjects were immediately started in the study 1x/week to prevent concerns of disuse deterioration and for four weeks to mimic common limitations seen accessing therapy. Motor adaptation and repetition utilizing knowledge of results and positive feedback were the primary intervention techniques for the hour long ambulation circuit. The following outcome measures were utilized: comfortable gait speed for 25 feet (cg25), fast gait speed for 25 feet (fg25) and the distance/speed of a 10 minute walk (10mw).

Results : Average ambulation distance during conventional therapy was 191ft (± 150) while intervention therapy was 2354ft (± 2163). No changes noted in gait speeds after conventional therapy for any subjects or in comfortable speeds after 4 week intervention. Two subjects were divided into a fast walking group (FWG) .94m/s avg \pm .18 and two subjects into a slow walking group (SWG) .32m/s \pm .16. The FWG made clinical detectable changes (MDC) in fg25 increasing by .31m/s \pm .01 and .55m/s \pm .27 in the 10mw. The SWG made no MDC in fg25 only increasing .01m/s \pm .06 and increasing .01m/s \pm .05 in 10mw. Distance walked in 10 minutes increased in the FWG to 1,088feet \pm 522 while the SWG increased to 20feet \pm 99.

Conclusions : The IGOE appeared to improve gait speed in subjects who were community ambulators ($>.8$ m/s). Two subjects demonstrated a MDC in gait speed after intervention 1x/wk for 4 weeks. This suggests if therapy is intensive enough a person who ambulates faster could benefit from therapy 1x/week. Future studies should adjust dosage versus intensity for those ambulating at household speeds (.4-.8m/s) to assess IGOE benefits.

Clinical Relevance : Therapists have a limited number of visits and time with patients and need strategies to improve outcomes. This study may guide therapists in determining a visit frequency that can yield positive functional outcomes based on patient initial gait speed scores.

TITLE: Robot-assisted rehabilitation for the ankle in chronic stroke survivors

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ABSTRACT BODY:

Purpose/Hypothesis : Pretibial paresis/paralysis, commonly known as foot drop, is a common presentation following stroke that leads to impairment of locomotor function. Repetitive task practice has been shown to promote recovery of function after stroke. Robotic devices have been developed to assist with repetitive task practice and interventions using them have been shown to promote recovery. Only a few studies, however, have investigated the ability of robot- assisted distal lower extremity repetitive task practice to promote recovery in stroke survivors. The purpose of the current pilot study was to investigate the effects of robot-assisted ankle rehabilitation on strength, locomotion, and quality of life in chronic stroke survivors.

Number of Subjects : Eight stroke survivors who were at least 9 months post CVA and presented with unilateral deficits in dorsiflexion strength participated in this study.

Materials/Methods : This study used a single group pretest-posttest design. Isometric dorsiflexion strength, locomotor function, and quality of life were assessed three times during a 2 week baseline period, and following the three week intervention period. The intervention consisted of fourteen 60 minute robot assisted training sessions (Foot Mentor™, Kinetic Muscles Inc.) delivered over a 3 week period. Data were analyzed using a single sample t-test, based on the null hypothesis that the difference score = 0. The alpha value was set at $P < 0.05$.

Results : All 8 participants completed all 14 sessions with no reports of problems or adverse events. Significant improvements were observed in the 10 meter walk test ($p = 0.04$) and the Fugl-Meyer Assessment (lower extremity component) ($p = 0.008$). Review of individual data revealed that 4 of the 8 participants demonstrated clinically meaningful improvements on at least 8 of the 9 outcome measures. However, correlation analyses did not identify any covariates that may have been associated with participant responsiveness to the intervention.

Conclusions : Robot-assisted ankle rehabilitation delivered in the research laboratory is feasible and can improve lower extremity and locomotor function in chronic stroke survivors.

Clinical Relevance : Evidence is mounting that robot-assisted rehabilitation can be a valuable adjunct to traditional physical therapy. The current VA/DOD guidelines for stroke rehabilitation suggest the integration of upper, but not lower extremity robotics into a rehabilitation plan. The preliminary results presented here suggest that robot-assisted rehabilitation delivered in isolation may even promote recovery of lower extremity function in chronic stroke survivors. Further research on the effects of distal lower extremity robotics is warranted.

TITLE: Effects of an Advanced Ground Reaction Ankle Foot Orthosis compared to a Traditional Articulated Ankle Foot Orthosis on Walking in a Patient with Chronic Stroke

AUTHORS/INSTITUTIONS: G.N. Olivier, Neurologic Physical Therapy Residency Program in Collaboration with Texas Woman's University and the University of Texas Medical Branch at Galveston, TIRR Memorial Hermann, Houston, TX|J. Seale, J. Hale, Department of Physical Therapy, University of Texas Medical Branch at Galveston, Galveston, TX|J. Jennings, T. DiBello, , Hanger/Dynamic Orthotics and Prosthetics, Houston, TX|

ABSTRACT BODY:

Background & Purpose : Impairment from stroke can affect walking function, resulting in a lack of independence and participation. An ankle foot orthosis (AFO) is often prescribed for people with hemiparesis to improve gait speed, kinematics, and decrease the risk of falls. The advanced ground reaction ankle foot orthosis (GRAFO) is a novel type of AFO designed to increase stance stability by transferring the ground reaction force to the anterior tibia, creating a plantarflexion moment at the ankle and a knee extension moment during stance. The purpose of this case report was to prospectively assess the effect of a traditional AFO and an advanced GRAFO on walking function in a person with a chronic stroke.

Case Description : The subject was a male, age 38, with right hemiparesis following a left-sided ischemic stroke 7.5 years ago. Prior to this study, the subject utilized an articulated ankle foot orthosis (AAFO) for 7.5 years. Functional limitations included decreased gait speed, endurance, and balance, along with knee hyperextension in stance phase of gait. The subject was casted for the test orthosis, a DBS Balancer™ design GRAFO. This device uses a unique weight bearing casting method, very intimate fit, and rigid material to afford control in the coronal, transverse, and sagittal planes. An extended rigid toe ramp allows the brace to affect the knee through terminal stance. The subject's current orthosis was an AAFO, traditional in design and made of polypropylene. It was much less rigid than the test orthosis and allowed sagittal plane motion. The subject was assessed in 3 conditions: no AFO, traditional AAFO, and advanced GRAFO. Assessments included 6 Minute Walk (6MW), 10 Meter Walk (10mW), and Timed Up and Go (TUG). Follow-up testing was 4 weeks later in the GRAFO.

Outcomes : Compared to no brace, time to perform the TUG decreased by 13.94 (AAFO) and 15.31 (GRAFO) seconds. Self-selected walking speed (SSWS) increased by 0.34 (AAFO) and 0.45 (GRAFO) m/s, and fast walking speed (FWS) by 0.37 (AAFO) and 0.73 (GRAFO) m/s. Distance on the 6MW increased by 679.75 (AAFO) and 991.92 (GRAFO) feet. Follow-up testing was performed in the GRAFO and, compared to previous testing in the GRAFO, revealed a 195.25 foot increase on 6MW, a 0.12m/s increase in SSWS, a 0.18m/s increase in FWS, and a 0.99 second decrease in time to perform the TUG.

Discussion : While performance was better in both braces than in no brace, this subject with a chronic stroke had the greatest improvement in all outcome measures immediately after donning the GRAFO, as compared to walking in his previous brace (AAFO). This difference in improvement between the GRAFO and the AAFO did exceed the Minimal Clinically Important Difference (MCID) for the 6MW and 10mW (both SSWS and FWS). Additionally, at follow-up testing after walking in the GRAFO for 4 weeks, the subject improved further, with changes from initial GRAFO testing to GRAFO follow-up testing exceeding the MCID in all outcome measures except the TUG.

TITLE: Spatiotemporal gait asymmetry, walking efficiency and speed after stroke

AUTHORS/INSTITUTIONS: J.A. Palmer, S.A. Binder-Macleod, T. Wright, D. Reisman, Physical Therapy, University of Delaware, Newark, DE|

ABSTRACT BODY:

Purpose/Hypothesis : Asymmetrical gait patterns and slow walking speed are commonly observed deficits after stroke. In addition, the metabolic cost of walking after stroke is higher than normal. Previous research has shown that there is an inverse relationship between walking speed and the metabolic cost of walking. Many believe that gait asymmetry may contribute to the increased metabolic cost of walking following stroke. However, there are no studies to date investigating the relationship between increased metabolic cost of walking and asymmetrical gait patterns after stroke.

The purpose of this study was to investigate the relationship between gait asymmetry, slow walking speed and the metabolic cost of walking in persons with chronic stroke.

Number of Subjects : Twenty-two individuals with chronic (>6 months) stroke were recruited for this study.

Materials/Methods : Motion Capture: Individuals were asked to walk for two 30-second bouts at their self-selected walking speed. Kinetic and kinematic data was collected on a split-belt instrumented treadmill using an 8-camera 3D motion capture system. Stance time asymmetry was calculated as the paretic limb stance time/nonparetic limb stance time. Step length asymmetry was calculated as the paretic limb step length/nonparetic limb step length. VO₂: Individuals donned the mouthpiece and noseclip of the metabolic measurement system and sat at rest while 5 minutes of baseline expired air was collected. Then participants walked on a treadmill for 5 minutes at their self-selected walking speed while oxygen consumption was measured. VO₂ data were analyzed over the last minute of each trial, averaged and normalized to body mass and speed to obtain the metabolic cost of walking (mlO₂ . kg⁻¹ . m⁻¹).

Results : There was no correlation between stance time asymmetry ($r^2=0.0004$, $p>.05$) or step length asymmetry ($r^2=0.0121$, $p>.05$) and the metabolic cost of walking. There was no correlation between temporal ($r^2=.0085$, $p>.05$) or spatial ($r^2=0.0121$, $p>.05$) symmetry and walking speed. There is a relationship between walking speed and the metabolic cost of walking ($r^2=0.444$, $p<.05$), in agreement with previous research.

Conclusions : Results from this study indicate that spatiotemporal asymmetry is not related to the metabolic cost of walking or walking speed in individuals with chronic stroke. However, subjects with faster self-selected walking speeds have a lower metabolic cost of walking.

Clinical Relevance : Spatiotemporal gait asymmetry after stroke is often the target of rehabilitation interventions. The results of this study suggest that while spatiotemporal asymmetries may be related to some aspect of walking function after stroke, they are not related to either gait speed or the metabolic cost of walking. Future research should examine whether changes in spatiotemporal asymmetry are associated with changes in the metabolic cost of walking or walking speed following intervention in persons with chronic stroke.

TITLE: Determining Measurement Error and Minimum Detectable Change in Two Balance Outcome Measures for Patients with Stroke

AUTHORS/INSTITUTIONS: V. Pardo, D. Genoff, A. Humes, E. Boguslawski, Physical Therapy, Wayne State Univ, Detroit, MI|A. Goldberg, Department of Health Care Sciences, Program in Physical Therapy, Mobility Research Laboratory, Institute of Gerontology, Wayne State University, Detroit, MI|

ABSTRACT BODY:

Purpose/Hypothesis : The Berg Balance Scale (BBS) is a 14-item objective assessment of balance during functional activities. The Activities-specific Balance Confidence Scale (ABC) is a subjective measure of self-confidence in maintaining balance during 16 functional activities. Minimum detectable change (MDC) represents a value for real change exceeding that due to chance variation or random measurement error. The purpose of this study was to quantify measurement error and MDC in the BBS and the ABC in people who have had a stroke.

Number of Subjects : Ten community-dwelling participants with a history of stroke resulting in unilateral hemiparesis were recruited from the Metro Detroit area.

Materials/Methods : Participants were assessed using the BBS and the ABC on two separate occasions with 2 to 7 days between tests. All data were tested for normality using the Kolmogorov-Smirnov test. The intraclass coefficient (ICC 2.1) was computed to assess test-retest reliability of each test. Standard error of measurement (SEM), which quantifies measurement error in absolute values, was calculated as the standard deviation $\times \sqrt{(1-ICC)}$. MDC at a 95% confidence level (MDC95) was calculated as $z \times SEM \times \sqrt{2}$ where $z=1.96$.

Results : The BBS and ABC were both normally distributed. Mean BBS was 41.7, with an ICC of 0.98 (SEM was 1.48, MDC95 was 4.1). SEM and MDC95 expressed as a percentage of mean BBS were 3.55% and 9.8% respectively. Mean ABC was 77.17, with an ICC of 0.87 (SEM was 7.39, MDC95 was 20.49). SEM and MDC95 expressed as a percentage of mean ABC were 9.57% and 26.6% respectively.

Conclusions : The high ICC for the BBS and the ABC suggest high test-retest reliability. SEM% for the BBS was low (3.55%) while the SEM% for the ABC was higher (9.57%). MDC% for the BBS was low (9.8%) while the MDC% for the ABC was higher (26.6%). These results suggest that the BBS has very low measurement error and high sensitivity to detect real change in balance performance in people with stroke. In contrast, the ABC has higher measurement error and may have limited ability to detect real change in balance confidence. The results of this study suggest that objective measures may have lower measurement error and be more sensitive to detecting real change than subjective measures in people with stroke.

Clinical Relevance : In patients with stroke, real change was computed to be >4.1 points on the BBS and >20.49 on the ABC. These results will assist clinicians and researchers in interpreting whether real change has occurred when comparing repeated measures of BBS and ABC.

TITLE: The Influence of Postural Core Activation Training on Gait and Balance in Patients Post-Stroke: A Case Series.

AUTHORS/INSTITUTIONS: V. Pardo, J. Kudla, J. Nawrocki, K. Weber, Physical Therapy, Wayne State University, Detroit, MI|A. Goldberg, Department of Health Care Sciences ,Program in Physical Therapy, Mobility Research Laboratory, Institute of Gerontology, Wayne State University, Detroit, MI|

ABSTRACT BODY:

Purpose/Hypothesis : Traditional post-stroke rehabilitation has mainly focused on restoring independence in gait and extremity function, but the development of greater trunk stability should not be overlooked by therapists. Improving trunk stability post-stroke may lead to an improved ability to coordinate movement sequences of both the trunk and limbs and ultimately improve performance of daily activities. There is no current research that examines the effect of an exercise program that focuses on improving core stability for populations post-stroke. The purpose of this case series was to examine the effects of a postural core activation program on people with stroke.

Number of Subjects : Three individuals (aged 39, 48 and 69) with right hemiparesis due to a chronic stroke participated in this study.

Materials/Methods : Participants attended 12 hour-long training sessions (2x/wk for 6 weeks). Gait parameters (gait symmetry, step length, single leg stance, and gait velocity), the BalanceMaster Limits of Stability (LOS) and weight bearing tests, and the Step Test were assessed twice pre-intervention (3 weeks prior and day 1 of intervention) and once post-intervention.

Results : Each participant completed 12 hour-long core activation exercise sessions. All participants demonstrated improvements in movement velocity (LOS) after the intervention. Two of the three participants improved on the Step Test, reaction time (LOS), and maximal excursion (LOS). Outcome measures that did not show improvements were end-point excursion (LOS), percentage weight bearing (BalanceMaster), and most of the gait parameters (single leg stance, gait velocity and step length).

Conclusions : These findings suggest that 12 sessions of core activation exercises can positively affect movement velocity, reaction time, maximal excursion and performance on the Step Test in people with stroke.

Clinical Relevance : It appears that the LOS Test on the BalanceMaster and the Step Test were appropriate outcome measures, whereas the gait parameters on the GaitRite did not capture changes from pre- to post-intervention. Future studies should consider using the LOS and Step Tests in a larger sample of participants with stroke.

TITLE: RESPONSE OF NON-PARETIC LEG TO LOCOMOTOR TRAINING POST-STROKE

AUTHORS/INSTITUTIONS: B. Raja, A. Behrman, , University of Florida, Gainesville, FL|R.R. Neptune, , University of Texas at Austin, Austin, TX|M. Bowden, S.A. Kautz, , Medical University of South Carolina, Charleston, SC|

ABSTRACT BODY:

Purpose/Hypothesis : Rehabilitation techniques post-stroke focus primarily on the performance of the paretic leg without much concern about the mechanisms used by the non-paretic leg to compensate for the weakness and poor coordination of the paretic leg. However, the increased non-paretic leg compensation could inhibit development of more biomechanically appropriate use of the paretic leg. Although the non-paretic leg muscle activity is clearly altered, changes in the patterns following a task-specific locomotor training remain to be investigated.

Number of Subjects : twenty seven

Materials/Methods : Kinesiological data were recorded from twenty seven individuals with chronic hemiparesis pre and post thirty-six sessions of locomotor training using body weight supported treadmill training. Subjects were grouped based on their self- selected speed as slow $0 < 0.4\text{m/s}$, moderate $0.4\text{-}0.8\text{ m/s}$ and fast $> 0.8\text{m/s}$. We evaluated the differences in the magnitude and timing of the non-paretic leg EMG relative to speed matched healthy control subjects pre and post-training.

Results : While the non-paretic leg muscle activity was normalized in some speed-based groups suggesting reduced compensation, significant differences in the non-paretic leg muscle activity post-training existed in others when compared to healthy subjects ($p < 0.05$). Individuals changing from moderate to fast speed and those not changing their speed group exhibited reduced compensatory non-paretic leg EMG magnitude and timing changes. On the other hand, those progressing from the slow to moderate group increased compensatory EMG activity of the non-paretic leg.

Conclusions : The results of this study suggest that locomotor training can be an effective technique of gait rehabilitation post-stroke for altering non-paretic leg muscle activity, implying that the motor control of the non-paretic leg is responsive to locomotor interventions. However, this response is inconsistent and the alterations appear compensatory in some groups and adaptive in others. The resultant effect on overall locomotor coordination cannot be determined without the analysis of the paretic lower extremity as well. Future work investigating the coordinative effect of the non-paretic and paretic legs on locomotor coordination need to be completed to fully elucidate the ability to promote recovery and limit compensation.

Clinical Relevance : Emphasizing reduction of the compensatory mechanisms of the non-paretic leg would force increased use of the paretic leg (beyond to the conventional emphasis of increasing the paretic leg use). This dual pronged approach to modulate the performance of individuals walking after stroke might produce more effective response to therapy.

TITLE: Kinematic Changes in Reaching, Swinging, and Punching following ENGAGE Video Gaming in an Individual with Chronic Stroke

AUTHORS/INSTITUTIONS: A. Reinthal, A. Cupp, P. Kelly, School of Health Sciences, Cleveland State University, Cleveland, OH|

ABSTRACT BODY:

Background & Purpose : Residual upper extremity (UE) impairment can limit function post stroke. The purpose of this study is to examine kinematic changes after participation in the ENGAGE video gaming protocol in order to clarify why and how functional change occurs as a result of this intervention.

Case Description : This case describes a 51 year old male six years post stroke with right hemiparesis and an initial Fugl Meyer (FM) UE motor score of 20/66. He received 720 minutes of individualized video gaming as an adjunct to physical therapy over 12 weeks following the established ENGAGE protocol. Three activities of increasing difficulty were analyzed using three-dimensional motion analysis before and after the intervention: reaching from hand in lap to table top (HT), swinging a golf club (GS), and punching a hanging 8" ball (PB). Motion capture and analysis were used to calculate hemiparetic shoulder (S) and wrist (W) displacement, time, and velocity.

Outcomes : After intervention, the FM score increased from 20/66 to 25/66. Mean movement time decreased in all conditions (8-33%). Shoulder and wrist excursion decreased 16-71%, except shoulder excursion increased 33% in GS and 49% in PB. Mean movement velocity decreased slightly for HT and GS (3-7%), but increased for PB (56% S; 10% W). Peak movement velocity decreased in all conditions (5-49%) except S-PB increased 40%. Qualitatively, the velocity curves became smoother for HT and GS following the intervention. Trunk and arm motion became better coordinated in GS and PB. Finally, the movement pattern changed in PB from a circular hook swing to a straighter plane forward punch, albeit with increased movement jerkiness.

Discussion : In HT, the least complex task with no force demands, movement became more efficient following the gaming intervention with the hand following a more direct movement path in a smoother manner. In GS, shoulder displacement increased while wrist displacement decreased, resulting in a more normal swing pattern in this bilateral task with force demands. The motion also became less jerky, with decreased peak velocity and a shorter overall movement time. PB, the most demanding task, required unilateral, forceful, and target specific motion. The movement strategy changed completely for PB from a one-motion circular swing to a posterior set-up followed by a straight plane anterior punch after the intervention. This is the only task in which mean movement velocity and jerkiness increased, suggesting that learning had not consolidated as well for this new movement pattern as compared to HT and GS. Finally, shoulder excursion increased in the GS and PB conditions in which the trunk is an integral part of normal motion. The more normal increased shoulder movement in GS and PB after the intervention suggests less unnecessary trunk co-contraction as movement quality improved.

TITLE: Using the Physical Activity Scale for Individuals with Physical Disability in persons with chronic stroke

AUTHORS/INSTITUTIONS: P. Ressler, K. Danks, M. Roos, D. Reisman, Department of Physical Therapy, University of Delaware, Newark, DE|J. Ciampa, Physical Medicine and Rehabilitation Department, The Johns Hopkins Hospital, Baltimore, MD|

ABSTRACT BODY:

Purpose/Hypothesis : The Physical Activity Scale for Individuals with Physical Disability (PASIPD) is a self-report measure of physical activity that may provide useful information to clinicians about a patient's daily physical activity. Two purposes of this research were to understand the feasibility and accuracy of using the PASIPD as a measure of walking activity in persons with chronic stroke and to identify whether there is a relationship between measured walking activity and self-report activity from the PASIPD in this patient group.

Number of Subjects : 10

Materials/Methods : Community dwelling persons with stroke participated in a step activity monitoring program with the goal of increasing steps/day. Steps/day were measured utilizing a StepWatch Activity Monitor (SAM) at baseline and then for 4 consecutive weeks. Participants reported to the clinic weekly to review the previous week's step activity, to establish new step goals for the upcoming week and to complete the PASIPD. The PASIPD is a 13 item self-report measure that asks a participant to report how many days in the past week and how many hours/day they participated in certain activities. The score is created by multiplying the average hours/day for each item by a MET value associated with the intensity of the item. If a participant responds that they "never" participated in an item over the past week, a score for that item cannot be calculated. Responses to the PASIPD were correlated with step activity using Pearson correlations.

Results : 70% of participants answered "never" to >50% of the questionnaire in week 1 and 80% of participants answered "never" to >50% of the questionnaire in week 5. The relationship between the change in the number of questions for which participants did not answer "never", and the change in the number of steps/day taken was not significant between week 1 and week 5 ($r = 0.178$). There was a negative correlation between the change in a score on an individual question from week 1 to week 5 and the change in steps/day from week 1 to week 5 (question 2; $r = 0.87$).

Conclusions : The limited number of questions that participants were able to provide an answer other than "never", even at the end of a study where step activity had increased significantly, suggests that the score on the PASIPD may not be an accurate representation of walking activity in those with chronic stroke. This suggestion is supported by the weak relationship between steps/day and score on the PASIPD in this group. This indicates that the PASIPD may not be an optimal choice as a self-report measure of walking activity in persons with chronic stroke.

Clinical Relevance : Utilizing a SAM may be an accurate way to monitor change in activity over time, but it is expensive. A questionnaire like the PASIPD would be easier and more cost effective in the clinic. Unfortunately, based on the present research, it appears that the PASIPD is a poor substitute for measured walking activity.

TITLE: The Effect of Peripheral Electrical Stimulation on Reaction Time and Cortical Excitability

AUTHORS/INSTITUTIONS: A. Roughton, L. Argetsinger, C. Lairamore, T. Huitt, Physical Therapy, University of Central Arkansas, Conway, AR|

ABSTRACT BODY:

Purpose/Hypothesis : Stroke is one of the leading causes of long-term disability in the United States, and individuals recovering from a severe stroke require extensive rehabilitation. In order to improve the efficiency of rehabilitation, trials have been conducted with the use of peripheral sensory stimulation and functional electrical stimulation for modulating neural activity and improving motor re-learning. However, the use of neuromuscular electrical stimulation (NMES) for exciting and potentially priming motor and sensory areas of the cortex has not been investigated. The purposes of this research were to: 1) determine if the application of NMES would increase cortical activity in the motor and sensorimotor cortices of healthy individuals and 2) determine if the application of NMES would improve motor responses as measured by reaction time.

Number of Subjects : 10

Materials/Methods : Participants underwent a baseline measurement of electroencephalography (EEG) followed by a series of 3 reaction time tests. Participants then received 10 minutes of NMES followed by a second series of 3 reaction time tests. Treatment (NMES) was applied over the thenar muscles of the dominant hand and median nerve at the wrist with the stimulation cycling on for 10 seconds (NMES on) and off for 20 seconds (NMES off) with enough amplitude to elicit a muscle contraction. Reaction time (sec) in response to an auditory tone was measured with a thumb trigger, and EEG was used to measure spectral frequency (Hz) and amplitude (microV) in the areas of the somatosensory and motor cortices throughout the duration of the study.

Results : Data was analyzed using a repeated measure ANOVA with post hoc paired sample t-test with Bonferroni correction of alpha. No significant difference was found in reaction times between pre- and post-administration of NMES ($p=0.143$). Analysis of maximum amplitude of EEG beta waves (beta-max) indicated a significant difference when comparing baseline resting EEG, EEG during NMES on, and EEG during the NMES off ($p=0.000$). Comparison of beta-max during NMES on cycle and baseline indicated a significant increase in activity ($p=0.001$). Additionally, comparison of beta-max during NMES off cycle and baseline indicated a significant increase in activity ($p=0.020$). However, there was no significant difference between beta-max amplitude during NMES on cycle and NMES off cycle ($p=0.123$).

Conclusions : In this study, NMES did not affect reaction time in healthy participants. However, NMES did increase the maximum EEG beta wave amplitude during both NMES on cycle and NMES off cycle compared to baseline.

Clinical Relevance : Results suggest that using NMES as a treatment method to improve cortical processing time in healthy individuals is inappropriate. However, finding that NMES increases cortical excitability in healthy individuals leads to a hypothesis that use of NMES could potentially influence the excitability of neural networks in patients post-stroke which may aid neural recovery and speed the rehabilitation process.

TITLE: Hip Flexor Fatigue Following Sub-maximal Concentric Contractions and Walking Function Post Stroke

AUTHORS/INSTITUTIONS: M. Rybar, H. Kuhnen, E. Walker, D. Ouellette, L. Dillon, M. Patel, S. Hunter, B.D. Schmit, A. Hyingstrom, , Marquette University, Milwaukee, WI

ABSTRACT BODY:

Purpose/Hypothesis : Post stroke, baseline force generating deficits at the hip joint are associated with decreased walking function. However, increased paretic leg muscle fatigability in hip flexors (Hyingstrom et al 2012), could exacerbate baseline weakness and further impair walking ability. For example, impaired walking function post fatigue could affect an individual's ability to walk fast enough to cross the street safely or total distance walked while out in the community. Understanding the specific impact of hip flexor fatigue on walking function post stroke will help direct neurorehabilitation strategies. The purpose of this study was to quantify the effects of neuromuscular fatigue of the paretic hip flexors on measures of maximum walking speed and distance walked in six minutes. Our hypothesis was that fatigue of the paretic hip flexors following sub-maximal concentric contractions would result in larger decreases in walking distances and maximal walking speed compared with the controls.

Number of Subjects : Ten individuals with stroke (63 ± 6 yrs) and nine controls (mean age = 63 ± 6 yrs) participated in this study.

Materials/Methods : In order to determine baseline strength and power, subjects first performed 3-5 baseline isometric hip flexion maximal voluntary contractions (MVCs). Force produced during contractions was measured by a load cell. Subjects then completed three bouts of six minute overground walking (to control for any warm up effect of walking). Distance walked was measured for each bout and averaged across trials. In addition, subjects were instructed to walk "as fast as possible" for the first 4 meters traversed per walking bout. In an upright supported posture, subjects then performed the fatigue protocol that involved repeated sub-maximal concentric hip flexion contractions at 20% of MVC through a 50 degree range of motion until task failure. Immediately following task failure, subjects performed a final six minute walk.

Results : Stroke and control subjects performed the fatigue protocol with equivalent times (58.8 ± 20 s and 69.1 ± 46 s, t-test, $p > 0.05$). However, the stroke subjects had a lower post fatigue hip flexion MVC (170 ± 39 N) compared with the controls (255.3 ± 50 N, $p < 0.05$). Post fatigue, stroke subjects had a larger percent decline in maximal walking speed (25%) compared with controls (4%, t-test, $p < 0.05$). For both groups, walking distances pre (stroke = 222.6 ± 114 m; control = 413.7 ± 30 m) and post fatigue (stroke = 233.0 ± 118 m; control = 440.1 ± 25 m) were not significantly different (paired t-test, $p > 0.05$).

Conclusions : Despite equivalent task durations, fatigue of the paretic hip flexors had a larger impact on maximal walking speed (versus distance) compared with controls.

Clinical Relevance : These data suggest that paretic neuromuscular fatigue had a larger negative impact on walking speed (versus distance) than neurologically intact individuals. Importantly, targeted strength training of the hip flexors maybe important in normalizing maximal walking function after stroke.

TITLE: Description of Functional Outcomes following a Short Intensive Neurologic Clinic in Rural Jamaica

AUTHORS/INSTITUTIONS: K.L. Sawyer, K. von Nieda, A.H. Miller, Physical Therapy, Arcadia University, Glenside, PA|B. Riley, Physiotherapy Clinic, St. Vincent Strambi Health Centre, Bull Savannah, St. Elizabeth Parish, JAMAICA|

ABSTRACT BODY:

Background & Purpose : Current literature supports intensive rehabilitation to promote functional gains in people post stroke. Based on this literature a program was designed to provide intensive rehabilitation in a rural Jamaican community (Stroke Camp). Faculty and students from physical therapist (PT) programs in the USA collaborated with the clinic to provide 3 1/2 days (21 hours) of intensive functional task practice and forced use interventions. The purpose of this case series is to report changes in functional performance of people post stroke.

Case Description : Twenty-two people participated in Stroke Camps which were conducted over 4 ½ consecutive days including pre- and post-testing. The mean length of time since stroke was 16.1 +/- 16.5 months. Eight people were in the sub-acute phase of recovery post stroke and 14 were in the chronic phase. All demonstrated hemiplegia, with 50% having right-sided involvement. The mean age was 54.5 +/- 13.7 years, and the most common co-morbidities were hypertension (19), hyperlipidemia (10), diabetes (7), and sickle cell disease (2). All were ambulatory and 13 used an assistive device. The primary goal for all people was to improve ambulatory function.

Interventions were provided for 6 hours per day: 1 hour of group mat exercises, 4 hours of individualized functional gait, balance, upper extremity and hand activities, and 1 hour of group recreation. The functional performance measures included Timed Up and Go (TUG), gait speed (GS), 6 minute walk test (6MWT) for all participants and either Functional Gait Analysis (FGA) or Berg Balance Scale (BBS).

Outcomes : Improvements were noted in functional performance for all people and for groups subdivided by sub-acute and chronic and are reported as percent exceeding minimal detectable change (MDC) or minimal clinically important difference (MCID): 86% all people, 100% sub-acute, 79% chronic exceeded MDC for TUG (2.9 s); 77% all people, 88% sub-acute, 71% chronic exceeded MCID for GS (0.1 m/s); 67% all people, 75% sub-acute, 62% chronic exceeded MCID for 6MWT (50 m). Improvements were noted for the people who were tested using the FGA or BBS and are reported as percent exceeding MDC: 88% FGA (4.2 points) and 71% BBS (2.5 points).

Discussion : People attending Stroke Camp achieved marked functional gains as evidenced by the large majority making detectable changes in all performance measures. The magnitudes of change exceeded the MDC or MCID suggesting a meaningful differences across all functional outcome measures. Patients who were in the more sub-acute phase of recovery showed greater changes than those who were more chronic. This camp model of rehabilitation suggests 21 hours of intensive functional task practice may be a useful modality for people post stroke.

TITLE: Exploring individual dose-response relationships between task-specific movement and functional recovery of the upper extremity after stroke: A secondary analysis

AUTHORS/INSTITUTIONS: J.M. Seelbach, C.E. Lang, Program in Physical Therapy, Washington University , St. Louis, MO|R.L. Birkenmeier, Program in Occupational Therapy, Washington University , St. Louis, MO|

ABSTRACT BODY:

Purpose/Hypothesis : The dose of task-specific practice in rehabilitation settings is significantly lower than what is provided in animal models of stroke. Previous research suggests that higher doses are feasible to deliver, possibly leading to enhanced functional recovery post-stroke. The purpose of this secondary analysis was to explore individual dose-response relationships between repetition of movement and functional recovery of the hemiparetic upper extremity (UE).

Number of Subjects : 13 adults with chronic stroke (>6 mos) resulting in UE hemiparesis completed the study.

Materials/Methods : In the proof-of-concept study from which these data were taken, subjects were challenged to perform high repetitions of graded and progressive task-specific movement targeting the hemiparetic UE. Participants attempted to complete ≥ 300 repetitions during 1-hr treatment sessions, 3 times per week for 6 weeks. The primary outcome measure used to track functional progress was the Action Research Arm Test (ARAT). Assessments were completed at baseline, weekly, and after treatment to measure benefit of the intervention. Here, we used the numbers of repetitions and change scores on the ARAT from baseline to end of treatment. Only data from subjects with ARAT change scores that reached or exceeded the minimum detectable change of 4 points were analyzed. Thus, dose-response data from 9 subjects were plotted, visually inspected, and curve-fit using a 4-parameter logistic equation. The maximal effective dose of repetitions for each individual, i.e. the number of repetitions at which 95% of the maximal response was achieved, was derived from the curve-fits.

Results : Data from 7 of the 9 subjects could be fit with dose-response curves ($r^2 = 0.60-0.97$). Actual doses delivered ranged from 4176 to 7568 repetitions, with ARAT change scores ranging from 4-26. Maximal effective doses generated from individual equations ranged from 1951 to 7149 repetitions. The shape of the curves and the maximal effective doses spanned a broad range across subjects.

Conclusions : It is possible to determine dose-response curves in individual subjects. Our sample is too small to determine how modifying factors and additional stroke-related impairments of each individual influenced the dose-response relationship. The broad range of doses suggests that the maximal effective dose is likely not a single number for everyone.

Clinical Relevance : It is important to consider how dose may influence outcomes in individuals receiving rehabilitation. Taking repeated assessment of the key outcome will allow a clinician to track an individual's response to the therapy provided, regardless of whether dose is measured in repetitions, time, or another metric. Through tracking the individual dose-response relationship, one can best determine the need for continuing rehabilitation services.

TITLE: The Efficacy of Functional, Task-Oriented Treatment for Gait Deficits in Individuals Following Stroke: A Systematic Review

AUTHORS/INSTITUTIONS: E. Short, A. Fountain, P.W. Stegall, R. McRae, University Rehabilitation Center, Department of Physical Therapy, University of Mississippi Medical Center, Jackson, MS|L.J. Barnes, K. Curbow-Wilcox, School of Health Related Professions, Department of Physical Therapy, University of Mississippi Medical Center, Jackson, MS|

ABSTRACT BODY:

Purpose/Hypothesis : Strokes are one of the leading causes of disability in the world. While 60-80% of people regain the ability to walk independently after stroke rehabilitation, only 7% regain the ability to become community ambulators. The vast majority of individuals report low levels of activity post rehabilitation and few regain complete functional independence. Current trends in rehabilitation emphasize task-oriented training that focuses on skills needed for daily life. The purpose of this systematic review was to examine the literature to evaluate the efficacy of functional, task-oriented treatment on gait in individuals following stroke.

Number of Subjects : 11

Materials/Methods : A computer-aided search of the literature was conducted in PubMed through February, 2012. Search terms were variations of stroke, functional training, and ambulation. Inclusion criteria were (1) randomized control trials (RCT) and (2) English language. Exclusion criteria were: (1) all other types of studies, including RCT protocols, (2) diagnoses other than stroke (3) non-task based intervention including virtual reality, orthotics, or pharmacology, (4) intervention of treadmill training, and (5) outcomes without a gait measure. The electronic search was completed followed by title and abstract screens. Articles were included based on stated inclusion and exclusion criteria. Articles were scored using PEDro and Oxford Center for Evidence-Based Medicine (CEBM) levels of evidence.

Results : The electronic search yielded sixty-six articles. The title screen reduced the number to 23 and the title abstract screen further decreased appropriate articles to 13. Eleven articles remained following the article screen, which included application of the inclusion and exclusion criteria. Articles were found to have an average PEDro score of 6.9 with the highest score being eight and lowest being 5. CEBM scores were level I for nine articles and level II for two articles.

Conclusions : Findings indicate that functional, task-oriented interventions are effective in treating patients following stroke at all stages during recovery. The articles included in this systematic review were of CEBM levels I and II with PEDro scores ranging from 5 to 8. With this strong evidence, functional, task-oriented interventions are clinically relevant. It should be noted that patients in each stage of recovery receiving functional, task oriented treatment showed greater improvements in strength and gait characteristics than the counterpart groups.

Clinical Relevance : Results show that functional tasks increase strength while allowing the patient to practice daily activities, which in turn improves quality of life, self-efficacy, and gait parameters. Overall, the evidence suggests that functional, task-oriented treatment is appropriate across the continuum of care for patients post-stroke.

TITLE: Evaluating postural instability in adults with stroke after training with plantar surface vibration

AUTHORS/INSTITUTIONS: J.C. Slaboda, Physical Therapy, University of Nevada, Las Vegas, NV|E.A. Keshner, Physical Therapy, Temple University, Philadelphia, PA|

ABSTRACT BODY:

Purpose/Hypothesis : Postural control is a rapid process that has been shown to be interfered with by multitasking. Thus identifying methods of training that modify the postural responses without adding attentional demands would significantly enhance interventions focused on reducing falls during functional activities. We have employed a stochastic resonant input, which has been shown to enhance sensory information processing and perception. We hypothesized that a training paradigm using sub-threshold vibratory noise applied to the plantar surface of the feet would reduce postural instability in patients with stroke.

Number of Subjects : During one baseline and 2 post-intervention visits, 5 patients with stroke (4 with right hemiparesis and 1 with left hemiparesis) signed an informed consent to participate in these experiments as approved by the IRB at Temple University.

Materials/Methods : Subjects stood quietly on a support surface that was sway referenced in the tilt plane while viewing a visual field that rotated pitch up or down at 30 deg/sec or was dark. Between the pre- and post-intervention visits, 10 days of training included standing in the dark on a sway referenced platform for 60 sec trials for a total of 15 minutes while wearing vibrating footwear. The footwear was embedded with 3 DC vibrator disks that produced white noise vibration that was sub-threshold for tactile perception. Sway referencing magnitudes were continuously increased to challenge balance. During training, patients were instructed to focus on motion of their hips and knees in order to maintain their balance. Center of pressure (COP) and center of mass were used to measure postural responses during the pre- and post-treatment sessions. Power spectral densities of the COP were calculated. Area under the power spectra density curve from 0-1 Hz was calculated and used for comparison.

Results : After training, patients exhibited both decreased amplitude and power over the entire COP spectra (0-1 Hz) during visual field rotations. At an assessment two-weeks after the intervention, patients with stroke still demonstrated reduced COP responses while immersed in a disturbing visual flow field.

Conclusions : Adding a sub-cortical stochastic resonant input at the base of support may help regulate postural sway in patients with stroke and changes are maintained at least 2 weeks after treatment.

Clinical Relevance : Plantar surface vibration has the potential to serve as an adjunct to exercise interventions that reduce postural instability without presenting increased attention demands.

TITLE: A hippotherapy simulator is effective to shift weight bearing toward the affected side during gait in hemiplegic patients after stroke

AUTHORS/INSTITUTIONS: Y. Sung, J. Park, Physical therapy, Kyungnam Univeristy, Changwon-si, KOREA, REPUBLIC OF|C. Kim, Physiology, Kyung Hee University, seoul, KOREA, REPUBLIC OF|B. Yu, Physical therapy, Shingu University, Seongnam, KOREA, REPUBLIC OF|

ABSTRACT BODY:

Purpose/Hypothesis : Overcoming disability is a crucial goal in rehabilitation. Particularly, restoration of normal gait is an important target for stroke patients. To treat abnormal gait in stroke patients, many therapists have used effective gait-training methods such as conventional rehabilitation, ankle foot orthosis, treadmill training, functional electrical stimulation, robot-assisted training, transcranial direct current stimulation, and hippotherapy. Among them, hippotherapy improves physiological aspects including balance, strength, coordination, muscle tone, joint range of movement, weight-bearing, posture, and gait in patients with neurological problems. We investigated whether use of a hippotherapy simulator has a beneficial effect on gait in patients recovering from stroke.

Number of Subjects : 20

Materials/Methods : The patients were divided into a control group that received conventional rehabilitation for 60 min/day and an experimental group that used a hippotherapy simulator for 15 min/day after conventional rehabilitation for 45 min/day. Each group was treated; 5 times/week for 4 weeks. Temporospatial gait parameters including step length, stance phase, swing phase, single support, load response, and pre-swing, assessed using OptoGait and trunk muscle activity, evaluated using surface electromyography.

Results : Of the gait parameters, load response, single support, total double support, and pre-swing showed significant changes in the experimental group with a hippotherapy simulator compared to control group ($p < 0.05$). During sit-to-stand, activation of the erector spinae in the experimental group was significantly increased compared to that in the control group ($p < 0.01$), whereas activation of the rectus abdominis decreased. Moreover, activation of the erector spinae and inhibition of the rectus abdominis after hippotherapy simulator treatment correlate with changes in gait parameters including load response, single support, total double support, and pre-swing in experimental group.

Conclusions : These findings suggest that use of a hippotherapy simulator may benefit stroke patients by improving gait performance and influencing trunk muscles.

Clinical Relevance : Our findings suggest that use of a hippotherapy simulator may help patients to shift weight bearing to the affected side by facilitating activation of the erector spinae, and inhibiting the rectus abdominis.

TITLE: Assessment and Treatment of a Patient with Concurrent Gait Apraxia and Right Hemiplegia

AUTHORS/INSTITUTIONS: K.B. Szirony, Physical Medicine and Rehabilitation, Cleveland Clinic, Cleveland, OH|

ABSTRACT BODY:

Background & Purpose : The purpose of this case study to identify appropriate assessment tools for gait apraxia in a patient with concurrent right hemiplegia. Additionally, treatment strategies will be highlighted that address functional outcomes that address both gait apraxia and right hemiplegia

Case Description : 54 year old right handed female who developed right hemiplegia after suicide attempt with carbon monoxide. CT scan indicated bleed in thalamus. Hospital course complicated by hydrocephalus requiring VP shunt. Referred for outpatient PT after prolonged acute hospitalization and acute inpatient rehabilitation. Examination revealed difficulty with verbal expression with good comprehension. Overall Fugl-Meyer score of 22. Berg Balance Score 33/56. Five time sit to stand using UE's 28.8 seconds. Functional reach 8 inches in standing. Timed Up and Go 40.3 seconds with use of right AFO. 10 meter walk 69.8 seconds with step to gait pattern with standard cane. 28 treatment sessions consisting of stretching and use of night splint for ankle plantarflexors and hip flexors, use of Ultraflex AFO, partial body weight support treadmill training, external visual cues such as walking line and rhythmic auditory stimulation starting at music with 70 bpm progressing to 105 bpm

Outcomes : Berg Balance score 41/56. Functional reach 9 inches in standing. Timed Up and Go 29.1 seconds. Five time sit to stand using UE's 19.8 seconds with use of right AFO. 10 meter walk 39.6 seconds with step ahead pattern using walking pole

Discussion : Patient responded well with improvement in all parameters. Treadmill training combined with rhythmic auditory stimulation appears to improve gait apraxia and functional mobility. Further research is required to support results of this case study.

TITLE: Rehabilitation of the Upper Limb Post Stroke: MRI results of a Randomized Controlled Pilot Study

AUTHORS/INSTITUTIONS: G.T. Thielman, Physical Therapy, University Of The Sciences , Philadelphia, PA|A.

Bandyopadhyay, F. Mohamed, Radiology, Temple University Hospital , Philadelphia , PA|

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of this randomized controlled trial was to compare training protocols used on chronic post stroke individuals' specifically measuring sensorimotor recovery, neuroplasticity, and kinematic changes. Exploratory MRI data is expected to yield information on neuroplastic changes of the cortex.

Number of Subjects : Eight subjects participated in this randomized controlled trial.

Materials/Methods : Subjects were scanned using a 3T Siemens MRI scanner. Pre-testing and post- testing included task based Functional MRI BOLD images as well as resting state BOLD images were acquired using a standard echo planar gradient echo sequence, with a 12 channel head coil. The post-acquisition preprocessing and statistical analysis was performed using SPM8, run under the Matlab environment (The Mathworks, Inc., Natick, MA).

Polhemus electromagnetic tracking device was also used to measure kinematic changes, and the Fugl-Meyer Scale, Reaching Performance Scale, Wolf Motor Function Scale and Mini-Mental to measure sensorimotor recovery.

Results : Preliminary results at the end of the first level analysis showed BOLD activation in the motor cortex area presumed to be involved in these tasks. Quantitative analysis between the pre and post conditions is in process to correlate the results with the effect of treatment. Kinematics revealed more efficient reaching movements were evident post training, for both individuals trained in each group- with an increase in peak velocity and a decrease in deceleration time, as well as a decrease in movement time. Several clinical measures revealed improvements post either training.

Conclusions : An increase in neurotransmitter activity is correlated with an increase in blood flow and metabolic activity, therefore a blood oxygenation level dependent (BOLD) fMRI is a valid measure of neural activity in the brain. This study provides a thorough evaluation of the kinematics, neuroplasticity, ADL status, ROM and strength of the paretic upper extremity.

Clinical Relevance : Changes in upper extremity impairments in post-stroke patients may be determined through comparison of inter-hemispheric activity.. The results from this study may change the way rehabilitation for a stroke patient is performed, as well as the information needed to evaluate lasting changes in and outside of the brain.

TITLE: Current Physical Therapy Approaches for Stroke Rehabilitation in In-Patient Settings in Florida:
A Survey

AUTHORS/INSTITUTIONS: A.J. van Duijn, M. Venglar, K. Barbee, C. Fioravante, Physical Therapy, Florida Gulf Coast University, Fort Myers, FL|

ABSTRACT BODY:

Purpose/Hypothesis : The three main theoretical approaches used in neurological rehabilitation are NeuroDevelopmental Treatment (NDT), Proprioceptive Neuromuscular Facilitation (PNF) and Motor Learning/Motor Control (MLMC). The purposes of this study were to identify the use of treatment key concepts in the clinical setting by physical therapists (PTs) practicing in stroke rehabilitation in Florida; to determine which theoretical approach PTs prefer to utilize for intervention; and to determine the correlations between the theoretical approach PTs claim to utilize and their use of key concepts from that approach during treatment.

Number of Subjects : 41 physical therapists practicing at 16 Florida CARF certified inpatient stroke centers. Survey return rate was 40.2% (41/102 mailed surveys were returned).

Materials/Methods : A survey instrument was developed collecting demographic information, data regarding therapist training in each of the three theoretical approaches, therapist preference for the theoretical approaches, and the utilization of core treatment concepts of each of these approaches in the daily treatment of patients with stroke. Data analysis included: descriptive statistics, instrument reliability using Cronbach's Alpha, and correlational analyses using Spearman's Rho. Treatment concept "importance scores" were calculated combining the key treatment concepts belonging to each of the theoretical approaches, and these "importance scores" were correlated to the PTs' self-identified preferred theoretical approach.

Results : Instrument reliability was moderate to good (Cronbach's alpha: 0.51-0.77). A majority of respondents received entry-level education on all three major approaches: NDT 78%, MLMC 80.5%, PNF 95.1%. 77% reported post professional education: 67% in NDT and 32% in PNF and MLMC. A low to fair correlation was found between the self-identified theoretical approaches of NDT and PNF and the corresponding treatment concept "importance scores" (Spearman's rho correlations of .388 and .358 respectively, $p < .05$). No relationship was found for MLMC (Spearman's Rho: .005, $p > .05$).

Conclusions : The majority of therapists received education in and utilize treatment concepts from all three theoretical approaches. Correlations between the clinical utilization of treatment concepts and the self-identified preferred theoretical approach were weak or absent. This could be due to 1) PTs may be uncertain of the key concepts belonging to the theoretical approach from which they claim to utilize most frequently. 2) PTs identify themselves as using a certain theoretical approach, yet simultaneously recognize and hold value in key concepts from other approaches.

Clinical Relevance : PTs working in the inpatient setting in Florida utilize an eclectic approach to the treatment of patients after stroke. Furthermore, therapists appear to recognize the importance of key concepts from all theoretical approaches represented in this survey for stroke rehabilitation, as opposed to a singular approach.

TITLE: Optimization of Lower Extremity Kinetics During Transfers Using a Wearable, Portable, Robotic Lower Extremity Orthosis: a Case Study

AUTHORS/INSTITUTIONS: J.G. Vose, E. Tacdol, R.W. Horst, Clinical Affairs, Tibion Bionics, Sunnyvale, CA|A. McCarthy, Physical Therapy, Kaiser Permanente, Redwood City, CA|

ABSTRACT BODY:

Purpose/Hypothesis : Post-stroke individuals demonstrate significant kinetic differences between paretic and non-paretic limbs during transfers. These differences are attributed to a combination of CNS disruption, primarily, and muscular atrophy, exacerbated by disuse and compensatory movement patterns favoring the non-paretic limb. Conventional neurorehabilitation seeks to ameliorate these impairments, however it lacks methods to capture objective data for force and work output away from comprehensive motion analysis labs, or provide dosed, progressive assistance aside from tethered bodyweight-support devices. A wearable, portable, battery-powered robotic lower extremity orthosis designed to augment concentric and eccentric knee extension, as a percentage of body weight (BW), was created to meet these needs. We hypothesized that via use of the robotic lower-extremity orthosis (RLEO: Tibion Bionic Leg) it would be possible to optimize three limb parameters during transfers: maximum and mean force, total force output compared to ideal, and paretic limb work. Secondly, wireless data transfer from the RLEO in real-time was evaluated and compared to data obtained from a validated motion analysis laboratory (UCSF).

Number of Subjects : 1

Materials/Methods : A single male subject, nine (9) years post-single ischemic stroke, 74 years, 5'7" and 160 lbs was evaluated. Impairment was characterized as moderate by the Modified Rankin (3), Fugl-Meyer (90), and Berg Balance (45) scores. Multiple, kinetic analyses of sit-to-stand-to-sit transfers were conducted without (w/o and w/coaching) and with (assistance of 30 – 80% BW) the RLEO using force plates and the Vicon MX system.

Results : Without the RLEO and coaching, the subject demonstrated significant differences in paretic (P) and non-paretic (NP) mean (288 ± 16 vs. 397 ± 14 N, $p < 0.005$) and maximum (383 ± 18 vs. 522 ± 29 N, $p < 0.005$) force allocation; with coaching, this difference was maintained (Mean: 309 ± 8 vs. 379 ± 9 N, $p < 0.005$; Max: 397 ± 30 vs. 504 ± 29 , $p < 0.005$). With the RLEO and progressive assistance, P and NP force was optimized between 30 (Mean: 339 ± 11 vs. 380 ± 8 N, $p < 0.05$; Max: 534 ± 87 vs. 525 ± 27 N, $p = 0.87$) and 40% (Mean: 310 ± 60 vs. 332 ± 70 N, $p = 0.71$; Max: 468 ± 67 vs. 478 ± 6 , $p = 0.81$) BW, and diverged to pre-RLEO levels with increasing assistance. Compared to the ideal total force output, P and NP values without (69 ± 7 vs. 124 ± 7 %AUC Ideal, $p < 0.005$) and with (79 ± 3 vs. 113 ± 5 %AUC, $p < 0.005$) coaching were significantly different; with the RLEO, between 30 (97 ± 9 vs. 112 ± 3 %AUC, $p = 0.05$) and 40% (97 ± 8 vs. 108 ± 3 %AUC, $p = 0.09$) BW optimization was achieved with divergence at higher settings. Using the RLEO, paretic work was greatest between 30 (13165 ± 1128 ft-lb) and 40% (12904 ± 5159 ft-lb) BW with lower values at higher RLEO assistance.

Conclusions : Use of a wearable, portable RLEO with adjustable assistance settings may enable optimization of P and NP limb kinetics during transfer therapy in post-stroke individuals.

Clinical Relevance : Restorative movement patterns in therapy may enable improved clinical outcomes.

TITLE: CLUSTER ANALYSIS OF UPPER EXTREMITY FUGL-MEYER ASSESSMENT DEFINES LEVELS OF MOTOR IMPAIRMENT SEVERITY

AUTHORS/INSTITUTIONS: E. Woytowicz, J. Whitall, S. McCombe-Waller, Physical Therapy and Rehabilitation Science, University of Maryland Baltimore, Baltimore, MD|J. Rietschel, R. Goodman, , Baltimore Veterans Affairs Medical Center, Baltimore, MD|

ABSTRACT BODY:

Purpose/Hypothesis : Individuals with chronic stroke have a wide range of upper extremity (UE) motor impairments. The Fugl-Meyer (FM) Scale of Motor Impairment is the most commonly used scale for categorizing impairments post stroke. Previously, Woodbury (2007) used factor analysis to demonstrate FM-UE individual scores measured a single unidimensional construct, except for the reflex items. Despite the frequent use of the FM to categorize severity of paresis no quantitative analyses have determined severity ranges. Here, we quantitatively define the levels of severity using cluster analysis with and without the reflex items. This exploratory research had no a priori hypothesis but, based on Woodbury's findings, we expected cluster memberships to differ with and without reflex items.

Number of Subjects : 247 subjects with chronic UE hemiparesis (113 female, 134 left paresis), aged 32-89 years ($M=58.6\pm 11.75$).

Materials/Methods : FM scores for individual items were compiled from baseline testing of 5 studies with consistent testing procedures. Two hierarchical cluster analyses were run on the full sample: once with and once without reflex items. A between groups-linkage method was used with a squared Euclidian distance interval. Individual cluster characteristics were then analyzed.

Results : The range of FM scores included was 2-63 ($M=26.9\pm 15.7$) with reflex items and 0-57 ($M=22.1 \pm 15.3$) without. Three distinct clusters were found. FM scores with reflex items for cluster 1, 2, and 3 ranged between 2-27, 28-42, and 43-63 with 151, 49, and 47 subjects respectively. FM scores without reflex measures for cluster 1, 2, and 3 ranged between 0-21, 22-38, and 39-57 with 147, 59, and 41 subjects respectively. When reflex items were removed, classification changed to an adjacent cluster for 28/247 subjects (11%). Classification change occurred for 12, 9, and 7 subjects from clusters 1, 2, and 3 respectively.

Conclusions : The cluster analysis of the original scale verifies that individuals with UE hemiparesis can be distinctly categorized into 3 levels of severity that can be described as severe (<28), moderate (28 to 43) and mild (>43). The fact that more individuals were in the severe category may reflect the actual distribution of the population or be reflective of the small sample bias caused by, for example, more stroke survivors with severe impairments seeking to be in research studies. The 11% difference in cluster identification between the two analyses supports the findings of Woodbury et al. that the reflexes represent a different construct. These data suggest the consideration of whether reflexes should be included in the final scoring of the FM.

Clinical Relevance : Knowledge of UE motor impairment severity levels of the FM could assist clinicians in interpreting current literature with relevance to the research sample studied. This information could guide therapists in selecting intervention options most appropriate for their individual patients.

TITLE: Cortico-Muscular Connectivity for Single and Two Degree-Of-Freedom Tasks

AUTHORS/INSTITUTIONS: J. Yao, C. Carmona, L. Anderson, K. Larson, R. Sharkey, I. Wolfe, J.P. Dewald, , Northwestern University, Chicago, IL|

ABSTRACT BODY:

Purpose/Hypothesis : Purpose/Hypothesis: The purpose of this study is to understand how cortico-muscular connectivity (CMC) changes corresponding to the requirement for muscle selectivity. Able-bodied individuals can activate muscles/joints independently; however, individuals with stroke express abnormal synergies i.e., obligatory co-activation between muscles/joints. Because stroke can affect cortical and/or subcortical motor structures, the synergy can be caused by changes in CMC. It has been shown that synchronized oscillation serves as one of the effective ways for the cortex to connect with target motor units. Briefly, each synapse and neuron has its own resonant frequency. Inputs oscillating at the postsynaptic resonant frequency are more likely to cause a postsynaptic cell to fire. By using inputs of different frequencies, the presynaptic cell can selectively affect postsynaptic targets. We therefore hypothesize that in able-bodied individuals the cortex connects with different muscles at distinguished frequencies to guarantee selective muscle activation. We also report a preliminary result demonstrating the usage of shared frequencies for connecting with different muscles following stroke.

Number of Subjects : Eight able-bodied (4 young and 4 age-matched) adults and 1 individual with stroke participated the study.

Materials/Methods : All the participants performed a single Degree-Of-Freedom (DOF) shoulder abduction and a two-DOF shoulder abduction + elbow flexion torque generation tasks, all at the level of 25% of subject's maximum voluntary torques. Motor tasks were performed in blocks of alternating order with enough resting time to avoid fatigue. We collected 160-channel scalp EEGs and EMGs from intermediate deltoid (IDL) and biceps (BIC). For each motor task, the coherence between EEGs and a target muscle (i.e., IDL or BIC) was analyzed. The CMC frequency distribution was then calculated as the number of EEG electrodes with significant coherence at a specific frequency.

Results : For 1 DOF tasks, CMC frequency distributions for IDL and BIC overlap in both controls and the individual with stroke. This distribution widens in elderly able-bodied subjects and is even broader following stroke. During the 2 DOF task, a shift in the frequency distribution for both IDL and BIC and a reduction in their overlap were observed in all control subjects but not in the individual with stroke.

Conclusions : In healthy subjects, CMC occurs at more selective frequencies during a 2 DOF task as compared to a 1 DOF task, suggesting a 'fine-tuned' communication with the desired muscles when high-level muscle coordination is required. The pilot data in the individual with stroke, however, demonstrated that such selectivity in the frequency domain was lost.

Clinical Relevance : Understanding CMC in individuals with/out stroke could aid in the development of more effective therapies in the future: for example to use a brain stimulation method to change the resonant frequency of cortex, and thus enhancing the CMC.

TITLE: Exploring the Relationship between Balance, Fear of Falling, and Falls in Individuals with Acoustic Neuroma: A Pilot Study.

AUTHORS/INSTITUTIONS: J.G. Barry, K. Loos, P. Ward, T. Charlton, Physical Therapy, Maryville University, St. Louis, MO

ABSTRACT BODY:

Purpose/Hypothesis : Individuals with acoustic neuroma (AN) have a unilateral vestibular hypofunction. As these individuals age, residual balance deficits may increase the risk of falls. Falls are of great concern as injuries may result along with the financial costs. The purpose of this study was to investigate the relationship between balance, falls and fear of falling in individuals after an AN resection.

Number of Subjects : Included were six individuals with history of an AN who were greater than 3-months post surgical resection.

Materials/Methods : Data collected included the number of reported falls, fear of falling measured with the Modified Falls Efficacy Scale (MFES) and standing balance recorded on the Basic Balance Master using the modified Clinical Test for Sensory Integration and Balance (mCTSIB) and Single Leg Stance (SLS) collecting both sway velocity and time completed. Data Analysis included Spearman Rho correlations between two variables at a time. In addition, scatter plots were used to explore relationships between the variables and identify outliers.

Results : Six participants completed the study, the mean age was 62.2 years with a range from 55-71 years; the mean time since AN resection was 9.1 years with a range of 0.8- 18.9 years. One participant reported a fall in the previous year with another reporting one fall during the 2-month follow-up call. The scores on the MFES were high (mean=9.4/10 range=8.6-10/10) indicating a low fear of falling. When analyzing the performance during the mCTSIB, participants performed worst on foam with eyes closed with no participants able to complete the 10 seconds for all three trials. They also performed poorly when attempting SLS with eyes closed, not a single participant could successfully complete even one trial. The correlations were weak to moderate but not statistically significant (r-value range = -0.15-0.64; p-value range = 0.17-0.92).

Conclusions : Participants with AN have vestibular deficits which could explain their difficulty balancing with eyes closed on foam and during SLS. The findings that participants were unable to balance on SLS with eyes closed for a 10 second trial supports previous research on individuals with AN which found the inability to maintain SLS eyes closed for 30 seconds. Yet, no relationships were found between balance performance and falls or fear of falling; nor between actual falls and fear of falling. The small sample size with apparent outliers made analyzing the relationship between falls, fear of falling and balance performance difficult. Further studies with a larger sample and possibly using a fear of falling measure more applicable to the AN population is warranted. While participants with AN had balance deficits, they did not report frequent falls and their fear of falling was low based on the MFES.

Clinical Relevance : Participants with AN have vestibular deficits which could explain their difficulty balancing with eyes closed on foam and SLS. Yet this group studied had very few falls, indicating they may avoid situations that would lead to falls.

TITLE: Measurement Properties of the Dizziness Handicap Inventory

AUTHORS/INSTITUTIONS: R. Clendaniel, A. Goode, , Duke University School of Medicine, Durham, NC|

ABSTRACT BODY:

Purpose/Hypothesis : The Dizziness Handicap Inventory (DHI) is a widely accepted clinical tool used to measure one's self-perceived handicap due to dizziness. The original studies suggested that an 18 point difference between pre-treatment and post-treatment scores was necessary to indicate a significant change. This value was based on the standard error of measurement (SEM) in a small sample of patients who were given the DHI on two separate occasions on the same day. The purposes of the present study are 1) to determine the test-retest reliability of the DHI in a larger sample over a longer time frame, and 2) determine the clinically significant difference for the DHI.

Number of Subjects : 45 (Exp1) and 50 (Exp2)

Materials/Methods : Experiment 1: Participants completed the initial DHI as part of the vestibular function test battery. The DHI was administered in a face-to-face format by the audiologist performing the vestibular function tests. The second DHI was administered at a later date during the initial PT assessment, also in a face-to-face format. Pearson product-moment correlations were calculated to assess test-retest reliability of the DHI. The SEM was calculated to determine the relative change needed for a significant difference. Experiment 2: Participants undergoing PT treatments for chronic dizziness completed the DHI as part of their initial assessment and at 4-6 weeks into their rehabilitation program. At the time of the second administration of the DHI, participants also completed the 15 point Global Rating of Change (GROC) scale (-7="A very great deal worse"; 0="The same"; and 7="A very great deal better"). Receiver Operating Curve (ROC) analyses were performed to determine the responsiveness of the DHI and the clinically significant difference.

Results : Experiment 1: There was good test-retest reliability of the DHI ($r=0.95$, $p<0.01$). The SEM was 5.31, with calculated $MDC(95\%)=14.7$ and $MDC(90\%)=12.3$. The initial DHI scores were subdivided into low (DHI < 34), midrange ($33 < \text{DHI} < 67$), and high (DHI > 66) ranges. There was little difference in the SEM values for the 3 groups: 7.25, 5.53, and 5.20 respectively. Experiment 2: Responsiveness of the DHI to change was good. Using a GROC value of 4 ("moderately better") to discriminate between improved and unimproved, the AUC was 0.90. Based on ROC curve analysis, a DHI change of 10 points correctly classified 83% of the improved and 79% of the unimproved participants.

Conclusions : The results suggest that the DHI retains good test-retest reliability when administered weeks apart. The significant difference score (12 to 14 points) is several points less than that determined in the original study. Initial DHI level does not affect the measurement error. The DHI is responsive to change, and a pre-treatment post-treatment difference of 10 points on the DHI corresponds to an improvement in symptoms.

Clinical Relevance : The DHI remains a valid outcome measure for individuals receiving treatment for dizziness. The critical value for change in the DHI should be lowered from 18 points to at least 14 points.

TITLE: Pediatric vestibulopathy screening in an outpatient rehabilitation setting

AUTHORS/INSTITUTIONS: E. Dannenbaum, Vestibular Program, Jewish Rehabilitation Hospital, Laval, Quebec, CANADA|S. Lora, Pediatric Program, Jewish Rehabilitation Hospital, Laval, Quebec, CANADA|A. Lamontagne, School of Physical and Occupational Therapy, McGill University, Montreal, Quebec, CANADA|J. Fung, Interdisciplinary Rehabilitation Research Center, Jewish Rehabilitation Hospital, Laval, Quebec, CANADA|

ABSTRACT BODY:

Purpose/Hypothesis : The awareness that children may have vestibular pathology is increasing. It is known that gaze stability, reading proficiency and balance are affected in children with vestibular deficiencies. The goal of this pilot study was to investigate if vestibulopathies were present in children receiving rehabilitation for cerebral palsy, global developmental delay-or specific language impairment.

Number of Subjects : The study observed children above 3 years old at the Jewish Rehabilitation Hospital (JRH) Pediatric program receiving outpatient rehabilitation services (speech therapy, physiotherapy, and/or occupational therapy) and who have completed a Vestibular Screening Questionnaire (VSQ) (n=73) . A clinical vestibular assessment was performed on the children whose responses to the questionnaire placed them at risk of having a vestibulopathy (n= 25)

Materials/Methods : The VSQ consisted of 9 yes-no questions. Each question was a possible risk indicator for vestibular impairment. A questionnaire was deemed positive if two or more questions were positive or if the child had a hearing deficit. The vestibular assessment consisted of various clinical evaluations of vestibular function such as; head impulse test, dynamic visual acuity, and post rotary chair nystagmus. Videonystagmography was used to evaluate the presence of spontaneous nystagmus, mastoid oscillation, post head shake induced nystagmus as well as the presence of ocular counter roll. Balance was assessed through; the Romberg test, foam stance, 4-item dynamic gait index, and the Sensory Organization Test. Descriptive statistics were performed on the results of the vestibular assessment and the questionnaire. A positive vestibular evaluation was defined as having a minimum of 2 abnormal results on the vestibular assessment.

Results : The vestibular questionnaire was completed for 73 children, of which 35 (47.95%) were positive and 38 (52.05%) were negative. Twenty-five children underwent a vestibular assessment (10 children were not able to complete the assessment, and thus were not included in the results). Positive vestibular results were found in 13/25 children, while 12/25 had a normal vestibular assessment. Sixty-two percent of subjects tested abnormal on 4 to 7 items of the battery of tests during the vestibular assessment. The mastoid oscillation, ocular counter roll and the post rotary chair nystagmus were the items with the highest frequencies of pathologic response.

Conclusions : Vestibulopathies are found in children with cerebral palsy, global developmental delay and specific language impairment. All but one of the children (a child with CHARGE syndrome) had not been diagnosed with vestibular involvement prior to the study. Further research is needed to evaluate the incidence of vestibulopathies in this population and its impact on function.

Clinical Relevance : There are two points of clinical relevance, 1) the importance of screening children for vestibulopathies and 2) for children who have vestibulopathy this information can be incorporated to understand their clinical presentation and treatment plan.

TITLE: Variables Associated with Outcome in Patients with Bilateral Vestibular Hypofunction: preliminary study

AUTHORS/INSTITUTIONS: S.J. Herdman, M. Ebert, J.L. Ferris, S.S. Knight, B. Maloney, Rehabilitation Medicine, Emory University, Atlanta, GA|C. Hall, Rehabilitation Research and Development, James H Quillen VAMC, Mountain Home, TN|W. Delaune, Rehabilitation Research and Development, Atlanta VAMC, Atlanta, GA|

ABSTRACT BODY:

Purpose/Hypothesis : To identify factors associated with rehabilitation outcome in patients with bilateral vestibular hypofunction (BVH).

Number of Subjects : Sixty-nine patients with BVH.

Materials/Methods : All patients participated in similar vestibular rehabilitation (6 weeks of home exercises (gaze stabilization and balance) and once weekly clinic visits). Bivariate correlations were calculated to determine the strength of the relationship between the independent variables and each outcome measure at discharge.

Independent variables were age, gender, time from onset, degree of deficit, specific co-morbidities, number of co-morbidities and baseline measures of subjective complaints and physical function. Outcome measures included intensity of oscillopsia, dysequilibrium and head movement induced dizziness, balance confidence, perceived disability, percent of time symptoms interfere with activities, gait speed, fall risk (Dynamic Gait Index, DGI), and dynamic visual acuity (DVA). Level of significance was set at $p < 0.001$ to control for the large number of variables examined. Relative strengths of the correlations were defined as $r = 0.25 - 0.50$ as fair to moderate, $0.50 - 0.75$ as moderate to good and > 0.75 as strong relationships.

Results : Idiopathic etiology was correlated with lower disability ($r=0.451$) and higher balance confidence scores ($r=0.387$) at discharge, indicating perceived improvement. There was a strong relationship ($r=0.870$) between the absence of responses from the entire vestibular nerve bilaterally and a higher intensity of oscillopsia at discharge. Longer time from onset to initiation of exercises correlated with poorer balance confidence ($r=0.466$) after rehabilitation. Greater numbers of co-morbidities correlated with higher self-rating of disability ($r=0.447$). Greater intensity of dizziness during head movement ($r=0.569$) and poorer DVA initially ($r=0.584$) correlated with greater intensity of dysequilibrium at discharge. Interestingly, greater age correlated with less intense oscillopsia ($r=0.517$) and head movement induced dizziness ($r=0.524$) at discharge. Shorter time from onset ($r=0.466$), less intense dysequilibrium initially ($r=0.661$) and higher DGI score initially ($r=0.408$) correlated with greater balance confidence at discharge. Greater percent of time symptoms interfered with life ($r=0.827$) and greater intensity of dizziness with head movements initially ($r=0.624$), and the lower the DGI score initially ($r=0.594$) correlated with greater disability at discharge. The presence of Ménière's disease ($r=0.409$), lower extremity sensory deficits ($r=0.368$) and hearing loss ($r=0.408$) correlated with slower gait speed at discharge. Older age ($r=0.666$) and higher DVA scores initially ($r=0.723$) correlated with higher DVA scores at discharge.

Conclusions : These results provide insight into the relationships between findings on the initial physical therapy evaluation and the recovery of patients with BVH.

Clinical Relevance : Therapists can use this information in the development of expectations for patient outcome and treatment priorities.

TITLE: Effectiveness of Physical Therapy Intervention in Patients with Degenerative Cerebellar Ataxia

AUTHORS/INSTITUTIONS: L. Heusel-Gillig, C. Hall, , Emory Dizziness and Balance Center, Atlanta , GA|

ABSTRACT BODY:

Purpose/Hypothesis : Many patients with degenerative cerebellar disease have vestibular deficits; yet, there is little research examining the effectiveness of vestibular adaptation and habituation exercises at remediating associated balance and gait impairments. The purpose of this study was to determine: 1) whether patients with degenerative cerebellar disease could improve in balance and mobility with physical therapy (PT) that included balance and vestibular rehabilitation as appropriate; and 2) whether specific factors (including time from onset, age, vestibular/oculomotor deficits) affected rehabilitation outcomes.

Number of Subjects : 43 ambulatory patients (mean age = 54.0 years + 14.7) with cerebellar degeneration.

Materials/Methods : Retrospective chart review from an outpatient clinic specializing in dizziness and balance. Participants were evaluated at baseline and discharge on balance confidence (measured by Activities-specific balance confidence scale, ABC), fall risk (measured by dynamic gait index, DGI, or Tinetti Performance Oriented Mobility Assessment, POMA), and sensory integration (measured by sensory organization test, SOT). Patients underwent individualized PT including coordination/strengthening, gait and balance training, plus gaze stability exercises for patients with peripheral vestibular loss and habituation exercises for those with motion sensitivity. Patients were seen weekly and given a customized home exercise program (HEP). Repeated measures analyses of variance (RM ANOVAs) were performed with time (baseline and discharge) as the within subjects variable. 2 X 2 (Group by Time) RM ANOVAs were performed with time from onset (< 5 years and > 5 years), age group (< 65 years and > 65 years) and presence or absence of vestibular loss as the between subjects variables. Dependent variables included ABC, DGI, POMA, and SOT.

Results : Of 43 patients, 29 (68%) had ataxia plus oculomotor and/or vestibular involvement. There were significant improvements for ABC (baseline mean = 41.2 + 27.2; discharge mean = 66.8 + 18.9), DGI (baseline mean = 14.5 + 4.2; discharge mean = 19.1 + 2.9), POMA (baseline mean = 23.1 + 6.6; discharge mean = 31.0 + 4.4), and SOT (baseline mean = 49.1 + 11.5; discharge mean = 66.8 + 18.9). There was a significant interaction ($p = .047$) between years from onset and time on POMA score (those over five years from onset had less improvement). Older patients had a significantly lower baseline POMA score, but greater improvement than younger patients ($p = .038$). Those with vestibular deficits had lower baseline scores on DGI and SOT and improved to a greater extent on DGI ($p = .007$).

Conclusions : Ambulatory individuals with cerebellar degeneration made significant improvements in gait and balance following balance and vestibular rehabilitation.

Clinical Relevance : Patients with cerebellar degeneration should be evaluated for vestibular deficits to facilitate identification and appropriately address specific impairments, including gaze stability and motion sensitivity.

TITLE: Test-retest reliability and responsiveness of gaze stability and dynamic visual acuity in high school and college football players

AUTHORS/INSTITUTIONS: D.R. Kaufman, M.J. Puckett, M.J. Smith, M.R. Landers, Physical Therapy, University of Nevada Las Vegas, Las Vegas, NV|

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of this study was to establish reliability and responsiveness of the dynamic visual acuity test (DVAT) at speeds of 150 to 200 degrees per second and the gaze stabilization test (GST) in high school and college football players. In addition, responsiveness of the DVAT and GST were calculated. A secondary purpose was to determine if a history of concussion leads to long term changes in DVAT and GST.

Number of Subjects : Overall, 50 football athletes (age=18.3, SD=2.3) participated in the study: high school (n=20; age=15.9, SD=0.85) and college (n=30; age=19.9, SD=1.25).

Materials/Methods : High school football athletes were recruited from an urban high school and college athletes were recruited from a Division I football team. All subjects were tested twice within two weeks on the DVAT and the GST using the NeuroCom inVision system. On the first test, subjects were acclimatized to the testing by utilizing the practice mode prior to each test.

Results : Test-retest reliability for the DVAT was good in yaw, ICC (3,3) = 0.770 (95% confidence interval (CI): 0.595 to 0.861), and moderate to good in pitch, ICC (3,3) = 0.725 (95% CI: 0.515 to 0.844). Minimal detectable change (MDC) at the 95% confidence level was 0.16 logMAR for yaw and 0.21 logMAR for pitch. DVAT logMAR scores improved from test 1 to test 2 in both planes, $p \leq 0.04$. Test-retest reliability for the GST was moderate in yaw, ICC (3,3) = 0.634 (95% CI: 0.355 to 0.792), and poor in pitch, ICC (3,3) = 0.411 (95% CI: -0.037 to 0.666). MDC was 73.4 degrees per second (deg/sec) for yaw and 81.2 deg/sec for pitch. GST speeds improved from test 1 to test 2: yaw (mean 1 = 184.6, SD = 38.9; mean 2 = 208.9, SD = 48.6) and pitch (mean 1 = 162.5, SD = 33.9; mean 2 = 175.7, SD = 42.5), $p \leq 0.05$. In general, there were no differences between the high school and college athletes for either DVAT or GST. Likewise, there were no differences between those with and without a self-reported history of concussion for either DVAT or GST.

Conclusions : Our results provide evidence that the DVAT is reliable at relatively high speeds (150 to 200 deg/sec) in high school and college football athletes in both yaw and pitch; however, DVAT scores improved over the two tests suggesting a possible learning effect. GST speeds were considerably higher than previously reported in the literature and suggest that football athletes are capable of maintaining visual acuity at high speeds with GST. However, these results were only moderately reliable. In addition, a learning effect may have also occurred for GST as improvements were noted in both planes. Future testing using several measurement periods is warranted to determine the extent of the learning effect.

Clinical Relevance : From a clinical perspective, DVAT can be reliably used in the assessment of high school and college football athletes and may offer some value in the assessment of vestibular concussions; however, GST may not be appropriate since the reliability is marginal.

TITLE: The Effectiveness of Current Interventions in the Management of Lateral Canal Benign Paroxysmal Positional Vertigo: A Systematic Review

AUTHORS/INSTITUTIONS: B. Kinne, C. Strace, N. Crouch, , Grand Valley State University, Grand Rapids, MI

ABSTRACT BODY:

Purpose/Hypothesis : Lateral canal benign paroxysmal positional vertigo (LC-BPPV) may affect up to 40% of all individuals who have been diagnosed with BPPV. It causes a greater intensity of vertigo, nausea, and vomiting than that associated with posterior canal BPPV; and it can have an adverse effect upon an individual's postural control. Despite the recent development of techniques designed for the specific management of LC-BPPV, very few studies have examined the efficacy of these proposed treatments. Therefore, the purpose of this systematic review was to evaluate the effectiveness of current treatment techniques in alleviating the vertigo and nystagmus encountered by individuals with LC-BPPV.

Number of Subjects : N/A

Materials/Methods : The databases that were searched included CINAHL Plus with Full Text from 1990 through the present date, ProQuest Medical Library for all dates, and MEDLINE from 1950 through the present date. The search terms used for each of these databases were "lateral canal" OR "horizontal canal" AND "positional vertigo" OR "positioning vertigo" OR "positional nystagmus" OR "positioning nystagmus". The inclusion criteria were as follows: (1) individuals with BPPV only affecting one of the lateral semicircular canals; (2) non-pharmacological techniques designed specifically for the treatment of LC-BPPV; (3) diagnosis based upon the supine roll test; (4) outcome based upon the absence of nystagmus and vertigo; and (5) randomized or non-randomized controlled trials that could be classified as level 2 evidence. The method used to evaluate evidence level was based upon the Oxford Centre For Evidence-Based Medicine 2011 Levels of Evidence tool, and the method used to evaluate methodological rigor was adapted from Medicott and Harris.

Results : A total of 543 articles were originally identified through the database search. After 535 articles were progressively eliminated from consideration by the PRISMA 2009 flow diagram, eight studies were ultimately included in the qualitative analysis. The qualitative analysis revealed three effective techniques for treating geotropic LC-BPPV, the 270-degree roll, the Gufoni technique, and prolonged position. It also revealed two potential techniques for treating apogeotropic LC-BPPV, the modified Semont and head shaking.

Conclusions : Although LC-BPPV tends to spontaneously resolve in a relatively short period of time, it can also be associated with extremely severe symptoms as well as impaired postural control. This systematic review presented several techniques that may expedite the natural remission process and lead to a quicker recovery. These techniques would also be necessary for those individuals who report persistent subjective complaints and/or demonstrate long-term functional problems if their condition is left untreated.

Clinical Relevance : These LC-BPPV techniques give the clinician several treatment options from which to choose based upon his skill level as well as the patient's physical and cognitive abilities.

TITLE: Anterior Canal Benign Paroxysmal Positional Vertigo Treatment Techniques: A Systematic Review

AUTHORS/INSTITUTIONS: B. Kinne, N. Crouch, C. Strace, , Grand Valley State University, Grand Rapids, MI|

ABSTRACT BODY:

Purpose/Hypothesis : Benign paroxysmal positional vertigo (BPPV) is a peripheral vestibular dysfunction that causes bouts of vertigo and nystagmus elicited by particular head movements. Anterior canal BPPV (AC-BPPV), which accounts for an estimated frequency of 1% to 11% of all cases, is characterized by a latency period, a short duration, fatigability, and downbeating-torsional nystagmus. The purpose of this systematic review was to evaluate the effectiveness of current non-pharmacological interventions in alleviating the vertigo and/or nystagmus associated with AC-BPPV.

Number of Subjects : N/A

Materials/Methods : A literature search in the Cumulative Index to Nursing and Allied Health Literature (CINAHL) Plus with Full-Text, MEDLINE, and ProQuest Medical Library databases was conducted using the search terms "positional vertigo" or "positional nystagmus" or "positioning vertigo" or "positioning nystagmus" and "anterior canal" or "superior canal". Inclusion criteria for the systematic review were as follows: (1) individuals diagnosed with AC-BPPV; (2) unilateral canal involvement; (3) non-pharmacological interventions specifically designed for AC-BPPV; and (4) all studies except those that used mechanism-based reasoning. The evidence level for each included study was evaluated using the 2011 Oxford Centre for Evidence-Based Medicine Guide. The methodological rigor of each included study was evaluated using a scale adapted from Medicott and Harris.

Results : Three hundred forty-two records were identified through an electronic database search. Seven of these articles met the inclusion criteria and were included in the qualitative synthesis. Five out of the seven included studies used the resolution of vertigo and nystagmus as their desired outcome response. Two of these studies reported a resolution rate of 100% after two treatments. Two out of the seven included studies used the resolution of vertigo only as their desired outcome response. One of these studies reported a resolution rate of 98% after two treatments. This result was significant, because this study had the largest number of subjects in the qualitative synthesis.

Conclusions : Finding interventions for AC-BPPV is important, because BPPV can be a severe disabling problem that may lead patients to purposely avoid specific head movements. Additionally, patients with BPPV often experience loneliness, depression, a greater incidence of falls, and the inability to complete activities of daily living. This systematic review revealed seven particle repositioning maneuvers that were specifically developed for the treatment of AC-BPPV. Three of these maneuvers appeared to successfully alleviate the vertigo and/or nystagmus associated with AC-BPPV.

Clinical Relevance : Of the seven included studies, the interventions by Yacovino et al., Korres et al., and Rahko appeared to be the best methods for alleviating the vertigo and/or nystagmus associated with AC-BPPV. Each of these studies demonstrated high resolution rates, could be easily replicated, and did not require the use of any specialized equipment.

TITLE: Investigation into an Exercise Program for Unilateral Labyrinthine Dysfunction

AUTHORS/INSTITUTIONS: E.M. Clark, J. Mowder-Tinney, Physical Therapy, Nazareth College, Rochester, NY|K. Mancuso, Physical Therapy, HealthSouth, Aldie, VA|

ABSTRACT BODY:

Background & Purpose : It is estimated that the prevalence of dizziness is 30% in those over 65. However, according to the APTA, only slightly over 300 physical therapists report having significant vestibular experience across the United States. There are no clinical guidelines for treating those with generalized dizziness. Four guidelines are found pertaining to management of dizziness: ischaemic stroke, herpes zoster, nystagmus, and acoustic neuroma. However, there is limited data demonstrating detailed exercise programs with progressions. The purpose of this case study was to implement an evidence-based, progressive exercise program for a patient with labyrinthine dysfunction.

Case Description : Patient was a 68 y.o. Caucasian female with instability and an “abnormal sensation” inside her head. Examination revealed a Dizziness Handicap Inventory (DHI) score of 42/100, Berg Balance Scale (BBS) of 46/56, Functional Gait Assessment (FGA) of 15/30, Timed Up and Go (TUG) of 10s, and Single Leg Stance (SLS) of 5s bilaterally. Oculomotor exam was normal, except Vestibular Ocular Reflex (VOR) reproduced symptoms and pt. demonstrated irregular head movements during testing.

Outcomes : One hour physical therapy sessions occurred twice a week for eight weeks. A specific, stepwise exercise program targeting dynamic balance, gaze stabilization, and habituation was implemented. For example, treatment of the VOR began with the pt. seated, while focusing on a stationary card in front of a blank wall. This was progressed to a checkered background while sitting on a physioball. It was then progressed to a card moving right and left with a simultaneous VOR, followed by the card moving up and down while completing a VOR. Finally, this pt. completed the exercise with eyes closed. An additional functional activity was that the pt. began by completing opposite eye and head movements while seated. This was progressed to completing the eye and head movements while stepping up and down on a step. At eight weeks, an improvement in instability and her “abnormal sensation” were reported, as well as the pt.’s ability to ambulate in the community without her cane. Pt.’s TUG improved 3s, BBS 9 points, FGA by 10 points, and SLS by 25 seconds. DHI remained constant at 42/100 points.

Discussion : The improvements in this case study are consistent with findings aimed at the effectiveness of physical therapy on dizziness. Although no subjective changes were noted with the DHI, significant clinical gains were noted with functional outcome measures. It is believed that this treatment was effective due to stimulation of the vestibular system, enabling the system to create compensations for the deficiency. PTs are able to safely treat those with labyrinthine dysfunction utilizing a treatment plan consisting of dynamic balance, gaze stabilization, and habituation exercises. Entry-level physical therapists in all settings could carry-out similar treatment plans effectively. Additional research regarding specific exercise progression to treat patients with vestibular symptoms is recommended.

TITLE: MAL DE DEBARQUEMENT CASE SERIES: TREATMENT AND OUTCOMES

AUTHORS/INSTITUTIONS: S. Oxborough, S. Olson, , National Dizzy and Balance Center, Coon Rapids, MN|

ABSTRACT BODY:

Background & Purpose : According to the literature, Mal de Debarquement (MdDS) can last months to a year or more and can severely impact daily function. Some of the literature reports no improvement with physical therapy; however, the physical therapy treatment was not specifically described. The purpose of this case series is to describe a treatment protocol and outcomes for patients diagnosed with MdDS.

Case Description : Data was collected from nine patients seen at an outpatient clinic over the past 5 years. Patients were treated by therapists following a protocol for MdDS. The following criteria were necessary for inclusion: 1. History of passive form of transportation that proceeding symptoms 2. Negative VNG 3. Subjective symptoms of persistent rocking or swaying sensation. The physical therapy evaluation included balance testing with Sensory Organizational Test (SOT), the Functional Gait Assessment (FGA), and a subjective rating of their current symptoms. All patients were female. Only one patient demonstrated essentially normal balance scores. Two patients were at risk for falls. The treatment frequency was 2 times per week, then 1 time per week once patients were compliant with home program. Each program included an adaptation exercise, sensory re-weighting, and dynamic balance retraining to be completed 2-3 times per day. At least 5 patients had training on the NeuroCom® Smart Balance Master. All patients participated in therapy for at least one month. If progress was made, they continued an additional month. Some completed the program before two months due to symptom resolution.

Outcomes : After completing the VRT program, eight out of nine patient cases showed improvement in overall balance scores. Two patients did not return for final testing. Nearly all patients demonstrated an improvement in FGA scores. Two patients who were initially at risk for falls were no longer at risk for falls. Seven patients reported full to nearly full resolution of symptoms, one reported some improvement in symptoms, and two reported minimal to no change in symptoms.

Discussion : VRT appeared to improve balance with MdDS. Symptom resolution occurred for most patients in this study. MdDS can resolve over time without treatment and therefore it is difficult to determine if the outcomes from this study are due to the effects of the treatment, or natural resolution of symptoms.

TITLE: ABILITY OF CLINICAL BALANCE, GAIT AND FUNCTIONAL MOBILITY MEASURES TO PREDICT VIDEONYSTAGMOGRAPHY IN PERSONS WITH COMPLAINTS OF DIZZINESS AND IMBALANCE

AUTHORS/INSTITUTIONS: T.A. Rice, C. Mancinelli, R.R. Utzman, D.S. Davis, A.K. Swisher, Physical Therapy, West Virginia University, Morgantown, WV

ABSTRACT BODY:

Purpose/Hypothesis : Individuals with dizziness have functional limitations in daily life and are at an increased risk for falling. Currently, the best test to assess dizziness is not known. The purpose of this study was to determine if common clinical measures of balance and gait could predict results of the more complex and expensive gold standard test (videonystagmography).

Number of Subjects : Seventy four patients (mean age = 63.8 years; 46 women and 28 men) seen for complaints of dizziness and imbalance in the Balance Clinic in the university's multidisciplinary Department of Otolaryngology were evaluated between January 2011 and August 2011.

Materials/Methods : The participants were referred for a physical therapy examination in which the following measures were completed: Activities-Specific Balance Confidence Scale (ABC), Dizziness Handicap Inventory (DHI), Timed Up and Go Test (TUG), Berg Balance Scale (BBS), Dynamic Gait Index (DGI) and Gait Velocity over 15 feet. The participants underwent videonystagmography (VNG) immediately following the physical therapy assessment and results were dichotomized to normal vs. abnormal. Logistic regression was used to predict VNG outcome with a p value ≤ 0.05 considered to be significant.

Results : There were no significant relationships between ABC, DHI, BBS, and Gait Velocity with VNG result. However, TUG did predict abnormal VNG result (p-value = 0.0151, R² (U) = 0.10, sensitivity = 0.61, specificity = 0.84 and a positive predictive value = 0.89). TUG scores greater than 15 seconds explained 10% of the variance in an abnormal VNG result. DGI was also a significant predictor of VNG outcome (p-value = 0.0273, R² (U) = 0.21, sensitivity = 0.68, specificity = 0.86, positive predictive value = 0.93 and negative predictive value = 0.50). DGI scores of 18 or less explain 21% of the variance to predict an abnormal VNG.

Conclusions : Although many common clinical assessments were not found to be predictive of VNG results, both the TUG and DGI had moderate predictive value. This may reflect measurements of different constructs of balance, suggesting that both types of testing may be needed to fully understand the effects of dizziness on physiologic function and impact on daily life. However, cutoff scores for TUG and DGI suggest a contribution of these tests to VNG results. Further work is needed to examine these relationships in more detail.

Clinical Relevance : Clinical use of both the TUG and the DGI, with further work, may be predictive of abnormal VNG in individuals with complaints of dizziness and imbalance. Streamlining the assessment process by selecting the most appropriate clinical measures of balance and gait is essential to maximize therapist efficiency and determining effective outcome measures for intervention.

TITLE: Physical Therapy intervention in the management of Mal de Debarquement

AUTHORS/INSTITUTIONS: D. Struiksma, J. Harrison, , England Physical Therapy, Garden Grove, CA|

ABSTRACT BODY:

Background & Purpose : Mal de Debarquement (MdD) is a syndrome that occurs when habituation from a rhythmic movement, such as a cruise ship, resists readaptation once returning to a stable environment and symptoms of rocking, imbalance and anxiety result. Current medical management of MdD includes benzodiazepines to provide relief of the continuous symptom of rocking. There is minimal evidence that physical therapy intervention is of benefit in the treatment of MdD. The purpose of this case study is to demonstrate the use of systematic physical therapy intervention on MdD symptoms in an adult female.

Case Description : A 63 year old female was diagnosed with MdD by Otolaryngology after disembarking from a cruise. Diagnostic tests of VNG and MRI of the brain were normal. She was referred to PT with complaints of rocking and imbalance. At initial assessment she reported a childhood head injury and sensory organization test (SOT) showed impaired use of somatosensory and vestibular feedback. Her oculomotor examination was normal. Eighteen, 45 minute sessions of PT were completed over 3 months. Interventions included, core stabilization program, to decrease her rocking sensation, increase her postural control and provide symptom management. These exercises were done with her eyes closed and body positioned over a firm surface to re-weight her somatosensory system and facilitate readaptation to the stable condition. Once equilibrium scores for condition 2 on the SOT were normal, vestibular exercises of gaze stabilization and head turns while standing on compliant surface were initiated. Emphasis was placed on patient and spousal education on use of core stabilization for somatosensory feedback to decrease symptoms and allow for pacing through her ADL's.

Outcomes : At completion of PT there was an improvement in her subjective scores on the DHI from 60/100 to 28/100 and ABC Scale from 47% to 76%. Functional measures revealed improved scores on the DGI from 21/24 to 23/24. SOT composite scores improved from 34% to 68% and scores for conditions 2, 5, and 6 increased to normal limits. At a 6 month interview, the patient reported that her symptoms were occasional and she was planning to return to 3-4 day cruises.

Discussion : This case suggests that a systematic PT program may result in an improvement in symptoms related to MdD. The intervention was designed to use the somatosensory system to provide stable feedback by using recruitment of deep neck flexors and abdominals for readaptation. Traditional vestibular exercises were not initiated until the patient could demonstrate use of somatosensory feedback for symptom management. The improved equilibrium scores on SOT suggest that after intervention, her use of somatosensory and vestibular feedback improved to normal limits. A key component of the intervention was patient and spousal education to provide reinforcement of symptom management with stabilization techniques. Further study is needed to identify effectiveness of this type of customized therapy intervention in individuals with MdD.

TITLE: Comprehensive treatment of a 77 year old female diagnosed with Chronic Subjective Dizziness

AUTHORS/INSTITUTIONS: K.J. Thompson, Physical Medicine and Rehabilitation, Mayo Clinic, Rochester, MN|

ABSTRACT BODY:

Background & Purpose : Chronic subjective dizziness (CSD) is a new diagnostic term in use since 2007 and is defined as non vertiginous dizziness which has persisted for greater than 3 months and includes hypersensitivity to one's own motion or objects moving in the environment, exacerbation in complex visual environments, and absence of an active medical condition. Patients with this diagnosis often present with anxiety as a primary cause or secondary reaction. Other causes include migraines, traumatic brain injury, and past history of compensated vestibular crisis event. The optimal treatment for patients with this diagnosis has not been established and little research exists on use of vestibular rehabilitation. The purpose of this case report is to describe the results of a comprehensive physical therapy program developed for a patient with chronic subjective dizziness.

Case Description : The patient was a 77 year old female who presented to our clinic with a 20 month history of severe dizziness, nausea, and imbalance, which was insidious in onset. ENG showed no evidence of a peripheral vestibular disorder. Visual patterns, including reading exacerbated her symptoms. She was driving short distances only. The patient was instructed in a home exercise program that included habituation exercises, balance exercises, and relaxed breathing. After the initial treatment session, the patient was seen for a second session 5 days later and a third session 2 1/2 months later. The home exercise program was updated at each visit.

Outcomes : Outcome measures were performed at initial and final visits. Dynamic gait index (DGI) score at initial visit was 6/24 and 21/24 at final visit. Motion sensitivity quotient was 26.3 at initial visit and 0 at final visit. Timed up and go test was 17.4 seconds at initial visit and 9.4 seconds at final visit. At the final visit the patient rated 99% improvement in symptoms, had returned to driving unlimited distances, and had increased her tolerance to reading.

Discussion : This patient showed improvement in both subjective and objective measures. She was able to decrease her symptoms through use of habituation exercises, along with balance exercises and relaxation techniques. She was able to return to near normal activity and able to walk safely without a gait support. This case demonstrated the positive outcome of a comprehensive vestibular rehabilitation program, including habituation for the treatment of chronic subjective dizziness.

TITLE: Recovery after severe brain injury: Theories of common neural mechanisms underlying consciousness, posture, locomotion, and breathing

AUTHORS/INSTITUTIONS: L. Sawaki, Physical Medicine and Rehabilitation , University of Kentucky, Lexington, KY| K.V. Day, , Moss Rehabilitation Research Institute, Elkins Park, PA|

ABSTRACT BODY:

Abstract Body : Traumatic brain injury (TBI) affects 1.7 million Americans annually. Of those individuals who survive traumatic events and sustain severe TBIs, the majority emerge from coma within 2-4 weeks. However, many are slow to recover consciousness from that point forward. These individuals are diagnosed with a disorder of consciousness (ie. vegetative state or minimally conscious state). If the ability to participate actively in rehabilitation is deemed limited and documentation fails to detect progress beyond these states, acute inpatient rehabilitation facilities commonly deny admission to these patients. Consequently, a discharge to home or a skilled nursing facility without specialized brain injury services could have a profound impact on subsequent recovery potential, medical follow-up, long-term costs, and burden of care. Therefore, continued efforts aimed toward discovering interventions for increasing consciousness are necessary. Currently, evidence is lacking for effective rehabilitation treatments to stimulate arousal and awareness, both components of consciousness. However, an abundance of evidence from basic science and human clinical literature demonstrates that experience-dependent neural plasticity can occur in the injured nervous system through intensive physical interventions, such as locomotor training with bodyweight support and a treadmill. Additionally, a synthesis of this literature with other scientific work, including sleep and respiratory research, reveals commonalities in neural substrates and feedback mechanisms underlying consciousness and physical activity. Based on this synthesis, two newly-generated mechanistic theories will be presented: the posture and locomotion theory and the aerobic drive theory. These theories will discuss 1) the role of the locus coeruleus in both sleep-wake cycle regulation as well as static and dynamic postural control, 2) the mesencephalic locomotor region and reticular activating system as common components of the pedunculo-pontine tegmental nucleus, 3) the evidence describing enhanced cognition post-aerobic exercise in aging adults and persons with neurological disorders, and 4) the overlap in neural circuitry responsible for breathing, locomotion, and arousal. We hypothesize that physical exercise, in particular locomotor-like activity, is capable of priming the reticular activating system for arousal, thus preparing the cortex to receive, process, and respond to afferent information via thalamocortical pathways. Should these theories ultimately receive support from primary research evidence, individuals with disorders of consciousness may be more readily viewed as able to actively participate in rehabilitation via continual neural engagement, regardless of state of awareness.

TITLE: “Physical Therapy Management of an Individual with Right Occipital Condyle Avulsion-Dislocation Fracture and Medullary Compression Resulting in Severe Hemi-Ataxia and Tetraparesis”

AUTHORS/INSTITUTIONS: J. Elliott, , Northern Colorado Rehabilitation Hospital, Johnstown, CO|C. Langer, W. Kriekels, Physical Therapy Program, University of Colorado, Aurora, CO|

ABSTRACT BODY:

Background & Purpose : Individuals involved in motor vehicle accidents (MVAs) often present with multiple complex injuries to the spine, brain, extremities, and viscera. While brain injuries and strokes resulting in ataxia are common, little evidence is available addressing the examination and management of individuals with this impairment. This case report discusses current evidence and limitations in the evaluation and treatment of an individual with severe hemi-ataxia.

Case Description : A 48 year old male involved in a high speed MVA sustained a right occipital condyle avulsion-dislocation fracture with fragment displacement into the upper medulla, compression fractures of C5 and C6, and bilateral pneumothoraces. He underwent an occipital to C1 posterior fusion followed by Miami J Collar placement for 14 weeks. Due to severe dysphagia he required enteral feedings for four months and was ventilator dependent due to respiratory failure for several weeks following the accident. The patient experienced a prolonged stay in an Intensive Care Unit and in a Long Term Acute Hospital prior to admission to Inpatient Rehabilitation. Upon admission to Inpatient Rehabilitation, the patient presented with complete right-sided proprioceptive loss, impaired pain and light touch sensation bilaterally, multiple peripheral nerve injuries, cranial nerve involvement, and severe right-sided ataxia.

Outcomes : Upon discharge the patient was able to ambulate independently with a walker and perform all self-care without assistance. His Six Minute Walk Test improved from 10' in the parallel bars requiring 2 person maximal assistance, to 230' independently with a walker. His right-upper and -lower extremity coordination progressed from severely impaired to mildly impaired and he experienced full recovery of proprioception and light touch. In this case, the patient appeared to benefit from progression of closed-chain fatiguing exercises to open-chain exercises, right lower extremity bracing, and taping for muscle inhibition. Use of visual feedback and cognitive compensatory strategies were also beneficial in the neurological re-education of this patient.

Discussion : While evidence is evolving in chronic and progressive forms of ataxia and significant evidence exists regarding the management of individuals with hemiplegia from stroke, we lack evidence regarding the best evaluation and intervention methods in the management of individuals with traumatic-onset ataxia. This case report discusses treatments that were clinically effective for this individual, evaluation and treatment methods supported in literature, and where evidence is lacking in the objective evaluation and treatment of individuals with traumatic-onset ataxia resulting in physical disability.

TITLE: Effect of Aerobic Exercise on Brain Activity and Cognition following Traumatic Brain Injury

AUTHORS/INSTITUTIONS: K. Feeney, R. Femrite, S. Gates, J. Lojovich, J. Carey, Program in Physical Therapy, University of Minnesota, Minneapolis, MN|

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of this study was to investigate the changes in intensity, volume and location of brain activation and measure the reaction time and accuracy during the N-back working memory task in 5 subjects with moderate to severe TBI prior to and following participation in a twelve week aerobic exercise program.

Number of Subjects : Five male subjects (mean age 45 years \pm 14.83) with a moderate to severe, non-penetrating, TBI (mean time since TBI 8 yrs \pm 9.35).

Materials/Methods : A multiple baseline, pretest-posttest design was used. Cortical activation data were obtained using a Siemens 3T fMRI scanner during performance of a visual fixation condition (control) as well as 0-back and 2-back conditions of the N-back working memory task in a pseudo-randomized block design. fMRI scans were performed on 3 different days prior to and after 12 weeks of participation in a supervised aerobic exercise program consisting of 3, 30-40 minute sessions per week. Analysis of changes in activation during each condition of the N-back task was performed using the Brain Voyager software package. Regions of interest included the rostral/caudal ACC, PreC, and DLPFC. Two types of activation thresholds were evaluated to obtain significance $P \leq .05$ and false discovery rate = .02. Measurements of working memory were measured through accuracy and reaction time on the N-back task using E-Prime software. The between-group analyses used paired t-tests; within-group analyses used a one-sample t-test.

Results : Following 12 weeks of aerobic exercise, 4 of the subjects significantly improved in accuracy of the 0-back and 2-back tasks. Following completion of the 12-week exercise program all 5 subjects demonstrated a decrease in the intensity of the caudal ACC and PreC and right DLPFC areas during the 0-back task compared to the control task. However, an increase in the intensity and voxel count in the left DLPFC was noted during the 0-back task compared to the 2-back task. In 4 of the subjects, an increase in the intensity of the ACC(caudal and rostral) and the right DLPFC was also noted during the 2-back task when compared to the 0-back task.

Conclusions : Findings indicate that an aerobic exercise intervention for 5 subjects with TBI resulted in changes in cortical activation in the ACC, PreC & DLPFC and working memory. The decrease in the the PreC and caudal ACC intensity and the increase in the left DLPFC during the 0-back task may indicate an improved ability make un-conflicted decisions during this easier task. The increased intensity of the right DLPFC and ACC during the 2-back task may reflect improved ability to the added difficulty and mental effort required for this task.

Clinical Relevance : This study contributes to emerging evidence supporting the use of aerobic exercise following chronic moderate to severe TBI. These findings indicate the need for further research to determine if these findings exist in a larger population.

TITLE: Accuracy of Body Worn Sensors in Detecting Walking Activity

AUTHORS/INSTITUTIONS: G.D. Fulk, Physical Therapy, Clarkson University, Potsdam, NY|K. Danks, D. Reisman, Physical Therapy, University of Delaware, Newark, DE|C. Nirider, , Touchstone Neurorecovery Center, Conroe, TX|

ABSTRACT BODY:

Purpose/Hypothesis : Advances in sensor technology, signal processing and pattern recognition techniques allow for unobtrusive, accurate and precise measurement of walking activity in the home and community. This information could be used to examine the effectiveness of rehabilitation interventions and to provide feedback to increase walking activity. Most commercially available sensors whose accuracy has been tested in neurologic populations are expensive and cannot be used easily by consumers or clinicians. The purpose of this study was to examine the accuracy of 3 different commercially available step count sensors in people with stroke and traumatic brain injury (TBI).

Number of Subjects : 21 participants, 10 post-stroke and 11 post-TBI

Materials/Methods : Participants with stroke or TBI who could ambulate without assistance were recruited to participate. Participants performed a 2-minute walk test (2MWT) at their comfortable pace while wearing a pedometer and two accelerometer based sensors (Fitbit and Nike+Fuelband). Participants were videotaped during the 2MWT and actual steps taken (aSteps) were counted from the video. Accuracy and agreement of the different sensors was determined using two different analyses techniques: Bland Altman and ICC2,1.

Results : Participants were 54.5 (75.0) months post injury. Mean Berg Balance Scale score was 50.0 (6.1), mean gait speed 0.98 m/s (0.30), and mean lower extremity Fugl Meyer motor score of the most affected lower extremity was 26.2 (6.3). The Bland Altman plot revealed a mean difference of -18.0 steps (95% limits of agreement (LOA) 77.6 to -113.6) between aSteps and pedometer, 0.67 steps (95% LOA 45.7 to -44.4) between aSteps and Fitbit, and -71.8 steps (95% LOA 82.1 to -225.7) between aSteps and Nike+Fuelband. ICC2,1 between aSteps and pedometer was 0.54 (95% CI 0.17-0.78) between aSteps and Fitbit was 0.86 (95% CI 0.68-0.94), and aSteps and Nike+Fuelband was 0.08 (95% CI -0.18-0.43).

Conclusions : The Fitbit accelerometer based sensor accurately identified stepping activity in people with chronic stroke and TBI who were able to walk at relatively fast speeds. The pedometer and the Nike+Fuelband were not as accurate. The Fitbit could be an inexpensive, simple alternative to more expensive, cumbersome sensors to identify walking activity in those post-stroke or TBI. Further research is necessary with participants with different levels of walking ability and in the real world.

Clinical Relevance : There is a need for an inexpensive, accurate and easy to use device to monitor real-world walking activity in persons with neurologic injury. The Fitbit appears to meet these criteria. In addition to its utility for monitoring walking activity, it can also be used to provide immediate feedback on steps taken. This behavioral enhancing feedback could be useful in programs designed to increase walking activity after neurologic injury.

TITLE: Balance Performance among Intercollegiate Football Players and the Relationship to Performance on a Neurocognitive Test

AUTHORS/INSTITUTIONS: T.E. Leahy, Physical Therapy, Langston University, Langston, OK|M. Blackinton, Physical Therapy, Nova Southeastern University, Tampa, FL|S.C. Livingston, Department of Rehabilitation Sciences, University of Kentucky, Lexington, KY|M. Cheng, Physical Therapy, Nova Southeastern University, Ft. Lauderdale, FL|

ABSTRACT BODY:

Purpose/Hypothesis : Performance on measures of balance and cognition are utilized for assessment of concussion and its recovery in athletes by comparing baseline scores to those post injury. Measures of postural steadiness are used most frequently to assess balance; performance is reported to be independent of performance on cognitive measures. Postural steadiness tests may not provide enough challenge for athletes to adequately assess their state of neural processing. Tests requiring targeted, volitional shifting of center of pressure (COP) may offer greater challenge and be of benefit in the testing battery. The goals of this study were to: 1) provide normative data on commonly used postural steadiness tests and on tests requiring volitional COP shifting for a population of college football players not included in previous studies, and 2) examine the relationships among balance and cognitive test performances.

Number of Subjects : 52

Materials/Methods : Football players from a NAIA university were recruited for pre-season baseline assessment. Participants underwent testing with a computerized neurocognitive assessment, the Immediate Post-concussion Assessment and Cognitive Testing (ImPACT), 2 steadiness-based tests of balance [BESS and Modified Clinical Test of Sensory Interaction on Balance, (mCTSIB)], and 2 balance tests requiring controlled shifting of the COP [Rhythmic Weight Shift (RWS) and Limits of Stability (LOS)].

Results : Normative data for the 4 balance tests are reported for this cohort of football players. Mean BESS scores (21.6) were noted to be higher than that reported for NCAA football players (12). No correlation was observed between static balance measures nor between static balance and cognitive measures. Reaction times (RT) measured on the LOS and the ImPACT tests were noted to vary independently. A weak, but significant correlation was detected between LOS movement velocity and two measures of cognition on the ImPACT [visual motor processing speed ($r=.344$; $p=.014$) and verbal memory ($r=.351$; $p=.012$)].

Conclusions : Fatigue and task novelty may have played a role in the higher scores on the BESS. Clinicians should include a practice session when obtaining baseline scores. Evidence is provided for a correlation between more dynamic tests and cognition that is not apparent with postural steadiness testing. Further research is needed with larger samples to explore this relationship. Measures of RT are not related between cognitive and balance tasks, but likely indicate different types of neural processing.

Clinical Relevance : 1) Normative data are reported for intercollegiate football players on the LOS and RWS. 2) RT is used to estimate neural processing efficiency. Since RT measured during balance tasks appears to be unrelated to RT on cognitive tasks, both should be assessed separately as part of baseline testing. RT is not obtained with static balance testing; tests requiring dynamic control of COP should be included in the pre-season assessment of athletes. Research on athletes' performance on these tests post-concussion is needed.

TITLE: NeuroGame Therapy for upper extremity function in adults with stroke and traumatic brain injury

AUTHORS/INSTITUTIONS: K.E. Miller, E. Donoso Brown, S. Westcott McCoy, T. Gilbertson, R. Price, K. Gutman, C. Moritz, Rehabilitation Medicine, University of Washington, Seattle, WA|

ABSTRACT BODY:

Background & Purpose : Training at a high intensity, for a long period, and with salient specific feedback can improve motor learning. Biofeedback with surface electromyography (sEMG) is one way to apply these motor learning principles. Prior applications of sEMG for biofeedback, however, have not focused on the specificity of improving reciprocal contraction/relaxation of agonist/antagonist muscles. This pilot project employed NeuroGame Therapy (NGT), a sEMG biofeedback system connected to a video game, in order to enhance wrist extensor selective muscle activation by requiring wrist flexor relaxation coordinated with wrist extensor activity to play the engaging video game.

Case Description : Participants were two men with traumatic brain injury, ages 31 and 47 years, and a man and a woman with stroke, ages 68 and 70 years. Participants were assessed with the Wolf Motor Function Test (WMFT), Chedoke Arm & Hand Activity Inventory (CAHAI), and sEMG, while completing active range of wrist motion (AROM), maximum voluntary contraction (MVC), and two functional tasks that involved the use of wrist extension, two times before the use of NGT, once immediately following the completion of NGT, and a month after the completion of NGT. The NeuroGame Therapy intervention involved 2-5 sessions of training in the lab followed by 3-4 weeks of video game play with NGT at home. Participants were asked to play the game for 3-5 30-minute sessions per week. Therapy progressed by increasing the requirement for flexors relaxation and extensors contraction in order to play the game.

Outcomes : All participants used NGT for 3-5 times per week and reported enjoyment with the therapy. On the WMFT, the two participants with TBI increased their performance in one or more of the outcome measures immediately following completion of NGT. One participant continued to show improvement at the one-month follow-up. The two participants with more motor function demonstrated greater speed in completing tasks. None of the participants demonstrated substantial changes on the CAHAI. This may be due to the bilateral nature of the CAHAI, which allowed use of the unaffected limb to complete the tasks. Three participants experienced decreased co-contraction during extensor AROM. One participant maintained decreased co-contraction during extensor AROM at the one-month follow-up. Two participants had decreased co-contraction during an extensor-based task and another participant had decreased co-contraction while attempting the task. Three participants showed a trend of increasing mean wrist extension MVC after using NGT.

Discussion : This pilot study demonstrated that NGT is feasible, fun, and engaging for adult patients with TBI and stroke. Most of the participants experienced different benefits from NGT, which may be a reflection of their diverse medical histories and life stages. These differences also emphasize the need to control for outside medical treatment in future work. A more focused study on the effects of NGT in patients post-stroke is underway.

TITLE: Helping College Students with mild TBI: Issues for PTs in Clinical Care and Academia

AUTHORS/INSTITUTIONS: R. OShea, R. Washington, R. Sweeney, PT, Governors State University, University Park, IL

ABSTRACT BODY:

Purpose : Colleges and universities are faced with educating students post mild Traumatic Brain Injury (mTBI). Physical therapists are integral in preparing the student to return to school. Academic faculty may help modify the academic setting once the student returns to campus. The percentage of students returning to college post mTBI is unknown. This project investigates current supports afforded to students post mTBI and begins the task of determining appropriate interventions, in rehab and on campus, to enhance return to higher education after a mTBI. For the patient, these interventions begin with PT while in rehab and continue upon return to campus and life as a student.

Description : Two surveys were developed to query the issue of how many students are enrolled in higher education in Illinois post TBI and what services the students were using. Every college and university was identified and initial contacts made via phone to the Director of Disability Services on each campus. Following phone contact, an initial survey was emailed to the Director. After return of the first survey, a second more in-depth survey was emailed. Additionally, the Illinois Department of Human Services (DHS) generated a report on services provided to Illinois college students with TBI. Along with the survey results, a single case study was identified to exemplify the enormous supports necessary to keep a University level senior enrolled and eligible for graduation. The case demonstrates the need for collaboration across many services and departments.

Summary of Use : Initial results indicate that students with mTBI may not consider themselves disabled or seek services from the Office of Disability Services. Many students tend to drop out of their 4 year programs due to struggles with sensory sensitivity, ongoing fatigue, and cognitive overload issues. Service providers also report that the majority of the students with mTBI have issues with cognitive fatigue, lack of endurance, and memory problems. In addition, the typical disability services is reported as not appropriate for the high functioning student with mTBI. Physical therapists can begin to work on return to school interventions within the scope of rehabilitation. New data illuminates the specific issues students face and help to guide the PT in specific interventions including working closely with rehabilitation counselors and other healthcare staff to provide wrap around services following discharge from the therapeutic rehab setting.

Importance to Members: This study is important as the incidence of mTBI increases among young adults and soldiers with blast injuries return to civilian life and become students in higher education. Physical therapists and rehabilitation counselors play an integral role in a client/student's return to higher education. Additionally, academic faculty may help students adjust and succeed in higher education. It behooves clinicians and faculty to be aware of the unique needs of the students with mTBI.

TITLE: Case Report: A Description of the Clinical Decision Making Process for an Individual following a Severe Traumatic Brain Injury with Traumatic Amputation

AUTHORS/INSTITUTIONS: N. Sibley, J. Ricci, , Bryn Mawr Rehab Hospital, Malvern, PA|

ABSTRACT BODY:

Background & Purpose : Restoration of walking is a major goal in the rehabilitation of patients with Traumatic Brain Injury (TBI) and multi-trauma. Previous studies have shown only 40% of individuals with TBI and lower extremity amputations become ambulatory (Stone et al. 1990). This case report describes the decision making process utilized to select the most appropriate prosthesis for an individual following a severe TBI and trans-femoral amputation in order to safely provide the greatest level of functional independence. Currently, there is limited evidence looking at this dual diagnosis to help guide clinical decision making.

The deficits common to TBI, which have specific relevance to rehabilitation, are attention, memory, and executive functioning. These cognitive deficits require special consideration during the process of prosthetic fitting, component selection, training, and education.

Case Description : The subject was a 21 year old female with a severe TBI and multi-trauma including a traumatic transfemoral amputation secondary to a motor vehicle accident. At 2 months post injury the patient was deemed appropriate to initiate prosthetic training. Cognitive impairments included persistent confusion, decreased attention, decreased insight, decreased memory, impaired motor planning, aphasia, restlessness, and agitation. The patient was initially fitted for a quadrilateral test socket with a manual lock knee. Considering the patient's agitation, a quadrilateral design was chosen over a more commonly used ischial containment design, as it produces less pressure on the residual limb. A manual lock knee was chosen to provide increased stability in stance by reducing the degrees of freedom until the patient became more accustomed to controlling a prosthetic limb. Initial prosthetic training sessions emphasized increased time, repetition, task specific training, reduced external distractions, and an errorless learning approach. The subject was reassessed by a multidisciplinary team, and after 5 weeks, was progressed to an ischial containment socket with a polycentric knee. The ischial containment socket provided improved suspension and prosthetic control and the polycentric knee provided the patient with a more normalized gait pattern. As the subject progressed, training sessions incorporated divided attention tasks as well as problem solving using variable practice, and a trial and error learning approach.

Outcomes : Upon discharge from acute rehab, the subject was able to ambulate in the home and community with a rolling walker and minimal assistance and was able to climb stairs with the use of bilateral rails and minimal assistance.

Discussion : Due to the cognitive deficits associated with TBI, additional time and special consideration is required throughout the prosthetic training process. Further research is warranted to guide clinical decision making in the complex population of TBI with concomitant amputation.

TITLE: The Role of the Physical Therapist in the Management of Youth Athletes Whom Have Sustained a Concussion

AUTHORS/INSTITUTIONS: A.M. Yorke, Physical Therapy, University of Michigan-Flint, Flint, MI|

ABSTRACT BODY:

Purpose : To explore the role of the physical therapist in the management of youth athletes whom have sustained a concussion as related to current legislation.

Description : Currently an estimated 44 million children and adolescents participate in organized sports in the US. Many of these activities are associated with an increased risk of traumatic brain injury (TBI). A concussion is a type of TBI. In the US, emergency departments treat approximately 175,000 sports and recreation related TBIs among those from birth to 19 years of age. There is a lack of knowledge regarding the recognition and management of concussions in youth athletes from the athletes themselves, as well as parents, coaches, and health care professionals. Lack of knowledge may allow a student to return to play prior to recovering from the effects of a concussion potentially resulting in significant disability and possibly death. The Zackery Lystedt Law passed in the state of Washington in 2009 has served as model legislation for other state legislation on the management of concussions in youth athletes. The three key tenants of the Lystedt Law are immediate removal from play if a concussion is suspected; return to play only after receiving written clearance by a licensed health care provider trained in the evaluation and management of concussion; and mandatory education for student athletes, coaches, and parents. There is currently limited evidence on the effectiveness of education of athletes, parents, coaches, and health care professionals.

Summary of Use : There is little research available on the role of physical therapists in the management of concussed youth athletes. Currently, physical therapists are not consistently considered as a health care provider who is allowed to make return to play decisions. Physical therapists have an opportunity to assist in the management of concussed youth athletes.

Importance to Members: The APTA House of Delegates will be reviewing RC 14-12 in June which proposes to amend the APTAs position on the physical therapist's role in the management of the person with a concussion. Physical therapists may encounter a young athlete who has sustained a concussion in a variety of settings and specialties including but not limited to pediatrics, orthopedics, and neurology. Physical therapists should be aware of current guidelines of the management of an young athlete who sustains a concussion and actively lobby in order to be considered one member of the health care team who manages a young athlete with a history of concussion.

TITLE: The Effects of Multi-Sensory and Cognitive-Behavior Stimulation in the Minimally Conscious State

AUTHORS/INSTITUTIONS: J. Zapanta, , Regis University, Denver, CO|P. Graham, , TIRR Memorial Hermann, Houston, TX|

ABSTRACT BODY:

Background & Purpose : People with brain injuries suffer from disturbances of consciousness that inhibit meaningful interaction with self and the environment. Disorders of consciousness (DOC) include coma state, vegetative state, and the minimally conscious state (MCS). Common treatments for DOC include multi-sensory stimulation to enhance the reticular activating system necessary for arousal which improves consciousness and purposeful movements. However, literature suggests that multi-sensory stimulation may or may not be effective in improving consciousness. Although there have been studies on different arousal techniques such as uni-modal versus multi-modal, non-meaningful versus meaningful stimuli, and cognitive-behavioral conditioning, there is little consensus on which interventions can most improve arousal and consciousness in people with DOC. The purpose of this study was to explore the effectiveness of a meaningful multi-sensory and cognitive-behavior stimulation protocol plus conventional rehabilitation versus conventional rehabilitation alone on level of consciousness, response time to 1-step commands, and arousal with a patient in the MCS.

Case Description : A 25 year old male with a history of anoxic brain injury on May 21st, 2011 resulting in spastic quadriplegia was admitted into acute rehab on October, 3rd, 2011. He scored a 5 on the Coma Recovery Scale – Revised (CRS-R) upon admission. At the start of this study on November 27th, 2011 he had aspiration precautions, was non-verbal, and did not startle to visual threats 1 inch away from the eye.

Outcomes : Study design was a B-A-B design with two weeks in each phase. Level of consciousness was measured by the CRS-R every week. CRS-R scores were 4 and 6 at pre-intervention (B), 8 and 9 at intervention (A), followed by 5 and 7 at post-intervention (B). Within session outcomes included response time and frequency to 1-step command. The ability to kick right leg pre and post protocol was 16/32 (50%) in 17.14 seconds and 28/32 (88%) in 12.76 seconds, respectively. The ability to turn head to opposite side pre and post protocol was 2/32 (6%) in 21.24 seconds and 8/32 (25%) in 58.66 seconds. Level of sustained arousal was measured each session by the number of times the CRS-R Arousal Protocol had to be administered. The CRS-R Arousal Protocol had to be administered on average .66 times on the weekdays and 3.5 times on the weekends.

Discussion : The CRS-R scores were highest during intervention than compared to baseline and washout period which may indicate a positive response to multi-sensory and cognitive-behavioral stimulation. Within session results showed an increase in behavioral response and response time to 1-step commands after administration of protocol which may indicate higher arousal and consistency of purposeful movements. An increase in the number of times the CRS-R Arousal Protocol had to be administered on the weekend versus weekday may indicate a decreased baseline arousal level consisted with limited rehabilitation provided on the weekend.

TITLE: The impact of a physical therapy program on the activity limitations and participation restrictions of a 32 year old female with Allgrove Syndrome.

AUTHORS/INSTITUTIONS: J. Adams, , The Rusk Institute - NYU Langone Medical Center, New York, NY|

ABSTRACT BODY:

Background & Purpose : Allgrove syndrome is a rare genetic disorder characterized by alacrima, achalasia, and adrenocortical insufficiency. Other clinical manifestations often include peripheral neuropathy, progressive demyelinating polyneuropathy, pyramidal syndrome, cerebellar dysfunction, dysautonomia, and bulbar symptoms.

While there have been research publications on the impairments of body structures and body functions, there has been no literature to guide physical therapy management of the activity limitations and participation restrictions of patients with Allgrove Syndrome. As a result, guidelines for rehabilitation and the return to life situations are lacking for this population. This report describes the physical therapy interventions provided to a patient with Allgrove Syndrome, and its impact at the body function, activity, and participation levels.

Case Description : C.A. is a 32 year old female with genetically confirmed Allgrove syndrome. Initially her impairments consisted of decreased anticipatory and reactive balance, muscle weakness, orthostatic hypotension with supine hypertension, decreased sweat production with heat intolerance, and increased fall frequency. Her activity limitations consisted of moving from sitting to standing, ambulation distance, and self care activities. Her main participation restrictions consisted of participating in school, accessing public transportation, and attending local social activities.

Outcomes : The subject participated in an outpatient physical therapy program twice weekly for 12 weeks with a home exercise program performed daily. Her functional limitations and participation restrictions were measured through the Lower Extremity Functional Scale (LEFS), her balance was assessed through the Balance Evaluation Systems Test (BEST), and her endurance was measured through the 6 Minute Walk Test (6MWT). Manual muscle testing was performed to assess strength.

Improvements in endurance (6MWT initial 246m, final 298m), balance (BEST initial 50.43%, final 62.08%), activity and participation ability (LEFS initial 27/80, final 41/80) were observed for this subject. Muscle strength and active range of motion remained unchanged.

Discussion : Physical therapist management of this case focused on restoration of functional activities with intervention intensity guided by physiologic and self reported responses. Low to moderate intensity strength training was issued to prevent over fatigue of muscles similar to guidelines for other diseases with progressive demyelination such as Guillain Barre Syndrome. Additionally, blood pressure was monitored closely during postural changes to minimize orthostatic hypotension. No exercise was permitted during high environmental temperatures as a precaution of her diminished sweat production. By reporting these results, this case study seeks to contribute to the body of knowledge of rehabilitation, and to begin the conversation to establish guidelines of intervention for this understudied syndrome.

TITLE: The Effects of Massed or Distributed Practice Treadmill Training on Gait Parameters, Balance, and Motor Function in Individuals with Parkinson's Disease.

AUTHORS/INSTITUTIONS: C.L. Barnes, B. Tschoepe, M.B. Smith, N. Mulligan, R. Hawkins, E. Hulke, D. Main, A. Marshall, A. Murray, J. Zapanta, School of Physical Therapy, Regis University, Denver, CO

ABSTRACT BODY:

Purpose/Hypothesis : High-intensity treadmill training (TmT) has been shown to improve gait parameters in individuals with Parkinson's disease (PD). However, the benefit of different practice schedules using TmT is unknown in this population. The purpose of this study was to examine the effects of massed practice schedule versus distributed practice schedule of TmT on gait, balance, endurance on individuals with mild-moderate stage PD.

Number of Subjects : Twenty-three individuals (10 female, 13 male) with PD, Hoehn and Yahr (H&Y) levels 1-3, were randomly divided into a massed or distributed practice schedule intervention group.

Materials/Methods : Subjects trained 2 times a week for 6 weeks at a target training speed of 80% of fast walking speed. The massed practice group walked for 2-15 minute increments with a 5-minute rest period. The distributed practice group walked for 3- 10-minute increments with 2- 12-minute rest periods. Outcome measures included the MDS-UPDRS, 6-minute-walk test (6-MWT), Timed-Up-and-Go (TUG), Functional Gait Assessment (FGA), Romberg, Sharpened Romberg, and Single Leg Stance. Gait parameters were measured using GaitRite software. Outcome measures were taken at baseline, post testing, and 4 weeks post-testing.

Results : SPSS (version 17.0) was used for statistical analysis. Of the 23 subjects, 15 met protocol of 5 or more sessions at 80% of their fast forward walking speed. The distributed practice group who met protocol showed improvement in gait cadence at comfortable forward and backward walking speeds from pre to post testing ($p < 0.05$). The massed practice group showed a decline in gait cadence at both forward and backward comfortable walking speed from pre to post testing ($p < 0.05$). Trends were found within the distributed group including increased velocity and 6-MWT from pre to post testing for subjects who met protocol ($p > 0.05$). After combining data from both groups, all subjects improved significantly in the MDS-UPDRS, TUG, FGA, and 6-MWT from pre to post testing ($p < 0.05$). Outcome measures between post-test to 1-month follow-up did not significantly change, except for the MDS-UPDRS motor scale which had significant improvements with a trend towards continual improvement ($p < 0.05$, change = 6.91, MCID = 2.5).

Conclusions : Although all participants improved in functional outcome measures from TmT, the distributed protocol appears to be more beneficial for gait characteristics compared to the massed protocol. However, both practice schedules demonstrate improvement in functional measures such as dynamic balance, walking endurance, and motor function.

Clinical Relevance : High-intensity TmT program 2 days per week for 30 minutes, may improve dynamic balance, motor function, and walking endurance for individuals with mild-moderate PD.

This study was supported by funding from Sponsored Projects Academic Research Council (SPARC) Regis University. No authors have any potential for material gain as a result of this current study.

TITLE: The effect of progressive resistance exercise on perceived fatigue in persons with multiple sclerosis

AUTHORS/INSTITUTIONS: E.T. Cohen, N. Caputo, V. Luddy, R. Rekhi, J. Therlonge, K. Weiss, , UMDNJ-SHRP and Rutgers-Camden, Stratford, NJ

ABSTRACT BODY:

Purpose/Hypothesis : Fatigue is one of the most common and disabling symptoms experienced by persons with multiple sclerosis (PWMS). The fatigue experienced by PWMS is multifactorial, and accurate assessment is complicated by its subjective nature. Fatigue in PWMS may be primary, secondary, or a combination of the two. The purpose of this systematic review was to examine the effect of a program of progressive resistance exercise (PRE) on perceived fatigue in PWMS, and to make relevant recommendations based on the results.

Number of Subjects : N/A

Materials/Methods : A search of OVID and CINAHL databases was conducted in September, 2011 using the keywords: multiple sclerosis, progressive resistance exercise, strengthening, and fatigue. Articles included in this review were clinical trials examining the effect of a PRE program in PWMS that included at least one fatigue-related outcome measure. Seven research studies met these criteria.

Results : Each article was examined for internal validity using MacDermid's Evaluation of Effectiveness of Study Design (MEESD). The MEESD has a range from 0-48, with 48 being the highest quality. Two team members reviewed each of the seven articles, and the average score was recorded for each article. The average MEESD score was 34.5/48 (range 24.5-47). Four studies measured perceived fatigue with the Modified Fatigue Impact Scale (MFIS), three with the Fatigue Severity Scale (FSS), and one with the Multidimensional Fatigue Inventory (MFI-20). In addition, several of the studies measured outcomes normally associated with strength and mobility (e.g. Dynamometry and 6-Minute Walk Tests). PRE interventions varied in type, frequency, duration, and intensity. Interventions included high-resistance cycle ergometry, and isotonic and/or isometric exercises across various muscle groups.

Conclusions : Significant within-group reductions (i.e. improvement) in perceived fatigue were found in the PRE groups for all seven studies. Inconsistent improvements were found in body function-, activity- and participation-level outcomes (e.g. dynamometry, 25-foot timed walk test, and Multiple Sclerosis Impact Scale, respectively).

Clinical Relevance : The current evidence indicates that a program of PRE can significantly improve perceived fatigue in PWMS. PRE is a cost-effective and non-pharmaceutical alternative or adjunct to current treatment and intervention protocols to treat fatigue. There was no evidence of adverse effects induced by a PRE program. Various exercise modalities and programs were effective in improving fatigue in PWMS. Physical Therapists should confidently prescribe an appropriate PRE program to ameliorate perceived fatigue in PWMS.

TITLE: Mechanical Assist sit to stand training in a person with Parkinson's Disease

AUTHORS/INSTITUTIONS: K. Fisher, P. Boyne, M. Reuter, K. Dunning, Department of Rehab Sciences, University of Cincinnati, Cincinnati, OH

ABSTRACT BODY:

Background & Purpose : The purpose of this study is to determine the feasibility and outcomes of mechanical assisted sit to stand (STS) training in a person with Parkinson's Disease (PD).

Eighty percent of people with PD report difficulty with STS. Challenges with STS may be due to both central and peripheral factors. Evidence suggests that to attain long term improvements in function repeated practice of challenging, task-specific movements is needed. There are no studies to date incorporating these principles to improve STS in a person with severe PD. We hypothesized that the use of mechanical assistance would improve STS by allowing the subject to perform a high number of repetitions of task specific training at an effort just beneath maximal ability.

Case Description : The participant was a 67 yo female with a 6 year history of PD (Hoen & Yahr 4, H&Y). Screening revealed strength and ROM within normal limits and intact sensation. The subject presented with orthostatic tremors and dyskinesias. She exhibited impaired anterior weight shift throughout STS and standing, which resulted in unsuccessful STS attempts and an inability to attain full upright posture without physical assistance. She was unable to maintain standing without an assistive device and only able to stand at her rolling walker for less than 30 seconds. Treatment sessions were 45-60 minutes, 3x/wk for 8 weeks and consisted of repetitive STS practice using a mechanical assist device (Neurogym sit to stand trainer©). Each session started with as little lifting assistance as needed to achieve 3 consecutive STSs without UE use. The subject then performed repeated sets of 3 STS repetitions while attempting to maintain or further decrease the lifting assistance. A blinded rater assessed the following outcomes before and after intervention: mechanical assistance required to achieve STS, lower extremity power (STS rate of rise in force) and center of pressure (COP) sway (force-plate), muscular endurance (5repetitionSTS), balance (Berg Balance Assessment), quality of life (PDQ-39 mobility subscale), and fear of falling (Falls efficacy scale-international, FES).

Outcomes : During the course of treatment the participant performed over 2000 STSs, averaging 95 reps/session at an intensity of 7-9 on the 10-point RPE scale. From pre to post all outcomes improved: Mechanical assist decreased from 56 to 0lbs; STS rate of rise in force increased from 103.6 to 229.4% body weight/sec; STS lateral sway decreased from 15.1 to 4.8 inches; 5 repetition STS time decreased from 81.2 to 15.2 seconds; Berg increased from 6 to 20; PDQ-39 mobility improved from 82.5 to 67.5; FES improved from 53-37.

Discussion : A person with advanced PD (H&Y 4) was able to perform high intensity STS practice (95 reps/session at 7-9/10 RPE) using mechanical assistance. The intervention was associated with clinically meaningful improvement in STS ability and improvements in lower extremity power, balance, and quality of life.

TITLE: The Effects of External Cueing as a Strategy to Improve Balance and Gait in the Rehabilitation of Patient's with Parkinson's Disease:A Systematic Review

AUTHORS/INSTITUTIONS: M. Gildea, C. Gregowicz, T. Liccione, N. Schrecengost, R.M. Hakim, Physical Therapy, University of Scranton, Scranton, PA, PA|

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of this systematic review was to assess the effectiveness of external cue-based interventions on balance and gait in patients with Parkinson's Disease (PD) across rehabilitation settings.

Number of Subjects : N/A

Materials/Methods : A literature search of CINAHL, PubMed, and Science Direct (2002-2012) was conducted to identify randomized controlled trials (RCTs) and systematic reviews examining the effect of external cue-based interventions on balance and gait in patients with PD. Inclusion criteria were: Peer-reviewed, articles in English, external cueing to improve balance and/or gait and subjects with a diagnosis of PD. Studies were excluded if balance and/or gait outcome measures were not used or if subjects had received deep brain stimulation. Four reviewers independently rated each study for methodological quality and came to consensus based on PEDro Guidelines.

Results : A total of 377 articles were screened for eligibility in this review. Six additional articles were identified through hand searching. Following a detailed appraisal, 13 studies fulfilled the inclusion/ exclusion criteria and were included in the systematic review. The quality assessment ranged from a PEDro score of 5 to 8/10 with an average of 6.9. Types of cueing included auditory (3), visual (1), somatosensory (2), dance (3) and a combination (4). In addition, 3 systematic reviews examined a variety of cues across studies. Sample size for the RCTs ranged from 11 to 153 subjects, with a total of 555. The 3 systematic reviews included a total of 46 studies with a range of 2 to 136 subjects and a total of 847. Studies were conducted in home, outpatient, inpatient, and laboratory settings. Outcome measures included the Berg Balance Scale (BBS), Functional Reach (FR), Single Limb Stance (SLS) and Timed-Up-and-Go (TUG) for balance and the Six Minute Walk Test (6MWT), Freezing of Gait (FOG), and bradykinesia for gait. Nine RCTs showed statistically significant improvements in balance (5) and/or gait (8) outcomes, while two studies had non-significant findings for gait. Three systematic reviews reported mixed evidence for improvements in gait parameters using a variety of external cues.

Conclusions : There is moderate to strong evidence supporting the recommendation of external cues as a component of interventions designed to improve balance and gait in the rehabilitation of patients with PD. Limitations included small sample sizes, the need for a longer follow-up to determine retention, and the lack of a uniform definition for external cueing. More RCTs with standardized outcome measures are needed to determine the optimal type, duration and intensity for effective external cueing of gait and balance.

Clinical Relevance : External cueing should be considered to address balance and gait across all rehabilitation settings for patients with PD. The use of external cues allows a physical therapist to provide augmented feedback which may improve the safety of activities and participation in this population.

TITLE: Patient RS: A Unique Case of Corticobasal Degeneration

AUTHORS/INSTITUTIONS: J.A. Hershberg, C.J. Winstein, R. Howard, K. Cahoon, L. Levonian, S. Heung, J. Lin, Biokinesiology and Physical Therapy, University of Southern California, Los Angeles, CA | R. Schmidt, Human Performance Research, Marina Del Rey, CA |

ABSTRACT BODY:

Background & Purpose : This case of Corticobasal Degeneration is unique for two reasons. First, this is a relatively rare neurological condition. Second, the patient RS has more insight into his condition than most because he has a distinguished career as a movement scientist as one of the modern founding fathers of the field of motor behavior and motor learning. The purpose of this report is to describe the components and outcomes of a 3-month multifaceted and collaborative intervention.

Case Description : RS is a 70 year old retired professor who currently works from home as a consultant. He exhibited high motivation to participate in a collaborative, targeted physical therapy program. The therapist-patient team identified the following goals: 1) Decrease falls with improved balance; 2) Improve ability to get up from seated position and in and out of his cars; 3) Improve ability to use left UE in functional activities; 4) Increase strength in left side. Physical therapy treatment included 22 one- hour sessions (1-2x/week) for 12 weeks. Each session was guided by patient goal-driven task training incorporating principles of motor learning, motor control and exercise. Specific facets of training included getting on/out of different cars; sit to stand from different surfaces; anticipatory, reactive and sensory training for balance; functional training with UE including sensory cues, forced use, manual therapy, weight bearing and manipulation tasks; weight supported gait training with dual task using the Alter G treadmill; and home evaluation and training.

Outcomes : Considering the progressive nature of this condition, RS exhibited the following improvements over a 3-month period (gait symmetry, weight bearing and COP were measured using an instrumented treadmill with Zebris FDM-T software): Comfortable gait speed (1.0 to 1.2 m/s) with improved step length symmetry. Five times sit-to-stand test (4s faster with weight bearing improved by 28.4% on the left lower extremity). Self-reported frequency of falls (decrease from 1 fall/1-2 days to 1-2 falls/week). MiniBEST test score (22 to 26/32). Functional Gait Assessment score (20 to 23/30). Single leg stance COP excursion on left (822.6 mm² to 317.2 mm²). Time to complete an UE reaching/manipulation task decreased by 10.6s.

Discussion : RS's specific goals and prior knowledge fostered a therapy environment that was dynamic yet centered on meaningful outcomes. This multifaceted intervention program was unique in three ways: 1) an intense collaborative, challenging and task specific training program applied in a degenerative condition was shown to not only slow decline but to result in meaningful changes in mobility, balance and fall frequency; 2) it empowered patient autonomy through fall prevention strategies; and 3) it enlisted RS in decisions about the intervention program, further fostering control and autonomy.

TITLE: Relationship between Core Muscle Strength, Pulmonary Function, Balance and Physical Performance in Persons with Multiple Sclerosis

AUTHORS/INSTITUTIONS: M. Huang, B. Rodda, D.K. Fry, Physical Therapy Department, The University of Michigan-Flint, Flint, MI

ABSTRACT BODY:

Purpose/Hypothesis : Multiple sclerosis (MS) can cause weakness of muscles in the limbs and trunk, and ventilation. Abnormal findings of pulmonary function tests and pulmonary muscle strength are common in persons with MS. Our previous research showed that static balance significantly improved following a respiratory muscle strengthening program in persons with MS compared to a non-treatment control group of persons with MS. The improvement in balance may have resulted from increased core muscle strength secondary to the respiratory muscle strengthening. Therefore, the purpose of this study was to determine the relationship between core muscle strength, respiratory muscle strength, balance and physical function in persons with MS. We hypothesized that there would be a high correlation between the core muscle strength, pulmonary muscle strength, and measures of balance and physical function.

Number of Subjects : Eighteen adults (age = 55 ± 10 years) were recruited. Inclusion criteria were a physician confirmed diagnosis of MS, age 18-69 years, and ability to ambulate at least six minutes with or without assistive devices.

Materials/Methods : Kurtzke Expanded Disability Status Scale (EDSS) was determined by the researcher after the participants gave consent. Pulmonary muscle strength was determined indirectly through measurement of maximal inspiratory pressure (MIP) and maximal expiratory pressure (MEP). Core muscle strength was assessed by YMCA half sit-up test, standing pelvic tilt test, and the reclined sitting test. Balance was assessed by Static Standing Balance Test, Four Square Step Tests (FSST), and Maximum Step Test (MST). Physical performance tests included Sit-to-Stand (STS), Functional Stair Test (FST), and 6 Minute Walk Test (6MWT). Pearson product moment correlation coefficients were used to examine the relationships between the pulmonary muscle strength tests, core muscle strength tests, balance and physical performance tests. Significance level was set at an alpha level of $p < .05$.

Results : The EDSS mean was 3.8 ± 1.8 (range 1.5 to 6.5). Pulmonary function tests were not significantly correlated with any other tests. Tests of core muscle strength were significantly correlated with all balance tests ($r = 0.48$ to 0.60 , $p < 0.05$) and the STS test ($r = 0.57$ to 0.72 , $p < 0.05$), but not the FST or 6MWT. Tests of balance were significantly correlated with all physical function tests ($r = 0.48$ to 0.88 , $p < 0.05$).

Conclusions : The low correlation between balance and respiratory muscle strength in this study contradicts findings from an earlier study by Pfalzer & Fry (2011). Core muscles strength may contribute to balance control and is important during tasks that involve proximal muscles and trunk, e.g. sit to stand. On the other hand, factors other than core muscle strength, such as coordination or balance, may account for the performance of physical functions that involve ambulation.

Clinical Relevance : Interventions to improve balance and physical function in persons with multiple sclerosis should incorporate exercises targeting core muscles.

TITLE: Timed finger-to-nose performance correlates with the Amyotrophic Lateral Sclerosis–Functional Rating Scale score

AUTHORS/INSTITUTIONS: D. Lanzino, K.J. Ohm, K. Reed, S. Schmitz, H. Subich, J.H. Hollman, , Mayo Clinic, Rochester, MN|

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of the current study was to determine if performance on timed limb coordination tests in persons with Amyotrophic Lateral Sclerosis (ALS) correlates with function as assessed by the ALS-Functional Rating Scale (ALS-FRS). Two timed tests, finger tapping and foot tapping, have shown potential for marking ALS disease progression but have not been widely examined in the literature.

Number of Subjects : 18 (mean age = 59.9 yrs.)

Materials/Methods : Participants were diagnosed with ALS within two years prior to the study and reported full movement of their arms and legs. Five repetitions of 6 coordination tests (finger-to-nose, pronation-supination, precision finger-tap, heel-on-shin, heel-to-knee, foot-tap) were individually timed with a stopwatch. The ALS-FRS was administered by patient interview. A Pearson-product correlation coefficient was calculated for each timed limb coordination test and the ALS-FRS.

Results : There was a strong negative correlation (-0.745) between timed finger-to-nose performance and the ALS-FRS score ($p=0.001$). No other significant correlations with the ALS-FRS were found.

Conclusions : Of the 6 coordination tests administered, only timed finger-to-nose performance correlated to the ALS-FRS score. Patients who took longer to complete 5 repetitions of finger-to-nose had lower ALS-FRS scores, indicating poorer functional status. The study sample contained a mixture of subjects with limb-onset and bulbar-onset ALS. It was not designed to determine whether the correlation differed between these two subpopulations. This is the first known study to examine finger-to-nose performance in ALS.

Clinical Relevance : Timing 5 repetitions of finger-to-nose performance in persons with ALS may provide a quick means to assess overall function.

TITLE: PHYSICAL THERAPIST CONSIDERATIONS IN THE TREATMENT OF PEOPLE WITH YOUNG-ONSET PARKINSON'S DISEASE

AUTHORS/INSTITUTIONS: D.A. Lehman, B. Cox, A. Grindol, J. Vu, Physical Therapy, Tennessee State University, Nashville, TN|

ABSTRACT BODY:

Purpose : The purpose of this study is to provide a better understanding of physical therapy interventions for people with Young Onset Parkinson's Disease (YOPD) and how these interventions may differ between people with YOPD and people with idiopathic Parkinson's disease (PD).

Description : A literature search of peer-reviewed articles from Ebsco, PubMed, American Search Premiere, and the Journal of Physical Therapy from 1990 to 2011 was conducted using the following key words: YOPD, idiopathic PD, and physical therapy in YOPD. Research and interviews with health care professionals and people with YOPD were also conducted. Similarities and differences in the treatment of people with YOPD and idiopathic PD were examined through guidance of the International Classification of Functioning, Disability, and Health (ICF) Model. Evidence was grouped according to the following ICF categories: 5 for pathology, 5 for body structure/function, 3 environmental factors, 4 participation, and 4 for psychosocial. Research evidence suggests the following preliminary finding: the key variables that influence the treatment of people with YOPD are central fatigue, psychosocial factors, and exercise participation. Compared to people with idiopathic PD, people with YOPD are more at risk for depression, poor emotional wellbeing, central fatigue, and decreased exercise participation.

Summary of Use : Evidence regarding the effectiveness of physical therapy interventions is currently specific to people with idiopathic PD thus raising concerns about generalizing this evidence to people with YOPD. At this point, there is a lack of evidence that speaks to the efficacy of physical therapy interventions for people with YOPD. More specific guidelines incorporating environmental, psychosocial, and participation factors need to be recommended to physical therapists that treat people with YOPD.

Importance to Members: There are distinct differences between people with YOPD and idopathic PD. These differences must be considered when providing physical therapy for individuals with YOPD.

TITLE: Functional Outcomes After a Combined Intervention of Unilateral and Bilateral Lower-Extremity Exercise in a Person with Multiple Sclerosis: A Case Report

AUTHORS/INSTITUTIONS: M. McCormick, J. Freund, , Elon University, Elon, NC|

ABSTRACT BODY:

Background & Purpose : Individuals with multiple sclerosis (MS) often present with hemiparesis. There is modest evidence supporting unilateral lower-extremity exercise to improve gait in individuals with hemiparesis from stroke. The purpose of this case report was to describe the functional outcomes in a person with MS following a novel physical therapy intervention of combined unilateral and bilateral lower-extremity exercise.

Case Description : The patient was a 34 year old female diagnosed with relapsing-remitting MS ten years prior. She had right lower-extremity hemiparesis with extensor hypertonicity, walked independently and had frequent falls. As a volunteer participant in a university physical therapy course, twice a week for 5 weeks, she attended 10 of 10 scheduled sessions. Sessions included: 2 examination sessions and 8 intervention sessions of bilateral and unilateral cycling and stepping on treadmill, and unilateral strength training. Unilateral cycling was without resistance for 5 minutes forward, progressing to an additional 5 minutes backwards. Unilateral treadmill stepping progressed in time (5 to 9 minutes with each leg) and speed (1.0 to 1.9 mph), mostly without hand support. Total average time for cycling and treadmill stepping was 20 minutes each. Leg press was performed with 5 lbs and progressed from 2 sets to 3 sets of 10-15 repetitions.

Outcomes : The following measures improved (pre to post-intervention): 10 meter gait speed (1.21 to 1.30 m/s), five times sit to stand test (5TSTS), (13.5 to 11.5 s); Fullerton Advanced Balance Scale (FABS), (27/40 to 34/40 points); average steps per weekday (8,770 to 10,644 steps); and MSIS-29 (physical impact 50 to 31.3%, psychological impact 30.6 to 22.2%). Her two foot jump improved from asymmetrical to symmetrical. Based on an 11 point (-5 to +5) global rate of change scale she rated both her balance and walking quality as moderately better (+3) post-intervention. She reported 3 falls in 3 months pre-intervention and no falls during the intervention period.

Discussion : A combined intervention of single limb and double limb lower-extremity exercise may be effective in improving balance, gait, activity level, quality of life, and decreasing fall risk in ambulatory individuals with relapsing-remitting MS. Increased FABS score denotes decreased fall risk. The change in MSIS-29 physical and psychological impact scores exceeded the MCID of 8 points. A minimal clinically important difference has not been established for persons with MS for the 5TSTS or FABS. This case report describes improved functional outcomes following a novel combined intervention of single and double limb lower extremity exercise in a person with hemiparesis and hypertonicity secondary to MS. Further research is needed to evaluate the effectiveness of a similar intervention in a larger group of ambulatory persons with MS.

TITLE: The Diagnostic Accuracy of the BESTest to Assess Balance in Persons with Multiple Sclerosis

AUTHORS/INSTITUTIONS: K.D. Mitchell, A. Beuti, K. Eberhardt, H. Chen, PT & Rehab Sciences, Drexel University, Philadelphia, PA|D. Tabby, Neurology, Drexel University (DCOM), Philadelphia, PA|

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of this research study was to evaluate the reliability and validity of the BESTest to assess balance in individuals with Multiple Sclerosis, and to compare the sensitivity of the BESTest and the Berg Balance Scale to identify persons with MS who are fallers. We hypothesized that the BESTest would be a reliable and valid functional balance tool but may be too fatiguing for this patient population.

Number of Subjects : 10

Materials/Methods : This study recruited 10 participants during routine visits to an urban university based MS Clinic. Interested participants were educated about the study and scheduled for the first of two balance assessments. Consented participants answered several questions regarding age, onset of disease and number of falls in the past month. Disease severity was assessed using the Expanded Disability Status Scale. Balance assessment was completed using the BESTest and the Berg Balance Scale (BBS). Eight participants were retested to determine test-retest reliability for the BESTest.

Results : The BESTest demonstrated strong test-retest reliability [ICC (2, 1) p = 0.0] and was highly correlated with the BBS (r = 0.954, p = 0.0). Using a score of <45/56 as indicator of fall risk, the BBS demonstrated poor sensitivity (0.43) to identify fallers. Small sample size precluded analysis of the correlation of BESTest total score and fall history.

Conclusions : The BESTest has strong test-retest reliability and is highly correlated with the BBS when used as a measure of functional balance in persons with MS. The traditional falls risk cut score of 45/56 fails to identify persons with MS with a recent fall history.

Clinical Relevance : Ambulatory persons with MS possess the stamina to complete the BESTest. The BESTest is a reliable and valid measure of balance in ambulatory persons with MS. The BBS has a ceiling effect when used to assess fall risk in this population.

TITLE: Effect of Treadmill Training versus Conventional Physical Therapy on Gait in People with Parkinson's Disease: A Systematic Review of the Literature

AUTHORS/INSTITUTIONS: J. Mount, R. DeLaurentis, T. Edger, M. Henninger, B. Kozitzky, M. Whitley, L. Hunter, , Thomas Jefferson University, Philadelphia, PA]

ABSTRACT BODY:

Purpose/Hypothesis : Background: People with Parkinson's Disease (PD) frequently present with varying degrees of gait dysfunction. This often includes a decreased step length, a shuffling gait pattern with inadequate hip extension, and decreased gait speed which can lead to difficulty performing activities of daily living and an increased fall risk. A variety of physical therapy intervention approaches are currently used to address this problem including treadmill based training but there is limited evidence supporting the effectiveness of one intervention in comparison to another.

Objectives: The purpose of this study was to evaluate the evidence of an improvement in gait parameters and quality of life in people with PD using treadmill training as compared to conventional therapy as a control condition.

Number of Subjects : na

Materials/Methods : Search Strategy: Data were obtained through searches of Scopus, CINAHL, Sportsdiscus, OVID (Medline, In-Process, and Old Medline), PEDro, Cochrane (Database of systematic reviews, Central register of controlled trials, and Database of abstracts of reviews of effects), Google Scholar from their start to July 2011. Our search strategy included the use of the terms of "Parkinson\$" AND "treadmill" OR "lokomat" OR "bodyweight support" OR "gait training" OR "ambulation training" without limitations during initial search.

Selection Criteria: Five reviewers examined the studies and assessed whether they met the following inclusion criteria:

1. Subjects in the study must have Parkinson's disease.
2. The study must include a treadmill based intervention and a control group which receives some form of conventional physical therapy intervention.
3. Outcome measures are based on overground walking ability.

Data Collection and Analysis: Five reviewers independently reviewed articles for the inclusion criteria, conducted the risk of bias assessment using the PEDro scale and extracted the results. Strength of evidence was analyzed using the United States Agency for Health Care Policy and Research (AHCPR) scale.

Results : Main Results: Five articles were included. When compared with conventional PT, treadmill training resulted in greater improvements in both gait velocity and stride length. There were significant improvements in UPDRS total scores, motor and ADL subscales for treadmill training versus conventional PT. There is also limited evidence to support that PDQ-39 scores are increased after treadmill training.

Conclusions : Author's Conclusions: Treadmill training is more effective than conventional physical therapy for increasing gait velocity and stride length for people with PD. Further research is needed to determine what protocol for treadmill training gives the best results.

Clinical Relevance : Treadmill training is recommended for people with PD when the clinical goal is to increase gait velocity and stride length.

TITLE: A Tandem Biking Program for Individuals with Parkinson's Disease

AUTHORS/INSTITUTIONS: M. Nelson, G. Park, L. Love, C. Robinson, E.L. McGough, Department of Rehabilitation Medicine, University of Washington, Seattle, WA|

ABSTRACT BODY:

Purpose : To describe a novel community-based tandem biking program for individuals with Parkinson's disease (PD), and to present focus group results from 24 participants using the International Classification of Function, Disability and Health (ICF) as a framework.

Description : The Tandem Biking Program is a stationary biking class for community-dwelling individuals with Parkinson's disease (PD). Tandem bicycles mounted on trainers and healthy volunteer riders provide an innovative way for individuals with PD to train at a higher cadence than they would self-select and maintain. Volunteer healthy riders ('captains') provide pacing and camaraderie for riders with PD ('stokers'). Participants are 45-75 years-old and have mild to moderate PD.

Program objectives include: 1) Health Promotion through achieving a training intensity and duration that meets the American Heart Association's guidelines for aerobic exercise and providing education for injury prevention, bike fitting and exercise progression; 2) Educational opportunities for students in our rehab programs; and 3) Research on the motor and non-motor effects of high cadence, aerobic exercise in individuals with PD. The University of Washington DPT program has partnered with the City of Seattle Parks & Recreation and the Outdoors for All, a non-profit organization that provides recreation for individuals with disabilities.

The tandem biking class incorporates a protocol similar to 'the forced exercise' described by Rigdel et al. (2009). Each session is 60 minutes and meets 3x/week for 10 weeks. The routine for each session includes 10-minute at 50-70 RPMs, 40-minutes at 80-90 RPMs, and a 5-10 minutes cool-down and stretching routine.

Summary of Use : Twenty-four participants have completed our program with 100% class completion and 98% attendance rate. Greater than 80% of participants have exercised at 60-75% of their maximum estimated heart rate and report a self-reported perceived exertion = 3-5/10 from week 3 through week 10. More than 90% of participants have been riding at a cadence of 80-90 RPMs for 40 minutes/session by week 3.

Themes from mid and late session focus groups represented all aspects of the ICF model. Feedback included the program environment of support and network building and personal factors of self-efficacy and improved outlook. Participants also reported having more strength and energy to participate in social and physical activities.

Importance to Members: This program demonstrates the ability of physical therapists to implement a community-based tandem biking program for individuals with Parkinson's disease with high completion and attendance rates. Feedback from focus groups represent all aspects of the International Classification of Function, Disability and Health framework.

TITLE: Using the Bioness L300 Foot Drop System to Determine Changes in Gait Speed and Physiological Cost Index with a person with Multiple Sclerosis: A Case Study

AUTHORS/INSTITUTIONS: S. O'Neal, , Scottsdale Healthcare, Phoenix, AZ]

ABSTRACT BODY:

Background & Purpose : Multiple Sclerosis (MS) is a progressive neurological disorder which is characterized by the demyelination of upper motor neurons that can occur in the brain and/or spinal cord. Two common symptoms of MS are foot drop and fatigue, which can have a profound effect on a patient's ability to ambulate community distances. Functional electrical stimulation systems such as the Bioness L300 foot drop system, has been shown to improve gait mechanics in patients with upper motor neuron disorders. The purpose of this study was to investigate the use of the Bioness L300 with a single patient diagnosed with MS to observe the effects on her gait speed and energy efficiency during ambulation.

Case Description : The patient was a 53 year old female diagnosed with MS approximately 24 years ago with R sided foot drop and history of falls. The patient was able to ambulate household distances with a single point cane independently. The patient's goal was to be able to ambulate community distances with less fatigue.

This subject participated in approximately 8 weeks of gait training with the Bioness L300 foot drop system. After the 8 weeks of training, a 2 Minute Walk Test (2MWT) was used to calculate the patient's ambulation distance and energy cost. Energy cost of walking was estimated using the Physiological Cost Index (PCI). A 10 Meter Walk Test was administered to calculate the changes in gait speed over shorter distances. These outcome measures were performed with both the L300 foot drop system donned and doffed.

Outcomes : Improvements were seen in both gait speed and energy cost of walking with use of the L300. During the 10MWT, gait speed improved from 1.11 meters/second (without L300 donned) to 1.25 m/s (with L300 donned), a positive change of 0.14 m/s. During the 2 Minute Walk Test, use of the Bioness L300 system dropped the PCI (an estimated measure of oxygen cost) value from 0.40 beats/meter to 0.36 beats/meter. This translates into an 11.1% decrease of oxygen cost with use of the FES system.

Discussion : Results from this study suggest that the Bioness L300 foot drop system can have a positive effect in terms of decreased oxygen cost and increased gait speed with patients with Multiple Sclerosis. Fatigue is a common symptom with many patients with MS therefore use of the Bioness may allow the patient to conserve more energy during ambulation, and subsequently, walk further distances. Clinicians addressing energy conservation with these patients may find the use of this FES system helpful.

TITLE: The use of a gaming device for multimodal exercise intervention in individuals with Parkinson disease

AUTHORS/INSTITUTIONS: S.D. Pradhan, C. Moritz, Rehabilitation Medicine, University of Washington - Seattle, Seattle, WA|

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of this study is to investigate the potential for combined cognitive and physical exercises to positively influence functional status in individuals with Parkinson disease (PD)

H1 – Individuals with PD who participate in exercising with the Kinect device for an hour, three times a week will show improvements in function and clinical disease status when tested before and after their participation over a four week period.

H2 – Changes in function and clinical disease status between the pre and post game assessments will be greater compared to the changes in the control period (no exercise)

Number of Subjects : 10 participants with PD

Materials/Methods : Participants came in for 15 sessions in total – 3 of which were assessment sessions (pre and post intervention and baseline - 4 weeks prior to intervention) and 12 exercise intervention sessions. The exercise intervention includes 3-1 hour sessions/week for 4 weeks. We used the XBOX360 gaming console in conjunction with the Kinect camera sensor to enable our participants to perform game exercises specifically targeting 4 training goals:

1. Games that target balance, 2. Games that target reflex responses and speed of movement, 3. Games that focus on aerobic activity and 4. Games that provide cognitive engagement and multitasking. The level of difficulty for each participant was adjusted based on individual capability and was increased gradually as the participants got better at performance. Outcome measures : Kinematic data from a second Kinect sensor that recorded joint angles for shoulder, elbow, hip, knee and ankle, functional changes based on the 6 min walk test (6MWT) , Gait speed (GS) – self selected and fastest possible, Functional reach test (FRT) , Single limb stance (SLS) for each leg in seconds.

Results : Preliminary results from 3 participants tested before and after 6 intervention sessions showed a 44% (9.7) improvement in FRT, a 50.6%(4.04) improvement in SLS, a 9.7% (7.4)improvement in 6MWT and a 10.2%(4.2) improvement in fastest possible GS.

Conclusions : Using a gaming device as an exercise intervention mode provides an enriched environment and a mechanism to provide physically as well as cognitively engaging exercises. that have the potential to cause functional improvements in individuals with PD.

Clinical Relevance : The most compelling results supporting exercise interventions in PD are when when animals are subjected to motor skill learning (in complex/enriched environments that can be changed frequently) as opposed to fixed exercise conditions. Findings by others have strongly suggested that exercise programs should include a component of skill enhancement in an enriched environment, and not just repetitive movement, in order to induce functional neural reorganization. Exercising using this new technology as an adjunct is fun, cognitively engaging, has all components of skilled This would qualify as an enriched environment that can be easily used in most clinical settings, may have the potential to cause neuro-protection and can be changed as the performance improves.

TITLE: Test-Retest Reliability of Core Muscle Strength Tests and Maximum Step Length Test in Persons with Multiple Sclerosis

AUTHORS/INSTITUTIONS: B. Rodda, M. Huang, D.K. Fry, C. Pfalzer, D. Engman, Physical Therapy, University of Michigan Flint, Flint, MI|

ABSTRACT BODY:

Purpose/Hypothesis : Multiple sclerosis (MS) can lead to a variety of impairments in body systems and structures and limitations in functional activities and participation. Utilization of standard tests and measures is essential to determine the optimal plan of care in order to manage the deficits related to weakness of core muscles and balance in persons with MS. The purpose of this study was to examine test-retest reliability of a battery of core muscle strength tests and the balance test measured by the Maximum Step Test in persons with multiple sclerosis (MS).

Number of Subjects : 21 ambulatory adults with clinically diagnosed MS (Expanded Disability Status Scale scores: mean= 3.8 ± 1.8, range=1.5 to 6.5; age = 55 ± 10 years) participated in this test-retest study with a one week interval between testing sessions.

Materials/Methods : Core muscle strength tests included standing pelvic tilt test, the reclined sitting test, and the YMCA half sit-up test. Balance was assessed by the Maximum Step Test in the forward (MSTF), sideway (MSTS), and backward (MSTB) directions. All tests were performed by an ABPTS board certified clinical specialists in orthopedics and neurology. Test-retest reliability of the test scores between the two sessions was determined using the intra-class correlation coefficients (ICC model (3, 1)). Significance level was set at an alpha level of $p < .05$.

Results : Good reliability($r > 0.75$) was established for two of the core muscle strength tests: standing pelvic tilt test ($r = 0.82$, $p < 0.001$) and YMCA half sit-up test ($r = 0.96$, $p < 0.001$). Moderate reliability ($r = 0.5-0.75$) was established for the, reclined sitting test ($r = 0.65$, $p < 0.01$) and the MSTF ($r = 0.65$, $p < 0.01$).

Conclusions : In ambulatory persons with MS, the standing pelvic tilt test, and the YMCA half sit-up test have good reliability for assessing the core muscle strength. Only the Maximum Step Test in the forward but not the sideway or backward directions demonstrated moderate test-retest reliability. During daily activities, individuals commonly walk or step in the forward directions. Stepping sideways and backward might not have been a familiar task for the participants, which could have contributed to the lack of test-retest reliability of Maximum Step Length in the sideways and backward directions.

Clinical Relevance : This is the first report establishing reliability of core muscle strength tests in persons with multiple sclerosis

TITLE: Isokinetic Knee Torque in Early and Advanced Stages of Parkinson's Disease: Relation to Physical Function

AUTHORS/INSTITUTIONS: G. Singh, N. Sharma, Physical Therapy & Rehabilitation Science, University of Kansas Medical Center, Kansas city, KS|R. Pahwa, K.E. Lyons, Neurology, University of Kansas Medical Center, Kansas City, KS|

ABSTRACT BODY:

Purpose/Hypothesis : Individuals with Parkinson's disease (PD) often complain of muscle weakness and associated gait and balance difficulties. However, few studies have quantitatively measured strength in PD and its relation to physical functioning. The purpose of this study was to determine if isokinetic knee strength and force production rate (FPR) are affected in PD, changes in these measures as PD progresses, and if they impact physical functioning.

Number of Subjects : 20 subjects with PD and 9 controls without PD matched for age participated in the study. PD subjects were grouped according to disease severity. There were 13 PD subjects without postural instability (Group I) defined as Hoehn & Yahr Stage I and II and 7 more advanced PD subjects with postural instability (Group II) defined as Hoehn & Yahr Stage III.

Materials/Methods : Participants performed maximal isokinetic knee flexion and extension bilaterally to quantify the muscle strength at 30°/sec and 60°/sec using a Cybex 6000 dynamometer. The participants also completed the timed up and go test (TUG), which is an indicator of physical function. All the subjects were tested in the medication "ON" state. We normalized the torque by body weight to overcome the confounding factor of body mass index (BMI).

Results : There were significant group differences for mean flexion torque at both 30°/sec and 60°/sec. There were also significant between group differences in force production rate (peak torque/ time to reach peak torque) during flexion at both 30°/sec and 60°/sec. Additionally, there were significant negative correlations between flexion torque and TUG and between force production rate and TUG at both 30°/sec and 60°/sec.

Conclusions : Peak torque in flexion and force production rate in flexion decreases as PD progresses. Physical function is negatively related to torque and FPR. We found differences in flexion torque as opposed to previous research studies, where extension torque was reported to change with PD progression. Although, we did not find differences in extension torque and FPR in extension, there was a trend towards a reduction as PD progresses.

Clinical Relevance : Physical therapists are challenged to plan interventions that promote strength and functional improvement in individuals with PD. Patients often report weakness and have problems with gait, balance and transitioning, especially with disease progression. It is important that the interventions developed address these issues. The results of the present study suggest that weakness and worsening in physical functioning may be related to decreases in torque and FPR, particularly in activities involving transitioning between positions. However, further research is necessary as it is difficult to generalize these results due to small sample size and other confounding factors such as current medications. Improved understanding of the cause of gait, balance and transitioning problems in PD will help clinicians to plan more effective treatment strategies to improve function in individuals with PD.

TITLE: Effects of “Think Big” verbal cuing on the modulation of postural responses and cortical preparatory activity in people with in Parkinson’s disease.

AUTHORS/INSTITUTIONS: B.A. Smith, F.B. Horak, Neurology, Oregon Health and Science University, Portland, OR|J.V. Jacobs, Rehabilitation and Movement Science, University of Vermont, Burlington, VT|

ABSTRACT BODY:

Purpose/Hypothesis : People with Parkinson’s disease (PD) are unable to modify their postural responses based on previous experience and knowledge about the upcoming perturbation. Correspondingly, they demonstrate different patterns of cortical motor preparation than their healthy peers. We used the “Think Big” attentional and movement cuing strategy for PD to elicit changes in postural responses and tested for resulting modulation of cortical preparation.

Number of Subjects : Twelve participants with moderate PD participated.

Materials/Methods : Participants were instructed to maintain balance without taking a step in response to a fast, 12-cm backward translation of the support surface. They received a visual warning cue 2 s before each surface translation. There were 30 baseline trials without specific cuing, 30 trials with “Think Big” cuing and another 30 trials without specific cuing. Postural responses were measured using kinematic and kinetic data. We measured cortical preparation using electroencephalography (EEG). We analyzed event-related desynchronization (ERD) as a measure of cortical excitability and contingent negative variation (CNV) as a measure of anticipation and motor preparation.

Results : Participants modulated their postural responses when receiving “Think Big” cuing: they demonstrated more hip flexion ($p = 0.02$) and a slower rate of initial forward displacement of their center of pressure ($p = 0.01$). Preliminary analysis showed more ERD in the upper beta frequency band before “Think Big” trials ($p = 0.046$), indicating more cortical excitability. Participants did not modify CNV amplitudes in response to “Think Big” cuing ($p = 0.77$).

Conclusions : When receiving “Think Big” cuing, participants with PD were able to modulate their postural responses. They also showed an increase in cortical excitability, which may be related to increased response preparation. Modulation of postural responses was not related to modulation of CNV potentials, suggesting the “Think Big” cuing modified responses by alternative circuits of response anticipation and preparation.

Clinical Relevance : Our preliminary results indicate that modification of postural responses with “Think Big” verbal cuing occurs concomitantly with increased cortical excitability but is not associated with recovery of modifiability of CNV potentials. “Think Big” verbal cuing appears to alter postural responses through compensation, as opposed to recovery, of neural function in PD.

TITLE: Cannabinoid Pharmacology for Physical Therapists

AUTHORS/INSTITUTIONS: B. Stockert, Physical Therapy, California State University Sacramento, Sacramento, CA

ABSTRACT BODY:

Purpose : Cannabis has been used for medicinal purposes, religious ceremonies and recreationally for 5000 years. Cannabis is currently legal for medicinal purposes in 16 states. The purpose of this presentation is to explain some of the pharmacological properties of cannabis and the endocannabinoid system as well as discuss some of the current medicinal uses of cannabinoids in patients that may be receiving physical therapy.

Description : The endogenous cannabinoid system appeared early in evolution and is found in all vertebrates as well as some invertebrates. There are at least two naturally occurring ligands for the endocannabinoid system. Both ligands are derivatives of arachidonic acid and are similar to prostaglandins and leukotrienes which are also derived from arachidonic acid. There are two receptors in the endocannabinoid system: CB1 and CB2. CB1 receptors are found primarily in nerve cells in the central and autonomic nervous systems whereas CB2 receptors are found primarily in multiple lymphoid organs and cells. Human, mouse and rat cannabinoid receptors have amino acid sequences that are 97-99% identical. The highly conserved amino acid sequence and widespread distribution of the endocannabinoid system in the animal kingdom reflect the physiological importance of the system.

Summary of Use : The distribution of CB1 receptors appears to be related to their ability to induce analgesia and neuromodulation. The role of CB2 receptors as anti-inflammatory mediators appears to be related to their ability to inhibit the release of pro-inflammatory cytokines and inhibit immune cells migration. CB1 and CB2 receptor number is abnormal in several neurodegenerative disorders including multiple sclerosis, Huntington, Parkinson and Alzheimer Disease. Cannabis contains at least 66 different cannabinoids. Trans-delta-9-tetrahydrocannabinol [THC] is the only cannabinoid known to have a psychotropic effect. Cannabidiol is a second phytochemical found in cannabis. While this chemical lacks psychotropic activity, it does retain some analgesic, neuromodulation and anti-inflammatory properties. THC is currently used as an appetite stimulant and anti-emetic in patients undergoing chemotherapy and as an appetite stimulant in patients with AIDS. Development of synthetic agonists and antagonists has resulted in new intervention strategies for several neurodegenerative disorders. Sativex is a cannabis-based medicine licensed in Canada for the treatment of neuropathic pain, spasms and spasticity in patients with multiple sclerosis. A synthetic competitive CB1 receptor antagonist is being developed for use as an appetite suppressant for the treatment of obesity.

Importance to Members: Many potential interventions utilizing cannabinoids are on the horizon. Physical Therapists need to be aware of the effects of various cannabinoid compounds in order to design appropriate interventions for patients that may be taking these medicines.

TITLE: A Novel Intervention in a Patient with Advanced Multiple Sclerosis and Severe Disability

AUTHORS/INSTITUTIONS: K.G. Volkman, Division of Physical Therapy Education, University of Nebraska Medical Center, Omaha, NE|B.B. Corr, R. Harbourne, M. Kurz, Department of Physical Therapy, Munroe-Meyer Institute, Omaha, NE|

ABSTRACT BODY:

Background & Purpose : 10% of Multiple Sclerosis (MS) is diagnosed as the primary progressive type and 90% of MS patients will have progressive disease after 25 years. Patients with progressive MS have fewer treatment options available for them, and only palliative care is provided to individuals with advanced MS. Research using cranial nerve noninvasive neuromodulation (CN-NINM) via the tongue during exercise has been found to improve balance and walking abilities of subjects with MS, but has not been tried with individuals with advanced MS. The purpose of this case is to present outcomes of a non-ambulatory subject with severe MS who used CN-NINM combined with therapeutic exercise and functional training.

Case Description : A 51 year old male with progressive MS (EDSS = 8) participated in CN-NINM+physical therapy (PT) following a pre-post design. He presented with quadriparesis, required a power wheelchair (W/C) and moderate to maximal assist for transfers, and was dependent for bed mobility. CN-NINM was used to deliver stimulation to the tongue during PT interventions of therapeutic exercise, developmental sequence activities, W/C propulsion, balance activities, and body-weight supported standing/stepping training. An intervention phase (22 sessions in 24 weeks) of one hour/week of CN-NINM+PT intervention plus a daily home exercise program (HEP) of 1 to 1.5 hours was followed by an 8-week CN-NINM+HEP only phase. Assessments included the Multiple Sclerosis Impact Scale (MSIS-29); Gross Motor Function Measure (GMFM), modified Functional Reach Test (FRT), timed stand test and timed wheelchair pushup; Fatigue Impact Scale (FIS), and sitting sway kinematics on firm and soft surfaces with eyes open/closed.

Outcomes : At completion, improvements occurred in the FIS, MSIS-29 (57 point drop), GMFM lying and rolling score (increase of 12), GMFM sitting score (increase of 18), timed stance (increase of 42 sec), W/C transfers improved to standby assist, and W/C floor transfers were independent with arm support. At follow-up of the CN-NINM+HEP phase, the MSIS-29 and timed stand test further improved and timed W/C pushup improved over baseline (10 sec). Sitting kinematic measures showed increased movement variability in the frontal plane. There was no change in the FRT.

Discussion : Results reflect the patient/family's perception that quality of life and fatigue improved with a decreased burden of care. He achieved independence on 15/17 GMFM bed mobility items. Patient improved his ability to perform transfers without assistance, perform exercise on his floor at home, achieve tall kneeling with arm support, and stand long enough to do a stand-pivot toilet transfer. It is not clear from these results whether improvements are attributed to the CN-NINM or the PT, but improvement was meaningful to the patient and many outcomes were maintained 8 weeks after the CN-NINM+PT ended. Further study is needed to separate the effects of these interventions, study optimal dose, and investigate the effects of rehabilitation intervention in the advanced stage of MS.

TITLE: Relationships between ankle spasticity and strength, walking capacity and self-perceived walking limitations in ambulant persons with multiple sclerosis

AUTHORS/INSTITUTIONS: J.M. Wagner, Physical Therapy and Athletic Training, Saint Louis University, St. Louis, MO|T.R. Kremer, School of Medicine, Saint Louis University, St. Louis, MO|

ABSTRACT BODY:

Purpose/Hypothesis : To determine the relationships between ankle spasticity, ankle strength, walking capacity and self-perceived walking limitations in ambulant persons with multiple sclerosis (pwMS).

Number of Subjects : 42 pwMS (27 female, 15 male; age 42.9. 9 ± 10.1 years) with moderate clinical disability (EDSS 3.6 ± 1.6).

Materials/Methods : Bilateral ankle plantarflexor (PF) spasticity was assessed using the Modified Ashworth Scale (MAS) and an isokinetic dynamometer. For the instrumented spasticity measure (ISM), the dynamometer measured the resistive torque of the PFs during passive ankle dorsiflexion (DF) at four different speeds. Data were processed to yield a single spasticity value for each ankle. Bilateral ankle DF and PF maximal voluntary isometric torque (MVIT) was assessed using an isokinetic dynamometer. Walking capacity was assessed by the Timed 25-Foot Walk Test (T25FWT) and the Six Minute Walk Test (6MWT). Self-perceived limitations in walking were documented by the 12-item Multiple Sclerosis Walking Scale (MSWS-12).

Results : Twenty-nine (69%) participants had PF spasticity (MAS > 1). PF spasticity was not related to PF strength (MAS $r = -0.13$; ISM $p = 0.02$), but was weakly related to DF strength (MAS $r = -0.36$; ISM $r = 0.08$). PF spasticity was weakly correlated with walking capacity (MAS $|r| < 0.27$; ISM $|r| < 0.26$) and self-perceived walking limitations (MAS $|r| < 0.11$; ISM $|r| < 0.23$). Ankle strength had a larger correlation with walking capacity (DF MVIT $|r| < 0.45$; PF MVIT $|r| < 0.50$) and self-perceived walking limitations (DF MVIT $|r| < 0.35$; PF MVIT $|r| < 0.37$).

Conclusions : There is a limited relationship between ankle spasticity and ankle strength, and ankle spasticity and walking limitations in ambulant pwMS. Ankle weakness contributes to walking limitations in pwMS.

Clinical Relevance : The assessment of ankle strength should be an important component in the evaluation of ambulatory pwMS. Future research is needed to determine if ankle strengthening translates to improved walking in pwMS.

TITLE: The use of EMG biofeedback as a treatment for facial paralysis secondary to Bell's Palsy

AUTHORS/INSTITUTIONS: M. Allamby, D. Cherry, X. Gao, E. Paolantonio, L. Trosch, S.C. Lee, , University of Delaware, Newark, DE|

ABSTRACT BODY:

Background & Purpose : There are a variety of treatment techniques that focus on the restoration of function of facial muscles after paralysis from Bell's Palsy. A literature review was performed to assess the effectiveness and safety of treatments including acupuncture, electrical stimulation, and EMG biofeedback. The purpose of this case is to explore the safety and effectiveness of combined EMG biofeedback and therapeutic exercise focused on AROM and AAROM as a therapeutic intervention for a patient with Bell's Palsy.

Case Description : Setting: Physical Therapy Clinic

Patient: A 58 y/o female that presented to her physician with flu-like symptoms diagnosed with Bell's Palsy on 1/1/2012. She initially sought treatment at a different PT clinic and also received acupuncture treatment as part of her care. The patient reported negative results from previous treatments and was referred to our clinic 4 months after her initial diagnosis. The patient demonstrated R-sided hearing loss, R facial droop, difficulty with speech and inability to close her R eye. Her composite score on the Facial Grading System was 20/100 (0=complete facial paralysis). The patient was in the Initiation category of muscle activation. At rest, she had a sagging lower eyelid, sunken cheek, and a drooped corner of the mouth. Her voluntary movement included incomplete eye closing, and minimal initiation of facial movements.

Treatment: EMG biofeedback while performing a range of therapeutic exercises with an emphasis on creating controlled, symmetrical facial expressions, with the additional use of facial massage and mirror feedback therapy occurred once a week for one hour. Two EMG sensors were placed on the R-side of the face. Therapeutic exercises included AAROM with mirror forehead wrinkle, AAROM with mirror smiling, and AAROM with mirror eye closing. Additionally, a home exercise program was assigned consisting of exercises 3 times a day, everyday (approx. 20 hours of home exercise for every hour of skilled therapy time).

Outcomes : After four weeks of treatment and a return to acupuncture, our patient began to see improvements in excursion of facial muscles and functional gains. Facial muscles were considered activated when the EMG read >2 mV. The patient demonstrated an average of 3.5 mV with smiling, 2-3 mV with puffing air into cheeks, 3 mV with puckering, and 1.5 mV with eye closing. She will continue physical therapy, reducing her treatment sessions to once every two weeks. Her sessions will include continuation of AROM facial exercises utilizing EMG biofeedback and mirror, while progressively removing the feedback. There will also be a reassessment of her "B" and "P" sounds.

Discussion : A combination of EMG biofeedback and therapeutic exercises focused on AROM and AAROM were deemed the safest approaches to treatment with the smallest risk of adverse side-effects, i.e. synkinesis. The patient demonstrated improved muscular activation through the use of biofeedback, with greater muscle activation during biofeedback than when using visual feedback alone.

TITLE: Increased duration and intensity of gait and balance training in a young woman with chronic gait ataxia: a case study

AUTHORS/INSTITUTIONS: M. Burgess, J. Orozco, J. Blank, B. Bour, G. Miller, M.T. Thigpen, Physical Therapy, University of Florida, Gainesville, FL|

ABSTRACT BODY:

Background & Purpose : Gait ataxia is a debilitating problem in individuals with cerebellar damage. Many question whether these individuals can benefit from treatments aimed at recovery of function due to the fact that motor learning, or re-learning, requires cerebellar processing. Others suggest that though cerebellar function is impaired, perhaps individuals with cerebellar pathology simply require a longer duration or intensity of practice to promote balance or walking recovery. The purpose of this case study is to describe balance and gait outcomes following a two-phase high intensity physical therapy intervention in a young woman with severe cerebellar damage.

Case Description : A 23-year-old female with severe gait ataxia presented with the goal of walking independently. She was 3 years post brain surgery for a pilocystic astrocytoma in the rostral aspect of the 4th ventricle. Surgical approach required splitting the cerebellar vermis. She experienced a complicated post-surgical course with multiple hospitalizations followed by extensive inpatient and outpatient rehabilitation. Initial exam indicated severe standing balance impairments and a non-functional gait. She was seen for 26 visits over a 6 week span, 4 days/week. The first 3 weeks (Phase 1) were dedicated to 45 minute massed practice sessions of balance and gait training, respectively. The second 3 weeks (Phase 2) shifted to 1 hour locomotor training using body weight support 3 days/week and balance training 1time per week for 45 min (phase II).

Outcomes : Prior to training, she used a rolling walker for short distances at slow speeds, requiring moderate assistance and frequent manual corrections to prevent free-falling. Outcome measures were assessed before and after Phase 1 and immediately after Phase 2. A GaitMat II® was used to measure time-distance gait parameters. Clinically meaningful improvements were observed in stance time, step length, double limb support time, and self-selected walking speed at the end of Phase 1, and again at the end of Phase 2. Self-selected gait velocity improved from .04 to .08 m/sec, remaining at a non-functional velocity. Improvements were observed in fast walking speed, TUG scores, and 6MWT scores after Phase I but not after Phase II. Berg Balance Scale and Brunel Balance Assessment scores also showed meaningful positive changes over Phase 1, but then actually deteriorated during Phase II.

Discussion : Clinically meaningful improvements in balance and walking occurred after 3 weeks of high dosage, high intensity training despite the patient's chronic cerebellar damage. Gait skills continued to improve when the shift was made to locomotor training with BWS, while deterioration of balance skills was observed. The outcomes of this case suggest that larger doses of task-specific training may be a factor in promoting motor re-learning in individuals with chronic cerebellar damage.

TITLE: Trunk and Lower Extremity Muscle Activation in Children in Six Therapeutic Positions on Horseback

AUTHORS/INSTITUTIONS: J. Encheff, L. Fickert, A. Vondenhueval, J. Wheeler, B. Webb, B. Zellner, Physical Therapy, University of Findlay, Findlay, OH

ABSTRACT BODY:

Purpose/Hypothesis : Hippotherapy treatment for children with neurological diagnoses often involves positioning clients in various seated positions on a horse in attempt to facilitate particular postural muscle groups according to each client's needs. These positions often include sitting astride forward or backward or seated sideways, and may also involve various positioning of the arms. The purpose of this study was to examine activation of several postural and proximal lower extremity muscles of children while in various positions on horseback to determine any differences in activation based on position. It was hypothesized that the backward astride position would most target the postural muscles of the trunk due to the slope of the horse's back and the increased challenge to the rider from travelling backwards.

Number of Subjects : Fifteen healthy children with an average age of 8.8 +/- 3.17 years participated.

Materials/Methods : Surface EMG electrodes were applied to the lumbar erector spinae, latissimus dorsi, rectus abdominus, external oblique, lower trapezius, gluteus medius, gluteus maximus, and proximal hip adductor group on the dominant side of each subject. Activity was recorded while the subjects sat forward astride, backward astride and sideways on the horse while it was being led at a walk. In addition, for each of the three positions, subjects were also tested with arms resting lightly in the lap vs. arms abducted to 90 degrees. Muscle activity while riding was normalized to activity of the same muscles during ambulation to allow comparison across the group. Differences in percent muscle activation among riding trials were determined via Wilcoxon Signed Ranks Test. Level of significance was set at $p \leq .01$ due to multiple comparisons.

Results : Significant differences in activation levels were found among the six positions only for erector spinae ($p=0.002$) and rectus abdominus ($p=0.000$). Seated sideways with arms abducted to 90 degrees promoted a significantly higher level of activity in the erector spinae than any of the other positions. Significantly higher activity in the rectus abdominus was exhibited while seated sideways with arms resting in the lap. No differences in any of the other muscles were found among the other positions.

Conclusions : All six positions tested resulted in similar levels of activation of postural and proximal lower extremity muscles except for seated sideways with arms at 90 degrees of abduction and arms resting in the lap.

Clinical Relevance : Although the forward astride and backward astride positions are commonly used during hippotherapy to promote postural control, therapists may want to consider choosing the sideways position to best target either the erector spinae (arms abducted) or rectus abdominus (arms resting in lap) if this is a treatment goal.

TITLE: A systematic framework to guide clinical decision making in gaming choices for therapeutic use.

AUTHORS/INSTITUTIONS: D.D. Espy, A. Reinthal, Physical Therapy Program, Cleveland State University, Cleveland, OH|V. Dal Bello-Haas, Physiotherapy Program, McMaster University, Hamilton, Ontario, CANADA|

ABSTRACT BODY:

Purpose : Video games are used increasingly as therapy tools, adjuncts to therapy, and within community exercise contexts. The choices in technologies and the range of games are overwhelming. As with any exercise prescription, to realize maximum therapeutic benefit the characteristics of the system/game must be carefully matched to the impairments, activity limitations and functional goals of each client. This entails thorough assessment and consideration of the person's goals, abilities and limitations, the characteristics of the task and the specific environment in which it will be performed, and the interactions among these. To be most effective, the games should appropriately structure the relevant therapeutic task and environment characteristics, and should progressively address those impairments hypothesized to contribute to the functional difficulties. This is the same clinical reasoning process used routinely by therapists for exercise prescription. However, the virtual reality nature of many video games allows incorporation of many more personal, task and environment parameters than more traditional modes of exercise.

The purpose of this framework is to facilitate clinical decision making in task (game) selection and progression for video gaming that is used therapeutically to address movement, mobility, balance and motor re-learning goals.

Description : This systematic framework outlines individual client characteristics to be assessed, including those of the person, upper and lower extremity and/or whole body task, balance/postural control, and environment. It facilitates the organization and integration of the many important factors to be considered when choosing a video game based therapeutic exercise program and can be utilized to identify those game characteristics that would be of most benefit to the patient, and those that may pose a risk.

Summary of Use : Use of the framework has been piloted in a biomechanical research study involving gaming and high level balance tasks, in clinical research studies involving gaming and UE function and balance among patients who have chronic stroke, and as an exercise prescription tool in in the neuromuscular curriculum of an entry-level DPT program. Examples of its use in each setting will be discussed.

Importance to Members: Video game exercise can address a much larger realm of therapeutic parameters at once than traditional exercise modalities; thus, there are more factors for a clinician to consider in order to maximize the benefit of the activity and to minimize the risk of mismatching game choice and the client's abilities and goals. The technology and the games are being developed more rapidly than clinicians or researchers can possibly keep up with. A framework of variables of importance will allow generalization of the clinical decision making process across systems and games to ensure this exercise modality is being used optimally.

TITLE: Implementation of the Barry-Albright Dystonia Scale in a long-term care facility for the developmentally disabled

AUTHORS/INSTITUTIONS: V. First, S.M. Deprey, Dept of Health and Human Movement Sciences, Carroll University, Waukesha, WI|

ABSTRACT BODY:

Background & Purpose : Dystonia is a movement disorder characterized by involuntary sustained muscle contractions which cause abnormal postures or twisting and repetitive movements. The prevalence of dystonia is not known, however, it is estimated that dystonia affects 15-25% of people with Cerebral Palsy, in whom it is typically generalized and affects the entire body. Dystonia may frequently occur with other movement disorders such as spasticity. In patients who have movement disorders, the Modified Ashworth scale (MAS) and the Barry-Albright Dystonia (BAD) scale can be used to quantify spasticity and dystonia respectively. Research has found that dystonia and spasticity can be measured independently, though not correlated with one another, did correlate with their respective clinical measurement tools. The BAD scale is a 5-point, criterion based, ordinal scale designed to assess dystonia in eight body regions: eyes, mouth, neck, trunk, and the four extremities. Raters score dystonia as none (0), slight (1), mild (2), moderate (3), or severe (4). Individual scores for each region are added for a total score out of 32. There are a variety of treatments available for movement disorders, but responses can differ based on the patient's cause of hypertonia. Therefore, the purpose of this case report is to describe the development of a facility process and implementation of a dystonia scale, specifically the BAD scale, into standard practice for rehabilitation services in a state residential facility for individuals with developmental disabilities.

Case Description : The rehabilitation staff at a long-term residential facility routinely used the MAS to assess hypertonia, however, a quantitative measurement tool for dystonia was not common practice. After a literature review and staff consensus, a new evaluation form was developed utilizing the BAD scale. The rehabilitation staff was educated on the scale, new documentation form and scale implementation process. The new procedure was then applied to two individuals with dystonia to assess validity of the scale and practicality of the new procedure by comparing BAD scale scores and current changes in Baclofen pump dosages.

Outcomes : Survey of staff feedback after implementation was positive. The new evaluation form allowed longitudinal dystonia score tracking and comparison with two individual's current Baclofen dosages treatments. Data from the facility's new evaluation form suggested that both individuals responded better to bolus Baclofen dosing as shown with reduced BAD score scales.

Discussion : The BAD scale is an appropriate quantitative measurement tool to assess dystonia in patients who do not have voluntary control of their movements, have few functional abilities, and have significant cognitive impairments. Staff training should be incorporated when implementing this scale into standard practice at facilities that treat individuals with developmental disabilities.

TITLE: Comparison of lower extremity kinematic patterns in individuals with Parkinson's disease during stationary upright and semi-reclined cycling

AUTHORS/INSTITUTIONS: R. Gallagher, W.G. Werner, Physical Therapy, New York Institute of Technology, Old Westbury, NY|V. Gade, J. Deutsch, Physical Therapy, University of Medicine and Dentistry of New Jersey, Newark, NJ|

ABSTRACT BODY:

Purpose/Hypothesis : Cycling is used in rehabilitation of people with Parkinson disease (PD). The purpose of this study was to compare cycling kinematics in people with PD and healthy controls (HC) during stationary upright (U) and recumbent (R) cycling. We hypothesized that kinematics in people with PD would differ compared to HC and between U and R cycling.

Number of Subjects : Five adults with PD, (70.2 +/- 2.9 yrs, Hoehn and Yahr stages II to IV), and five HC, (66.2 +/- 8.8 yrs) participated. Individuals with a history of severe cardiovascular disease, stroke, neurological conditions other than PD, prior neurosurgery, or musculoskeletal disorders that would affect their biking kinematics were excluded. Participants were tested during their "on phase."

Materials/Methods : Lower extremity (LE) and trunk range of motion (ROM) measurements were obtained. Participants were instrumented with reflective markers (ASIS, greater trochanter, lateral femoral epicondyle, lateral malleolus, posterior calcaneus, distal phalange of the great toe, and C7, T4/T6, sternal notch and manubrium); and then cycled on both an (U) and (R) bicycle (order was counterbalanced) at their self-selected sub-maximal cadence, constant power of 40 watts, and self-selected seat height. Kinematics of the LE and trunk were obtained using the Vicon Peak Motus motion capture system sampled at 120 Hz. Relative joint angles were calculated for the trunk, hip, knee, and ankle joint in the sagittal plane. Between (PD and HC) group differences were calculated using the Mann Whitney U assuming a two-tailed test. Within group bike (U and R) cycling differences were analyzed using a paired t-test (assuming a two-tailed test).

Results : For people with PD, there was significantly less hip extension on both the (U) ($p=0.02$) and (R) ($p=0.03$) bicycle when compared with HC. There were no differences between the U and R bicycle in people with PD. For the HC, there were significantly greater excursions in the trunk ($p=0.03$), and hip flexion ($p=0.02$) and extension ($p=0.01$) on the upright bicycle. While there were no differences in trunk ROM between the two groups, ROM of the LE revealed significantly less hip extension range for people with PD ($p<0.01$)

Conclusions : This preliminary study found the choice of bicycle did not influence cycling patterns in people with PD. Cycling kinematics did differ in those with PD, particularly in hip extensor range and trunk motion, compared to HC on both styles of bicycle. This may be related to the decrease in hip extension range in the people with PD, or to rigidity associated with PD interfering with the ability to adjust their hip and trunk during the cycling pattern.

Clinical Relevance : Clinicians may need to adjust seat heights higher than the self-selected choice for people with PD to gain more hip extension during cycling. Further, observation of the trunk to identify hypomobility may require cueing to augment trunk movement or longer practice on the bike for the trunk to become involved in the cycling pattern.

TITLE: Side-to-side differences in lower extremity muscle strength and activation in Parkinson's disease

AUTHORS/INSTITUTIONS: E. Hoke, A.C. Thomas, B. Kluger, M. Schenkman, J. Stevens-Lapsley, , University of Colorado Anschutz Medical Campus, Aurora, CO|

ABSTRACT BODY:

Purpose/Hypothesis : Force production is impaired in people who have Parkinson's disease (PD). Symptoms of PD typically begin on and are more severe on one side. These asymmetries have not been characterized for individuals with a range of PD severity. Furthermore, it is unclear whether potential asymmetries in muscle strength are paralleled by comparable asymmetries in quadriceps activation deficits. The purpose of this study was to characterize side-to-side differences in quadriceps and hamstrings muscle strength and quadriceps activation in individuals with a range of PD disease severity.

Number of Subjects : 17

Materials/Methods : This was a cross-sectional assessment of individuals with PD who had Unified Parkinson's Disease Rating Scale motor scores (UPDRS motor) ranging from 9.5-61.0. Participants were divided into two subgroups: low-PD motor signs (UPDRS motor < 31.7) and high-PD motor signs (UPDRS motor \geq 31.7). Maximal quadriceps and hamstrings isometric strength were measured bilaterally. Quadriceps muscle activation was measured using a doublet interpolation technique. Paired t-tests were used to compare strength and activation between limbs for all individuals and subsequently for low- and high-PD motor signs subgroups.

Results : The stronger quadriceps produced 15.2% more torque than the weaker limb ($P < 0.001$) and the stronger hamstring produced 12.9% more torque than the weaker limb ($P = 0.001$) for all subjects as well as for the subgroups: In the low-PD motor signs subgroup, the strong quadriceps was 16.2% ($P = 0.001$) greater and the strong hamstrings was 9% ($P = 0.013$) greater than the weaker limb. In the high-PD motor signs subgroup, the strong quadriceps was 13.2% ($P = 0.006$) greater and the strong hamstrings was 17.9% ($P = 0.037$) greater than the weaker limb. There was an 18% difference in central activation between the stronger and weaker limbs ($P = 0.07$). Additionally, the stronger quadriceps torque was on the opposite side as the stronger hamstring torque in greater than 50% of subjects. Furthermore, there was no association between reported side of dominance, side of initial PD symptoms or severity of disease progression with the stronger and weaker limbs.

Conclusions : Asymmetry in muscle strength is present across a range of PD disease severity and was greater than the 10% difference expected in healthy individuals for a number of measures. This presentation is variable and emphasizes the importance of a detailed clinical examination, as the side of greater PD symptom severity does not always indicate the weaker limb. Activation deficits are also present in this population and parallel patterns of muscle weaknesses, suggesting that interventions targeting activation deficits should be explored.

Clinical Relevance : Characterization of this population and its impairments can lead to more targeted rehabilitation interventions. The variability of muscle performance capabilities in patients with a range of disease severity suggests that tailored clinical examinations are necessary to more fully assess individuals with PD.

TITLE: Partnering to enhance feasibility and success of a residency program

AUTHORS/INSTITUTIONS: G. Keenan, , Univ Delaware, Newark, DE|J. Ciampa, Physical Medicine and Rehabilitation, Johns Hopkins Hospital, Baltimore, MD|

ABSTRACT BODY:

Purpose : Describe the collaboration of Johns Hopkins Hospital (JHH) and the University of Delaware Physical Therapy Clinic (UDPT) in the development of a neurologic residency program.

Description : Collaboration among sites can enhance the success and feasibility of a residency program development. UD has credentialed residencies in orthopedics, sports, and geriatrics; and requires all PT staff to be board certified specialists. JHH hoped to promote professional development, staff retention, and strengthen evidence based practice through a residency program while UD hoped to gain clinical exposure to the JHH neurologic population.

JHH rehab approached UDPT to partner in a neurologic residency program. JHH and UD reviewed the Description of Specialty Practice (DSP) and identified both limited exposure and strength areas at their respective sites in areas of neurology, practice expectations, patient client management, and medical conditions. Programs met to discuss which institution could provide the best clinical and academic mentorship in each area. Residency faculty members, clinical mentors and directors at both sites were identified and positions were developed. Roles were assigned to each institution; JHH provides exposure to neurology PT and patient care in acute, pediatrics, inpatient, outpatient, and shadowing of physicians. UD provides scholarly activity, neurologic physical therapy research, assisting with the DPT curriculum, and mentorship as clinical instructor for students. A financial decision determined the resident is a JHH employee.

Summary of Use : 4 members of the residency faculty pursued and received specialty certification in neurologic PT. Advertisement was conducted at CSM and the APTA developing residency site. The first resident is completing the residency and taking the neurologic specialist exam in 2013. The program is undergoing credentialing review by the APTA. Inspired by the program; other JHH therapists aside from this program pursued specialty certification and initiated development of residency programs in their areas.

Importance to Members: The goal of the JHH/UD partnership to start a successful neurologic residency was achieved. The level of professionalism and clinical expertise in the area of neurologic PT at both institutions has benefitted. Collaboration led to the development of a neurologic residency program pending credentialing.

TITLE: Relationship of Mobility, Balance Confidence, and Depression with Falls among Survivors of Polio

AUTHORS/INSTITUTIONS: C.P. Kelley, School of Physical Therapy, Texas Woman's University, Houston, TX|E.

Housinger, , Texas Children's Hospital, Houston, TX|

ABSTRACT BODY:

Purpose/Hypothesis : The purpose was to explore the relationship between falls and mobility, balance confidence, and depression in survivors of polio, with and without post-polio syndrome (PPS). The null hypothesis was that no relationship exists between falls and mobility, balance confidence, and depression in survivors of polio.

Number of Subjects : 173 of 300 mailed surveys were returned. Of the returned surveys, 105 were fully completed and usable for data analyses.

Materials/Methods : A written survey was developed with input from the International Polio Directors group. The pilot version was distributed to members of the Texas Polio Survivors' Association with permission to distribute to other nonmember survivors. Outcome measures that were embedded within the survey were the Western Ontario and McMaster University Osteoarthritis Index – Physical Function (WOMAC-PF), Activities-Specific Balance Confidence (ABC) scale, and Geriatric Depression Scale short form (GDS-15). SPSS version 17.0 was used for descriptive analyses of demographic data, health problems, number of prescribed medications, number of falls within previous year, and injuries related to most recent fall. Binary linear regression was performed to determine if WOMAC-PF, ABC, and GDS-15 scores affected the probability of a survivor being within the faller or non-faller category.

Results : Sixty-four percent of the people with completed surveys reported at least one fall in the previous 12 months, with 30% of those reporting a fall sustaining an injury. Mean number of prescribed medications was 5.1. WOMAC-PF mean was 1.68. ABC mean was 52.1%. GDS-15 mean was 4.36, although 23% reported depression or treatment for depression in the health portion of the survey. Combined values of the WOMAC-PF, ABC and GDS-15 indicated a significant ($p=0.002$) impact of probability, or 65.7% correct prediction, of the person being within the faller category. Independent measure testing revealed the GDS-15 as the only significant predictor with an odds ratio = 1.232, 95% confidence interval ($p=0.013$).

Conclusions : Although survivors with completed surveys had a mean WOMAC-PF score indicating minimal to moderate difficulty completing everyday tasks and a mean ABC score suggesting low balance confidence, these two measures were not significant individual predictors of people who had fallen in the past year. Depression appears to be a significant predictor of fall incidence in survivors of polio. Future study is needed in this area to determine answer patterns of survivors of polio on the embedded measures, explore on-line survey method to force answer choices, and translate into Spanish for more ethnic variability in respondents.

Clinical Relevance : Physical therapists need to understand that a significant relationship between depression and falls appears to exist in survivors of polio, with and without PPS. The risk of injury is significant, and fall prevention, as well as screening for depression, is important when providing comprehensive care to this population.

TITLE: Coordinating and Assisting the Reuse of Assistive Technology

AUTHORS/INSTITUTIONS: P. Kitzman, Rehabilitation Sciences, University of Kentucky, Lexington, KY|C. Weber, , Kentucky Office of Vocational Rehabilitation, Frankfort, KY|D. Sharon, , Bluegrass Technology Center|ational Rehabilitation, Lexington, KY|

ABSTRACT BODY:

Purpose : Appalachian Eastern Kentucky is an extremely rural area of persistent economic stagnation and a high incidence of disability and chronic health problems including stroke (KY is considered part of the “Stroke Belt”) and traumatic brain injury (TBI). Project CARAT (Coordinating and Assisting the Reuse of Assistive Technology) was funded through the Health Resources and Services and Administration (HRSA) and is a collaborative project with the goal of improving the health and quality of life of individuals with disabilities, especially those with neurological conditions such as stroke and TBI, in the Appalachian region of Kentucky through the provision and redistribution of assistive technology (AT) and durable medical equipment (DME).

Description : To accomplish its goals, CARAT provides the following services: 1) development of a system of providers who identify and collect unused AT and DME; 2) reconditioning and refurbishing of the equipment to make it suitable for use; and 3) redistribution of the equipment to individuals who need it and are unable to acquire it otherwise. The principal partners include the Kentucky Office of Vocational Rehabilitation, the Kentucky Appalachian Rural Rehabilitation Network, Bluegrass Technology Center, the University of Kentucky (UK) Physical Therapy program, and the Kentucky Assistive Technology Services Network. Additional partners include Kentucky HomePlace, a lay health navigator program, and the Appalachian Regional Healthcare System. Other innovative features of CARAT include an on-line database to match available equipment to potential users and using on-line social networking and other Internet resources to solicit contributions of equipment and identify individuals in need. Students at three locations, including Physical Therapy students from the UK satellite program in Hazard, the Bridges to Success program in Hazard KY, and students at the Carl D. Perkins Vocational Training Center aid in the refurbishing, distribution and patient education as part of a service learning (SL) approach that combines academics with meaningful community service. Evaluation of project efficacy includes initial and follow-up questionnaires for consumers, initial and follow-up questionnaires for all students involved with the SL program, and initial and end of year questionnaires for each of the community partners. Inventory (number and type of AT and DME) are tracked through our on-line database.

Summary of Use : Since its launch, five additional community organizations have been added to the network. The first pieces of AT and DME have been acquired, refurbished and redistributed to those in need. The first cohort of DPT and Bridges to Success students have begun the SL portion of this project.

Importance to Members: This project provides a viable model for the reuse of DME and assistive technology to support the long-term needs of individuals with chronic neurological conditions living in rural communities. It also provides a sustainable service learning opportunity for rural students, particularly those in our satellite DPT program.

TITLE: Utilization of Cognitive Behavior Principles of Pain Management in a Patient with Allodynia after Heavy Metal Exposure

AUTHORS/INSTITUTIONS: C. Almgren, , Bellarmine University, Louisville, KY|E. Lonnemann, , Bellarmine University, Louisville, KY|

ABSTRACT BODY:

Background & Purpose : Physical therapists are regularly involved in the management of neuropathic and chronic pain conditions. Interventions may consist of; therapeutic exercise, therapeutic activities, desensitization techniques, pain relieving modalities, and cognitive behavioral therapy. Pain management approaches using cognitive behavioral therapy (CBT) principles have been reported in patients with chronic musculoskeletal pain primarily nociceptive in nature versus neuropathic. This case report describes the management of a patient with neuropathic pain utilizing CBT principles of a pain management approach including graded exercise, attention diversion techniques, and emphasis on desirable activities in a patient diagnosed with full body allodynia from heavy metal toxicity.

Case Description : A 38 year old male, occupied in powder metallurgy at a metal fabrication plant was diagnosed with heavy metal exposure and toxicity two years prior to PT referral. The patient's chief complaint was shocking, burning pain exacerbated by superficial tactile stimuli in all areas of the body worse in the thoracic region and LE's. He reported an inability to walk or negotiate stairs without pain. Posture and Gait observation revealed limitations. Sensory testing revealed hypersensitivity to light touch in the trunk and LE's and slightly decreased in both hands via Semmes Weinstein testing. A modified 3 minute step test revealed below average cardiovascular status. Diagnosis was decreased aerobic capacity from deconditioning, secondary to impaired motor function and sensory integrity associated with a non-progressive CNS disorder. A behavioral analysis was performed to evaluate the interaction between pattern of movement limitations and the environment. It was hypothesized that the patient's fear that pain would be reproduced by movement contributed to a kinesiophobic disorder which resulted in limited ADL's, decreased cardiovascular endurance, and a sedentary lifestyle. Desensitization techniques were implemented with limited success. This was followed by graded activity, attention diversion strategies and aerobic exercise.

Outcomes : By week eight the patient achieved long term goals including tolerance to LE impact activities with minimal to no exacerbations of pain. He was able to negotiate stairs pain-free and gait technique was improved to normal by observational assessment.

Discussion : Interventions were based on the patient's goals, prior level of function, preferred recreational activities, and overall avoidance to movement due to neuropathic pain. Treatments targeted increasing tolerance of LE impact activities and superficial light touch through graded activity, attention diversion and aerobic exercise. Another CBT strategy was reduced focus on pain during treatment to reduce focus. Limitations include the lack of a fear avoidance measure, although most have been described for patients with LBP. Also, physical measures were based on observation of improvement in activity and function versus cardiovascular assessment.

TITLE: Comparing Cortical Excitability in Focal Dystonia Using Transcranial Magnetic Stimulation

AUTHORS/INSTITUTIONS: M. Moore, Physical Medicine and Rehabilitation, University of Minnesota - Twin Cities, Minneapolis, MN|

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of this study is to investigate the differences in cortical silent periods (CSP) measured with transcranial magnetic stimulation (TMS) between subjects with focal hand dystonia (FHD), laryngeal dystonia (LD), and healthy controls to determine if these disorders share a common central nervous system (CNS) pathology. CSP is a measure of cortical excitability.

Number of Subjects : Data analysis was completed on 11 subjects with FHD (53.4±20.0y) from a prior study, 11 subjects with LD (56.8±7.2y), and 19 healthy controls (41.6±12.9y) from the current study.

Materials/Methods : All subjects received single pulse TMS to determine the resting motor threshold (RMT) of their first dorsal interosseus (FDI) muscle. Cortical excitability was measured by the length of the CSP following single pulse TMS delivered at 120% RMT during a submaximal isometric contraction of the FDI muscle.

Results : The one-way ANCOVA showed a significant main effect of group. Post hoc analysis revealed significant difference in CSP duration between the healthy group and LD and FHD ($p < .001$). Healthy subjects showed the longest CSP, 131.69 ms (95% CI: 126.7, 136.7), followed by FHD, 105.95 ms (95% CI: 99.4, 112.5), and LD had the shortest CSP duration, 103.92 ms (95% CI: 97.1, 110.7). No significant difference was found between LD and FHD.

Conclusions : Decreases in CSPs were found for FHD and LD subjects compared to healthy controls. This commonality of decreased cortical inhibition in a seemingly non-affected muscle gives evidence to indicate that focal dystonias may be one CNS disorder presenting in different regions of the body.

Clinical Relevance : Cortical excitability changes may be used for a more accurate diagnosis of FHD and LD. Furthermore, research results and treatments may be generalizable between the two dystonia presentations.

TITLE: Clinical Presentation of Sjögren's Syndrome – A Case Study.

AUTHORS/INSTITUTIONS: R. Zimmerman, , Texas Woman's University, Dallas, TX|C. Swank, , Baylor Institute for Rehabilitation, Dallas, TX|

ABSTRACT BODY:

Background & Purpose : Sjögren's syndrome (SS) is one of three most common systemic autoimmune diseases with primary manifestations including xerophthalmia (dry eyes), xerostomia (dry mouth), and fatigue as well as neurological complications from Sjögren's associated neuropathy. Characterized by lymphocytic infiltration of the exocrine glands and involvement of exocrine and non-exocrine symptoms including peripheral and central nervous system involvement, SS is associated with increased disability, decreased quality of life, and decreased aerobic capacity. However, no studies describe physical therapy intervention and outcomes related to SS. The purpose of this case study is to describe the physical therapy intervention and outcomes for a patient with SS.

Case Description : Following progressive weakness beginning in late 2010, MH was admitted to hospitalized in April 2011 with a diagnosis of autoimmune myeloradiculopathy vs. transverse myelitis. Upon hospital discharge, he was admitted to post-acute rehabilitation for 3 weeks followed by 4 weeks of home health. In November 2011, MH presented to outpatient physical therapy as a 30 y.o. male with primary impairments of muscle weakness and hyperreflexia, abnormal muscle tone, and abnormal sensation including decreased proprioception. These contributed to functional limitations of imbalance, gait abnormalities, and decreased mobility. He reported a history of 12 falls since onset of progressive muscle weakness. Furthermore, MH was no longer able to participate in vocational responsibilities as a forklift driver. Upon examination, he used a wheelchair as primary means of mobility and was able to ambulate only 35 feet with a rolling walker (RW). Initial recommendations were for PT 3x/week for 3 months to advance mobility and address his primary goal of returning to work. Physical therapy interventions focused on gait training, static and dynamic balance, strength training, stair training, patient education, and community reintegration.

Outcomes : At baseline, MH performed the 5-times sit-to-stand test (5TSST) in 29.6 sec and 10-meter walk test (10MWT) in 77.56 sec with a RW. At one month he performed the 5TSST in 16.09 sec, 10MWT in 26.97 sec with a RW, and 127' on the 2-minute walk test (2MWT) with a RW. At 2 months, MH was using a RW for community mobility and bilateral single tip canes (STC) for household mobility. He performed the 5TSST in 9.94 sec, 10MWT in 15.06 sec with bilateral STC, and ambulated 231' on the 2MWT with a RW. At 5 months, MH was ambulating with modified independence in the community with one STC. He performed the 5TSST in 7.79 sec, the 10MWT in 10.03 sec without an assistive device (AD), and 358' on the 2MWT without an AD. MH was discharged from physical therapy to vocational training for return to work.

Discussion : This case study provides evidence of physical therapy intervention and outcomes in a person with SS. This case study implies that people with SS may benefit from intensive physical therapy to improve functional limitations and community participation.

TITLE: The effect of Aerobic Exercise on Executive Function in People with Parkinson's Disease: A Case Series

AUTHORS/INSTITUTIONS: R. Tabak, G. Aquije, B. Fisher, Division of Biokinesiology and Physical Therapy, University of Southern California, Los Angeles, CA|

ABSTRACT BODY:

Background & Purpose : People with Parkinson's disease (PD) demonstrate impaired cognition within the domains of executive function. Impaired cognition affects motor performance and gait and is directly related to fall risk in people with PD. Evidence suggests that aerobic exercise improves cognition in healthy older adults. Importantly, aerobic exercise may improve executive function in individuals with neurological disorders, such as stroke and Alzheimer's Dementia. To date, only studies with both aerobic and resistance exercise components have investigated exercise-induced effects on executive function in people with PD. The purpose of this case study series is to determine the effects of aerobic exercise alone on cognition and motor performance in people with cognitive deficits related to PD.

Case Description : In this ongoing trial, 3 subjects with PD and mild to moderate cognitive deficits based on the Montreal Cognitive Assessment (MOCA) will be recruited. S1: LA is a 61-year-old female with PD x 13 years and moderate cognitive deficits (MOCA=17). S2: SW is a 77-year-old male with PD x 5 years and mild cognitive deficits (MOCA= 22). Both subjects are stable on PD medication.

Intervention

Subjects will complete 24 sessions over 8 weeks of 40 minutes cycling on an upright stationary bicycle. Heart rate (HR) will be progressed incrementally from 50% of maximum at week 1 to 75% by week 8. Primary outcomes of cognition include the MOCA, Color Trails Test, Parkinson's Disease Cognitive Rating Scale, attention to task duration, and dual task cost. Secondary motor and participation measures include the Functional Gait Assessment, 10 Meter Walk Test, PDQ-39, Geriatric Depression Scale, and the UPDRS sections I and II. All measures will be performed pre- and post-exercise, and 1-month post exercise.

Outcomes : Preliminary motor (gait speed for S1 and S2) and cognitive data (attention to task duration and dual task cost for S1) are presented. LA has completed 12 sessions. Gait speed has increased by .11 m/s with the potential to achieve a clinically meaningful change of .18 m/s by session 24. Attention to the task of cycling has improved from 90 seconds at session 2 to 5 minutes at session 12. While average cycling cadence increased from 25 to 50 revolutions per minute (RPM) by session 6, her cadence decreased from 50 to 36 RPM when conversing, a dual task cost of 28% (difference of single and dual task performance)/single task performance x100). By session 12, the dual task cost has decreased to 14%. SW has completed 3 sessions with gait speed improving by .04 m/s.

Discussion : Our preliminary findings suggest that aerobic exercise may help to improve executive function and motor performance in people with PD and thus may be a potentially important component of treatment for people with PD-related cognitive deficits. Controlled studies with larger samples are necessary to determine the relationship between aerobic exercise-induced changes in executive function and changes in motor performance in people with PD.

TITLE: Movement Strategies and Motor Control in the Sit-to-Stand Task in persons with PD

AUTHORS/INSTITUTIONS: J. Tomlinson, S. Evans, M. Smith, L. VanArsdale, M. Eastlack, R. Craik, PT, Arcadia University, Glenside, PA|

ABSTRACT BODY:

Purpose/Hypothesis : Persons with Parkinson Disease (PD) experience difficulty with the sit-to-stand (STS) transfer which is required for independent mobility. Examining STS movement patterns can identify the relationship between impairments and activities (ICF model). Motor control for successful chair rise requires force generation with appropriate magnitude and timing. We compared vertical ground reaction (VGR) and anterior-posterior (A-P) shear forces with STS strategies in community dwelling older adults with and without PD. Our hypothesis was that timing and magnitude of forces would differ between the groups.

Number of Subjects : 11 persons with PD and 11 age, sex and BMI-matched controls.

Materials/Methods : The Lower Extremity Function Scale (LEFS) determined self-reported activity. The motor portion of the Unified Parkinson's Disease Rating Scale (UPDRS) determined disability level. Functional tasks (unilateral heel raises, gait speed, 5-times chair rise test) measured muscle strength. Subjects were videotaped in the sagittal plane in response to usual, fast and slow commands rising from an adjustable height stool that standardized biomechanical constraints. Forces were collected using a single force plate (Bertec 6090S).

Results : Subjects were 68 ± 8 years old with a BMI of 28 ± 5 . Persons with and without PD reported, on average, 2 comorbidities and 5 medications/supplements compared to 1 and 3, respectively. Scores ranged from 16-43/136 on the UPDRS. LEFS scores were $52 \pm 7/80$ and 73 ± 6 , respectively for persons with and without PD. The STS strategies selected were the most similar between groups when subjects were asked to rise "as fast as possible." Both groups selected momentum transfer (MT) or Dominant Vertical Rise (DVR) strategies, not Excessive Trunk Flexion (ETF) at this speed. Higher UPDRS scores were associated with worse performance on all strength measures and using the same STS strategy regardless of speed command. Preparation for weight transfer onto the feet, i.e., coordination between onset of VGR and A-P shear force, differed among strategies; onset of VGR preceded A-P shear force for DVR, followed for ETF, and occurred nearly coincidentally for MT. The rate of weight transfer onto the feet (N/s) was also different among the strategies regardless of group; the fastest to the slowest rate was DVR, MT, and ETF.

Conclusions : In response to different speed commands older adults with and without PD changed STS strategy and timing between VGR and A-P shear force production and rate of weight transfer during chair rise. The strategy chosen in response to a speed command differed between the two groups but was most similar at the fast speed. Persons with more disability chose different strategies than persons with less disability. The variables selected to examine the STS movement provide insight into the controlled sequence of events that produce an upright position from a seated posture.

Clinical Relevance : The STS movement may be useful to identify specific motor control deficits in timing and magnitude of forces and can lead to more effective intervention focus.

TITLE: Changes in Functional Mobility Outcomes of Individuals Receiving a New Seating/Mobility Device

AUTHORS/INSTITUTIONS: R.M. Brown, V. Fly, M. Law, S. Lindsley, L.L. Little, S. Tomlinson, Physical Therapy, Belmont University, Nashville, TN|P.J. Powers, Pi Beta Phi Rehabilitation Institute, Vanderbilt University Medical Center, Nashville, TN|

ABSTRACT BODY:

Purpose/Hypothesis : Background: With the increased prevalence of individuals using wheelchairs, there is a growing need to validate the fit and functionality of users with their prescribed devices. Improper fit of a seating system can lead to pressure ulcers, compromised posture and pulmonary function, and overall decreased function. Appropriately prescribed seating systems can enhance an individual's functioning as well as quality of life. There is a need to assess an individual's functioning with their seating system to validate the prescription and to evaluate new seating and mobility technology. Purpose: The purpose of this study was to examine the functional outcomes of patients receiving a new wheelchair or seating system

Number of Subjects : Any adult without a progressive disorder who received a new seating or mobility device was eligible to participate. Fifty-three subjects consented to participate. Forty-three subjects completed the pre-fit Functional Mobility Assessment (FMA), and 19 of those have completed both the pre-fit and post-fit FMA.

Materials/Methods : Each subject was contacted by phone within 7 days of their initial evaluation, and the FMA was administered. The subjects were contacted again 10 to 20 days after receiving their new seating or mobility system, and the FMA was administered again. The subject's responses were documented, and additional comments they provided were noted for further qualitative analysis.

Results : The average FMA response for each question was higher for the post-fit as compared to the pre-fit, indicating that overall subjects reported a higher level of functioning with their new seating system. For those that completed both the pre-fit and post-fit FMA, 84% (16/19) reported a positive change in their average FMA score indicating improved functioning. Two subjects reported no change in functioning, and one subject reported a slight decline in functioning on the post-fit FMA. The greatest number of subjects reported a positive change in Question 2 which relates to meeting their comfort needs, indicating that their new seating improved their comfort level. Question 10 regarding access to personal or public transportation had the greatest number of subjects reporting no change or a decline. This may be due to the fact that some individuals were transitioning from an assistive device for ambulation to a wheelchair or from a manual chair to a power chair. These transitions may make it more difficult for an individual to access transportation. In addition, there is limited accessible public transportation for those with disabilities in the surrounding communities

Conclusions : Subjects reported a higher level of functioning with their new seating system. Improvement in their comfort level was reported most often. Access to public and private transportation for wheelchair users is an issue in this community.

Clinical Relevance : It is importance to assure quality of care in wheelchair prescription and fit by measuring patient's functional outcomes.

TITLE: Clinical Education in Seating and Mobility: Designing and Implementing a Specialty Affiliation

AUTHORS/INSTITUTIONS: P.J. Powers, Pi Beta Phi Rehabilitation Institute, Vanderbilt Medical Center, Nashville, TN|R.M. Brown, J.E. Hackett, School of Physical Therapy, Belmont University, Nashville, TN|

ABSTRACT BODY:

Background & Purpose : As the number of individuals with disabilities requiring assistance with mobility increases, there is a greater need for Physical Therapists (PT) to be trained in Seating and Mobility

Case Description : Many specialty practice settings are reluctant to offer entry-level clinical affiliations as the students may lack adequate preparation for that specialty and the students need to focus on their generalist entry-level skills. However, specialty practice settings can provide training in skills that can be applied to a variety of populations. The Clinician's Task Force, which works to address CMS coverage policies for wheeled mobility, and industry leaders are collaborating with the APTA –Neurology Section to develop entry-level expectations for seating and mobility. In addition, suppliers of seating and mobility devices have expressed frustration with the inability to access adequately trained professionals (PT and Occupational therapists (OT)) who have knowledge and skill in seating and mobility. This lack of access to trained individuals puts patients at risk as they may be limited to media or web based information which may not provide optimal care due to lack of skilled evaluation of their impairments. To address this identified need, an 8-week clinical experience was designed and is currently being implemented in the Seating and Mobility Clinic. The student participated in inter-professional Muscular Dystrophy and ALS clinics, providing consultation in seating and mobility as well as general PT needs. The student had the opportunity to work directly with suppliers in the clinic, workshop, and home environments. In addition to the Clinical Performance Instrument, the student was asked to reflect on the diagnoses seen, how diagnoses and individual characteristics influenced decisions and how the skills developed in this setting could be applied to other settings. This reflection will help to apply the skills of a specialty setting to general practice. The student was asked to provide specific feedback regarding each learning opportunity to determine the value of each experience as well as the overall affiliation for program revision. Education and training of future professionals in the area of Seating and Mobility are essential to improving access for patients and facilitating the best patient outcomes.

Outcomes : A pre-test was administered to determine the student's level of preparation in Seating and Mobility evaluation and intervention. The same test will be used as a post-test to determine mastery. In addition to PT assessments , learning experiences encompassed seating specific tools such as the Functional Mobility Assessment, pressure mapping, and assessment of the fit of seating devices.

Discussion : With the structure and specifically designed experiences, specialty settings for clinical affiliations can provide entry-level students with experiences that are unique and address an identified need but yet still support the development and refinement of their entry-level skills.

TITLE: Development of a Clinical Reasoning and Reflection Framework for Mentorship within a Neurologic Physical Therapy Residency Program

AUTHORS/INSTITUTIONS: A.L. de Joya, H. Fishman, Physical Therapy, TIRR Memorial Hermann, Houston, TX|

ABSTRACT BODY:

Purpose : With the increasing development of neurologic physical therapy (PT) residency programs, there comes an increased demand for mentoring at the advanced level. There is limited formal training and few resources in the literature to provide structure for effective mentoring to guide mentors in a neurologic PT residency program. The purpose of this project is to develop a structured mentoring process within a neurologic PT residency program to guide clinical reasoning and reflective thinking across the continuum of care.

Description : A literature search on mentoring processes for neurologic PT residency programs was conducted. Information from the literature facilitated the development of guiding questions for clinician interviews. Thirteen clinicians who practice in neurologic rehabilitation along the continuum of care were interviewed about their clinical decision making process, mentoring strategies, and skills unique to their clinical setting. Themes unique for acute care, inpatient and outpatient settings were identified. This facilitated the development of a tool aimed to help guide clinical reasoning and reflective thinking. It provides reflective key points and questions for the resident and mentor and helps standardize the quality and depth of clinical education across the continuum of care in the neurologic PT residency program.

Summary of Use : The development of the clinical reasoning and reflection framework established standardization in the mentoring program within a neurologic PT residency program. It provided a detailed analysis of patient management across the continuum of care as supported by the literature and by clinicians. The framework provided a structured format that enhanced and guided clinical reasoning and reflection during clinical mentorship sessions within a neurologic PT residency program. It standardized the assessment of a resident's professional competence as an advanced clinician and facilitated the standardization of mentoring skills by the clinical mentors. Further refinement of this tool and more purposeful integration into the mentoring process is recommended.

Importance to Members: APTA's Vision 2020 identifies clinical residency programs as one of the key elements in preparing advanced clinical practitioners. The growth and development of residency programs will depend on enhancing the mentoring skills of clinical mentors for the next generation of expert clinicians. This clinical reasoning and reflection framework for neurologic PT practice in a residency program serves as a tool for residents to enhance their professional competence. It provides clinicians with the skills to mentor residents towards clinical expertise. This framework will facilitate the growth of neurologic clinical residency programs through the advancement of clinical teaching and best practice during clinical mentorship. It also promotes integration and modeling of behaviors congruent with APTA's Vision 2020.

TITLE: Supporting Evidence-Based Behavior Change in Neurologic Physical Therapists: A Case Report

AUTHORS/INSTITUTIONS: S. Perry, Physical Therapy Program, Chatham University, Pittsburgh, PA|H. Zeleznik, T. Breisinger, , UPMC Centers for Rehab Services, Pittsburgh, PA|

ABSTRACT BODY:

Background & Purpose : The recent emphasis on evidence-based practice (EBP) in physical therapy has focused on finding and analyzing research evidence. Little has been written on the behavior change required to actually use such evidence in practice. Many therapists attend in-services and continuing education courses, and while these methods can increase knowledge, they may not be effective in overcoming barriers to real behavior change. The purpose of this case report is to describe a year-long effort to promote EBP and behavior change in inpatient rehabilitation.

Case Description : This department Quality Improvement project encouraged therapists to use an evidence-based method of gait training for patients with hemiparesis. Non-supported gait training (NSGT) allows patients to safely commit balance errors while re-learning to walk without physical assistance or devices, and stresses intensity of practice. Criteria for the use of NSGT were developed, consisting of 5 indicators such as a stable knee during weightbearing. A training session was held with 10 therapists from the stroke and brain injury units to review the evidence for NSGT, the 5 clinical indicators, the NSGT technique, and documentation of indicators and NSGT trials. Lists of the criteria and NSGT technique summaries were posted in each gym. In the ensuing weeks, the authors (HZ and TB) answered staff questions and consulted on specific patients. At the end of the first, second and fourth quarter, a retrospective chart review on all eligible patients demonstrated whether each met the 5 criteria, and whether the therapist trialed NSGT. At subsequent staff meetings, data on the frequency of appropriate NSGT use was reviewed, with facilitated discussion on perceived successes and challenges to using the approach. The authors worked with staff during these discussions to overcome barriers. Therapists (n=9) completed an anonymous survey in the second-quarter meeting to further discern perceived changes in knowledge and behavior, and obstacles to implementation.

Outcomes : In the first quarter, 19 of 41 patients met the 5 clinical indicators, and 42% of these were trained with NSGT. Of 38 second-quarter patients, 20 met the indicators, and 60% of these were trained with NSGT. In the fourth quarter, 11 of 32 patients met the indicators, and 73% were trained with NSGT. Survey data revealed 19% of therapists were very or moderately familiar with NSGT in the 6 months prior to the project, vs. 78% at the survey administration. Furthermore, 33% stated they used NSGT almost always or often prior to the training, vs. 66% at the current time.

Discussion : Consistent support by way of training, staff meetings, feedback and discussion, and role modeling appeared to positively influence the frequency of appropriate use of NSGT, and was feasible within busy inpatient stroke and brain injury units. Clinical teams may benefit from de-emphasizing learning based on traditional one-time lectures, and adopting methods that support true behavior change in clinical practice.

TITLE: Novel model of care for the person with Multiple Sclerosis: Physical Therapist in the Neurology office.

AUTHORS/INSTITUTIONS: A. Danni, S.M. Tremblay, Rehabilitation Services, Lehigh Valley Health Network, Allentown, PA|

ABSTRACT BODY:

Purpose : To describe a unique model of care for the person with Multiple Sclerosis; the Physical Therapist as an integral team member in the Neurologists' office.

Description : In an MS Center of Excellence, we have introduced a Physical Therapist as a member of the Neurology office team. As a member of the office team, the Physical Therapist functions as a portal to Rehabilitation Services. The PT provides functional screens and fall risk assessments to identify further need for rehabilitation services, and to chronicle changes in disability. They also provide valued input into necessary assistive devices and adaptive equipment, power mobility and seating needs, bracing, and management of orthopedic impairments. Perhaps most importantly, the PT educates patients, caregivers, physicians, and physician extenders about the importance of early intervention and appropriate use of Rehab Services throughout the course of the disease.

Summary of Use : Integrating a Physical Therapist as a consultant within the offices of the Neurologist is a novel and welcome practice. This model has lead to high satisfaction for patients, caregivers, providers, and the Rehabilitation staff. The PT is able to identify functional changes early and make recommendations appropriately. The Neurologists and their mid-level providers have come to an improved understanding of the role of the Physical Therapist in preventing disability and promoting wellness and general fitness. The PT can facilitate communication among medical providers and the treating therapists.

Importance to Members: The interdisciplinary team caring for the MS patient population works most effectively in an integrated model of care. This describes the role the Physical Therapist takes as an integral part of the medical team. The Physical Therapist in this model is a partner with the Neurologist under a network whose goal is to provide comprehensive care to the person with Multiple Sclerosis.

TITLE: Investigation of a non-surgical option to correct neuromuscular scoliosis in adult quadriplegic: a case review

AUTHORS/INSTITUTIONS: C. Baniewicz, J. Dickson, C. Levine, L. McLennan, J. Hastings, Physical Therapy, University of Puget Sound, Tacoma, WA|

ABSTRACT BODY:

Background & Purpose : : Current literature regarding non-surgical scoliosis treatments is limited to bracing addressing only adolescent idiopathic scoliosis. The lack of research concerning treatments for adults with neuromuscular scoliosis is alarming. The purpose of this case study is to investigate the usage of prolonged stretching, paraspinal botulinum toxin injection, and progressive seating changes in an adult with C6 quadriplegia as a viable, non-surgical intervention for correcting neuromuscular scoliosis. This comprehensive case review will establish a clinical decision algorithm, which will set an objective treatment protocol for patients with a similar presentation of symptoms. The results will help generate a conservative physical therapy intervention for neuromuscular scoliosis correction and provide a basis for further research into non-surgical interventions for scoliosis correction.

Case Description : This retrospective case study focuses on the correction of neuromuscular scoliosis in an adult with C6 quadriplegia. Researchers will utilize measurements from radiographic images and photographs, documented PROM, and postural quantitative measures to assess progression and curvature correction throughout treatment. Qualitative comments will be extracted from the subject's journal, medical records and interviews with the subject and the medical team.

Outcomes : Full correction of neuromuscular scoliosis and return to normal Cobb angle was achieved for the subject after six months of physical therapy with botulinum toxin injections.

Discussion : Neuromuscular scoliosis can be treated via conservative measures including prolonged stretching, seating adjustments, and paraspinal botulinum toxin injection. Further research is necessary to determine the efficacy of these interventions for patients with spinal cord injuries and neuromuscular scoliosis. Future studies should include larger sample sizes to confirm the positive outcome of this single subject study.

TITLE: Use of a Clinical Practice Guideline and Robotics for Locomotor Training of A Patient With Chronic Incomplete Spinal Cord Injury: A Case Report

AUTHORS/INSTITUTIONS: A. Crawford, M. Banta, A. Chan, Z. Crump, A.M. Devers, M.S. Olejer, J. Vaught, M. Wilks, , Sheltering Arms Hospital, Mechanicsville, VA|

ABSTRACT BODY:

Background & Purpose : Research has suggested that locomotor training can increase walking speed, distance, and level of independence with ambulation for patients with incomplete spinal cord injury. The purpose of this case report is to demonstrate the effectiveness of utilizing a clinical practice guideline (CPG) to direct clinical decision making when using advanced technology for gait training a patient with incomplete spinal cord injury.

Case Description : The patient was a 48 year-old male with an American Spinal Cord Association impairment D tetraplegia following a motorcycle accident. The patient's injury level was C6-C7. The patient was seen for outpatient therapy 19 months after his initial accident for three separate courses of therapy over two years. During his two previous courses of therapy, which were completed at the same clinic, the patient demonstrated minimal functional gains. After implementation of a CPG for walking recovery at this clinic, the patient returned for a third course of therapy. For his most recent episode of care, the patient was classified in the CPG based on his impairments. This categorization guided his treatment interventions and progression through locomotor training sessions using advanced technology, including robotics.

Outcomes : The patient demonstrated improvements in strength, balance, transfers, and independence with gait. The patient had been unable to safely complete outcome measures during his first two courses of therapy. During his most recent course of therapy, he was able to complete the Five Time Sit to Stand, Timed Up and Go test, and 6 Minute Walk Test (6 MWT). The Five Time Sit to Stand score improved from 43 seconds to 25.6 seconds. The patient's 6 MWT improved from 357 feet with rolling walker (RW) and contact guard assistance to 450 feet with a RW at a modified independent level. The patient's strength improved significantly by discharge, and he was ambulating with bilateral long leg braces at modified independent level upon discharge from outpatient therapy.

Discussion : This case report demonstrates the importance of a clinical practice guideline to direct clinical decision making when using body weight support and robotics for locomotor retraining. It also exhibits the importance of reassessing outcomes throughout a patient's course of therapy including when a patient progresses to a less restrictive assistive device. Future research should focus on follow-up assessment of patients to ensure carry over of functional gains made for re-entry into community. Additionally, results of this case demonstrate the need for further refinement of the clinical practice guideline for treatment selection and progression.

TITLE: Cardiovascular Outcomes During Functional Electrical Stimulation Ergometry After Complete Cervical and Upper Thoracic Spinal Cord Injury.

AUTHORS/INSTITUTIONS: B.E. Day, D.J. Simpson, , CarePartners Health Services, Asheville, NC|

ABSTRACT BODY:

Purpose/Hypothesis : Cardiovascular (CV) disease has been reported to be up to 5 times more prevalent in persons with spinal cord injury (SCI) compared to the general population. Research based best practice recommendations have identified Functional Electrical Stimulation (FES) lower extremity (LE) ergometry as a potential method of CV training after SCI. With these recommendations a CV treatment program for patients with SCI was implemented in an inpatient rehabilitation hospital. CV outcomes were tracked to evaluate the program effectiveness. Research translation to practice was measured by evaluating CV outcomes.

Number of Subjects : 6

Materials/Methods : A RECK MOTomed & HASOmed FES ergometer was used in an inpatient rehabilitation hospital. Patients were scheduled 20 minutes FES per day, 5 days per week. Single channels were set to produce strong tetany of the quadriceps, hamstrings and gastroc/soleous muscles. Patients with cervical and upper thoracic complete SCI were given priority. Heart rate (HR), blood pressure (BP) and oxygen saturation (O-sat) were measured pre-treatment and during the last 2 minutes of FES. A custom de-identified data tracking program within the electronic medical record was used to evaluate program effectiveness. Twenty eight patients with SCI participated over 2 years. Evaluation focused on patients with the least other options for CV intervention. Six patients were identified with ASIA A or B SCI at level T3 or above and whose records were complete.

Results : In all three groups, Cervical ASIA A n=3, Cervical ASIA B n=1 and Upper Thoracic ASIA A n=2, change in HR was not statistically significant at 5.3 BPM and HR-max was below age predicted 40% HR-max which was considered to be the target training rate. Overall average change in blood pressure was systolic 6.7%, diastolic 11.9%. Overall average change in O-sat was 1.5%. There was no significant difference between groups. Overall average FES provided: 1.1 minutes/day per whole length of stay.

Conclusions : The program may have had little CV therapeutic benefit in these participants. According to other evidence there may have been improvements in oxidative metabolism, exercise tolerance and diabetic homeostasis. However these are not commonly measured directly in rehabilitation. HR, BP and O-sat may be limited diagnostic means of measuring aerobic exercise in this population due to abnormal autonomic regulation of HR. Further investigations should consider autonomic function and outcomes that can be measured in a traditional clinic. The average FES per day was very low. The following barriers to this program were identified: patients must be dressed appropriately, poor upright tolerance and timeliness to begin FES. It was scheduled in late afternoon when fatigue is greatest and other management priorities such as family training or bowel management took precedent.

Clinical Relevance : Physical therapists are primarily responsible for CV intervention after SCI. Criterion based best practice recommendations that consider autonomic function are not yet developed.

TITLE: MONITORING NEUROLOGICAL AND FUNCTIONAL RECOVERY DURING ROBOT-ASSISTED GAIT TRAINING IN SPINAL CORD INJURY

AUTHORS/INSTITUTIONS: S. Galen, Physical Therapy Program, Wayne State University, Detroit, MI|C. Clarke, B. Conway, Bioengineering Unit, University of Strathclyde, Glasgow, UNITED KINGDOM|D. Allan, , Queen Elizabeth National Spinal Injuries Unit, Glasgow, UNITED KINGDOM|

ABSTRACT BODY:

Purpose/Hypothesis : The neurophysiological adaptations that underpin functional improvements observed following robot-assisted gait training have not been monitored and consequently not completely understood. This study for the first time has used both functional and neurophysiological measures to monitor neural adaptations in incomplete spinal cord injured (ISCI) patients.

Number of Subjects : Eighteen subjects with either acute (n=13) or chronic (n=5) ISCI participated in a 6-week robot assisted gait training program using a commercial system known as the Lokomat (Hocoma, Switzerland).

Materials/Methods : The functional and neurophysiological assessments were performed at baseline (Week1), during (Week5) and at the end of the Lokomat training program (Week8). The functional Assessments included the Walking Index in Spinal Cord Injury (WISCI) and gait analysis. The neurophysiological assessments included recording Somato-Sensory Evoked Potentials (SSEP), and Motor Evoked Potentials (MEP) which help in assessing the function of the sensory and motor pathways respectively within the central nervous system. The results of the functional and neurophysiological tests were analyzed and compared in order to understand the neural basis of the functional recovery observed.

Results : All patients successfully completed the study. The temporal gait parameters such as walking speed, cadence, and step length showed statistically significant gains ($p < 0.05$) within the first three weeks of Lokomat training in acute subjects. Significant reduction in SSEP and MEP latencies were observed following the robotic training. These finding followed a similar time pattern to the recovery observed in gait parameters i.e. most significant changes occurred within the first 3 weeks of Lokomat training compared to the later 3 weeks. These changes were observed irrespective of the duration from the time of initial injury, after which the patients were recruited to perform the Lokomat training.

Conclusions : The conclusions of this study can be summarized as follows;

Monitoring both functional and neurophysiological recovery provided a more objective measure of the neural adaptations that underpin the functional recovery. We propose that these outcome measures have a potential to be used in future clinical trials for new interventions that aim to repair the spinal cord. The time line or pattern of recovery observed was similar in all outcome measures.

Clinical Relevance : For patients receiving Lokomat rehabilitation the observation that improved functional and neurophysiological outcome measures in responding patients can be seen by week 3 is indicative of treatment efficacy. However, in patients lacking a positive increase may denote that the patient is receiving no physiological benefit from the robot assisted training. Incorporating, regular assessments may therefore assist in revising treatment planning for patients who are considered for Lokomat or other forms of body weight supported treadmill training.

TITLE: Robotic Assistive Devices to Improve Quality of Life for Persons with Amputation and Paraplegia

AUTHORS/INSTITUTIONS: M. Goldfarb, Mechanical Engineering, Vanderbilt University, Nashville, TN|C. Hartigan, Physical Therapy , Shepherd Center, Atlanta, GA|

ABSTRACT BODY:

Purpose : To educate physical therapists on new robotic assistive devices that have potential to significantly improve patients' quality of life.

Description : Recent advances in robotics technology have brought to the near horizon some new possibilities with respect to the development of assistive devices for purposes of enhancing the mobility and/or functionality of persons with physical disabilities. This talk will focus on the development of three such assistive devices, which are intended to provide enhanced mobility and/or functionality for persons with lower limb loss, upper limb loss, and with paraplegia, respectively. Specifically, the talk will describe the development of a powered transfemoral prosthesis for lower extremity amputees, the development of a multigrasp hand for upper extremity amputees, and the development of a lower limb exoskeleton for legged mobility assistance in individuals with paraplegia.

Summary of Use : The lower limb loss device provides persons with a below knee amputation improved gait and mobility. The upper limb loss device will demonstrate functionality in terms of more sophisticated grasp and release. The powered exoskeleton device for persons with paraplegia is being developed through a collaborative effort between Shepherd Center and Vanderbilt University. The robotic exoskeleton is very light weight, can be worn in the persons own wheelchair and has been successful in navigating on even surfaces, sidewalks, grass, curbs and stairs.

Importance to Members: Robotic technology is a growing field in Physical Therapy and it is important that PTs are well informed.

TITLE: Seating for Persons with Tetraplegia as a Life Saving Measure - A Case Report

AUTHORS/INSTITUTIONS: V.M. Incantalupo, Physical Therapy, St Charles Rehabilitation, Albertson, NY|C.K. Collins, Physical Therapy, Long Island University, Brooklyn, NY|

ABSTRACT BODY:

Background & Purpose : Fifty to eighty percent of persons with spinal cord injury develop a pressure ulcer costing an estimated \$1.3 billion a year. Many develop chronic ulcerations, infections, osteomyelitis and life threatening complications leading to repeated hospitalizations. Contributing factors include inadequate seating evaluation and prescription, patient's refusal to accept a proper seating system, and limited funding for durable medical equipment. This case report outlines the progress in a patient's seating tolerance, skin integrity and function with a proper seating prescription.

Case Description : The patient was a 20 year old male with C5-C6 ASIA A tetraplegia. Following rehabilitation the patient was discharged home in a manual lightweight wheelchair with a gel seat cushion and standard upholstery back, self-propelling indoors for short distances (FIM=2), required moderate assistance for transfers with a sliding board (FIM=4), and performed pressure relief by weight shifting. As a result of seating pressures the patient developed a grade IV ulcer on his left ischial tuberosity and had a hip dislocation leading to a girdle stone procedure and a left pelvic obliquity. Flap surgery was performed to close the persistent pressure ulcer but the wound re-opened within days of discharge. The patient was managed conservatively for 10 years, with limited sitting tolerance (1-2 hours) requiring moderate assistance for functional activities (FIM: bed transfer = 3; wheelchair = 1). The wound progressed leading to widespread infection, osteomyelitis, and deep tunneling requiring 9 hours of surgery. The patient then agreed to a custom seating system. A complete mat and postural examination with a thorough skin inspection, pressure mapping statically and during pressure relief activities in a variety of seating cushions, and an inspection of all durable medical equipment in use were completed. A prescription was made for a power wheelchair with power seat functions, a custom ROHO cushion, a contoured back with removable lateral supports, a ROHO cushion for the commode chair, and a zero pressure mattress.

Outcomes : The patient has been free of pressure ulcers for six years, reports a significant decrease in previous and constant shoulder pain (NPRS 8 to 0), and has not required medical follow-up. Functionally, FIM score for wheelchair mobility has improved to 7 and the patient is able to tolerate sitting all day (9-11 hours) while working as a schoolteacher.

Discussion : The management of pressure ulcers is multifaceted. Proper seating and pressure ulcer prevention can be life saving. Clinicians must understand the importance of a proper positioning evaluation and must obtain proper training. Each component of the final recommendations for the patient described in this case had an extensive clinical and functional reasoning derived from a comprehensive examination and evaluation including the patient's unique functional needs. An individualized and skilled approach can assure a healthy and productive life while avoiding unnecessary risks.

TITLE: Multi-Center Survey of Rehabilitation Protocols after Tendon Transfer to Restore Pinch in Tetraplegia.

AUTHORS/INSTITUTIONS: M. Johanson, V.R. Hentz, Rehabilitation Research and Development Center, VA Palo Alto Health Care System, Palo Alto, CA|W.M. Murray, Biomedical Engineering, Northwestern University, Chicago, IL|J. Jaramillo, Spinal Cord Injury Service, VA Palo Alto Health Care System, Palo Alto, CA|

ABSTRACT BODY:

Purpose/Hypothesis : Multi-center trials and systematic literature reviews have become important methods for establishing evidence based clinical practice guidelines. Tendon transfer procedures are widely reported to improve upper limb function in tetraplegia, however there is variability the strength restored by these procedures. Small subject numbers, undocumented rehabilitation protocols, and lack of consensus in meaningful outcome measures can limit the ability to combine data sets from multiple sources. The purpose of this study was to determine if postoperative care is variable across multiple SCI Centers.

Number of Subjects : 28 individuals, with cervical SCI, level 4-7, who underwent transfer of the brachioradialis to flexor pollicis longus to restore lateral pinch participated.

Materials/Methods : Standard post-operative management and rehabilitation protocols were surveyed in 7 SCI centers following tendon transfer as part of an ongoing Multi-Center trial. The participating centers were instructed to complete a checklist documenting the key components of patient care following tendon transfer procedures. Information was recorded for duration and limb position for postoperative casting and splinting, therapeutic interventions (including initiation of passive and active mobilization, strengthening, and muscle re-education), and the utilization of home exercise programs.

Results : Immediately following tendon transfer procedures, care is directed to protecting the transfer and healing. One center allowed early mobilization of the transfer. The average days until all splints were removed was 79 days (range 48-146). Only 3 of 28 subjects used electrical stimulation or biofeedback for muscle re-education. Permitting active pinch postoperatively was variable (1–91 days) and time to performing light activities from the time of surgery averaged 32 days (range 4-48). Strength training was prescribed in all centers and varied in its intensity. The ability to self-propel a manual wheelchair without splints averaged 76 days (range 27-116). Postoperative rehabilitation often did not occur in the same center as the surgery and muscle re-education became a primary responsibility of the patient by practicing functional tasks in the home.

Conclusions : Tendon transfer outcomes may be improved by following consistent rehabilitation protocols. In the Centers we surveyed, similar protocols were followed during the immediate postoperative period, however variability across centers occurred in the timing, intensity, and focus of the rehabilitation programs. Discharge to community based therapy programs limited the ability to provide consistent postoperative care.

Clinical Relevance : This study emphasizes the need for developing a standardized prescription for conventional postoperative care after tendon transfer procedures. Documentation of rehabilitation protocols is necessary for future systematic review and meta-analysis studies that evaluate surgical outcome. Objective assessments of new rehabilitation approaches require knowledge of conventional rehabilitation protocols for comparison.

TITLE: Supramaximal torque production during repeated dynamic contractions in individuals with incomplete spinal cord injury

AUTHORS/INSTITUTIONS: H.E. Kim, C.K. Thompson, Department of Kinesiology and Nutrition, University of Illinois at Chicago, Chicago, IL|G. Hornby, Department of Physical Therapy, The University of Illinois at Chicago, Chicago, IL|

ABSTRACT BODY:

Purpose/Hypothesis : Individuals with motor incomplete spinal cord injury (SCI) demonstrate volitional torques ~15% greater than their one-repetition maximum during repeated maximal voluntary effort (MVE), isometric contractions of the knee extensor (KE) muscles. This finding is in direct contrast to the increased muscular fatigue individuals with SCI experience compared to neurologically intact subjects during fatiguing neuromuscular electrical stimulation (NMES) protocols. Proposed explanations for this supramaximal torque during MVEs include increased central excitability and complex interactions between mechanisms underlying spasticity. Previous protocols which have elicited this enhanced motor output have been conducted only under static conditions. The purpose of this research was to: 1) determine if this enhanced motor output with repeated MVEs exists under dynamic (i.e., isokinetic and isotonic) conditions, and 2) demonstrate a time dependency to any observed enhanced motor output.

Number of Subjects : 5

Materials/Methods : Repeated MVE dynamic contractions of the KEs were performed by five individuals with a motor incomplete SCI. Subjects performed a series of five MVEs (4s contraction/6s rest) followed by a one-minute rest period and a final 4s MVE. This sequence was performed under isometric, isokinetic, and isotonic conditions. Isometric contractions were performed with the knee flexed 90 degrees. Isokinetic concentric and eccentric contractions were performed over an 80 degree range (90 – 10° knee flexion) at a velocity of 20°/s. Isotonic contractions were performed using a load that could be moved 10 ± 4 degrees by subjects at baseline. Gravity-corrected torque, lower extremity electromyographic (EMG), and position signals were recorded during all trials.

Results : Subjects in this experiment demonstrated supramaximal torque production under isometric, isokinetic concentric, and isotonic conditions (+13.1%, +19.7%, +13.3 deg). Supramaximal torque production was not observed during eccentric trials (+2.5%), however, the ratios of eccentric/concentric EMG amplitude were much greater than those previously reported for neurologically intact subjects. Torque and/or angular excursion produced during the final MVE following a one-minute rest period returned to baseline levels under all conditions (+3.5%, +4.6%, +0.6 deg, +0.0%). Increased KE torque was associated with increased quadriceps EMG activity and rate of torque development.

Conclusions : Individuals with a motor incomplete SCI demonstrate enhanced motor output during dynamic MVE contractions. Increases in torque, rate of torque development, and EMG were observed under all tested conditions except eccentric. One minute of rest was sufficient to abolish any enhanced motor output.

Clinical Relevance : The proposed enhanced motor output demonstrated during both static and dynamic MVEs may potentially be harnessed by specific interventions to more effectively increase strength and endurance within individuals with incomplete SCI.

TITLE: Gait Training for a C4 Incomplete Spinal Cord Injury Patient Utilizing a High Intensity Training Program: A Case Study

AUTHORS/INSTITUTIONS: E. Kliver, S.L. Cornbleet, , Washington University in St. Louis, St. Louis, MO|

ABSTRACT BODY:

Background & Purpose : There are approximately 12,000 new spinal cord injuries (SCI) reported per year in the US. Of those individuals, 55% are incomplete injuries and less than 1% demonstrate full recovery. There is research to support body weight support (BWS) and over ground (OG) gait training for incomplete SCI, however the research is inconclusive about which method is superior. One trend identified in the research is that the level of injury may indicate which gait training method is most appropriate for the patient. The purpose of this case report is to demonstrate a progressive, high intensity gait training program using a combination of OG and BWS for a C4 ASIA C incomplete SCI patient who made rapid functional gains in an inpatient rehabilitation setting.

Case Description : The patient was a 19 year old male with an incomplete C4 SCI following a diving accident. The patient had a C5 burst fracture and underwent a C4-6 laminectomy and anterior/posterior fusion the following day. The patient initiated inpatient rehabilitation one week later. At initial evaluation, the patient was dependent for all ADLs and transfers. The initial treatment focused on patient education, safety, bed mobility, and transfer training. By week one, the patient was appropriate for sit to stand transfers and began ambulating with a cardiac walker for short distances with moderate assistance. As the patient progressed, the therapy focus was to continually challenge the patient by decreasing the assistive device (AD) for short distances in order to increase weight bearing through the lower extremities and by working on high level dynamic balance activities. The patient initiated aquatic BWS gait training in his third week of rehabilitation focusing on achieving higher level activities that could not be performed on land such as standing lunges and running. With the support of the water, he was able to achieve single leg stance along with increased gait speed and endurance gains.

Outcomes : The patient was seen for a total of 24 sessions over 4 weeks. The patient's lower extremity motor score increased from 27/50 to 49/50 as used in the ASIA neurological exam. His Functional Independence measures increased from a 0-1/7 (unsafe to dependent) to 5-6/7 (safety precaution to modified independent) in all categories. His Berg Balance Scale improved from a 48/56 to 56/56. Finally, his ambulation distance increased from 0 feet to over 300 feet without any braces or assistive devices with modified independence.

Discussion : The focus of treatment for this patient was to keep the patient challenged and working to fatigue the majority of sessions in order to maintain a high intensity of training. Using a combination of aquatic BWS and OG gait training appeared to facilitate increased independence with gait in a short time frame. Further research is needed to support the use of aquatic BWS for balance and gait training in patients with SCI. In addition, more research to support the therapeutic effects of combining OG with BWS gait training is needed.

TITLE: Effects of serotonergic agents on locomotor performance in individuals with motor incomplete spinal cord injury.

AUTHORS/INSTITUTIONS: K.A. Leech, Neuroscience, Northwestern University, Chicago, IL|C. Kinnaird, Sensory Motor Performance Program, Rehabilitation Institute of Chicago, Chicago, IL|C.K. Thompson, G. Hornby, Physical Therapy, University of Illinois at Chicago, Chicago, IL|

ABSTRACT BODY:

Purpose/Hypothesis : Serotonergic (5HT) agents have been shown to modulate locomotor activity in animal models of spinal cord injury (SCI), although their effect on walking ability in humans with motor incomplete SCI is unclear. The purpose of this study was to evaluate the effect of acute pharmacologic manipulation of 5HT on locomotor performance. We hypothesized that locomotor performance would be enhanced with use of SSRI and depressed with 5HT receptor antagonists.

Number of Subjects : 10 ambulatory male subjects with motor incomplete spinal cord injury.

Materials/Methods : In a randomized, cross-over, double-blinded design, peak treadmill speed, peak oxygen consumption (VO₂), joint kinematics, and EMG activity were collected during the performance of a modified graded treadmill test prior to and 5 hrs following single dose administration of 10mg of Lexapro (SSRI) or 8mg of cyproheptadine (5HT antagonist). Joint kinematics and EMG activity were evaluated at the highest treadmill speed common to pre and post drug treadmill tests. To determine any within day changes in performance, peak treadmill speeds were also collected in control conditions (no medication) for 6 subjects.

Results : Following administration of either SSRI or 5HT antagonist, peak speed and VO₂ decreased significantly (main effect for testing session $p=.02$ and $.01$ respectively). Post-hoc testing of within-group differences demonstrated significantly decreased peak speed ($p=.04$) and VO₂($p=.02$) following 5HT antagonists and but not following SSRIs. Evaluation of EMG activity during walking revealed increased rectus femoris (RF) activity ($p=.004$) during late swing following SSRIs, whereas RF activity decreased significantly ($p=.01$) during late stance/early swing following 5HT antagonists. Similar non-significant trends emerged in nearly all muscles (i.e., increased activity post-SSRI and decreased activity post-5HT antagonist). There were no significant changes in kinematic consistency of stepping or individual joint kinematics (peak flexion, peak extension, and total range of motion) with either medication. Peak speeds reached during the treadmill tests in control conditions were not significantly different, confirming demonstrated changes were not due to diurnal variations.

Conclusions : This study highlights the acute motor effects of commonly prescribed serotonergic agents in humans with motor incomplete SCI. The effects on muscle activity are consistent with the known effects of 5HT on spinal excitability. Despite increased muscle activity with SSRI administration, changes in locomotor performance were not demonstrated.

Clinical Relevance : Serotonergic agents administered acutely may demonstrate a negative impact on locomotor performance in people with motor incomplete SCI. Given the common use of these medications, further research to expand the understanding of the acute versus chronic effects on functional mobility is essential.

TITLE: The Influence of Aquatic Therapy in Combination with Activity Based Restorative Therapies (ABRT) on Gait Efficiency and Balance in an Adult with Chronic Spinal Cord Injury (SCI): A Case Report

AUTHORS/INSTITUTIONS: R. Mertins, R. Martin, D. Becker, C. Sadowsky, J. McDonald, International Center for Spinal Cord Injury, Kennedy Krieger Institute, Baltimore, MD

ABSTRACT BODY:

Background & Purpose : A desired goal stated by individuals with spinal cord related paralysis is to achieve a pre-injury walking level. To improve function, traditional therapy focuses mostly on compensatory strategies, whereas ABRT consists of patterned sensori-motor activation above and below injury level and task specific training utilized to concomitantly impact both neurologic and day-to-day function. A substantial amount of research supports the use of task specific training to encourage neural plastic changes in the central nervous system to enhance function.

However, there is little research that objectively evaluates the role of locomotor training and functional skill training utilizing aquatherapy to facilitate functional gains over-ground. The purpose of this case report is to describe the potential impact that aquatic therapy and ABRT have on balance and gait dysfunction after non-traumatic SCI.

Case Description : The participant is a 75-year old woman with T3 paraplegia ASIA Impairment Scale (AIS) D secondary to recurrent myelopathy, in the setting of neuromyelitis optica, since 1994. She was first seen in our clinic 17 years after the onset of neurologic deficit and, at that time, was independent in household ambulation with a rolling walker and left AFO. She underwent outpatient physical therapy for 3-hour sessions, twice a week, for three months. Therapy consisted primarily of over-ground gait training with a straight cane and left AFO, functional skill training (e.g., transfer training, balance training, stair training), and aquatic therapy, incorporating locomotor training principles via an under-water-treadmill (e.g., maximizing recovery and minimizing compensation).

Outcomes : The participant made significant improvements in her overall endurance, gait distance and speed, gait mechanics, and standing balance. Specifically, the patient's 6 Minute Walk Test improved from 142 feet (43 meters) to 688 feet (210 meters), her 10 Meter Walk Test improved from 90 seconds to 15 seconds (a 0.55 meters/second increase), and her Berg Balance Scale improved from 30/56 to 40/56 (a 10 point increase).

Discussion : Our report demonstrates the potential impact that aquatic therapy and ABRT have on improving gait parameters (endurance and speed) and balance in an adult with chronic, incomplete, non-traumatic SCI. The reported improvements translate clinically in increased mobility and participation, decreased fatigue and decreased fall risk. Therefore, it appears that utilizing ABRT, with both aquatic and over-ground interventions, effectively improves function even long after the onset of neurologic deficit.

TITLE: Comparison of Forward Versus Backward Walking using Body Weight Supported Treadmill Training in Someone with a Spinal Cord Injury: a Single Subject Design

AUTHORS/INSTITUTIONS: G. Moriello, N. Pathare, C. Cirone, D. Pastore, D. Shears, S. Sulehri, , The Sage Colleges, Troy, NY|

ABSTRACT BODY:

Purpose/Hypothesis : The primary goal of an individual with a spinal cord injury (SCI) is to be able to walk again. Body weight supported treadmill training (BWSTT) is a task-specific rehabilitation strategy that enhances functional locomotion. There is much research to support the use of forward walking BWSTT to increase walking speed, improve symmetry, and increase independence in individuals with SCI. However, there is no research evaluating the effect of backward walking in individuals with SCI. The purpose of this single subject design was to examine the differences between forward and backward walking on gait parameters, function, and cardiovascular measures in an individual with quadriplegia using BWSTT.

Number of Subjects : The participant was a 57 year-old male diagnosed with an incomplete C4-C7 SCI 8 months prior to the start of the study.

Materials/Methods : An ABABAB single subject experimental design was utilized with each phase consisting of 3 weeks of biweekly sessions. Each A phase consisted of an intense program of backward walking on the treadmill while each B phase involved forward walking on the treadmill. Each individual session consisted of 3 bouts of treadmill walking; 2 bouts were designed for speed and 1 for distance. Outcome measures were conducted every session throughout the course of the study and included stride length, single support time and gait velocity as measured by the GAITRite portable walkway system, a timed 4 meter walk, the 5-repetition sit-to-stand test, tandem stance time, 6 minute walk test (6MWT), post 6MWT heart rate, and post 6MWT blood pressure. All outcome measures were analyzed using visual analysis and celeration line analysis.

Results : Celeration line analysis revealed significant differences between forward and backward walking favoring backward walking in stride length bilaterally, single support time on the right, the 5-repetition sit-to-stand test, six minute walk test, and post six minute walk systolic blood pressure. There were differences favoring forward walking on the timed 4 meter walk. No differences were noted on the other outcome measures.

Conclusions : These findings suggest that the addition of backward walking using BWSTT to rehabilitation sessions of an individual who had an incomplete SCI may improve gait parameters and other functional outcomes. It is suspected these changes were due to the differences in muscle activation between forward and backward walking, the amount of difficulty of the tasks, and the self-reported gain in confidence during backward walking training.

Clinical Relevance : Therapists should consider the addition of backward walking to the plan of care.

TITLE: Use Of A Walking Recovery Clinical Practice Guideline To Guide Clinical Decision Making For The Rehabilitation Of A Patient With An Incomplete Spinal Cord Injury: A Case Report

AUTHORS/INSTITUTIONS: M.S. Olejer, M. Banta, A. Chan, A. Crawford, Z. Crump, A.M. Devers, J. Vaught, M. Wilks, , Sheltering Arms Physical Rehabilitation Centers, Mechanicsville , VA|

ABSTRACT BODY:

Background & Purpose : Research suggests specificity, intensity, repetition, time, salience, transference and interference all play an important role in neuroplastic changes during rehabilitation. However, there is not any published clinical practice guideline for walking recovery to assist practitioners in their clinical decision making as it relates to key gait training techniques and the use of advanced technology to augment the intervention. The purpose of this case report is to examine the use of a clinical practice guideline for walking recovery to guide clinical decision making and progression of treatment when assessing and treating a patient with an incomplete spinal cord injury.

Case Description : The participant was a 41 year-old-male with American Spinal Injury Association impairment D tetraplegia following cervical fusion at C4, 5, 6 and 7. The participant began his course of outpatient therapy five months post-injury. The patient was categorized into an impairment group based on tests and measures including strength, sensation and balance outcome scores. A guideline, developed by the Sheltering Arms iWALK therapy team, was followed to determine appropriate rehabilitation intervention and progression. The patient received a total of 23 physical therapy sessions. He elected to discontinue physical therapy after 23 visits due to financial and transportation burdens.

Outcomes : The participant demonstrated improvements in balance, strength and independence with gait. Berg Balance Scale scores improved from 29 when first assessed to 48 out of 56 on discharge. Six minute walk test distance improved from 80 feet with rolling walker on evaluation to 754 feet with single point cane on discharge. Timed Up & Go improved from 30 seconds with rolling walker when first assessed to 17.2 seconds with single point cane at discharge. The participant progressed from requiring minimal assistance for ambulation on evaluation to modified independent at the time of discharge.

Discussion : This case report emphasizes the usefulness of a systematic approach to combining techniques to reach the best functional outcomes. It also demonstrates the importance of regular re-evaluations and outcome collections in order to accurately gauge progress and adjust the plan of care accordingly.

TITLE: Soleus H-reflex modulation after motor incomplete spinal cord injury: Effects of locomotor training

AUTHORS/INSTITUTIONS: C.P. Phadke, Spasticity Research Program, West Park Healthcare Centre, Toronto, Ontario, CANADA|P. Nair, Physical Therapy, Seton Hall University, South Orange, NJ|S. Madhavan, Physical Therapy, University of Illinois at Chicago, Chicago, IL|M. Bowden, Physical Therapy, Medical University of South Carolina, Charleston, SC|F. Thompson, Brain Rehabilitation Research Center, Malcom Randall VA Medical Center, Gainesville, FL|A. Behrman, Physical Therapy, University of Florida, Gainesville, FL|

ABSTRACT BODY:

Purpose/Hypothesis : Soleus H-reflex modulation is impaired post-spinal cord injury (SCI). The purpose of this study was to examine the effect of 9-week locomotor training (LT; body weight support, treadmill, and manual assistance) on soleus H-reflex modulation and its relationship with changes in gait speed and walking assistance.

Number of Subjects : Thirteen subjects with motor incomplete SCI enrolled in the study and eight completed H-reflex experiments.

Materials/Methods : All subjects received LT (30min/day; 5 times/week; 9 weeks). Main Outcome Measure: (a) Soleus H-reflex tested during comfortable standing and walking (mid-stance and mid-swing) at self-selected (SS) and fastest comfortable (FS) walking speed, (b) over ground walking speed measured pre-, post-, and 1-month post-LT, and (c) walking index in SCI (WISCI). Clinical outcomes and neurophysiological data from eight subjects that completed H-reflex experiments is reported here. We used non-parametric statistics for data analysis and the p value was set at 0.05.

Results : The mean soleus H-reflex amplitude significantly decreased ($p < 0.05$) post-LT in all tested positions: standing (29%), SS-stance (31%), SS-swing (54%), FS-stance (34%), and FS swing (52%). The subject's SS speed (mean +/- standard deviation) increased from 0.31 +/- 0.22 to 0.43 +/- 0.34 m/s ($p = 0.16$) and the FS speed increased from 0.44 +/- 0.33 to 0.61 +/- 0.48 m/s post-LT ($p = 0.06$). WISCI score also significantly increased post-LT ($p < 0.05$). There was a weak correlation between change in FS walking speed and change in stance H-reflexes tested during FS walking ($r = -0.45$; $p = 0.13$) and between change in WISCI scores and standing H-reflex ($r = -0.53$; $p = 0.09$) and swing H-reflexes in SS walking ($r = -0.55$; $p = 0.08$).

Conclusions : Nine weeks of LT produced a significant decrease in an electrophysiological assay of spastic hyperreflexia, which also correlated to functional gains in walking speed, and decreased levels of walking assistance. The changes in walking speed were more readily observed during fastest comfortable walking. The level of assistance required during walking may be related to decreased spastic catch associated with a decrease in the velocity-dependent stretch reflex excitability of the lengthening muscles during the swing phase of walking.

Clinical Relevance : The results suggest that long term LT can promote normalization of reflex modulation and improve walking speed and may decrease the level of walking assistance.

TITLE: Somatosensory and Functional Changes Following Robotic Training of the UL in an Individual with Chronic, Complete Tetraplegia: A Case Study

AUTHORS/INSTITUTIONS: C. Riley, Spinal Cord Injury Research, Shepherd Center, Atlanta, GA | D. Backus, Multiple Sclerosis Research, Shepherd Center, Atlanta, GA |

ABSTRACT BODY:

Background & Purpose : The recent proliferation of robotic technology has regenerated hope and enthusiasm for improving function in people with neurological injury, such as spinal cord injury (SCI). A number of robotic devices are currently being assessed for treatment of the upper limb (UL) in people with tetraplegia due to SCI, though the functional outcomes reported have been varied (Staubli, 2009; Zariffa, 2011). The purpose of this case study was to determine the impact of robotic training on body structure (spasticity, somatosensation, and strength) and participation in one individual with chronic, high level, motor complete tetraplegia.

Case Description : The participant was a 70 year-old male with C4/C5, motor complete tetraplegia following a motor vehicle accident 15 years ago. He controlled his power wheelchair using a left hand drive, but was otherwise dependent on caregivers 24 hours per day for all activities of daily living (ADL's).

The participant trained 2x/week for 24, 1-hour sessions on a robotic exoskeleton (Armeo Spring, Hocoma, Switzerland) providing support of the arm against gravity. This device interfaces with a computer allowing participants to access and utilize available motor function to play games and perform exercises in a 3-dimensional interactive environment.

Outcomes : Evaluations examined the participant's impairments and participation; no functional outcome measure was appropriate to capture function in this participant based on his high injury level and functional abilities. The following were performed immediately before, half way through, and immediately post the intervention: somatosensation, strength, and spasticity (body structure/function); the Capabilities of Upper Extremity Instrument (CUE) and Self-Care Activities Supplement (SCAS) (participation).

The participant demonstrated improvements in proprioception and light touch in the trained (left) UL, as well as in participation (CUE total, left, and right UL scores). No changes were noted in strength. Spasticity varied throughout the study. The participant also subjectively reported strength changes in the non-trained (right) UL.

Discussion : Upper limb robotic training increased the somatosensation and participation in one individual with chronic, motor complete tetraplegia. This individual would not have been a candidate for physical or occupational therapy services based on current healthcare system requirements. This suggests that individuals with chronic tetraplegia may have the potential for functional change given the opportunity. These findings warrant further investigation.

TITLE: Impact of Somatosensory Augmentation and Repeated Movement Training on the Upper Limb: A Case Study
AUTHORS/INSTITUTIONS: C. Riley, Spinal Cord Injury Research, Shepherd Center, Atlanta , GA|D. Backus, Multiple Sclerosis Research, Shepherd Center, Atlanta , GA|

ABSTRACT BODY:

Background & Purpose : Regaining functional use of the upper limb (UL) is of the utmost importance to individuals with tetraplegia resulting from cervical spinal cord injury (SCI) (Anderson 2004). Recent studies have found changes in somatosensory perception and motor function in people with chronic, incomplete tetraplegia as early as the first day following UL training on a device combining somatosensory augmentation with repeated movements (Backus 2010; Backus 2011). The purpose of this case study is to describe clinically meaningful changes in pain, spasticity, somatosensation and strength (body structure/function), as well as changes in function and participation in one individual with incomplete tetraplegia after training on the same device.

Case Description : The participant was a 30 year-old male with C5 motor and sensory incomplete tetraplegia following a work-related automobile accident approximately 3 years ago. His primary complaints prior to training included intense neurogenic pain and spasticity that limited his performance of activities of daily living (ADL's). Prescribed medications for his pain and spasticity caused serious side effects, including dizziness, lethargy, and weakness. The participant trained 3x/week for 25, 1-hour sessions on a device that combines vibration with repeated hand and wrist movements (AMES Technology, Inc., Portland, OR).

Outcomes : Prescribed medications pre and post-training, as well as subjective comments regarding pain and spasticity, were collected from the participant and his spouse. Pre- and post- evaluations also included tests of: handedness; somatosensation, strength, and spasticity (body structure/function); the Grasp and Release Test (GRT) and Van Lieshout Test (VLT) (function); the Capabilities of Upper Extremity Instrument (CUE) and Self-Care Activities Supplement (SCAS) (participation).

The participant reported decreased pain and spasticity in the trained UL and was able to discontinue both Gabapentin (neuropathic pain) and Tizanidine (spasms/hypertonia). He also demonstrated improvements in somatosensation, strength, spasticity, function (GRT pre 15, post 26), and participation (CUE pre 107, post 178; SCAS pre 33, post 54). Pinch force and VLT scores did not change.

The participant and his spouse also subjectively reported increased independence during ADL's using the trained UL, including donning/doffing his pants, feeding himself, and grasping his cell phone.

Discussion : Somatosensory augmentation with repeated movements led to decreases in neurogenic pain and spasticity, as well as improvements in function and participation, in one person with chronic, incomplete tetraplegia. Somatosensory augmentation combined with repeated movements may be a useful training tool in this population, to decrease pain and spasticity, as well as to increase function. These findings warrant further investigation.

TITLE: Does early orthotic management delay motor learning and walking recovery in an individual with an incomplete spinal cord injury?

AUTHORS/INSTITUTIONS: L. Martin, , TIRR Memorial Hermann Rehabilitation Hospital, Houston, TX|L. Szot, , Texas Woman's University, Houston, TX|

ABSTRACT BODY:

Background & Purpose : The discovery of the spinal cord's capacity for activity-dependent plasticity has caused a shift from use of compensatory to recovery-based rehabilitation approaches. Locomotor training via manual- and robotic-assisted body weight supported treadmills have been utilized by physical therapists (PTs) to promote motor learning and walking recovery by minimizing compensatory strategies. The focus on enhancing recovery may cause PTs to question whether orthoses have a positive or negative impact on motor recovery, challenging them with the decision to use orthotic devices for walking re-training. While ankle-foot orthoses (AFOs) may alter kinematics and afferent input during walking, they have been shown to increase gait speed, step length, stability, and walking ability. This case study describes the walking outcomes despite early orthotic management of an individual with an incomplete spinal cord injury (SCI) after combining compensatory and recovery intervention approaches.

Case Description : A 39-year-old male with a T11 incomplete (SCI) participated in task-specific interventions for recovery of walking in an outpatient program 5 months post injury. Treatments (67 total) were 3x/week for 1 hour. Sessions included 20-30 minutes of locomotor training on a treadmill using body weight support (BWS) with 15 minutes of overground walking 2x/week and overground walking and functional training 1x/week. After 4 weeks, bilateral solid ankle AFOs were prescribed and later converted to posterior leaf spring (PLS) AFOs for running re-training. AFOs were worn during training to improve kinematics and stability to reduce need for BWS and manual assistance from PT to maximize lower extremity weight bearing during walking.

Outcomes : Improvements in walking speed, endurance, and balance as well as progression from assistive devices (ADs) and orthoses were noted. Self-selected walking speed improved from 0.63 meters/second (m/s) using lofstrand crutches to 1.37 m/s using no AFOs and no AD. Walking endurance, measured by the 6 Minute Walk Test, improved from 612 feet with a rolling walker (at 1 month) to 1,054 feet using solid ankle AFOs and lofstrand crutches (at 2 months), to 1087 feet with bilateral PLS AFOs and no AD (at 3 months), and to 1581 feet with no AFOs and no AD (at 4 months). Balance improved from 13/30 to 26/30 on the Functional Gait Assessment.

Discussion : In clinical practice the question arises of whether an orthosis reduces muscle activity, delaying motor recovery. These findings demonstrate the capacity for motor learning to occur in a client with an incomplete SCI despite use of compensatory strategies such as orthotic devices during walking re-training. Clinical decision making regarding the use of ADs, braces, and training environments for recovery of walking after spinal cord injury differs when using a compensatory versus a recovery approach. Thus, both approaches may be beneficial for PTs practicing in clinics where treadmills with BWS or robotic assist are unavailable.

TITLE: Comparison of the Berg Balance Scale and the PASS test in the Acute Stroke Rehabilitation Population

AUTHORS/INSTITUTIONS: S.A. Keller, M. Burns, K. Ruroede, , Marianjoy Rehabilitation Hospital, Wheaton, IL

ABSTRACT BODY:

Purpose/Hypothesis : The purpose was to assess the feasibility of a therapist to perform the Berg Balance Scale and the PASS test on the inpatient stroke rehabilitation population at both admission and discharge. The Berg Balance Scale and the PASS test will demonstrate a positive response to change during acute rehabilitation.

Number of Subjects : All patients admitted to the stroke unit of a rehabilitation hospital from February 2010-March 2011 were assessed for appropriateness. Inclusion criteria included admission to the stroke unit and a CVA within the past 30 days as confirmed by chart review. Exclusion criteria included a previous stroke, MD order for limited weight-bearing, and patients who were not independent ambulators prior to the CVA. There were 221 patients who met criteria. During the rehabilitation stay 21 patients were emergently discharged, leaving 200 patients that were included in the final data analyses. The mean age is 71 years (+/-13 years) with 100 males and 100 females. There were 164 patients with ischemic CVAs and 36 hemorrhagic CVAs.

Materials/Methods : Within 3 days of admission and discharge, the Berg Balance Test and the PASS test were performed on all patients who met criteria. The patients underwent a standard rehabilitation program. Functional Independence Measure (FIM) scores are completed at admission and discharge as part of the rehabilitation program.

Results : The mean admission Berg Balance Score (0-56 scale) was 11 points (+/- 12) and the mean discharge was 30 points (+/-17). The mean change score for the Berg Balance Scale from admission to discharge testing was 19 points (+/- 12) with a statistically significant change (P=0.00). The mean admission PASS score (0-36 scale) was 14 points (+/- 9) and the mean discharge was 26 points (+/- 8). The mean change score for the PASS test was 11 points (+/- 6) with a statistically significant change (P=0.00). The mean admission FIM Motor Composite Score (0-77 scale) was 32 points (+/- 12) and the mean discharge was 50 points (+/- 15). The mean change in the FIM Motor Composite Score was 17 points (+/- 19). The mean number of days between initial and discharge testing was 17 days (+/-8). Pearson correlation found significant correlation between all three measures at the .01 level.

Conclusions : Results reveal that it was feasible to give both the Berg Balance Scale and PASS test for patients admitted to acute stroke rehabilitation regardless of functional level or cognitive impairments. All three measures show a significant change during the inpatient rehabilitation stay. Patients who were at a lower functional level demonstrated more gains in the PASS test. Patients who were at a higher functional level demonstrated more gains in the Berg scale.

Clinical Relevance : Results show that both the PASS test and the BERG balance scale demonstrated a significant change and are feasible to use with the acute stroke rehabilitation population. This study also shows that the PASS test and BERG Balance Scale correlate significantly with FIM Motor Composite score.