Abstracts

Neurology Section Platform Presentations
TITLE: Development of a clinical balance evaluation systems test (BESTest) for differentiating balance deficits

AUTHORS/INSTITUTIONS: F. Horak, Neurology, OHSU, Beaverton, OR; J. Frank, Graduate Studies and Research, Windsor, Windsor, Quebec, CANADA; D.M. Wrisley, Department of Rehabilitation Science, University of Buffalo, Buffalo, NY; A. Nardone, M. Godi, F. Franchignoni, Physical Therapy and Rehabilitation, Rehabilitation Institute of Veruno, Salvatore Maugeri Foundation, Veruno, ITALY;

ABSTRACT BODY:
Purpose/Hypothesis: Current clinical balance assessment tools treat balance as a single control system and rarely include dynamic balance in a variety of functional conditions. The goal of this study was to develop and test a clinical balance assessment tool that differentiates involvement of a variety of balance control systems under dynamic conditions.

Number of Subjects: 21

Materials/Methods: The ‘BESTest’ consists of 36 items, grouped into 6 systems: Biomechanical Constraints, Stability Limits, Anticipatory-Transitions, Postural Responses, Sensory Orientation and Dynamic Gait. In two inter-rater trials, 21 subjects with and without balance disorders, ranging in age from 50 to 88 were rated concurrently on the BESTest by 19 therapists, students, and balance researchers. Concurrent validity was measured by correlation between the BESTest and balance confidence, measured with the Activities of Balance Confidence (ABC) Scale. A ‘Mini-BESTest for Dynamic Balance’ was then developed using analysis factor and Rasch analysis to optimize the psychometric properties of the test, based on testing 88 patients with balance deficits (aged 60.7 years ± 17) with diagnoses including Parkinson’s disease, vestibular disorders, cerebellar ataxia, stroke, neuropathy, multiple sclerosis, and orthopedic disorders.

Results: Consistent with our theoretical framework, patients with different diagnoses scored poorly on different sections of the BESTest. The intraclass correlation coefficient (ICC), measuring the inter-rater reliability for the test as a whole, was 0.91, with the 6 section ICCs ranging from 0.79 to 0.96. The Kendall’s coefficient of concordance among raters ranged from 0.46 to 1.0 for the 36 individual items. Concurrent validity of the BESTest with the ABC Scale was \( r = 0.636; \ p < .01 \). After removing correlated and nondiscriminatory items, the mini-BESTest was reduced to 14 items with a 3-, instead of a 4-level, ordinal scale that took 12 minutes to administer. The variance explained by the estimated Rasch measures was 82%, and the distribution map of subject ability and item difficulty showed a fairly even spread with a normal distribution. The reliability indices of the miniBESTest were: item separation index = 5.21 and item separation reliability = 0.96; person separation index = 2.29 and person separation reliability = 0.84.

Conclusions: The BESTest is unique in allowing clinicians to determine the type of balance problem to direct specific treatments. The miniBESTest quickly provides a novel clinical assessment of dynamic balance with excellent psychometric properties.

Clinical Relevance: The BESTest is unique in allowing clinicians to determine the type of balance problem to direct specific treatments. The miniBESTest quickly provides a novel clinical assessment of dynamic balance with excellent psychometric properties.
TITLE: Falls in Multiple Sclerosis: Incidence, Precipitating Causes, Risk Factors and Health Care Provider Response

AUTHORS/INSTITUTIONS: P.N. Matsuda, A. Shumway-Cook, A. Bamer, S. Johnson, D. Amtmann, G.H. Kraft, Rehabilitation Medicine, University of Washington, Seattle, WA;

ABSTRACT BODY:

Purpose/Hypothesis: Little is known about the incidence and risk factors related to falls in MS. No research has examined health care provider response to falls in persons with MS including strategies for preventing future falls. The purpose of this study was to examine the incidence and risk factors for falls in persons with multiple sclerosis (MS), and to characterize health care provider (HCP) response.

Number of Subjects: 473 community-dwelling persons with MS.

Materials/Methods: Survey research examined the incidence and factors associated with falls, and provider response in 473 community-dwelling persons with MS. Univariate ordinal regression analysis and multiple ordinal regression modeling identified variables significantly associated with single and multiple falls. Univariate logistic regression examined variables associated with injurious falls.

Results: 265 (58.2%) of participants reported one or more falls in previous 6 months; 48% of falls were due to trips or slips while walking; 58.5% of falls resulted in medical injuries. Risk factors included: cane or walker (OR: 2.62), income < $25K (OR=1.85), balance problems (OR = 1.28), and leg weakness (OR=1.26). 51% (135/265) of fallers reported speaking to a HCP about falls; recommended fall prevention strategies included: safety strategies such as slowing down (53.2%), use of gait assistive devices (42.1%), exercise/gait & balance training (22.2%) and home safety modifications (16.6%).

Conclusions: Risk factors for falls in persons with MS are similar to those reported in geriatric and other neurologic populations. Despite the high incidence less than 50% of people with MS receive fall prevention information from a healthcare provider.

Clinical Relevance: Fifty percent of people with MS fall with 23% sustaining serious injuries, yet less than half report talking to a HCP about this problem. HCP need to inquire about frequency and causes of falls, and help patients develop a management strategy to decrease risk for future falls. Future research should examine the number and causes of falls in persons with MS prospectively and verify the range and frequency of fall prevention advice given by HCP. Research to determine optimal treatments to decrease risk for falls among persons with MS are needed, including multifactorial risk factor identification and management shown to be an effective strategy to reduce falls among older adults.
Development and Validity of the Function In Sitting Test (FIST) in Adults with Acute Stroke

S. Gorman, Department of Physical Therapy, Samuel Merritt University, Oakland, CA; S. Radtka, M. Melnick, Department of Physical Therapy, San Francisco State University, San Francisco, CA; N.N. Byl, G. Abrams, Department of Physical Therapy and Rehabilitation Science, University of California, San Francisco, San Francisco, CA;

ABSTRACT BODY:

Purpose/Hypothesis: Current studies indicate that sitting balance ability is a substantial predictor of functional recovery after stroke. No gold standard for sitting balance assessment currently exists for adults post stroke. Commonly used balance measures also do not isolate sitting balance abilities. The Function In Sitting Test (FIST), a functional, performance-based test, was developed, pilot tested, and analyzed to establish a reliable and valid shorter test battery specific to sitting balance dysfunction.

Number of Subjects: Fifteen physical therapists provided input for initial FIST items. Surveys were sent to 12 experts regarding the initial FIST items and scoring scale, and 31 persons post acute stroke pilot tested the FIST.

Materials/Methods: The original 26 item FIST was constructed after interviews and review of existing balance measures. Surveys of physical therapists with expertise in measurement construction, balance assessment, and/or research examined the individual FIST items and scoring scale to reduce the number of items prior to pilot testing. Pilot testing of the 17 item FIST and demographic data collection in adults post stroke occurred in hospital and inpatient rehabilitation settings, and required stopwatch, tape measure, and step stool.

Results: An 83.3% return rate of expert panel surveys yielded a weighted rank analysis which reduced the number of FIST items from 26 to 17 items prior to pilot testing. Item Response Theory (IRT) analysis reduced the FIST by 3 additional items after pilot testing in adults post stroke. Person separation index of 0.978 and coefficient alpha of 0.98 indicated high internal consistency of the FIST. IRT analysis demonstrated content validity and construct validity. Concurrent validity is high via correlations to the modified Rankin Scale, a measure of disability post stroke, and static and dynamic balance grades, a common clinical measure of sitting balance.

Conclusions: The FIST, a 14 item, function-based tool for the assessment of seated postural control, is reliable and valid in adults post acute stroke. Intra/inter-tester reliability and evaluative validity studies are recommended, followed by validation studies in other populations with sitting balance deficits.

Clinical Relevance: Clinicians now have a valide measure to capture sitting balance dysfuction in lower functioning persons post-stroke. The FIST may be a useful balance measure covering the lower end of the balance spectrum when standing or ambulation proves difficult for patients/clients.
Purpose/Hypothesis: Animal models of stroke experience hundreds of repetitions of task-specific training during their "rehabilitation". In contrast, our recent studies show that people with stroke experience very little upper extremity (UE) task-specific practice during rehabilitation. The purposes of this study were to: 1) examine the feasibility of translating high-repetition doses of UE task-specific training to people with stroke within the confines of the current outpatient delivery system of 1 hr therapy sessions, and 2) to gather preliminary data regarding the potential functional benefits of these doses.

Number of Subjects: 11 people with chronic (> 6 mo) upper extremity paresis due to stroke.

Materials/Methods: Subjects underwent 3 weeks of baseline assessments followed by 6 weeks of the high-repetition intervention (3 sessions/wk for 6 wks). During each 1 hour session, subjects were challenged to complete 300 or more repetitions of upper extremity functional task training (3 tasks X 100 repetitions). Specific tasks practiced were individually selected, graded, and progressed to each subject's goals and their movement capabilities. Assessments during the intervention were used to measure feasibility and functional benefits. Post-intervention assessments were done at the end and again one month later. Variables to evaluate feasibility were: numbers of repetitions achieved, attendance at treatment sessions, and pain and fatigue ratings. Variables to evaluate functional benefits were: the Action Research Arm Test (ARAT) and 2 Stroke Impact Scale (SIS) subtests.

Results: Two subjects dropped out. For the remaining subjects, ≥ 300 repetitions of task-specific UE practice were typically achieved by the 2nd or 3rd week of the intervention. Attendance was consistent, with subjects missing 0-2 sessions. Patient reports of pain were minimal. Patient reports of fatigue increased appropriately after treatment sessions. ARAT scores improved over the course of the intervention, with the improvements largely maintained at the 1 month follow-up. SIS Hand Function and Activities of Daily Living scores also improved during the intervention and were maintained at the 1 month follow-up. Subjects with more severe UE paresis were less likely to tolerate and benefit from the intervention.

Conclusions: It is feasible to deliver hundreds of repetitions of task-specific training to people with stroke. Our preliminary efficacy data suggest that this intervention is beneficial for some participants. The feasibility and benefit of the intervention may be a function of initial UE paresis and/or function. Further studies are needed to examine optimal dosing for specific subpopulations of people with stroke.

Clinical Relevance: This is the first attempt to translate the high repetition does in animal models to humans with stroke in 1 hr therapy sessions. If eventually successful, this intervention can be easily implemented in rehabilitation clinics, adding little or no cost, nor schedule changes to the current outpatient delivery system.
TITLE: A Relationship Between Repetitions and Change in Hand Function for Individuals with Chronic Stroke
AUTHORS/INSTITUTIONS: J.G. Barry, S.A. Ross, J. Woehrle, Physical Therapy, Maryville University, St. Louis, MO;
ABSTRACT BODY:
Purpose/Hypothesis: III STEP sparked interest in how many repetitions (reps) are needed to cause neuroplastic changes. While motor learning studies show high reps are required, observational studies of actual therapy sessions show much lower numbers occur in the clinic. There is a need for research looking at the number of reps to change hand function and the best way to complete high reps in the clinic. The primary purpose of this study was to look for a relationship between the reps of grasp and release during practice sessions and change in hand function. The secondary purpose was to compare the number of reps completed using a dynamic wrist hand orthotic (WHO) versus manual assistance alone.

Number of Subjects: 19 participants (mean age = 52 years +/- 29, mean time since onset = 5.3 years +/- 9.7); Study criteria: ≥ 18 years age; ≥ 6 months post onset; Unable to grasp and release a ball (4 inch diameter)

Materials/Methods: Outcome measures were administered by blinded testers prior to intervention and after 6 weeks of intervention. They included the Box and Blocks Test (B&BT) and the Action Research Arm Test (ARAT). Participants were randomly assigned to a group; Group 1 (n=10) participants were fitted with a dynamic WHO which was used during therapy and the home exercise program (HEP); Group 2 (n=9) received therapy with manual assistance during attempts to grasp and release. Intervention for both groups consisted of one session (45 minutes) of therapy per week for 6 weeks and a HEP; Intervention focused on reaching tasks while grasping & releasing balls. Group 2 used a smaller ball due to difficulty opening the hand. Data Analysis: Pearson product moment correlation (r) was used to explore the relationship between reps during practice and the change in hand function on the B&BT and the ARAT. A T-test was used to look for differences in the number of reps completed for Group 1 versus Group 2. As this was an exploratory study the level of significance was set at p ≤ 0.10.

Results: For all participants the mean reps per session = 96 (SD = 21). Group 1’s mean reps = 103 (SD = 25) and for Group 2 the mean reps = 88 (SD = 13). A mild correlation was found between reps and B&BT change r =.391, p=.098. A moderate correlation was found between reps and ARAT change r =.546, p=.016. There was a trend for significant difference in number of reps for those wearing a dynamic WHO versus those without, t=1.713, p=.105.

Conclusions: This exploratory study showed a mild correlation between reps and change in the B&BT and a moderate correlation between reps and the ARAT score. There was a trend towards more reps being performed using a dynamic WHO than with no orthotic and manual assistance. More studies are needed with larger samples and different dosages or practice provided on this population with chronic stroke.

Clinical Relevance: This study supports the importance for striving for high numbers of reps in the clinic to impact hand function after stroke. The use of a dynamic WHO may help get more reps of grasp and release done in a session and also may allow for more practice at home.
TITLE: Responsiveness and minimal clinically important difference for the Dynamic Gait Index and Functional Gait Assessment in measuring gait performance in patients with balance and vestibular disorders.

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

ABSTRACT BODY:

Purpose/Hypothesis: Background: The Dynamic Gait Index (DGI) and the Functional Gait Assessment (FGA) are gait tools that have been used to determine if persons with balance and vestibular disorders are improving with physical therapy interventions. It is not clear in the literature what improvement score is needed to determine a clinically important difference. The purpose of this study was to determine the responsiveness to change and minimal clinically important difference (MCID) for the DGI and FGA in persons with balance and vestibular disorders.

Number of Subjects: The DGI and the FGA were administered as part of rehabilitation management of 404 patients, 66% female, mean (SD) age 55 (21) years with balance and vestibular disorders of varying diagnoses.

Materials/Methods: All patients had admission and discharge scores for the FGA and/or the DGI with 319 patients having admission and follow-up scores for both gait measures. Patients received a mean number of 8 clinic visits (range 2-54). Clinical change during treatment in 315 patients was determined by an 18 or greater improvement in the Dizziness Handicap Inventory (DHI), with an improvement rate of 32%. Responsiveness was operationalized using the standardized response mean (SRM) and receiver operating characteristic (ROC) curve with cut-point analysis.

Results: Responsiveness for the FGA to an 18 point improvement in DHI detected a SRM = 1.5, AUC = .64, 95% CI = .58-.71. This corresponds to an 8 point change in FGA score from admission to follow-up. The DGI SRM was .89, ROC AUC = .64, 95% CI = .57-.71, equivalent to a 4 point change in the DGI score. In unimproved patients, the SRM was 0.9 and 0.5 for the FGA and DGI respectively, p< 0.05 when compared with SRM in improved patients.

Cut-point analysis demonstrated that an FGA change cut-point of 8 points was 63% sensitive and 59% specific for identifying clinically meaningful improvement on the DHI. A DGI change cut-point of 3 points was 67% sensitive and 54% specific for detecting clinically meaningful improvement on the DHI. The responsiveness for the measure of percent change in FGA and DGI from evaluation was consistent with the raw change scores. The MCID and MCID% decreased across quartiles 1-3 of baseline performance for the DGI with cut-points of change ranging form 9 points (quartile 1) to 2 points (quartile 3). For the FGA, the MCID and MCID% increased across quartiles 1-3 of baseline performance FGA with cut-points of change ranging from 11 points (quartile 1) to 5 points (quartile 3).

Conclusions: The FGA and the DGI display significant indices of responsiveness for patients who make display a clinically important change in DHI scores. The responsiveness and MCID for the both the FGA and DGI is related to baseline performance of both measures.

Clinical Relevance: Clinically important changes in both measures obtained through rehabilitation will vary depending on the patient's baseline gait performance.
TITLE: Relationships between the Activities-specific Balance Confidence scale and clinical balance measures in people with Charcot-Marie-Tooth disease

AUTHORS/INSTITUTIONS: A. Goldberg, Department of Health Care Sciences, Program in Physical Therapy, Mobility Research Laboratory, and Institute of Gerontology, and Department of Internal Medicine, Wayne State University, Detroit, MI; S. Schepens, Department of Health Care Sciences, Program in Physical Therapy, Mobility Research Laboratory, and Institute of Gerontology, Wayne State University, Detroit, MI; N. McNevin, Department of Kinesiology, University of Windsor, Windsor, Ontario, CANADA; M. Shy, Department of Neurology, and Center for Molecular Medicine and Genetics, Wayne State University, Detroit, MI; B.A. Smith, Division of Kinesiology, University of Michigan, Ann Arbor, MI;

ABSTRACT BODY:

Purpose/Hypothesis: The Activities-specific Balance Confidence (ABC) scale is a valid and reliable measure of balance confidence in older adults. Low balance confidence is associated with balance impairment and falls in older adults. People with Charcot-Marie-Tooth (CMT) disease commonly present with weakness and abnormal proprioception leading to balance deficits. The purpose of this study is to examine the relationship between the ABC scale and clinical balance measures in people with CMT disease.

Number of Subjects: Twenty-four

Materials/Methods: Twenty-four people with CMT disease (mean age 52.1 years) completed the ABC scale, as well as a series of static (unipedal stance time [UST], tandem stance time [TST]), partially dynamic (functional reach [FR]) and dynamic (timed up and go [TUG], maximum step length [MSL]) clinical balance measures. Relationships between the ABC scale and these balance measures were evaluated using Pearson's correlation coefficient. An alpha level of p≤0.05 was used.

Results: All clinical measures assessed as part of this study displayed significant relationships with the ABC scale (p≤0.05). The strongest relationships were between the ABC scale and the dynamic/partially dynamic measures MSL, TUG, and FR (Pearson’s r 0.72—0.84; p<0.001). Static balance measures showed more modest relationships with the ABC scale (Pearson’s r 0.42—0.50; p≤0.05).

Conclusions: Balance capabilities are related to balance confidence in people with CMT disease, such that people with higher balance confidence have better balance capabilities than those with lower balance confidence. The ABC scale is a valid measure of underlying balance-impairment in people with CMT disease.

Clinical Relevance: The relationships between balance confidence and clinical balance measures observed here suggest that clinicians should utilize the ABC scale as a screening tool for underlying balance-impairments in people with CMT disease.
**TITLE:** Functional Improvement in Post-Acute Stroke: The Importance of Task-Specific Practice, Repetition and Progression

**AUTHORS/INSTITUTIONS:** D.K. Rose, A. Behrman, Physical Therapy, University of Florida, Gainesville, FL; T. Paris, E. Crews, Physical Medicine and Rehabilitation, Brooks Rehabilitation Hospital, Jacksonville, FL; P.W. Duncan, Physical Therapy, Duke University, Durham, NC; S. Wu, Statistics, University of Florida, Gainesville, FL;

**ABSTRACT BODY:**

**Purpose/Hypothesis:** Task-specific practice incorporating repetition and progression are known variables in motor skill learning but can be challenging to implement in acute post-stroke rehabilitation. The purposes of this study were to determine the feasibility of employing intensive task-specific practice in the acute stroke period and to assess the hypothesis that task-specific practice designed to increase repetitions and promote progression is superior to standard care for functional gains in mobility.

**Number of Subjects:** Individuals (n=180; 10.4±9.5 days post-stroke) admitted to an inpatient stroke program over two separate three-month periods participated.

**Materials/Methods:** Daily physical therapy was delivered either as Standard Physical Therapy (SPT) or Circuit Training Physical Therapy (CTPT). Group assignment was dependent on admission date to the rehabilitation hospital. Treatment time (1.5 hrs/day) was the same for both cohorts, while mode of delivery differed. SPT was delivered according to the therapists' treatment plan while CTPT consisted of four 15-minute functional task stations. The therapist and patient chose tasks from a task bank organized according to stroke severity. CTPT participants were systematically progressed by increasing number of repetitions or task difficulty. The remaining 30 minutes was allotted for family training and equipment assessment. Participants were assessed at admission and discharge on the 5-meter walk test (5MWT), Berg Balance Scale (BBS), Lower Extremity Fugl-Meyer Motor (LEFM-M) and Sensory (LEFM-S) Score. Change scores between admission and discharge and discharge destination were compared between the two cohorts.

**Results:** The two cohorts were similar in age (68+/-14 yrs), severity (NIH Stroke Scale: 7.0 +/- 6.0), functional status (Functional Independence Measure – Mobility: 6.0 +/- 2.5) and length of inpatient rehabilitation (19 +/- 9 days) (p > 0.05). The SPT group was more depressed than the CTPT cohort (p < .05). Both groups improved in all outcome measures regardless of severity level (p < .05). Adjusting for baseline differences in depression, the CTPT group had a significantly greater change in the 5MWT compared to SPT (0.21 +/- 0.25 m/s vs. 0.13 +/- 0.22 m/s; p < .05), in addition to a trend for greater change in BBS (p = .09) and LEFM-S (p =.06). There were no differences in discharge destination between the two cohorts.

**Conclusions:** Individuals 10 days post-stroke were able to actively engage in progressive functional task practice delivered in a circuit training model. CTPT that emphasized repetition and progression of functional tasks produced greater improvement in gait and balance than SPT, despite no differences in motor recovery as measured by the LEFM-M. Discharge to home was not solely dependent on functional mobility.

**Clinical Relevance:** CTPT with functional tasks provides an opportunity to maximize the limited number of days for inpatient rehabilitation. This model of physical therapy delivery is feasible in inpatient rehabilitation and may result in greater functional gains post-stroke.
TITLE: Somatosensation is central to motor learning: Experiment 1 - a study of focal stroke.

AUTHORS/INSTITUTIONS: E.D. Vidoni, Neurology, Univ. of Kansas Med Center, Kansas City, KS; L. Boyd, Physical Therapy, University of British Columbia, Vancouver, British Columbia, CANADA;

ABSTRACT BODY:

Purpose/Hypothesis : Our main aim was to determine the relationship between proprioception and continuous motor sequence learning at the level of the central nervous system in humans. We hypothesized that the degree of impaired hemiparetic arm proprioception resulting from stroke-related damage to somatosensory cortical areas would be related to the magnitude of change associated with motor sequence learning.

Number of Subjects : Ten individuals with chronic (>6mo) middle cerebral artery stroke and 9 age-matched healthy participants were studied.

Materials/Methods : Participants performed a continuous tracking task where a repeating sequence was embedded along side random tracking movements (100 practice trials total over 2 days). On a separate day, retention testing of the repeating sequence occurred. Error in the velocity of movement was recorded separately for random and repeated sequences. Differences in error between random and repeated movements over the course of practice were assessed. A limb-position matching task quantified hemiparetic arm proprioceptive deficit.

Results : Individuals with and without chronic stroke demonstrated motor learning of the repeating pattern (p=0.005); however, the magnitude of change associated with improvement on the repeated sequence by the group with stroke was directly related to the integrity of central proprioceptive processing as indexed by the limb-position matching task(r^2=0.55, p=0.015).

Conclusions : These results are consistent with animal models illustrating the impact of damage to central somatosensory processing areas in the development of internal models for movement and motor sequence learning. Further, support for the essential role of central sensory systems in motor sequence learning in humans is evident in our companion abstract Somatosensation is central to motor learning: Experiment 2 - a study of TMS induced virtual lesions.

Clinical Relevance : Clinician’s should carefully consider clients’ proprioceptive function when developing care plans designed to enhance motor skill acquisition as deficits may alter skill acquisition.
**Title:** Effects of Non-contact Boxing Training on Activity and Participation Outcomes in Persons with Parkinson's disease: A Case Series

**Authors/Institutions:** L. Conn, N. Lewis, K. Weisenberger, K. Schaneman, W.H. Staples, D. Diehl, S.A. Combs, Krannert School of Physical Therapy, University of Indianapolis, Indianapolis, IN;

**Abstract Body:**

**Background & Purpose:** High intensity interventions and non-traditional exercise programs have been shown to be beneficial in the treatment of individuals with Parkinson’s disease (PD). The purpose of this case series was to investigate changes in activity and participation outcomes in persons with PD following non-contact group boxing training.

**Case Description:** Seven male participants with idiopathic PD (age range 51-77) were recruited to participate in 24-36 boxing training sessions over a 12-week period. The 90-minute group sessions included warm-up and stretching activities, strength and resistance training, endurance activities, non-contact boxing training consisting of footwork skills, and punching a focus mitt, speed bag and heavy bag, and a cool down. Outcomes were tested prior to (pre-test) and immediately after (post-test) the training period. Outcome measures included: functional reach test (FRT), Berg balance scale (BBS), timed-up-and-go (TUG), six-minute walk test (6MWT), activities of daily living (ADL) and motor examination subscales of the Unified Parkinson’s disease Rating Scale (UPDRS), and Parkinson’s disease quality of life questionnaire (PDQL).

**Outcomes:** Six out of the seven participants completed at least 24 training sessions. One participant withdrew from the study due to a change in health status. Five out of the six participants that completed all phases of the study showed consistent improvements across the majority of measures. The one participant that did not make consistent improvements reported a change in medication immediately prior to post-testing. Improvements in balance were found in four out of six participants with the FRT and the BBS. With the FRT, one participant reached the minimal detectable change (MDC) score of greater than 9 cm. Improvements in mobility were seen in five out of six participants with the TUG and 6MWT. One participant achieved the MDC of greater than 82 feet with the 6MWT. Four out of six participants decreased their score on the ADL subscale of the UPDRS with three participants reaching the MDC score of greater than 4 points. Two out of six participants’ scores decreased on the motor examination subscale of the UPDRS. Five out of six participants reported increased scores on the overall PDQL scale indicating improved perceptions of quality of life.

**Discussion:** Despite the progressive nature of PD, five out of six participants in this case series showed improvements in activity and participation outcomes after 12 weeks of non-contact boxing training. The results of this study indicate that future research on the effects of non-contact boxing training for persons with PD is warranted.
TITLE: Differences Between Risk Factors For Falling In Homebound Diabetics And Non-diabetics

AUTHORS/INSTITUTIONS: S.J. Migliarese, Gentiva Home Health, Greensboro, NC; K. Williams, Exercise and Sport Science, University of North Carolina at Greensboro, Greensboro, NC;

ABSTRACT BODY:
Purpose/Hypothesis: The purpose of this study was to identify the differences in fall risk factors between diabetic and non-diabetic homebound adults. It was hypothesized that, 1) incidence and severity of somatosensory changes in the feet of diabetics surpassed that of non-diabetics; 2) incidence of lower leg and foot pain in diabetics surpassed that of non-diabetics; 3) deficits in sensory integration would be greater in diabetics than non-diabetics; 4) balance deficits were more evident in diabetics and non-diabetics; and 5) fear of falling was more prominent in diabetics than in non-diabetics.

Number of Subjects: The sample compared 210 non-diabetic homebound adults to 74 diabetic homebound adults.

Materials/Methods: Data collected over the past four years for adults who have received homecare from Gentiva Health Services in the Triad area of North Carolina. Study participants were grouped into two cohorts (one diabetic cohort and one cohort of non-diabetic adults). Participants were tested in their home and were informed verbally and in writing of the goals and risks involved in the physical therapy assessment prior to initiation of treatment and data collection. Participants were tested in their home after obtaining informed consent by physical therapists trained to collect data using pain analog scales, monofilament testing of sensation on the soles of the feet, the Dynamic Gait Index, the Modified Falls Efficacy Scale, and the modified Clinical Test for Sensory Integration in Balance. These tests were in addition to the standard physical therapy examination. This data was deidentified prior to statistical analysis. Cohorts were divided into five age categories to allow comparison in performance as age increased.

Results: An one-way ANOVA showed a significant difference in mean sensory scores between groups (p=.003), with diabetics reporting less sensation than non-diabetics in all age categories. No other significant differences emerged for the other fall risk factors. Gender and age category failed to influence differences between diagnostic groups. Moderate correlation existed between the fall risk factors of pain and sensation (r=-.417), sensory integration and balance (r=.544) and fear of falling and balance (r=.478) for the diabetic cohort. Moderate correlations existed between sensory integration and balance (r=.488) and for fear of falling and balance (r=.377) for the non-diabetic group.

Conclusions: Of the five risk factors studied, sensation on the soles of the feet represent the best differentiator between diabetics and non-diabetics who are homebound, supporting the use of monofilament testing in a comprehensive assessment of fall risk. Further research is needed to determine if pain, sensory integration, fear of falling, and balance can be measured with enough sensitivity to differentiate diabetics from non-diabetics in a homecare setting.

Clinical Relevance: Accurate identification of fall risk factors for homebound diabetics can potentially lead to more effective treatment targeted at decreasing falls.
Does repetitive transcranial magnetic stimulation (rTMS)-induced inhibition of the primary motor cortex following visuospatial motor skill training affect performance?

M.C. Furlong, D.N. Holsman, T.J. Kimberley, Program in Physical Therapy, University of Minnesota, Minneapolis, MN; M.R. Borich, Program in Rehabilitation Science, University of Minnesota, Minneapolis, MN;

Memory formation underlies motor skill learning. After a skill is acquired, it must be consolidated to allow future retrieval. Low-frequency rTMS has been shown to disrupt skill retention when applied to the primary motor cortex (M1) following simple, ballistic motor skill training. It remains unclear if rTMS-induced disruption of M1 activity would impair retention of an explicitly-acquired, goal-directed visuospatial motor skill. The purpose of this study is to determine the effect of rTMS-induced disruption of M1 activity on skill retention.

30 healthy (13 male), right-handed subjects, (mean age = 26.1 ± 3.9, range: 20-35 years).

A single-blind, randomized design was used. Subjects were randomly assigned to receive either real (n=16) or sham (n=14) rTMS. A novel tracking task involving right index finger flexion/extension movements was assessed and trained. The task included tracking a computer-generated waveform while wearing a finger potentiometer. One ten-minute session of rTMS (1Hz) was applied to the contralateral M1 directly following training. Tracking accuracy (AI) and measures of cortical excitability (CE) were assessed pre- and post-training, post-rTMS (5 and 15min), and again at 24-hour follow-up.

Two-way repeated measures ANOVAs with main effects of group and assessment were performed. Results demonstrated no significant difference between real and sham rTMS groups for AI or CE across assessments. Across groups, AI significantly increased after training (p<0.001) and continued without further training, maintained at follow-up (p<0.001). Across groups, significant increases in intracortical inhibition (p=0.004) and decreases in intracortical facilitation (p=0.04) following an interval of rTMS were observed.

Our preliminary findings suggest that rTMS-induced disruption of M1 does not substantially impair retention of an explicitly-acquired, goal-directed motor skill. Performance improved after training, was further enhanced without subsequent practice, and remained stable for at least one day regardless of stimulation level. Additionally, cortical excitability was modified following training irrespective of stimulation level.

In order to facilitate the acquisition of novel, or the reacquisition of previously-learned, motor skills following neurologic injury, it is necessary to determine the neural substrates underlying these learning processes. A comprehensive understanding will lead to the development of optimal neurorehabilitation strategies.
TITLE: Psychometric Analysis of the Berg Balance Scale in an Ambulatory Population with Subacute and Chronic Stroke

AUTHORS/INSTITUTIONS: D. Straube, K. Leech, G. Hornby, Physical Therapy, University of Illinois Chicago, Chicago, IL;

ABSTRACT BODY:

Purpose/Hypothesis: The purpose of this study was to further investigate the psychometric scaling of the Berg Balance Scale (BBS) in an ambulatory OP population with a history of stroke. Specifically, this investigation determined: 1) the responsiveness of the BBS (ability to measure change) along the construct of balance, and 2) assess the construct validity of each item as it contributes to the measure of balance in this population.

Number of Subjects: Data were collected from a sample of 58 patients with subacute and chronic stroke. Inclusion criteria included: hemiparesis resulting from unilateral ischemic or hemorrhagic stroke; time since stroke onset ≥ 1 month; age ≥ 18 years; and ability to ambulate with / without an assistive device or orthotic. Exclusion criteria included: severe osteoporosis; stroke of the brainstem or cerebellar regions; cognitive deficits (< 24 on the Mini-Mental State Examination). Informed consent was obtained from all participants.

Materials/Methods: The partial credit Rasch measurement model was used to generate the data for the analysis. Pivot anchoring was used to anchor response categories across all items. Logit measures provided by the Rasch model were used to assess the range of item difficulty relative to various levels of patient ability. T-tests were used to assess for significant areas of the item hierarchy that were non-continuous (gaps in item measures), demonstrating limited responsiveness. Infit Mean Square (MNSQ) values between .6 and 1.4 were used as an acceptable range for item fit, supportive of construct validity.

Results: The results demonstrate the following: 1) the range of item difficulty demonstrated sufficient responsiveness across the entire range of subject ability. This was true despite Item # 3 (Sit unsupported) being eliminated from the analysis as it did not meaningfully contribute to balance assessment (too easy). 2) Item fit statistics demonstrated one misfitting item (Tandem stance) with a MNSQ Infit value of 1.99, demonstrating higher variance than the model would predict.

Conclusions: Despite Item # 3 (Sit unsupported) and Item # 13 (Tandem stance) not contributing to the construct of balance in a meaningful way, the remaining items of the BBS demonstrate sufficient construct validity and responsiveness across the continuum of balance. Further investigation of Item # 13 (Tandem stance) is necessary to understand the misfit and provide insight into possible modifications to support its contribution to the construct.

Clinical Relevance: The findings provide additional data to support the use of the BBS as a measure for balance with sufficient responsiveness and construct validity to assess change in balance ability for ambulatory individuals with subacute and chronic stroke.
TITLE: Sensory Augmentation as a Precursor to Activity-Based Training in Individuals with Tetraplegia: Preliminary Findings

AUTHORS/INSTITUTIONS: K. Beekhuizen, C. Gomez-Orozco, Department of Veterans Affairs, Miami, FL;

ABSTRACT BODY:

Purpose/Hypothesis: The purpose of this study was to investigate the cortical and functional changes associated with the application of somatosensory stimulation (SS) to the median, radial and ulnar nerves immediately prior to initiating an activity-based training (ABT) protocol in individuals with tetraplegia.

Number of Subjects: 6 subjects with incomplete tetraplegia have completed this study to date

Materials/Methods: Subjects were randomly assigned to one of three groups: somatosensory stimulation followed by activity-based training (SS+ABT; n=3), somatosensory stimulation alone (SS only; n=2), or sham stimulation followed by activity-based training (sham+ABT; n=1). Subjects received their intervention 3 days/week for 6 weeks. The SS protocol consisted of 2 hours of sub-motor threshold level stimulation (1 ms pulses at 10 Hz, 500 ms trains delivered at 1 Hz) simultaneously to the median, radial and ulnar nerves at the level of the wrist. ABT protocol involved one hour of intensive, repetitive upper extremity exercises. Outcome measures were recorded prior to initiating the intervention and upon completion of the intervention. Outcome measures included: 1) motor evoked potential (MEP) amplitudes elicited via transcranial magnetic stimulation (TMS) at 90 and 100% Maximum Stimulator Output (MSO), 2) sensory function (Semmes-Weinstein Monofilament Testing), and 3) upper extremity function as measured by the Wolf Motor Function Test (WMFT) timed task scores and Jebsen Hand Function Test scores.

Results: Sensory perception scores increased by 12% in the SS+ABT and SS only group, whereas the sham+ABT sensory scores did not change. Performance on the WMFT improved by 28% and 27% in the SS+ABT and SS only groups, respectively. WMFT scores in the sham+SS group decreased by 3%. Jebsen test scores improved by 33% with SS+ABT, 23% with SS only, and 8% with sham+ABT. Motor evoked potential (MEP) amplitudes of the thenar muscles were measured at 90% and 100% of maximum stimulator output (MSO). MEPs of the thenar muscles increased at both 90% and 100% MSO in the SS+ABT and SS only groups, while an increase in MEP amplitude in the sham+ABT group was only seen at 100% MSO.

Conclusions: The preliminary data in this study presents a trend indicating that the individuals receiving an intervention of somatosensory stimulation followed by upper extremity training and those receiving somatosensory stimulation alone had greater improvements in sensory, upper extremity function and cortical excitability than those receiving the sham protocol. These preliminary findings suggest that the application of somatosensory stimulation, whether alone or in conjunction with exercise, has an effect on the functional outcomes measured in these subjects.

Clinical Relevance: The use of SS as a precursor to an intervention, rather than during the intervention, is a novel method of utilizing SS that may optimize the functional outcome of traditional rehabilitation strategies.
**TITLE:** Intensive training facilitates locomotor improvements beyond a “plateau” in motor recovery post-stroke  

**AUTHORS/INSTITUTIONS:** J.L. Moore, Sensory Motor Performance Program, Rehabilitation Institute of Chicago, Chicago, IL; G. Hornby, Department of Physical Therapy, University of Illinois at Chicago, Chicago, IL; C. Killian, Department of Physical Therapy, University of Indianapolis, Indianapolis, IN;  

**ABSTRACT BODY:**  
**Purpose/Hypothesis:** Extensive literature indicates that individuals may experience a “plateau” in motor recovery within 3-6 months post-stroke; accordingly, patients are frequently discharged from physical therapy (PT) because of this perceived “plateau.” However, numerous studies suggest substantial motor recovery can occur in individuals with chronic stroke when provided task-specific, intensive interventions. The primary question is whether this “plateau” is due to lack of goal-directed, intensive training provided to patients or they actually reach a limit in their recovery. The purpose of this study was to determine the potential causes of a perceived “plateau” in locomotor function in individuals with hemiparesis post-stroke.  

**Number of Subjects:** Twenty individuals with chronic stroke (> 6 months) and ~ 4-8 weeks from discharge from PT secondary to the therapists’ perception of a plateau in motor function participated in the study. The primary stated PT goals of the subjects were related to improving walking ability.  

**Materials/Methods:** The study utilized a repeated measures design in which biomechanical, physiological, and clinical assessments were taken at 4 time points throughout subject enrollment: 4 weeks prior to discharge from PT, at discharge from PT, and 4 and 8 weeks after discharge from PT. All subjects received 4 weeks of clinical PT to begin and were then randomized to either immediate or delayed locomotor training (LT), with the latter delayed for approximately 4 weeks. Intensive LT was performed using a treadmill with body weight support provided at the same weekly frequency as conventional PT, and was performed at the highest attainable speed based on published guidelines. Tests included measures of walking ability (overground gait velocity, peak treadmill speeds, 12 minute walking distance), lower extremity torques, and gait efficiency (O2 cost) performed overground and peak VO2 performed on the treadmill. Stepping frequency was recorded throughout the study using a step activity monitor (Cyma, Inc). Daily logs of activity during conventional PT were also collected.  

**Results:** Self-selected velocity improved by .05 m/s during clinical PT (p<.05) and .02 m/s during LT (p>.05) and fast velocity improved by .07 m/s during clinical PT and LT (both p<.05). 12 minute walking distance improved by 45 meters during clinical PT (p<.05) and by 27 meters during LT (p>.05). The oxygen cost to walk 12 minutes worsened by 52 ml/kg/meter during clinical PT (p<.05) and improved (decreased) by 99 ml/kg/meter during LT (p<.05). The average number of steps recorded during PT sessions was approximately 4-fold less than during LT (p<.01).  

**Conclusions:** Motor recovery did not plateau during PT as suggested at discharge. Rather, substantial functional and physiological gains were demonstrated after high intensity LT.  

**Clinical Relevance:** High-intensity LT can augment stepping practice and facilitates greater gains in physiological and functional improvements, even after termination of clinical services secondary to perceived “plateau” in motor recovery.
Purpose/Hypothesis: The purpose of this study was to examine the effects of an Intensive Mobility Training protocol (IMT) on static, dynamic, and self-report balance in a sample with chronic incomplete spinal cord injury (ISCI).

Number of Subjects: n = 15

Materials/Methods: IMT was implemented 3 hours per day for 10 days in participants (n = 15) with chronic ISCI. The intervention addressed components of gait, balance, and mobility in a massed practice schedule and was individualized to focus on each participant's specific impairments. Specifically, locomotor training employing the use of a body weight support system comprised one-third of the intervention, with balance activities implemented for another third, and therapeutic activities that addressed strength, coordination, and range of motion impairments consisted of the final third. Quantitative balance and self-report balance confidence outcome measures were used to assess changes in static and dynamic balance. Each individual participant served as his/her own control with outcome measures administered at baseline and pre and post intervention. Parametric data were analyzed using a repeated measures ANOVA with a post hoc analysis at an alpha level of 0.05. The Friedman's Test was utilized to identify differences in nonparametric data within the group at each timepoint, and the Wilcoxon Signed Ranks Test was used to locate the identified differences (alpha = 0.05).

Results: The data indicate improvements in static and dynamic balance following the intervention as determined by the Berg Balance Scale (BBS) with a pre-intervention mean score of 27.40 (21.02) and post-intervention score of 29.00 (20.95). Dynamic Gait Index (DGI) results indicate improvements in dynamic balance with a pre intervention mean score of 12.13 (5.96) and post-intervention score of 15.27 (6.10). The self-report Falls Efficacy Scale (FES) data indicate an improved confidence in performing daily tasks without fear of falling with a mean score of 79.53 (16.23) pre-intervention and 85.07 (12.69) following the intervention. The data analyses indicate that baseline and pre-intervention results were not different from each other (p > 0.05) and post-intervention data for all balance outcomes measures were statistically different from pre-intervention scores (p < 0.05). The minimal detectable change score (MDC) calculated for this sample for the BBS and DGI were determined to be 4 points and 3 points respectively.

Conclusions: Results suggest that the intervention may be an efficacious protocol for improving balance as determined by BBS, DGI, and FES. Eight subjects (53% of the total sample) exceeded the MDC for DGI and 4 subjects (27% of the total sample) exceeded the MDC for the BBS.

Clinical Relevance: Results suggest that IMT implemented for individuals with ISCI who are in the chronic stage of recovery may be beneficial for improving static and dynamic balance, fundamental components for functional ambulation necessary for the execution of activities of daily living.
TITLE: High-intensity intermittent vs. conventional resistance training: Impact on strength and function in individuals with incomplete spinal cord injury

AUTHORS/INSTITUTIONS: A. Jayaraman, W.Z. Rymer, Sensory and Motor Performance Program, Rehabilitation Institute of Chicago, Chicago, IL; C. Thompson, G. Hornby, Physical Therapy, University of Illinois at Chicago, Chicago, IL;

ABSTRACT BODY:

Purpose/Hypothesis: The ability for persons after an incomplete SCI to independently walk is largely dependent on their capacity to regain voluntary muscle strength and function. Recent evidence from our lab (Hornby et al. 2009) have shown individuals with incomplete SCI to have a reserve of force generating capability which is observed with high intensity intermittent maximal-effort volitional contractions (MVEs). This reserve of force generating capability is, in part, mediated by elevated spinal excitability during repeated MVEs. Whether this reserve of force generating capability can be harnessed by training is unclear. The objective of this proposed study is to harness the intrinsic excitability in spinal circuits to augment volitional force generation in individuals with chronic incomplete SCI. The specific aims of the current study is 1) to investigate the effect of a four-week high-intensity intermittent resistance training (IRT) vs. conventional resistance training protocols (CRT) on volitional strength and walking ability in people with chronic incomplete SCI and 2) to investigate contributions of spinal cord circuits and muscle properties on increased strength following these paradigms.

Number of Subjects: Preliminary data has been collected in eight individuals with chronic incomplete SCI (ASIA C or D). Total of number subjects in the study is twenty.

Materials/Methods: Using a randomized, crossover design, individuals were tested prior to and following 4-weeks of IRT or CRT of bilateral lower extremity muscle groups. Outcome measures include volitional strength, EMG, voluntary activation, spinal motoneuron excitability, muscle properties, and clinical measures of functional ambulation.

Results: Preliminary data indicate considerable increases in lower extremity volitional isometric torque generation (avg. increase 65%) following IRT in comparison to the CRT paradigm (avg. increase 15%). Alterations in spinal excitability appear to mediate changes in volitional activation following IRT, as a corollary, minimal change in segmental motor activity was observed following CRT. In addition, individuals showed substantial improvements in clinical measures of walking ability following IRT in comparison to the CRT group.

Conclusions: Four weeks of IRT is shown to increase torque generating capability in individuals with motor incomplete SCI as compared to CRT protocols. The brief period of the training suggests alterations in neural mechanisms substantiated with measures of spinal motoneuron excitability. Furthermore, the short term IRT also resulted in improvements in clinical measures of function, suggesting the impact of central nervous system activation on functional recovery.

Clinical Relevance: Our hope is to identify the mechanisms underlying the improvements in strength in subjects with incomplete SCI following a simple and cost effective yet robust strength training paradigm that can be performed in the clinical setting without substantial additional effort on rehabilitation personnel.
TITLE: Postural control and clinical balance test performance differs between Parkinson disease sub-types.

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

ABSTRACT BODY:

Purpose/Hypothesis: Previous research has suggested that persons with Parkinson disease (PD) and tremor as their predominant motor deficit may have slower disease progression, may be less likely to suffer cognitive deficits, and may fall less (Jankovic at al., 1990; Rudzinka et al., 2007). While persons with PD generally are considered to perform poorly on laboratory measures of postural control and clinical measures of balance relative to those without neurologic disease, variations in postural control and clinical balance test performance based on PD subtype is unclear. For this reason, we examined the variations in anticipatory postural control and clinical balance tests between disease subtypes.

Number of Subjects: Seventeen persons with PD were categorized into a tremor predominant (n=5) or a postural instability gait disorder (PIGD) predominant (n=12) group based on their off medication UPDRS motor subsection scores.

Materials/Methods: Two separate days of data gathering were performed, with clinical balance tests performed on one day and laboratory measures of postural control gathered two days later. Laboratory measures of postural control were characterized by the lateral and posterior shifts of the center of pressure (COP) toward the initial swing limb during gait initiation using a VICON motion capture system and AMTI force plates. Clinical balance test performance was characterized by Timed Up and Go (TUG) and Functional Gait Assessment (FGA) scores. All clinical balance tests were gathered by one investigator. Both laboratory and clinical balance measures were performed 1 to 1.5 hours after participants had taken their anti-PD medications. Differences in demographics, COP displacements as well as TUG and FGA scores were analyzed using separate Mann Whitney U tests for independent samples with a level of significance of 0.05.

Results: Persons in the tremor predominant group were significantly younger yet had a similar disease duration and disease severity as those in the PIGD group (P<0.05). Persons in the tremor predominate group demonstrated significantly greater magnitude of posterior COP displacements during gait initiation, faster TUG times and higher FGA scores than the PIGD predominant group (p<0.05).

Conclusions: These results suggest that the severity of postural instability and clinical balance test abilities may vary based on PD sub-type. Persons with PIGD predominant PD demonstrated deficits in the preparatory movements of the COP theorized to be responsible for acceleration of the body from static stance to on-going gait. In addition, participants in the PIGD group demonstrated deficits in clinical balance test performance relative to those in the tremor predominant group. These results suggest that persons with tremor predominant PD may be more balance competent than those with PIGD predominant PD.

Clinical Relevance: In clinical practice and in future research, attention should be directed to the progression of postural instability and response to intervention based on Parkinson disease sub-type.
TITLE: Evaluation of turning in people with Parkinson's disease

AUTHORS/INSTITUTIONS: L.A. King, F. Rodrigues-de-Paula, A. Salarian, F. Horak, Neurology, Oregon Health Science University, Portland, OR;

ABSTRACT BODY:

Purpose/Hypothesis: In addition to steady-state walking, other locomotor tasks, such as turning, are known to be impaired in patients with Parkinson's disease (PD). Nevertheless, it is often not quantified in physical therapy evaluations. If ‘turning’, as a singular task, is evaluated by the physical therapist, it is generally assessed by observing an ‘on-the-spot 180 degrees turn’, as indicated in the Berg Balance Scale (BBS). This type of on-the-spot turn may be very different from a turn which incorporates walking and less external cueing. The BBS has been validated for use in assessing balance in people with PD, but it is not known if this commonly used scale addresses the issue of turning adequately. The purpose of this study was to determine if the duration of turning during the timed up and go test, using inertial sensors for sensitive quantification, correlated with the commonly used scales of BBS, balance confidence, quality of life and the Unified Parkinson’s Disease Rating Scale (UPDRS).

Number of Subjects: Twenty-five

Materials/Methods: Twenty-five patients with PD (Hoehn and Yahr: 1 – 4), ages 57 to 83 years (65.6 ± 7.4) and UPDRS scores ranging from 3 to 49 (24.2 ± 13.1) were evaluated using several different scales ranging from patient perception to clinical scales of balance to inertial sensors. Specifically, all patients completed the Activities-specific Balance Confidence Scale (ABC), the Parkinson’s Disease Questionnaire (PDQ-39), the BBS and the timed up and go test using inertial sensors to quantify the turn duration. The severity of the disease was evaluated by the UPDRS motor section. The data was analyzed using descriptive statistics and Pearson Correlation Coefficient.

Results: BBS was not correlated with turning duration (r = -.35; p =.090). On the other hand, ABC and PDQ-39 were correlated with turning duration (r = -.44, p = 0.028; r = .60, p = .002 respectively). All scales and testing reported in this study were correlated with disease severity as determined by UPDRS motor scores: ABC (r= -.62, p=0.001); PDQ-39 (r=.61, p=.001); BBS (r= -.70; p=0.000) and turning duration (r= .43; p=0.03).

Conclusions: While the common tests for balance confidence, balance and mobility correlate well with disease severity, they do not necessarily correlate with turning duration in PD, which may be a very important aspect of mobility for the physical therapist to assess. Interestingly, the self perception questionnaires, both the ABC and the PDQ-39, correlated with turning duration, suggesting that this may be a quick and easy way in which to determine if turns are an area in which the physical therapist should focus treatment.

Clinical Relevance: If a therapist uses the BBS as the main assessment for balance, they should consider assessing turns separately in people with PD.
**TITLE:** Effects of Body Weight Supported Treadmill Training in Patients with Impaired Ambulatory Ability from a Traumatic Brain Injury

**AUTHORS/INSTITUTIONS:** K. Maloney, G. Moriello, G. George, L. Papa, A. Wagner, Physical Therapy, The Sage Colleges, Troy, NY;

**ABSTRACT BODY:**

**Purpose/Hypothesis:** The purpose of this study is to determine whether Body Weight Supported Treadmill Training (BWSTT) is more effective than conventional gait training for improving gait velocity, gait endurance, stride length differential, and level of functional independence in persons with traumatic brain injury (TBI). It was hypothesized that those receiving BWSTT would demonstrate greater ambulatory abilities and functional outcomes than those receiving conventional gait training.

**Number of Subjects:** Twenty-seven participants with TBI receiving physical therapy in a subacute rehabilitation setting.

**Materials/Methods:** A pretest posttest experimental design was utilized. Participants who met the inclusion criteria (at least 16 years of age, 4 week projected length of stay and an initial Glasgow Coma Scale of less than or equal to 8) were randomly assigned to an experimental (n=12) and control group (n=15). Both the experimental and control group received one hour of physical therapy split into two 30 minute sessions, five days per week for a duration of four weeks. The control group received conventional physical therapy and over-ground gait training, while the experimental group received conventional physical therapy and BWSTT. Outcomes were assessed on the basis of the 3-minute walk test, 5-meter walk test, stride length differential as measured by the GAITRite system, and Motor FIM score.

**Results:** MANOVA testing revealed there was no significance difference between the groups at posttest (p. = .127), however both the experimental and control groups improved from pretest to posttest. Participants in the experimental group with hemilateral impairments performed better on several outcome measures when compared to those with bilateral involvement. Median values for the 3-minute walk test, the 5-meter walk test and Motor FIM improved to 348 feet, .41 m/sec and 43.5 respectively in those with hemilateral involvement and only 111 feet, .28 m/sec and 31 in those with bilateral involvement.

**Conclusions:** The results of this study suggest that conventional gait training and BWSTT are equally effective in improving recovery of ambulatory ability in patients who have sustained a TBI but may be dependent on hemilateral or bilateral involvement.

**Clinical Relevance:** BWSTT can be an effective intervention in those diagnosed with TBI but further research is necessary to determine whether a certain subgroup of the population benefits more from BWSTT than conventional gait training.
ABSTRACT BODY:

**Purpose/Hypothesis**: Long-term follow up of training investigations are necessary to evaluate the rehabilitative effects of training protocols. For post-stroke individuals, extended Task-Related Training (TRT) effects on reaching with the paretic limb were evaluated using 2 separate trunk control techniques. Previously reported data demonstrated, by impairment and functional outcome measures, that using TRT with an auditory feedback signal (extrinsic feedback- EF) is a more effective approach than forcing the stabilization of the trunk (intrinsic feedback- IF) during rehabilitation of the upper-limb. It was expected that EF would continue to yield more significant changes over a one-year period.

**Number of Subjects**: Seventeen of the eighteen post stroke individuals that were trained were retested. Initial inclusion criteria: individuals with no receptive aphasia, apraxia or other cognitive deficits; all scoring between 20 and 44 on the Upper-Arm subsection of the Fugl-Meyer Scale (FM) and demonstrating trunk movement during the pretest reaching performance scale measures.

**Materials/Methods**: Initial rehabilitative sessions lasted between 50 and 65 minutes, 2-3 times a week over 4-6 weeks, totaling 12 sessions. One rehabilitation strategy served as the control (trunk-stabilized TRT). For the experimental group, sensors provided bandwidth auditory feedback to encourage maintenance of the trunk against the chair back (auditory signaling once the trunk has moved off of the chair back). Both groups performed TRT activities at varied locations across the workspace, using the paretic upper-limb for reaching and grasping as well as multiple bilateral activities. Feedback was systematically and equally faded throughout the training for both groups. A 2 (Training Group) x 3 (Pre-/Posttests/Follow-up) repeated measures ANOVA was used to evaluate one-year follow-up data. Rehabilitative effects were determined using disability measures, outcome scales, clinical shoulder/elbow, and grip strength measures.

**Results**: Training effects were maintained 1 year later for FM scores, elbow extension and grip strength, indicating continued changes for clinical outcome measures, and measures of impairment. No changes were evident for trunk control (Reaching performance scale), shoulder flexion strength, Wolf Motor Function Test outcome measure, or the Motor Activity Log (MAL) measure of disability.

**Conclusions**: The continued use of the arm and hand, may have led to the impairment and clinical measures evidenced.

**Clinical Relevance**: This long term follow-up training investigation is indicative of the extended TRT effects that can be maintained for post stroke patients, regardless of feedback techniques.
TITLE: DUAL TASK EFFECTS ON MOTOR PERFORMANCE OF POSTURAL AND SPEECH TASKS: PRELIMINARY EVIDENCE FOR A POSTURE-FIRST STRATEGY?

AUTHORS/INSTITUTIONS: E. Jarvis, S. Sondrup, K.B. Foreman, L.E. Dibble, Physical Therapy, University of Utah, Salt Lake City, UT; C. Dromey, Communication Disorders, Brigham Young University, Provo, UT;

ABSTRACT BODY:

Purpose/Hypothesis: When confronted with situations requiring postural stability and performance of an additional task, dual task associated performance deficits are often observed. However, given the consequences of losing postural stability, Bloem et al (2006) proposed that healthy individuals will incorporate a "posture first" strategy and sacrifice performance of the non-postural task. Unfortunately, most dual task studies lack sensitivity in the measurement of both tasks making it difficult to examine this theory. For this reason, we examined the "posture first" strategy by comparing the dual task performance deficits on postural and speech motor tasks.

Number of Subjects: 7 healthy young participants took part in this study (mean [sd] age = 25.86[1.57] years).

Materials/Methods: Postural stability was measured via kinematic and kinetic analysis (Vicon Colorado, USA) of a rise-to-toes task. Speech articulation performance was measured (Audacity, Praat) during reading of standardized sentences. Each participant performed 5 repetitions during single and dual task conditions with the order of conditions randomly determined. Performance during single and dual task conditions was measured using postural stability variables (center of mass [COM] and center of pressure [COP] difference, COP velocity, heel / COM displacement and variability) and speech articulatory acoustic measures (diphthong formant transitions and slopes, which reflect movement of the articulators). For each variable, the average of the 5 trials was used as the representative dependent variable. Between condition analyses of differences were performed using separate repeated measures ANOVAs and an alpha level of 0.05. The magnitude of dual task deficits between postural and speech motor variables were compared using effect size estimators.

Results: None of the postural stability variables were significantly different between conditions (p>0.20) although statistical power was low in all analyses. In contrast, significant reductions in measures of tongue movement were observed in the dual task condition compared to the single task (p<0.05). Between condition effect sizes were consistently greater for speech motor performance than on postural stability performance (partial eta² for speech >.40; partial eta² for postural stability <.20).

Conclusions: In this study, healthy young participants appeared to preserve postural stability at the expense of speech motor performance during dual task conditions.

Clinical Relevance: These preliminary results indicate that healthy young participants appear to demonstrate a "posture first" strategy during dual task conditions. Previous research suggests that persons with postural stability limitations (elderly, persons with PD) may not prioritize task performance in this manner and future research will examine the response these populations to similar task conditions. In clinical practice and in future research, attention should be paid to the effects of dual task performance on postural stability.
TITLE: Joint Kinetics Adapt Bilaterally Following Locomotor Training Post-stroke

AUTHORS/INSTITUTIONS: V.L. Little, E.J. Gonzalez-Rothi, Department of Physical Therapy, University of Florida, Gainesville, FL; K.P. Westlake, Department of Radiology, University of California, San Francisco, CA; T. McGuirk, C. Patten, Brain Rehabilitation and Research Center, Malcolm Randall VA Medical Center, Gainesville, FL;

ABSTRACT BODY:

Purpose/Hypothesis : Locomotor training (LT) is a contemporary approach to restore walking function post-stroke. While gait speed is often utilized as the benchmark for characterizing improved walking function, increased gait speed can result from multiple biomechanical and neural contributions. Our overriding goal is to determine the capacity to improve not only walking speed, but the fundamental locomotor pattern in persons post-stroke by investigating the effects of LT to identify biomechanical mechanisms contributing to improved locomotion.

Number of Subjects : Here we report findings from 6 participants (mn:54.83(+/-21.08) yrs, mn:45.33(+/-30.13) mos post-stroke, 5 males) who participated in either manually-assisted or robot-driven LT for 12, 30-minute sessions at training speeds corresponding with non-disabled overground walking speeds (>0.8m/s).

Materials/Methods : All participants were studied in two overground conditions: self-selected (SSWS) and fastest possible (FAST) walking speed. 3D kinematics were obtained using a modified Cleveland Clinic marker set (34 markers) and 7 digital cameras (Qualisys) sampled at 100 Hz. Marker data were tracked using Qualisys Trak Manager and analyzed in Visual 3D using a link-segment model. Kinetic data were extracted from isolated forceplate footstrikes and key parameters calculated with custom Matlab scripts.

Results : Improvements in SSWS (mn:0.144(+/-0.06)m/s), FAST (mn:0.03(+/-0.03)m/s), and paretic step-length ratio (mn:-0.05(+/-0.05)m/s) were revealed at SSWS. Kinetics captured at SSWS demonstrated improved hip extensor power (H1) (mn:0.03(+/-0.06)W/kg), and eccentric hip flexor power (H2) (mn:-0.13(+/-0.10)W/kg). Additionally, a decrease in the concentric hip flexor power (H3) (mn:-0.01(+/-0.26)W/kg) in the non-paretic (NP) limb was noted concurrently with an increase in paretic (P) limb H3 power (mn:0.11(+/-0.07)W/kg) and increased ankle plantarflexor power (A2) (NP: mn:0.28(+/-0.22)W/kg, P: mn:0.03(+/-0.03)W/kg) bilaterally. During FAST, H1 (NP: mn:0.22(+/-0.18)W/kg, P: mn:0.14(+/-0.22)W/kg) and H2 (NP: mn:-0.13(+/-0.19)W/kg, P: mn:-0.12(+/-0.15)W/kg) powers improved bilaterally. In the NP limb H3 power (mn:-0.28(+/-0.18)W/kg) decreased concurrently with increased A2 power (mn:0.77(+/-1.04)W/kg). However, the P limb demonstrated an increased compensatory pattern by increasing H3 power (mn:0.07(+/-0.16)W/kg) with a concomitant reduction in A2 power (mn:-0.03(+/-0.06)W/kg).

Conclusions : Gait speed increased and spatio-temporal symmetry improved in response to a modest dose of LT in persons post-stroke. Changes in joint powers suggest LT contributed to improved organization of force production at both the hip and ankle. As revealed by bilateral effects on joint kinetics, these improvements occur bilaterally at SSWS. In contrast, increases in gait speed during FAST involve compensatory patterns including exaggeration of NP limb joint powers.

Clinical Relevance : LT delivered at physiologic walking speeds shows promise for influencing the underlying bilateral locomotor pattern in persons post-stroke.
TITLE: Unilateral paretic limb power training produces bilateral locomotor effects post-stroke

AUTHORS/INSTITUTIONS: S. Patil, Physical Therapy, University of Florida, Gainesville, FL; I. Jonkers, Biomedical Kinesiology, Katholike University, Leuven, BELGIUM; C. Patten, Rehabilitation Research & Development Center, Malcolm Randall VA Medical Center, Gainesville, FL;

ABSTRACT BODY:

Purpose/Hypothesis: Hemiparetic walking dysfunction is characterized by slow walking speed, which involves decreased push-off during the terminal stance phase of gait. Lower extremity weakness has been attributed as one cause. Paretic propulsion, calculated from the antero-posterior ground reaction force (AP-GRF), reveals correlations between walking speed and hemiparetic severity. Here we compare lower extremity power training vs gait training on propulsive and braking impulses to understand potential biomechanical contributions to increased gait speed.

Number of Subjects: 36 persons post-stroke (61.9 (S.D 12.56) y, 13.9 (S.D 4.85) months post stroke, 10 females) capable of walking at least 10 M and 10 healthy controls (6 male, 4 female, mean 43 (s.d.11.6) y) participated.

Materials/Methods: Hemiparetic subjects participated in 15 sessions of LE power training (concentric vs. eccentric) followed by 9 sessions of clinic-based gait training. Force plate data were collected from healthy controls walking at their self selected speed (SS) and three consecutively slower speeds. Hemiparetic subjects were tested at their self-selected (SS) speed at baseline (eval1), after power training (eval2) and gait training (eval3). The AP-GRF was divided into 4 bins as defined by key features of the AP-GRF extracted from speed matched control data: time-to-peak braking force (TBF), time-to-peak push-off force (TPO) and the point of transition from braking to push-off (TP) represented as percentage of 0-100% stance phase. Positive and negative impulse were calculated for each bin with Bins 1 and 2 corresponding to early and late braking and Bins 3 and 4 to early and late push-off, respectively.

Results: Minimal important differences (MID) for impulse in each bin were calculated from baseline data. Chi-square analysis was performed to determine the proportion of individuals who achieved the MID following each intervention. Significant effects of hemiparetic severity were revealed following power training (eval2) including: increased braking impulse in Bin 1 for Paretic (P) leg (p=0.036) and Bin 2 for the non-paretic (NP) leg (p=0.044), propulsive impulse in Bin 4 for P leg (P=0.032) and in Bins 3 and 4 for the NP leg (P=0.024 & p=0.047) in higher functioning individuals. Eccentric power training revealed greater changes for braking in Bin 2 for the NP leg (p= 0.013) and propulsion in Bin 3 for the Paretic leg (p=0.018). No significant differences were revealed at eval 3.

Conclusions: Both hemiparetic severity and power training mode revealed significant effects on AP impulse. Increases in both braking during Bins 1 and 2 and propulsion in Bins 3 and 4 in P and NP contribute to increased gait speed observed after unilateral LE power training. All significant increases in propulsion and braking were seen after power training, with regression of some measures following gait training.

Clinical Relevance: Unilateral power training induces bilateral improvement in the task of walking in persons post-stroke.