

Abstracts



CSM 2016 Neurology Section POSTER Presentations

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TITLE: Safety and effectiveness of lowering blood pressure using a cardiovascular exercise program after transient ischemic attack or minor stroke: A Systematic Review

AUTHORS/INSTITUTIONS: J. Layman, B. Albers, S. Boyle, L. Carr, N. Pontecorvo, Physical Therapy, Southwest Baptist University, Bolivar, Missouri, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Traditionally, patients who have recently experienced a transient ischemic attack (TIA) or minor stroke are discharged from care with pharmaceutical medication and educational material regarding secondary stroke prevention. The purpose of this study was to examine whether a traditional cardiovascular exercise program is a safe and effective treatment to further reduce risk of a subsequent major stroke for this patient population. If patients can safely participate in a program designed to reduce coronary artery disease risk, such a program may offer similar benefits in damaged cerebrovascular vessels.

Number of Subjects : 165 subjects total across 5 randomized controlled trials (RCT).

Materials/Methods : A systematic review was conducted to identify articles that included treatment of patients with TIA or minor stroke. Five articles fitting the inclusion criteria (patients with TIA or minor stroke, peer reviewed, qualitative design, and published in the last 7 years in English) were identified. The RCT's included were scored on the PEDro scale to evaluate the strength of the evidence.

Results : The 5 studies used within this systematic review received an average strength score of 8.2/11 on the PEDro scale. Included studies showed some evidence that cardiovascular aerobic exercise was effective in reducing blood pressure in those patients post TIA or mild non-disabling stroke. Results showed cardiac exercise is a safe treatment for these patients.

Conclusions : Systolic and diastolic blood pressure can be effectively and safely lowered in patients who suffer a transient ischemic attack or minor stroke with the combined use of a short term aerobic exercise program along with medication. Although the findings were generally positive, research breadth was limited. More research needs to be conducted in this area to further support that aerobic exercise is effective in reducing the risk of stroke long term following minor insult.

Clinical Relevance : Although there may be limited tangible short term consequences after a minor cerebral infarction, research indicates a TIA or minor stroke is a strong predictor of a more significant brain insult in the future. Therefore, it is important for the clinician to educate patients on the benefits of reducing the risk factors that led to the initial TIA or minor stroke. Structured short term cardiac exercise programs can safely be incorporated into treatment protocols of patients who have recently been diagnosed with TIA or minor stroke. The potential blood pressure reducing effects of these programs may lead to decreased risk of stroke occurrence, thereby decreasing the ultimate risk of disability or death.

TITLE: The efficacy of physical therapy interventions related to improving balance and mobility in patients with multiple sclerosis: A systematic review.

AUTHORS/INSTITUTIONS: M. Pascal, K. Drayton, S. Hernandez, K. Kishel, C. McCullion, L. Paulshock, Physical Therapy, Misericordia University, Dallas, Pennsylvania, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of this systematic review was to evaluate how effective physical therapy interventions are in helping patients with multiple sclerosis improve their balance and functional mobility.

Number of Subjects : N/A

Materials/Methods : A search was conducted for available literature regarding effective interventions for improving balance and mobility in individuals with multiple sclerosis. Databases that were utilized include CINAHL, PEDro, Cochrane Library, and PubMed. The search was conducted between the months of January 2014 through January 2015 using the following key terms: multiple sclerosis, treatment, physical therapy, disability, balance training, gait, mobility, quality of life, function, functional impairments, and intervention. During the most recent and final search, "long term effects" was utilized as an additional key term. Review of abstracts was completed for articles yielded in the initial and subsequent searches to determine applicability. Once articles were determined to be applicable, they were included or excluded based on predetermined criteria.

Results : Utilizing varying combinations of the key terms in the four databases noted above, the initial search yielded 64 articles. Later searches that utilized "long-term effects" as a key word yielded an additional 49 articles, making a total of 113 articles. After being reviewed by the researchers for applicability to the research topic, 13 studies were included in this literature review. All articles that were chosen had a PEDro score of 4 or greater. The selected articles investigated various interventions aimed at improving balance and mobility in patients with multiple sclerosis. The following interventions were included in this review: resistance training, balance training, aerobic exercise, flexibility exercises, relaxation techniques, such as yoga, or a combination of these various interventions. Similar outcome measures were utilized in each of the chosen articles.

Conclusions : Traditional physical therapy interventions, such as resistance, treadmill, and balance training, have been shown to be effective in improving mobility and decreasing balance deficits in patients with multiple sclerosis. Additionally, the literature shows that alternative therapeutic means, including yoga and the Nintendo Wii Fit Plus® gaming system, can also be effective in improving balance and functional mobility in patients with multiple sclerosis. Long term effects of both traditional and alternative interventions need further research.

Clinical Relevance : Based on the literature review conducted, there are various physical therapy interventions that can be effective in treating patients with multiple sclerosis. Due to the varying clinical presentations of patients with multiple sclerosis, an individualized multi-faceted approach needs to be taken in order to promote patient specific improvements in balance and functional mobility.

TITLE: Force Platform Measures of Balance Impairment: Reliability and Validity in Individuals with Parkinson's Disease.

AUTHORS/INSTITUTIONS: C.C. Harro, C.M. Burdis, A. Marquis, N. Piper, S. Otieno, Physical Therapy, Grand Valley State University, Grand Rapids, Michigan, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Parkinson's disease (PD) is a highly prevalent neurodegenerative disorder with incidence increasing annually. Complex movement and balance impairments in PD contribute to high fall risk and devastating consequences of fall-related injuries. Therefore, comprehensive balance assessment is warranted to identify intrinsic fall risk factors and direct intervention. The purpose of this study was to examine the test psychometric properties of three balance measures on the NeuroCom™ Force Platform (FP) system in persons with PD.

Number of Subjects : 42 community-dwelling individuals with idiopathic PD (mean age 66.21 years, Hoehn & Yahr stage I-IV) on a stable PD medication regimen participated in this study.

Materials/Methods : Test retest reliability was assessed for the Limits of Stability (LOS), Motor Control Test (MCT) and Sensory Organization Test (SOT) by administering the FP tests twice within 10 days during on time of PD medications. Intraclass correlation coefficients (ICC) were calculated to determine test-retest reliability. Minimal detectable change (MDC) for the FP measures was calculated using standard error of mean from ICC values. Concurrent validity was assessed by comparing the FP measures with criterion gait (10 Meter Walk test, Six Minute Walk test), and clinical balance measures (Functional Gait Assessment [FGA], Mini Balance Evaluation Systems test [MiniBEST], Rapid Step Up test [RST]) using Pearson Product Moment correlations. Convergent validity of FP measures and PD characteristics (disease duration, severity, fall history) was analyzed using Pearson partial correlations.

Results : All FP variables demonstrated excellent test-retest reliability (ICC 0.78-0.92); with the exception of LOS average reaction time and LOS falls, which were moderately reliable (ICC 0.69, 0.62, respectively). The SOT and LOS measures demonstrated fair to good correlations ($p < 0.05$) with gait and clinical balance measures; whereas the MCT showed no correlations. The strongest correlations were found between SOT composite equilibrium score and the balance measures, MiniBEST ($r = 0.69$), FGA ($r = 0.60$) and RST ($r = -0.55$). One third of this study's sample had SOT composite equilibrium scores below normative values, reflecting impairment in sensory integration for balance. Both SOT composite equilibrium score and MCT average latency were moderately associated with disease severity (MDS-UPDRS).

Conclusions : FP measures are reliable and valid measures of balance impairment in persons with PD and are able to detect balance deficits in this population. The SOT and MCT measures differentiated individuals based on disease severity, perhaps reflecting that these tests are sensitive indicators of decline in postural control with disease progression.

Clinical Relevance : A battery of balance measures is needed to accurately assess balance deficits at both the functional and impairment levels in PD. Force platform measures may provide valuable quantitative information about underlying balance impairments in PD to guide therapeutic interventions for fall risk reduction.

TITLE: Effectiveness of the Parnes Particle Repositioning Maneuver for Posterior Canal Benign Paroxysmal Positional Vertigo

AUTHORS/INSTITUTIONS: B. Kinne, Grand Valley State University, Grand Rapids, Michigan, UNITED STATES|J. Leafman, A.T. Still University, Mesa, Arizona, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Benign paroxysmal positional vertigo is a common vestibular disorder that negatively affects an individual's health-related quality of life. The two interventions most often used to treat individuals with posterior canal canalolithiasis are the Epley canalith repositioning maneuver and the Parnes particle repositioning maneuver. Although the effectiveness of the Epley maneuver has been well documented, the effectiveness of the Parnes maneuver has not been as comprehensively investigated. Therefore, the purpose of this study was to examine the effectiveness of the Parnes particle repositioning maneuver as an intervention for individuals with posterior canal benign paroxysmal positional vertigo.

Number of Subjects : 155

Materials/Methods : The study, a descriptive case series that involved a retrospective chart review, included the de-identified records of 155 individuals who were treated with the Parnes particle repositioning maneuver for the canalolithiasis subtype of posterior canal benign paroxysmal positional vertigo. Descriptive statistics including frequency and valid percent were calculated for the number of participants whose nystagmus was resolved with the Parnes maneuver. Of the participants whose benign paroxysmal positional vertigo was cured, the frequency, valid percent, and mean were calculated for the number of Parnes maneuvers needed to resolve the nystagmus.

Results : The number of participants whose nystagmus was resolved with the Parnes particle repositioning maneuver was 145 (93.5%). Of the participants whose benign paroxysmal positional vertigo was cured, 113 (77.9%) required one Parnes maneuver, 22 (15.2%) required two Parnes maneuvers, and 10 (6.9%) required three Parnes maneuvers. The mean number of maneuvers needed to resolve the nystagmus was 1.2897.

Conclusions : The Parnes particle repositioning maneuver proved to be equally as effective as the Epley canalith repositioning maneuver, currently the most common intervention used to treat individuals with canalolithiasis of the posterior semicircular canal.

Clinical Relevance : The overall success rate of the Parnes particle repositioning maneuver (93.5%) approximated that of four Epley-related case series as the nystagmus of 91% to 95% of the participants was completely resolved using the Epley canalith repositioning maneuver. The one-treatment cure rate of the Parnes maneuver (77.9%) fell within the range of 56% discovered in an Epley-related case series and 89% discovered in an Epley-related randomized trial. Therefore, the Parnes particle repositioning maneuver provides an alternative intervention for clinicians who would like to use it in place of the Epley maneuver or who would like to apply it if the Epley maneuver is unsuccessful.

TITLE: Functional impairments in older adults: strength vs. motor control declines

AUTHORS/INSTITUTIONS: N. Lodha, A. Casamento-Moran, E.A. Christou, Applied Physiology and Kinesiology, University of Florida, Gainesville, Florida, UNITED STATES|J.B. Stephenson, School of Physical Therapy & Rehabilitation Sciences, University of South Florida, Tampa, Florida, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Motor control and strength decline with age¹. The decline in motor control is quantified as greater motor output variability^{2,3} and the decline in strength is quantified as lower maximal voluntary force during isolated contractions^{4,5}. Despite this, the relative contribution of the decline in motor control and strength to functional abilities has not been explicitly studied. We examine whether older adults exhibit walking and driving deficiencies compared with young adults as a consequence of greater motor output variability or a decline in strength. We test the hypothesis that greater motor output variability in older adults is the significant contributor to impaired walking and driving performance.

Number of Subjects : 28

Materials/Methods : Sixteen older (age = 72.69 ± 7.40 yrs.) and twelve young, healthy (age = 22.75 ± 3.69 yrs.) adults performed the following tasks: 1) maximum voluntary contractions (MVC) during isolated ankle dorsiflexion and plantarflexion; 2) tracking of a sinusoidal target with isolated ankle dorsiflexion; 3) 7-meter over ground walking; 4) simulated driving – reaction while car following and driving on winding roads with oncoming traffic. We quantified the strength of young and older adults as the maximal force they could exert during the MVC tasks. We quantified motor output variability using the variability of ankle dorsiflexion during the sinusoidal task, stride length variability during over ground walking, gas and brake pedal variability during car following, and lane maintenance variability during road driving.

Results : Compared with young adults, older adults exhibited greater movement variability during the isolated tracking task ($|t_{21.17}| = 2.76$; $p < 0.05$), greater stride length variability during over ground walking ($|t_{21.17}| = 1.73$; $p < 0.05$), greater gas pedal ($|t_{26}| = 1.87$; $p < 0.03$) and brake pedal ($|t_{22.61}| = 4.55$; $p < 0.01$) variability during car following, and greater lane maintenance variability ($|t_{26}| = 1.54$; $p < 0.03$) during road driving. In contrast, there were no significant strength differences ($p > 0.1$) in ankle dorsiflexion or plantarflexion between young and older adults. Furthermore, the strength of the participants did not correlate ($R^2 = 0.1$; $p > 0.2$) with walking or driving performance.

Conclusions : Greater motor output variability, but not a strength decline, contributes to deficits in walking and driving function in older adults. This is demonstrated by the age-related performance differences during walking and driving that were related to greater motor output variability.

Clinical Relevance : This study provides novel evidence that decline in motor control, but not strength, impair functional mobility of older adults. Therefore, rehabilitation protocols should focus on restoring motor control, particularly decreasing motor output variability, in older adults.

TITLE: Identifying Trends in Physical Therapy Interventions During Acute Inpatient Rehabilitation: Results from the TBI Practice-Based Evidence Project

AUTHORS/INSTITUTIONS: M.L. Timpson, K. Chung-Hoon, Physical Therapy, Rocky Mountain University, Provo, Utah, UNITED STATES|C.L. Beaulieu, Psychology, Brooks Rehabilitation Hospital, Jacksonville, Florida, UNITED STATES|J. Bogner, J.D. Corrigan, Physical Medicine and Rehabilitation, Ohio State University, Columbus, Ohio, UNITED STATES|S.D. Horn, School of Medicine, Department of Population Health Sciences, University of Utah, Salt Lake City, Utah, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Approximately 2.5 million individuals sustain a traumatic brain injury (TBI) annually, 17% of which are hospitalized and treated in acute inpatient rehabilitation (IR) facilities. Current practice patterns include three hours of daily skilled services provided by physical therapy (PT), occupational therapy (OT), and speech therapy (ST). However, PT interventions tend to vary between individuals due to the level of impairment assessed via cognitive and motor Functional Independence Measure (FIM™) scores. Understanding PT interventions that produce the desired outcomes is needed. The purpose of this prospective cohort study is to describe PT interventions received by individuals during acute IR following TBI based on their admission level of cognitive functioning.

Number of Subjects : 2116

Materials/Methods : Participants ≥ 14 years old (mean age = 44.5 ± 21.3 , M = 1,534; F = 582) who sustained a TBI and were admitted to one of 10 IR facilities, as part of a larger traumatic brain injury-practice based evidence project (TBI-PBE), were included in this study. Briefly, the TBI-PBE project documented therapeutic interventions provided to TBI patients by PT, OT, ST spanning a three-year period (2008-11). The documented data was then compared and categorized into five groups based on their level of cognitive functioning on the FIM. Further, daily therapeutic interventions for each skilled service were organized into PT activity groups based on their functional similarity. However, observations for this study are specific to PT interventions provided to each participant. Additionally, though the length of stay varied between participants, all PT activities were recorded.

Results : Current trends for PT activities included: assessment, preparation time, pre-functional, transitional movement, therapeutic exercise, pre-gait/standing, gait, resting, stairs, wheelchair mobility, and advanced gait/community mobility. Specifically, gait, transitional movement, and therapeutic exercise were the most common PT activities performed across all groups irrespective of level of cognitive functioning on the FIM. Interestingly, pre-gait/standing and advanced gait were additional PT activities occurring across all groups, however, they occurred with fewer participants.

Conclusions : PT activities received by TBI participants across all 10 IR facilities appeared to be uniform irrespective of level of cognitive functioning of the FIM. Further research is needed to determine what specific combinations of PT activities and dosages contribute to the greatest gains in cognitive and motor outcomes.

Clinical Relevance : Current practice trends favor PT interventions that include gait, transitional movement, and therapeutic exercises, regardless of the level of cognitive functioning, though the intensity levels may vary. These interventions may lead to increasing function while decreasing the need for dependence on others, however the impact on rehabilitation outcomes remains to be evaluated.

TITLE: Normative values for the King-Devick Test for persons 18-40 without recent concussion.

AUTHORS/INSTITUTIONS: H.D. Anderson, K. Angelucci, P. Byrne, G. Carroll, J.M. Schreppel, S. Biely, C. Bush, Physical Therapy, Neumann University, Havertown, Pennsylvania, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of this study was to develop age-defined normative values for the King Devick (K-D) Test in individuals 18-40, without recent concussion. The hypothesis was that scores within age groups would be similar enough to use as normative references when baseline scores for the K-D Test are not available.

Number of Subjects : 150 persons between the ages of 18 and 40. Exclusion criteria included a medical diagnosis of concussion within the past six months and/or difficulty reading.

Materials/Methods : Participants were instructed to complete the test as described by the developers of the K-D Test. This involved reading the numbers on each of three pages right to left as fast as possible without making errors. The total time of all three cards was recorded and the process was repeated until two error-free trials were completed. The fastest error-free trial was recorded for each participant. Demographic data such as age, gender, and educational level was also recorded.

Results : A total of 150 subjects participated with ages ranging from 18-40 years old. The mean age was 29.26. The fastest time scored was 26.19 seconds (age 32); the slowest time 65.90 seconds (age 24). Overall, there was no significant correlation of age to time ($P=.821$; Pearson correlation $r\text{-value}=.019$). There was no significant correlation ($P=.741$) based on age groups (18-29 and 30-40 years old). Grouping by age into smaller categories: 18-23 (group 1), 24-29 (group 2), and 30-35 (group 3) did not change significance ($P=.920$). When the oldest 10 subjects time were compared to the lowest 10 subjects time, a low correlation was found ($P=.895$). A relationship between education level and K-D score was also explored. The most common education level was a Bachelor's degree (41.1% of the 150 subjects). There was no significant correlation found between education level and K-D time ($P=.088$). There were a total of 62 males and 88 females included in the study. An independent T-Test was used to look at the relationship between gender and K-D time; no significant correlation was found ($P=.399$). Subjects with a remote history of concussion (not within the past 6 months) were included and accounted for 41 participants. There was no significant difference found between persons with a remote history of concussion versus those without ($P=.334$). Similar to findings in other studies (Vartiainen, 2014) most participants scored less than one minute (five participants scored > 60 seconds).

Conclusions : No statistically significant correlation was found between K-D Test time and age, gender, educational level or history of concussion in persons ages 18-40.

Clinical Relevance : The K-D Test is an established screening tool for persons with concussion when utilized appropriately. The hypothesis that there is a relationship between K-D Test time and age was not supported by this research. Therefore, normative values based on age could not be established for comparison in the absence of baseline scores. It is essential that individual baseline scores are compared with post injury scores to effectively utilize the K-D Test.

TITLE: Will balance training improve balance performance as well as confidence in order to prevent falls in individuals with chronic acoustic neuroma? A multiple single subject pilot study

AUTHORS/INSTITUTIONS: J.G. Barry, T. Teppen, K. Frey, S. Beffa, S. Haselhorst, K. Dwinell, Maryville University, St Louis, Missouri, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Individuals with acoustic neuromas (AN) have a vestibular hypofunction. Life expectancy is good and as these individuals age they may have increased risk of falls. While research has focused on improving balance in people with AN close to the time of diagnosis, research on improving balance as people enter the chronic phase of their recovery has been limited. The primary purpose of this pilot study was to determine if six-weeks of a group-based balance intervention program along with a home exercise program was effective in improving balance performance along with balance confidence in persons living long-term with AN. A secondary purpose was to analyze if change scores for any individuals decreased fall risk.

Number of Subjects : Four individuals living with a chronic, unilateral AN took part in this study; one man and three women that were a range of 4.5-15 years post diagnosis or the treatment of an AN.

Materials/Methods : This was a multiple single subject design. Outcome measures were the Mini Balance Evaluation Systems Test (Mini-BESTest) and the Activities-Specific Balance Confidence Scale (ABC Scale). Pre-tests were collected two days a week apart. The intervention program consisted of attending 8-12 sessions of a group class focusing on balance exercises that met twice a week along with home exercise instructions. Post-testing was then performed a week following the completion of the intervention program. The means and standard deviations (SD) were calculated after the two days of pre-testing and statistical significance was set as a change of greater than two standard deviations in the post-test score compared to the pre-test mean.

Results : All participants improved a significantly and clinically important amount on the Mini-BESTest scores. In addition 3 of the 4 participants started below the cut-off score for frequent fallers and they all finished above that score. Two of the four participants had a significant improvement in self-reported balance confidence on the ABC Scale with the most dramatic improvement in participant 2 from a pre-test mean of 54.3 (SD=5.1) to a post-test score of 78.1. This signifies an improvement beyond the cut-off score for fallers of 75. The other 3 started with ABC Scale scores above 90 which can cause a ceiling effect of this measure.

Conclusions : The findings of this study suggested balance classes along with a home exercise program may be effective in helping to decrease fall risk in people with chronic AN. In this small pilot study after 6 weeks of intervention all 4 participants showed significantly improved scores on the Mini-BESTest and half reported improved confidence in their balance. Further research is needed with a larger sample size and possibly with a longer or more intense intervention.

Clinical Relevance : The Mini-BESTest is an appropriate tool in the clinic when treating balance in individuals with chronic AN. In addition, those with chronic AN can improve balance performance which can help prevent future falls.

TITLE: The Dual-Task Effect of Texting while Performing Progressively Difficulty Gait Tasks

AUTHORS/INSTITUTIONS: A.J. Strubhar, B. Rapp, D.J. Thomas, Physical Therapy and Health Science, Bradley University, Peoria, Illinois, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Research has shown gait speed is slower while texting, yet it is unclear if walking affects texting ability and if there is a difference between texting and reading while walking. Studies have not explored the effect of texting during difficult gait tasks. This study explored the effect of progressively difficult gait tasks on reading, texting and gait. Hypotheses: 1) Gait will deteriorate while texting, 2) texting ability and gait time will decrease as the gait task is more difficult and, 3) gait speed will be longer while texting than while reading.

Number of Subjects : 36 healthy subjects (12 female, 24 male, mean age 22)

Materials/Methods : Subjects texted a standard text message while standing (BASE). Then subjects performed 3 gait tasks: a Timed Up & Go (TUG), TUG and stair ambulation (STAIR), and TUG tandem gait (TAN). Subjects completed each gait-based task 4 times: as a practice, while holding their cellular device (baseline), while completing a texting-based task, and while reading a message. The following measures were used: Gait speed, number of path deviations, texting errors per second (eps), and texting characters per second (cps). Repeated measures analyses were completed.

Results : The mean time to complete each gait task while texting was significantly longer than the baseline gait task, but despite the gait task being more difficult, texting did not add significantly more time to the more difficult tasks. The mean number of path deviations increased significantly while texting in TAN condition. Mean texting cps was significantly different only between BASE and the TAN gait tasks. However the mean number of texting eps increased significantly during the STAIR and TAN gait. The mean time to complete each gait task while reading was significantly longer than the baseline task, but not as long as the texting task.

Conclusions : The results of this study confirm that texting results in a slower gait, however the degree that gait slows does not appear proportional to the level of difficulty of the gait task. Yet with the increase in difficulty of the task, the number of path deviations increase and the number of texting errors increase despite the speed of the texting in cps remaining relatively unchanged. As with most dual task activities, walking and texting demonstrates that one or both tasks suffer in speed or efficiency. The results indicate the effects of texting are more profound than reading, perhaps due to the fine motor and different cognitive component involved in texting.

Clinical Relevance : When texting and walking, as the gait tasks increase in difficulty the number of errors in texting and path deviations increase. This indicates that in some situations, walking may interfere with the fine motor control of texting and that texting may interfere with gross motor control. Interference in normal gross motor control could lessen normal postural reactions. Conversely, because gross motor interference is noted, texting may be a viable, measurable and real world dual task challenge used in functional rehabilitation.

TITLE: The Impact of Anxiety and Depression on Subjective and Objective Outcome Measures in Patients with Vestibular Dysfunction

AUTHORS/INSTITUTIONS: R.D. Trommelen, A. Bissell, L. Knecht, C. Naquin, Physical Therapy , Louisiana State University Health Sciences Center, New Orleans , Louisiana, UNITED STATES|S. MacDowell, Hearing and Balance Center, Our Lady of the Lake, Baton Rouge, Louisiana, UNITED STATES|A.C. Karpinski, Office of Medical Education and Research, Louisiana State University Health Sciences Center, New Orleans , Louisiana, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : It has been observed clinically that vestibular patients with anxiety and/or depression show greater improvements in their objective outcome measures than their subjective measures. The investigators purport that patients who are anxious and/or depressed will show less improvement in their subjective outcome measure scores than their objective scores, and that there will be a significant difference in outcome achievement between patients who are anxious and/or depressed and patients who are not. The purpose of this study is to investigate the relationship between the subjective and objective outcome measures in patients with vestibular disorders who are either anxious and/or depressed and those who are neither anxious or depressed.

Number of Subjects : 118

Materials/Methods : A retrospective chart review was performed for all patients with a vestibular diagnosis who were referred to 2 specialized vestibular physical therapy clinics between January 2011 and August 2014. 272 charts were reviewed, and of these, 154 were excluded secondary to premature discharge or no vestibular diagnosis. The included charts were reviewed for diagnosis, demographic data, and subjective and objective outcome measures scores. The following information was recorded: subject identification, diagnosis, age, sex, ethnicity, Positive and negative affective schedule (PANAS), Dynamic Gait Index (DGI), Functional Gait Assessment (FGA), Activities Specific Balance Confidence Scale (ABC), Dizziness Handicap Inventory (DHI), gait speed, length of therapy in weeks, number of therapy sessions, and time since onset in weeks. Study measurements were recorded at the initial evaluation and again on discharge: DGI/FGA, ABC, DHI, and gait speed.

Results : A total of 22 subjects (18.6%) scored as anxious and/or depressed as determined by the PANAS, which left 96 subjects (81.4%) who were neither anxious nor depressed. There was a statistically significant within-subjects main effect for all outcome measures (DGI, FGA, gait speed, DHI, and ABC: $p < .001$). There was a trend in which subjects who were anxious and/or depressed had poorer scores on the subjective measures (ABC and DHI) as well as the objective measures (DGI, FGA, and gait speed) at both initial and final assessment, though the between group difference was not significant.

Conclusions : These results show that individualized vestibular rehabilitation improves both subjective and objective outcomes in patients with vestibular disorders, both in patients with and without anxiety and/or depression if they complete the recommended course of therapy.

Clinical Relevance : This study suggests that vestibular rehabilitation is effective even with confounding factor of anxiety and/or depression. These results can be used for physician education regarding appropriate referrals as well as to advocate for vestibular therapy to assist patients overcome obstacles that preclude completing recommended treatments.

TITLE: Clinical Decision Making for a patient with decreased ankle ROM post CVA: an individualized approach.

AUTHORS/INSTITUTIONS: J.M. Kuettel, Physical Therapy, Honor Health, Scottsdale, Arizona, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : Cerebrovascular accident (CVA) is the leading cause of adult disability with > 50% of CVA survivors having some impairment in walking capacity. Community ambulation is often a primary goal of rehabilitation but consequences of hemiparesis and/or hypertonicity post CVA can often inhibit this goal. Plantar flexion (PF) contractures are often one of these consequences and directly impact the patient's (pts) ability to perform functional transfers, symmetrical weight bearing and functional community ambulation. The purpose of this case study was to illustrate the importance of determining impairments due to spasticity versus ligament contracture in treatment of pts with limited ankle ROM s/p CVA.

Case Description : 43 y/o female with left hemiparesis s/p CVA in 2008. Pt initially presented in 2011 for therapy with complaints of difficulty walking, ankle rolling, knee hyperextension and imbalance. Evaluation showed left lower extremity weakness, foot drop, spasticity and development of a PF contracture. Pt was seen for 8 bouts of therapy over 5 years with overall goals to improve pts walking mechanics and community ambulation with specific emphasis on ankle mobility and strength. Multiple treatment techniques including manual stretching, dynamic weight bearing, muscle relaxer injections, night splinting, and serial casting were all attempted to improve pts ankle ROM without sustained success between bouts of therapy. Achilles tendon lengthening was recommended by therapist to achieve normal ROM and more symmetrical gait mechanics. Post lengthening pt was able to achieve normal dorsiflexion (DF) ROM both passively and actively, which allowed her to participate more effectively in therapy consisting of balance, strengthening and gait training.

Outcomes : After multiple trials of muscle relaxer injections pts average passive DF was -3degs with knee extended and -2 degs with knee flexed. With double limb squat pts average DF was 5 degs. With serial casting and muscle relaxer injections pt was able to achieve passive DF to neutral with both knee flexed and extended. In double limb squat position pt achieved +14degs. Following Achilles tendon lengthening, passive DF increased to +20 degs with knee extended and with knee flexed. Pt achieved +20 degs in double limb squat. After 18 visits pt was able to sustain ROM and increase ankle DF strength to 4 /5 and eversion strength to 4-/5. Ashworth scales improved to 2/5 in PF muscles

Discussion : This case highlights the importance of looking at both neurological and orthopaedic causes of ROM deficits. With muscle relaxer injections alone, ROM gains were minimal and never sustained over bouts of therapy. With tendon lengthening the pt was able to achieve full DF ROM and participate in intensive therapy making gains in active motion, strength, walking mechanics and community ambulation.

References: Must include 5 current references (less than 10 years old): Gao F, Ren Y, Roth EJ, Harvey R, Zhang LQ. Effects of repeated ankle stretching on calf muscle-tendon and ankle biomechanical properties in stroke survivors. *Clin Biomech.* 2011 Jun;26(5):516-22 Katalinic OM, Harvey LA, Herbert RD. Effectiveness of stretch for the treatment and prevention of contractures in people with neurological conditions: a systematic review. *Phys Ther.* 2011 Jan; 91 (1): 11-24 Prabhu RK, Swaminathan N, Harvey LA. Passive movements for the treatment and prevention of contractures. *Cochrane Database Syst Rev.* 2013 Dec 28:12 Katalini OM, Harvey LA, Herbert RD, Moseley AM, Lannin NA, Schurr K. Stretch for treatment and prevention of contractures. *Cochrane Database Syst Rev.* 2010 Sep 8: (9) Lee SJ, Sung IY, Jan DH, Yi JH, Lee JH, Ryu JS. The effect and complication of botulinum toxin type a injection with serial casting for the treatment of spastic equines foot. *Ann Rehabil Med,* 2011 Jun;35 (3):344-53. Moraru E, Onose G. Current issues and consideration about the central role of rehabilitation therapies in the functional recovery of neurological impairments after stroke in adults. *J Med Life.* 2014 Sep 15: 7(3): 368-72 Jost WH, Benecke R, Hauschke D, Jankovic J, Kanovsky P, Roggenkamper P, Simpson DM, Comella CL. Clinical and pharmacological properties of incobotulinum toxin A and its use in neurological disorders. *Drug De Devel Ther.* 2015 Apr 1:9:1913-26. Nalysnyk L, Papapetropoulos S, Rotella P, Simeone JC, Alter KE, Esquenazi A. OnabotulinumtoxinA muscle injection patterns in adult Spasticity: as systematic literature review. *BMC Neurol.* 2013 Sep 8:13:118. Radford JA, Burns J, Buchbinder R, Landorf KB, Cook C. Does stretching increase ankle dorsiflexion range of motion? A systematic review. *BR J Sports Med.* 2006 Oct;40(10):870-5. Mauritz KH. Gait training in Hemiplegia. *Eur J Neurol.* 2002 May 9.

TITLE: Current clinical practices in patients with CVA: National Survey

AUTHORS/INSTITUTIONS: E.L. Hollander, A. Richmond, R. Pruitt, D.A. George, PT, The University of Findlay, Tiffin, Ohio, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Cerebrovascular accidents (CVAs) have been the third leading cause of death in the United States, costing approximately \$38.6 billion each year. Given the high prevalence of CVAs and the costs, the study's purpose was to explore and describe the most commonly utilized neurotherapeutic interventions and outcome measures.

Number of Subjects : The participants surveyed were practicing physical therapists (PT), who had at least one years' experience working within an inpatient rehabilitation facility (IRF), accredited by the Commission on Accreditation of Rehabilitation Facilities (CARF). Out of the 43 states, there were a total of 39 states and 58 facilities that had agreed to participate. A total of 22 responses (29.73 %) from 17 different states were received. Subjects ranged in age from 27 to 53 years; had 5 males and 17 females; and practiced as a PT from 1 year to 30 years (mean of 15 years).

Materials/Methods : The survey was reviewed by six experts and piloted amongst five PT professionals. An introductory email with an invitation to participate was sent to all identified participants. The survey was electronically sent to the participants, two days after the initial contact. After 2 weeks, a reminder email was sent to the participants and at 4 weeks, a final reminder was sent.

Results : Not a single approach was used by all of the subjects; rather a mixed approach. The most popular approaches were the Motor Learning (95.45%); Proprioceptive Neuromuscular Facilitation (81.82 %); and Traditional (72.73%) approach. Task Oriented and Rood were amongst the least popular approaches with only 4.55% and 0%, respectively. Out of 54 outcome tools, the most popular were: the Berg Balance Scale (86.36%), Dynamic Gait Index (63.64%), Functional Independence Measure (77.27%), and Timed up and Go (54.55%). A total of 31 outcomes were not being used by the participants. In addition, two participants (9.09%) did not use outcome measures at all. No significant relationship was found between the socio-demographics of the participants (i.e., age, gender, location; levels of training) and the three identified treatment approaches (i.e., Motor Learning, Neurofacilitation, Traditional). There was also no significant relationship between socio-demographic variables and current use of outcome measures.

Conclusions : Due to the small number of respondents, significance could not be demonstrated. However, it was interesting to note that certain interventions and outcome tools are not being utilized. Majority of the therapists used a mixed treatment approach and only a few outcome tools in CARF accredited, IRF. Future studies should continue to investigate current clinical practices for the client with a CVA, not only in the IRF setting, but in other settings.

Clinical Relevance : Physical therapists should continuously reflect upon their beliefs, attitudes, and skills, as new evidence becomes available. The PT profession may need to support this lifelong growth, especially with the use of outcome tools. In addition, the results of this study could assist PT schools with curricular development.

TITLE: Patient Reports of Post-CVA Functional Impairments are the Driving Force Behind Post-Acute Therapy Referrals

AUTHORS/INSTITUTIONS: T.A. Sando, S.A. Cohen, S.M. Ratliff, Family Medicine and Population Health- Division of Epidemiology , Virginia Commonwealth University, Richmond, Virginia, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Cerebrovascular accidents (CVA) are the leading cause of disability in the US and cost more than \$34 billion per year. Physical therapy (PT) and occupational therapy (OT) can reduce disability following a CVA. The objectives of this study were to determine the odds of referral to post-acute PT/OT services in a post-CVA population based upon mobility and activity of daily living (ADL) impairments and assess what clinically relevant factors increase the odds of obtaining a referral to therapy services.

Number of Subjects : The sample included 255 participants in the 2012 Health and Retirement Survey who suffered a CVA in 2011-2012.

Materials/Methods : Bivariate and multi-variable models were examined by multiple logistic regression analyses to determine the association between PT/OT referral and post-CVA deficits.

Results : 60% of the CVA sample population reported continued functional limitations after CVA however only 19.1% of this population received a referral to post-acute PT/OT. The report of a CVA deficit to a healthcare provider was the strongest predictor of a referral (OR 12.10. 95% CI: 4.03-36.32). The odds of receiving a referral to PT/OT increased 1.41 times (95% CI: 1.11-1.79) for each additional mobility impairment. The odds of a therapy referral increased 1.47 times (95% CI: 1.15-1.88) for each additional ADL impairment. After adjusting for demographic and socioeconomic characteristics, moving supine to sit (OR 3.71: 95% CI 1.36-10.18) and walking across a room (OR 4.06: 95% CI 1.41-11.70) were the only 2 of 6 significant mobility impairments for predicting referral to PT/OT. Among 5 ADL impairments all but shoulder flexion over 90° were positively associated with referral to PT/OT.

Conclusions : The overall rate of referral to therapy services for individuals with a CVA was 19.1%, despite nearly 60% of the population reporting continued CVA functional limitations. Reporting any functional limitation to a health care provider increased the odds of a therapy referral 12 fold. In comparison, an increase in the number of mobility or ADL impairments only increases the odds of referral by less than 50%. Although four of the 5 ADL impairments examined increased the odds of receiving a PT/OT referral, only 2 of 6 mobility impairments improved the likelihood of obtaining a referral.

Clinical Relevance : This study provides evidence that post-acute referral to PT/OT services following a CVA may be strongly related to the CVA survivor reporting perceived impairments. If true, CVA survivors and their caregivers need to be empowered to speak to providers about their functional limitations. Additionally, this information can be utilized by health professionals, policy makers and third-party payers to initiate changes to increase referrals to therapy services based upon post-CVA mobility and ADL impairments. A reduction in CVA-associated functional limitations can lead to reduced survivor morbidity and mortality, decreased healthcare spending and improved quality of life following CVA.

TITLE: Treatment of brachial plexopathy following differential diagnosis of a post-operative, orthopedic patient

AUTHORS/INSTITUTIONS: A. Ross, OhioHealth Neighborhood Care, OhioHealth, Columbus, Ohio, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : Brachial plexopathy (also referred to as Parsonage-Turner syndrome) is a condition lacking definite etiology, which involves sudden onset of upper extremity (UE) pain followed by the development of weakness and muscle atrophy (Smith and Bevelaqua, 2014). Physical therapy is one approach in the treatment of this condition; however, there currently is a lack of evidence to make any conclusions on its benefit to this patient population (van Alfen et al, 2009). This case presents a unique opportunity to outline the progress of a subject with brachial plexopathy who initially presented without confirmation of this diagnosis.

Case Description : A 50 year old male subject with pertinent past medical history of mild mental retardation presented to an outpatient orthopedic clinic following arthroscopic sub-acromial decompression, distal clavicle resection, and debridement. The subject reported initial onset of shoulder limitations approximately 4 months prior to surgery when lifting a heavy object. The subject demonstrated potential neurologic involvement based on absent deep tendon reflex at C5-6, and a significant difference in myotome testing of C6 when compared to the uninvolved UE. The subject was referred back to the primary physician and electromyography testing was ordered, leading to a diagnosis of brachial plexopathy of the upper trunk with the possibility of Parsonage-Turner Syndrome as the etiology. Following the medical diagnosis, the subject was treated once a week for 15 weeks.

Outcomes : Prior to treatment directed toward the medical diagnosis, the subject scored a 5/12 on the simple shoulder test and 53.5 on the Disabilities of the Arm, Shoulder, and Hand (DASH) outcome measure. The subject had shoulder active range of motion (AROM) measures of 40 degrees flexion and 52 degrees abduction. The subject's pain was consistently a 6/10 on the Visual Analog Scale. After two months (9 weekly sessions), the subject scored 11/12 on the simple shoulder test and improved by 18.3 points on the DASH outcome measure surpassing the minimal clinically important difference of 10.83 points (Franchignoni et al, 2015). Shoulder AROM had increased to 109 degrees of flexion and 95 degrees of abduction. Pain was rated as intermittent and varying between 0-5/10. One month later (5 additional weekly sessions), the subject's simple shoulder test score remained 11/12 and DASH outcome measure score improved by 3.4 points. Shoulder AROM had increased to 140 degrees of flexion and abduction surpassing functional AROM for activities of daily living (ADLs) (Namdari et al, 2012).

Discussion : Following approximately 3 months of weekly physical therapy sessions, the subject made clinically significant functional gains based on the DASH outcome measure and achieved shoulder AROM considered sufficient for ADLs. Although further, high level evidence is clearly needed to identify the ideal methods to managing brachial plexopathy, this case provides further support for the utilization of physical therapy as a viable and logical approach.

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TITLE: Effects of a High Frequency Variable Gait Training Protocol on Functional Balance in a Dependent Individual Following Hemorrhagic Stroke

AUTHORS/INSTITUTIONS: J.M. Hadder, K.L. VanderArk, Central Michigan University, Mt Pleasant, Michigan, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : Task specific training has been shown to increase functional outcomes of the practiced functional task; however, with limited treatment sessions and many functional deficits it is difficult for physical therapists to allow patients opportunities to practice a plethora of functional deficits. In addition to gait deficits, patients rehabilitating from a stroke have functional balance impairments due to impaired sensation, integration, and motor output. In previous studies, patients have demonstrated functional gains in non locomotor functional activities with initiation of a high frequency gait training protocol, however these protocols utilized expensive equipment. This case report describes a high frequency gait training protocol initiated with manual assistance for leg advancement in a dependent individual with right sided hemiparesis after intracerebral hemorrhage in spite of a lack of access to technology that has been previously utilized in similar research studies.

Case Description : Functional mobility, balance, and strength of a 50 year old, primarily Spanish speaking, latino male were examined upon admission to a subacute rehabilitation setting 31 days after an intraparenchymal hemorrhagic stroke. He was dependent for all transfers and bed mobility and was unable to ambulate upon examination. He also demonstrated only trace contraction in his right lower extremity and an initial score of 0/56 on the Berg Balance Scale.

Outcomes : The patient completed treatment sessions 5 times per week for a total of 58 sessions. Despite requiring extensive manual assistance and 3 people, gait training was initiated on day 12. From day 12 forward, all of the patient's sessions included at least 30 minutes for ambulation training. This ambulation training progressed to variable ambulation training including stairs, retro ambulation, lateral ambulation, and over ground stepping and obstacle avoidance. The patient demonstrated improved functional balance activities with non-ambulatory tasks as evidenced on the Berg Balance Scale, scoring 44/56 at discharge examination. The patient also demonstrated increased strength, increased independence, and endurance with ambulation. The patient was discharged independently ambulating with a small based quad cane with a gait speed of 0.24 m/s. The patient continued to demonstrate minimally decreased balance in a distracting environment.

Discussion : This case report demonstrates a positive outcome without the use of unweighting or robotic assisted treadmill training and suggests potential modification of gait training protocols that call for this technology for use in smaller clinical setting with limited financial resources. Future work should investigate manually assisted high frequency gait training in dependent individuals in larger cohorts.

References: Must include 5 current references (less than 10 years old): Langhorne P, Coupar F, Pollock A. Motor recovery after stroke: a systematic review. *Lancet Neurol.* 2009;8(8):741-54. Straube DD, Holleran CL, Kinnaird CR, Leddy AL, Hennessy PW, Hornby TG. Effects of dynamic stepping training on nonlocomotor tasks in individuals post stroke. *Phys Ther.* 2014;94:921-933. Cheung RT. Update on medical and surgical management of intracerebral hemorrhage. *Rev Recent Clin Trials.* 2007;2(3):174-81. Mancini M, Horak FB. The relevance of clinical balance assessment tools to differentiate balance deficits. *Eur J Phys Rehabil Med.* 2010;46:239-248. Granger CV, Markello SJ, Graham JE, Deutsch A, Ottenbacher KJ. The uniform data system for medical rehabilitation: report of patients with stroke discharged from comprehensive medical programs from 2000-2007. *Am J Phys Med Rehabil.* 2009;88(12):961-72.

TITLE: THE CHARACTERISTICS OF CENTER OF PRESSURE DURING DYNAMIC TASKS ARE ASSOCIATED WITH FALL RISKS IN OLDER ADULTS

AUTHORS/INSTITUTIONS: K.E. Newman, T. Shilling, A. Righter, K. Miller, K. Smith, K. LaVictoire, M. Huang, Physical Therapy, University of Michigan-Flint, Flint, Michigan, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Age-related changes in postural control are major risk factors of falls. No consensus has been established on the biomechanical measures of postural stability during dynamic movements to identify those at risks of falling. This study investigated whether center of pressure (COP) parameters during reaching to objects of different loads would differ between young, older adults without (non-fallers) and with (fallers) a history of falls.

Number of Subjects : 40

Materials/Methods : 17 young adults (25±2.1 years), 11 non-fallers (65±9.2 years), and 12 fallers (68±7.3 years) living in the community volunteered. All were able to walk >50 ft without another person's assistance and with no history of neurologic conditions. Participants reached forward to grasp a basket placed at 30 cm in front of the feet on the floor using both hands, and returned to an upright posture while holding the basket as fast as possible. The basket's weight was altered in the sequence of 2.2 Kg, 0 Kg, and 2.2 Kg. Participants performed 3 trials in each load condition while data from the 1st and 3rd trials of a condition were analyzed to examine the changes across trials. A force platform and a VICON Motion Analysis System recorded ground reaction forces and body kinematics. COP parameters included COP displacement during anticipatory postural adjustments (APA), maximum forward displacement, peak velocity, and trajectory smoothness.. Linear Mixed Model analyzed variables with group as between subject factor, trial as within subject factor, and Tukey's LSD for post-hoc comparisons. Significance level was $p<0.05$.

Results : All groups had comparable COP parameters across trials. Arm reaching and returning movements measured using the wrist marker were significantly faster in fallers and non-fallers than young adults. APA amplitudes and durations were significantly larger in fallers compared to non-fallers and young adults ($p<0.01$). During reaching and returning, fallers had significantly smaller COP forward displacement than non-fallers ($p<0.05$) and young adults ($p<0.01$). In contrast, all groups achieved maximum COP forward displacement at comparable timings and had similar COP peak velocities. COP trajectory smoothness was significantly reduced in fallers compared to non-fallers and young adults ($p<0.01$).

Conclusions : The APA amplitudes and durations and the control of COP trajectory smoothness during movements, but not the extent and velocities of the COP displacement, is altered with a history of falls in older adults. Further research needs to investigate the kinematic strategies with relation to the control of COP during reaching tasks in fallers and non-fallers.

Clinical Relevance : Biomechanical parameters of COP variables may be sensitive and precise measures to identify older adults with fall risks.

TITLE: SMOOTHNESS OF CENTER OF PRESSURE TRAJECTORIES AS A MEASURE OF DYNAMIC BALANCE IN OLDER ADULTS

AUTHORS/INSTITUTIONS: A. Righter, K.E. Newman, T. Shilling, K. Miller, K. Smith, K. LaVictoire, M. Huang, Physical Therapy, University of Michigan-Flint, Flint, Michigan, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : The center of pressure (COP) reflects the neuromuscular control of postural stability in standing human. Previous studies have investigated the measures of COP as indicators for postural stability in static stance conditions. Our recent study has shown that the smoothness of COP trajectories during reaching movements could significantly differentiate young and older adults. These results suggested that the COP measures during dynamic task conditions may be useful for the assessment of postural stability. The purpose of this study was to examine the relationship of the smoothness of COP trajectories with the clinical balance tests in older adults.

Number of Subjects : 26

Materials/Methods : Twenty-six adults aged 55 years and older (age = 66.3 ± 7.92 years) living in the community participated in the study. The inclusion criteria included: able to walk >50 ft without another person's assistance, medically stable, and without a history of neurologic conditions. The dynamic task condition was a reaching task. The participants reached forward to grasp a basket (2.2 Kg) placed at 30 cm in front of the feet on the floor using both hands, and returned to an upright stance while holding the basket. Data from 3 trials were collected and averaged. A force platform (AMTI OR 6-5) measured the data to obtain the COP and an 8-camera VICON Motion Analysis System recorded the kinematics of body movements. The smoothness of the COP trajectories from the time after the participants grasped the basket to the time when they returned to an upright static stance was quantified using normalized jerk scores (NIJ). The COP and kinematic data were analyzed using Matlab programs. Clinical balance tests including Activities-specific Balance Scale (ABC) and Timed Up and Go (TUG). IBM-SPSS Version 22 was used for statistical analysis, including the descriptive statistics and Pearson's correlation coefficients between the NIJ and scores of clinical balance tests. Significance level was $p < 0.05$.

Results : The normalized jerk scores of COP trajectories was significantly correlated with the peak velocity of hand movements ($r = -0.565$, $p < 0.01$), age ($r = 0.430$, $p < 0.05$), and the score of ABC ($r = -0.520$, $p < 0.01$), but not with the scores of TUG. Reduced smoothness of COP trajectories during movements was significantly associated with slower hand movements, older age, and lower balance confidence.

Conclusions : This study is the first to validate the use of a COP measure during dynamic task conditions as an indicator of balance performance. The control of COP trajectories smoothness relates to the confidence in maintaining balance during daily activities in adults aged 55 years and older.

Clinical Relevance : Parameters quantifying the smoothness of the COP trajectories during movements may be sensitive and precise measures of balance.

TITLE: Development of a Clinically Viable Single-Value Robotic Evaluation of the Impact of Loss of Independent Joint Control on Reaching Function Following Stroke

AUTHORS/INSTITUTIONS: M.D. Ellis, C.J. Liang, M.E. Richardson, K.R. Sipple, D.O. Tafelski, J.P. Dewald, Physical Therapy and Human Movement Sciences, Northwestern University, Chicago, Illinois, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Quantitative measurements with the ACT^{3D} robotic device have been used to evaluate the impact of loss of independent joint control, or abnormal coupling of shoulder abduction with elbow flexion, on reaching function. The haptic device quantifies the deleterious effects of increasing abduction loads up to and beyond the weight of the arm during reaching. Prior work has validated a laboratory-based protocol, reaching work area, however it is time-inefficient and produces several variables that diminish its clinical application. An efficient and valid protocol is needed. We have reduced the original method to output a single value and tested its criterion validity. We hypothesized that the "Maximum Reaching Abduction Load," the shoulder abduction load at which reaching is reduced to zero, would have a strong and significant correlation with a gold standard clinical evaluation of arm function.

Number of Subjects : Ten participants (7 men, 3 women) age 48-69 with chronic stroke (4-29 years post-stroke) scored 16-36/66 on the Fugl-Meyer Motor Assessment and 3-4/7 on the Ranchos Los Amigos Functional Test for the Hemiparetic Upper Extremity.

Materials/Methods : Maximum Reaching Abduction Load or "MRAL" was identified using an evolving procedure that lead to increased efficiency. The protocol began by finding the maximum isometric abduction strength with a handheld dynamometer and later more efficiently and accurately with the ACT^{3D}. Reaching performance was assessed in 7 participants using shoulder abduction loads standardized to maximum strength and proceeded using a binary decision tree algorithm. In 3 participants, the protocol was performed without the abduction strength measurement by systematically loading the arm as a function of limb weight to evaluate a potential timesaving. The final value was always identified as the absolute force that reduced the reaching range of motion to zero. Correlation analysis was performed for the robotic and clinical measurement using a Spearman rank correlation coefficient with a 2-tailed t-test and alpha level of 0.05.

Results : There was a strong and significant correlation ($r_s = 0.685$, $p = 0.029$) between Maximum Reaching Abduction Load (absolute force) and the Fugl-Meyer Motor Assessment. The final protocol required 15 minutes for participant set-up, 15 minutes for maximum isometric abduction strength testing, and 5-20 minutes for the reaching evaluation.

Conclusions : Criterion validity is supported. The efficiency of the protocol was reduced substantially from prior reports of 1.5 to 3 hours for the original laboratory-based measure of reaching work area. Further research should be conducted using a larger, more diverse sample size to increase generalizability.

Clinical Relevance : Throughout recovery both single-joint strength and multi-joint coordination may be changing along discordant trajectories. Therefore, it is most appropriate, although more time-consuming, to measure and normalize Maximum Reaching Abduction Load by maximum isometric abduction strength.

TITLE: Differences in performance on standardized active and passive dynamic visual acuity testing using NeuroCom inVision testing in individuals with vestibular dysfunction: a retrospective study.

AUTHORS/INSTITUTIONS: J. Meyer, Pi Beta Phi Rehabilitation Institute, Vanderbilt University, Nashville, Tennessee, UNITED STATES|R.M. Brown, P. Sells, Department of Physical Therapy, Belmont University, Nashville, Tennessee, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Patients with vestibular dysfunction typically present with impairments in postural instability and/or gaze instability causing symptoms of dizziness, vertigo, or unsteadiness. One of the most common standardized outcome measures used in physical therapy to assess gaze instability is dynamic visual acuity (DVA) testing. NeuroCom inVision testing is a standard computerized test used to quantify visual acuity with head movement. Current NeuroCom inVision training teaches that DVA testing should be performed actively when able, whereas testing should be performed passively when using a Snellen chart. There is currently no evidence to substantiate either testing protocol. There seems to be inconsistency between clinicians regarding their preference for performing head movements actively or passively when administering DVA testing. Previous research has discussed different mechanisms of recovery when performing active versus passive head movements. The objective of this study was to determine if differences exist when performing DVA testing with active or passive head movements for patients with vestibular pathology.

Number of Subjects : Data was retrospectively analyzed from 34 patients with vestibular pathology in an outpatient neurologic physical therapy clinic from November 2014 to March 2015.

Materials/Methods : Subjects ranged from 12 to 77 years (mean 46) and included both peripheral and central diagnoses. Active and passive logMAR values from dynamic visual acuity testing were measured at initial and follow-up visits using standardized NeuroCom inVision protocol. All head movements during testing were performed in the yaw (transverse) plane.

Results : Data was analyzed using SPSS software using paired t-tests for overall comparison between active and passive for both ears and for affected ear only, if known. Mixed 2-way ANOVA within-subjects comparisons were used to stratify by diagnostic category, assessment time, and order of testing. No significant differences ($p > 0.05$) were found between active and passive performance on DVA testing even when analyzing affected ear only, and when stratified by diagnosis, time of assessment, or order of performance.

Conclusions : DVA testing can be performed actively or passively in the clinic for patients with vestibular pathology. Testing procedures should be determined based on patient factors including tolerance, preference, and ability to obtain accurate head speeds.

Clinical Relevance : Performance on dynamic visual acuity testing seems to be influenced by a combination of factors including neck proprioceptors, aVOR gain, input from the cervical ocular reflex, and compensatory saccades in patients with vestibular pathology. However, non-significant differences between active and passive head movements during DVA testing suggest that these factors do not significantly impact scores to distinguish differences in visual fixation between passive and active head movements during dynamic visual acuity testing.

TITLE: Misdiagnosis of a Patient with Lewis-Sumner Variant of Chronic Inflammatory Demyelinating Polyneuropathy

AUTHORS/INSTITUTIONS: D. Vander Linden, Physical Therapy, Eastern Washington University, Spokane, Washington, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : Chronic inflammatory demyelinating polyneuropathy (CIDP) is an autoimmune disorder characterized by progressive weakness and impaired sensory function in the upper extremities (UE) and lower extremities (LE). The disorder is caused by damage to the myelin sheath of the peripheral nerves. It often presents with symptoms that include paresthesia and weakness of the UE and LE. Diagnosis is made based upon clinical symptoms and nerve conduction velocity tests. Early treatment with intravenous immunoglobulin (IVIg) therapy is recommended to prevent loss of nerve axons or patients may be left with residual paresthesia, pain or weakness.

Case Description : The patient was a 58-year-old male who first presented with paresthesia bilaterally in the fingers. Based upon his symptoms and a nerve conduction velocity (NCV) of median and lunar nerves, he was referred to a physical therapist for treatment of carpal tunnel syndrome. Wrist splints and anti-inflammatories were used for 3 months without improvement in symptoms. 6 months after initially seeking treatment, a physical therapist recommended cervical spine mobilization and home cervical traction as it was thought the patient may have had spinal nerve impingement. After 6 weeks of cervical mobilization and 4 months of home exercises and home cervical traction, the symptoms of numbness and paresthesia did not improve. Because symptoms of paresthesia had not improved, the physical therapist referred the patient to a neurologist who performed repeated a NCV examination. Based upon the NCV findings, the neurologist diagnosed the patient with hereditary predisposition to pressure palsy (HDPP). To confirm the diagnosis, the neurologist ordered a DNA test. The results of the DNA test were not completed for 3 months, during which time the patient's paresthesia and numbness became much worse and the patient began to experience pain in both hands. When the DNA test determined that the patient did not have hereditary predisposition to pressure palsy, the neurologist informed the patient that he likely had CIDP and began treatment using intravenous gamma globulin.

Outcomes : Two years after the patient initially presented to his PCP and physical therapist with paresthesia in bilateral hands, the patient was correctly diagnosed with CIDP and IVIg treatment was started. Paresthesia in the patient's hands was improved, but the patient was left with severe pain in both hands.

Discussion : Physical therapists are biased toward explaining symptoms of paraesthesia by implicating impingement such as carpal tunnel syndrome or spinal nerve impingement. This patient was left with severe, persistent, chronic pain due to the delay in the accurate diagnosis of the cause of his initial paresthesia. Physical therapists need to be aware that the causes of paresthesia and weakness may be due to polyneuropathies such as CIDP, rather than impingement syndromes.

References: Must include 5 current references (less than 10 years old): Chroni E., Veltsista D, Gavanozi E, et al. Pure sensory chronic inflammatory polyneuropathy: rapid deterioration after steroid treatment. *BMC Neurol.* 2015. 15:27 doi:10.1186/s12883-015-0291-7. Nobile-Orazio E. Chronic inflammatory demyelinating polyradiculoneuropathy and variants: where we are and where we should go. *J Peripher Nerv Syst.* 2014;19(1):2-13. Bayas A1, Gold R, Naumann M. Long-term treatment of Lewis-Sumner syndrome with subcutaneous immunoglobulin infusions. *J Neurol Sci.* 2013;324(1-2):53-56. Vanhoutte EK, Latov N, Deng C, et al. Vigorimeter grip strength in CIDP: a responsive tool that rapidly measures the effect of IVIG - the ICE study. *Eur J Neurol.* 2013;20(5):748-755. Bussmann JB, Garssen MP, van Doorn PA, Stam HJ. Analysing the favourable effects of physical exercise: relationships between physical fitness, fatigue and functioning in Guillain-Barré syndrome and chronic inflammatory demyelinating polyneuropathy. *J Rehabil Med.* 2007;39(2):121-125.

TITLE: Impaired gait coordination after concussion; effects of dual task

AUTHORS/INSTITUTIONS: L.A. King, M. Mancini, C.W. Swanson, J. Chesnutt, Department of Neurology, Oregon Health Sciences University, Portland, Oregon, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : While gait may not be obviously impaired after concussion, there is some evidence suggesting that locomotion post concussion is suboptimal (1). Bilateral (interlimb) coordination of locomotion in humans has been quantified in different ways, one of which is the phase coordination index (PCI) (2). Dual task has also been reported to impair gait after concussion (3). We hypothesized that gait coordination would be impaired after concussion and that the incoordination would worsen by adding a dual task.

Number of Subjects : Twenty-two college athletes (age 20.6 ± 1.35 ; men 15, women 7) who sustained sports-related concussion 48-72 hours prior to testing and fifty age-matched students athletes with no history of concussion participated in the study. Athletes were tested at Portland State University, Lewis & Clark University, and George Fox University.

Materials/Methods : Subjects were asked to walk at their regular pace for 2 minutes and then to walk with head turns and while reading (dual task). Participants wore 3 Opal sensors, one on the posterior trunk at L5 and two on the ankles. The sensors record 3D accelerations and angular velocity and wirelessly stream data to a laptop. Spatio-temporal gait characteristics and PCI were derived using APDM system and software (4, 5).

Results : Our main finding was that the PCI was significantly higher in the concussion group when compared to controls (3.03 ± 0.85 vs 2.45 ± 0.60 , $p=0.003$) during regular gait. Stride time ($1.13s \pm 0.08$ vs $1.10s \pm 0.07$) and double support time ($24.08\% \pm 4.62$ vs $22.77\% \pm 3.91$) were slightly higher in the concussion group, while gait speed ($1.36 \pm 0.13m/s$ vs $1.40m/s \pm 0.12$) was slightly decreased, but differences didn't reach statistical significance. Across the dual task paradigms tested, the cost associated with adding a dual task was higher to the PCI compared to gait speed, and higher in the concussion group compared to controls. Specifically, the PCI increased (got worse) during walking while reading more in the concussed group ($36.12\% \pm 49.4$ concussed vs 18.02 ± 23.6 control) while gait speed decreased minimally for both groups ($-7.66\% \pm 3.12$ vs $-6.10\% \pm 4.57$). The cost of head turns while walking for PCI was $14.97\% \pm 25.30$ concussed vs $12.93\% \pm 16.28$ control and on gait speed was $-4.13\% \pm 2.99$ vs -2.26 ± 3.39 .

Conclusions : Traditionally, inter-limb coordination was thought to be generated only at the level of the spinal cord via central pattern generators but there is evidence that higher centers in the brain play an important role in inter-limb coordinating and may be further affected by dual task. The difference in mean PCI between the control and concussed groups is significant and suggests that PCI may be important to consider after a concussion.

Clinical Relevance : Though gait is not obviously impaired after concussion and not considered in return-to-play decision, this research provides some evidence that subtle coordination deficits may be present and can be detected with inertial sensors.

TITLE: Utilization of Sensory Discrimination Training for Improving Balance and Function in an Older Adult: A Case Report

AUTHORS/INSTITUTIONS: K. Zimney, B. Jordre, L. Inglis, A. Way, W. Ebke, J. Richey, A.K. Peterson, Physical Therapy, University of South Dakota, Vermillion, South Dakota, UNITED STATES]

ABSTRACT BODY:

Background & Purpose : Elderly individuals suffer from a heightened risk of falling that comes with increased age. In the elderly population decreased cutaneous sensation gradually declines with age. The decline in sensory functioning could be a factor leading to an increase in fall risk. Sensory discrimination training can improve sensory function. The purpose of our case report is to describe a novel use of a sensory discrimination training program on the plantar surface of the feet to improve sensory function and balance in an older adult.

Case Description : An 88 year-old female with balance deficits residing in an assisted living facility underwent a sensory discrimination training program. The intervention included a variety of sensory discrimination interventions each day to the plantar surface of the feet for 6 weeks. The intervention consisted of sensory discrimination of finding various items in a tub of beans, tactile discrimination of plastic letters and numbers with the plantar surface of the feet, discriminating different surfaces of carpet with their barefoot, and tactile stimulation of rubbing barefoot on a massage ball. The participant performed and documented these interventions daily up to 30 minutes each day for 6 weeks.

Outcomes : Improvements were made in the following assessments: Falls Efficacy Scale International (FES-I) (pre=28, post=29), Timed up and go (TUG) (pre= 17.18 sec, post=13.08 sec), Gait speed (GS) (pre=.78 m/sec, post=.81 m/sec), Functional Reach (FR) (pre= 15.1 cm, post=24.4cm) and Modified Clinical Test of Sensory Interaction and Balance (mCTSIB) (pre=72.66 sec., post=84.30 sec). Improvement of outcomes measurement scores meet minimal detectable change in TUG, GS, FR and mCTSIB. Her TUG and FR scores prior to the intervention placed this individual into a fall risk category; post intervention improvement placed her outside the risk category.

Discussion : A novel sensory discrimination intervention program over 6 weeks to the plantar surface of the feet exhibited favorable outcomes in improving balance measurement testing and enhancing subject's confidence in performing daily tasks with decreased fear of falling. Further research is warranted to validate the efficacy and efficiency of using sensory discrimination training to improve balance in elderly individuals to reduce risks of falling.

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TITLE: Reliability and Responsiveness of a Mobile Device Application for Measurement of Postural Sway in People with Parkinson Disease.

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ABSTRACT BODY:

Purpose/Hypothesis : Recent advancements in mobile technology are addressing the needs of health care professionals for affordable, portable and objective measures of postural sway; however, there is insufficient evidence for use in populations with neurologic conditions. The purpose of this study was to determine the test-retest reliability and responsiveness of the SWAY Balance™ mobile device application (SWAY) for measuring postural sway under varied static standing conditions in individuals with Parkinson disease (PD).

Number of Subjects : Thirty subjects with idiopathic PD who completed two sessions of testing were included in the analysis (mean age 69.2 ± 7.4 ; Hoehn & Yahr (H&Y) level 1= 20%, level 2=60%, level 3=20%; mean months since diagnosis 69.6 ± 51.6 ; female 57%).

Materials/Methods : Participants completed a Modified Clinical Test of Sensory Integration and Balance (mCTSIB) protocol (firm and foam surface with eyes open and closed each held for 30 seconds) and a Fall protocol (Romberg, semi-tandem, tandem and single leg each held for 10 seconds) from SWAY. Balance scores of 0-100 (100 indicates least sway) were calculated by SWAY for each condition and averaged as an overall score for each protocol. Three trials of each protocol were completed on two days, one week apart, at the same time of day and within one hour of taking their anti-PD medication. Intra-class correlation coefficients (ICC 2, k) were calculated on composite scores (derived as a mean from the two closest trial scores of the protocol) between day one and two. An ICC >0.60 was accepted as fair reliability, >0.75 as good reliability and > 0.90 as high reliability. Minimal detectable change (MDC) for both protocols at the 95% confidence interval was calculated.

Results : Test-retest reliability was high for the mCTSIB protocol (ICC = 0.96) and for the Fall protocol (ICC = 0.92). Minimal detectable change (MDC) for the mCTSIB and Fall protocol was calculated as 7.94 and 6.44 points respectively.

Conclusions : The mCTSIB and Fall protocols of SWAY can be used by health care professionals to reliably measure postural sway in individuals with PD who can reasonably maintain the test positions required. Both SWAY protocols were responsive to change with only a 6-7% change required to exceed potential measurement error.

Clinical Relevance : The SWAY balance application provides a reliable, objective, and user-friendly tool for measurement of postural sway that may enhance balance screening in this high fall-risk population. Its accessibility and economical cost allow it to be used by a variety of health providers including community health professionals who may not have access to or knowledge of more sophisticated measurement tools.

TITLE: The Effectiveness of Motor Imagery on Gait Outcomes in Individuals Post Stroke: A Systematic Review

AUTHORS/INSTITUTIONS: L.J. Barnes, M. Davis, R. MacNeill, M. Mikula, S. Woodward, K.J. Curbow Wilcox, School of Health Related Professions, Department of Physical Therapy, University of Mississippi Medical Center, Jackson, Mississippi, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Stroke is the foremost cause of chronic disability in adults worldwide. A stroke can lead to deficits in trunk control, balance, and gait kinematics with long term residual effects including risks of falls. Many of these patients have difficulties in achieving functional ambulation despite undergoing conventional physical therapy interventions. Motor imagery (MI), defined as the process of forming a mental representation of a task without producing any motor output, has been shown to improve gait abilities in individuals post stroke. The purpose of this systematic review is to determine the effectiveness of motor imagery on improving gait outcomes in post-stroke rehabilitation.

Number of Subjects : not applicable due to systematic review

Materials/Methods : PubMed and CINAHL databases were searched in September 2014 with date restrictions of 2005-2014 resulting in 21 possible articles for this review. Following the screening of titles, abstracts, inclusion criteria, and duplication within the two databases, 4 articles were chosen for review. Articles chosen met the inclusion criteria of: use of motor imagery as an intervention, study participants with residual gait deficits following stroke, and comparison of motor imagery to a control. Studies that used virtual reality were excluded. Study quality was evaluated using the PEDro scale; an 11-point scale, with 10 points measuring internal validity and 1 point measuring external validity of physical therapy intervention studies. Higher scores indicate higher internal validity for individual studies. Study designs were scored using the 2011 Centre of Evidence Based Medicine (CEBM) scale on a 5-point scale with lower numbers indicating higher levels of evidence based primarily on study design.

Results : The screening process led to 4 articles chosen for the review. The average PEDro score was 6.5, with a range of scores from 6-8. Each article scored II on the CEBM level of evidence scale. Experimental groups using MI in all studies demonstrated significant within-group improvements in parameters of gait, indicating that MI added to more traditional gait training may positively impact gait-related outcomes. Three of the four studies demonstrated significant between group improvements in a variety of gait parameters when comparing motor imagery added to conventional gait training to interventions of conventional gait training alone.

Conclusions : In all studies, MI demonstrated significant within-group improvements in parameters of gait indicating that MI added to more traditional gait training may positively impact gait-related outcomes. Three of the four studies showed significant between-group differences in a variety of gait parameters when MI was added to conventional gait training and compared to conventional gait training alone.

Clinical Relevance : The utilization of motor imagery in conjunction with traditional gait training strategies in patients post-stroke may lead to better outcomes in various gait characteristics including speed, distance, and balance reactions.

TITLE: The effect of posterior walker training on walking function after chronic spinal cord injury: A case study
AUTHORS/INSTITUTIONS: K. Mattern-Baxter, S. Yanez, R. Myers, T.D. MacLeod, M. McKeough, Physical Therapy, California State University, Sacramento, Sacramento, California, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Overground training has been shown to improve walking function after spinal cord injury (SCI) even in the absence of neurological recovery. This case study examined whether an intensive program of ambulation in a reverse walker (RW) could improve walking function in a borderline-ambulatory, wheelchair-dependent subject with C5 incomplete SCI, AISA Impairment Scale (AIS) C.

Number of Subjects : The subject was a 21-year old male former football athlete who suffered a C3/4 burst fracture during a football game 5 years prior to study onset, resulting in incomplete SCI at C5, AIS C. Since his injury, the subject had regained some supervised therapeutic ambulation with a platform walker (PW), but used a manual wheelchair for all locomotion.

Materials/Methods : The patient was assessed at study onset and after a 6-week training session consisting of 16 sessions of intensive walking training with a RW. A self-reported measure of confidence during walking activities, 3-D biomechanical motion analysis, Physiological Cost Index (PCI), timed 10-meter walk test (10MWT), 6-minute walk test (6minWT), and the Walking Index for Spinal Cord Injury-II (WISCI-II) were used as outcome measures.

Results : The subject reported immediate superior safety ratings in the RW compared to the PW, 8.2/10 versus 3/10, respectively (1= "extremely unsafe" and 10= "extremely safe"). He showed improvements in gait mechanics, PCI, and walking speed but not walking endurance in the RW condition compared to the PW condition, but they did not exceed the Minimal Clinically Important Difference (MCID) or Minimal Detectable Change (MDC). After 6 weeks of training, the subject improved self-selected walking speed on the 10MWT from 0.14 m/s to 0.22 m/s, exceeding the MCID with a decreased PCI from 3.87 beats/minute (b/min) to 3.14 b/min. Maximum walking speed improved from 0.27 m/s to 0.43 m/s, exceeding the MDC, with a decrease in PCI from 3.77 b/min to 2.13 b/min. Walking distance on the 6minWT increased from 42.6 meters (m) to 63.5 m. The subject improved the WISCI-II score from 8 to 13, indicating a change from supervised to independent walking. Biomechanical gait analysis revealed improved performance in double-support time, stance time and step length symmetry in the RW versus the PW.

Conclusions : The results of this case study show that the use of a RW led to superior gait temporospatial parameters, improvements in walking speed and self-reported safety compared to a PW even without practice in a young adult with C5 SCI, AIS C. An additional 6 weeks of training in the RW led to independent ambulation with improved walking speed and distance and decreased energy expenditure.

Clinical Relevance : This case study demonstrates that the use of a RW could lead to immediate positive effects on patient-perceived safety, walking speed, temporospatial gait parameters and energy expenditure compared to a PW in a patient with chronic SCI C5, AIS C. After 6 weeks of training, the patient progressed from supervised to independent ambulation with further improvements in walking capacity.

TITLE: RELATIONSHIPS BETWEEN FUNCTIONAL VESTIBULAR DEFICITS AND FORWARD HEAD POSTURE IN COMMUNITY-DWELLING OLDER ADULTS

AUTHORS/INSTITUTIONS: L. Allison, S.J. Migliarese, E. White, A. Greenberg, B.P. Messersmith, Physical Therapy, Winston-Salem State University, Winston-Salem, North Carolina, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Vestibular deficits are frequent in persons over age 60. Older adults also often display a forward head posture [FHP]. Research indicates that older adults with vestibular hypofunction are more prone to FHP, and this combination increases fall risk. Clinicians working with vestibular-deficient patients may not consider the potential effects of FHP on fall risk, and vice versa. The purpose of this study was to determine if there is a relationship between functional vestibular deficits and FHP in independent, community dwelling older adults.

Number of Subjects : Thirty community-dwelling adults (20 women) with a mean age of 76 yrs (SD=6.3; range 66-90) completed this study. Participants were without neurologic conditions, or any injuries or surgeries to the cervical spine or shoulder in the prior eight months.

Materials/Methods : Consented participants attended a single two-hour test session at a biomechanics laboratory. FHP was measured two ways, distance in cm with the Cervical Range of Motion device [CROM], and angle in deg with measures taken from sideview photographs in sitting & standing. Functional vestibular measures taken using the SMART® Balance Master (NeuroCom Intl, Inc) included the Sensory Organization Test (SOT)®, Head-Shake SOT® [HS-SOT], and Dynamic Visual Acuity Test® [DVAT]. Data were analyzed with Pearson's Product moment correlations using significance set at $p \leq 0.05$ (SPSS® v. 21).

Results : The standard HS-SOT protocol was too difficult for most participants to complete; only 7/30 were able to perform both HS-SOT Conditions 2 & 5. Seated and standing photographic FHP angular measures were significantly correlated with all three vestibular-relevant SOT measures (SOT-Condition 5, SOT Vestibular Ratio, and SOT Composite). Of the four DVAT measures, standing FHP angle was significantly correlated with DVAT-Static, and seated FHP angle was significantly correlated with DVAT-Static & DVAT Loss Right. FHP CROM measures were not correlated with any SOT measures, but were significantly correlated with DVAT-Static & DVAT Loss Right.

Conclusions : There is a moderately significant relationship between vestibular system dysfunction (as measured by the SOT and DVAT) and FHP (as measured by photographic FHP angles). This relationship might be more apparent if a measure more challenging than the SOT®, but less difficult than the current HS-SOT®, were developed.

Clinical Relevance : The standard HS-SOT protocol requires modification to be feasible for older adults. Older adults presenting with vestibular impairments should be screened for FHP, and vice versa.

TITLE: Concussion Balance Test (COBALT): An Objective Measure of Vestibular Balance Function in Athletes

AUTHORS/INSTITUTIONS: S. Massingale, A. Alexander, E. McQueary, S.M. Erickson, Banner Concussion Center, Phoenix, Arizona, UNITED STATES|R. Gerkin, Department of Medical Education, Banner University Medical Center Phoenix, Phoenix, Arizona, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Balance problems and dizziness are common following a concussion. Dizziness at the time of injury is one of the top three risk factors for prolonged recovery in sports-related head trauma. Force plate technology provides objective information about an individual's balance by calculating sway values that can identify how one uses visual, vestibular and somatosensory inputs for balance. One of the most widely used force plate balance tests is the modified Clinical Test for Sensory Integration and Balance (mCTSIB). This tool has high reliability in testing postural instability following head trauma but does not appear to be sensitive when identifying vestibular dysfunction in higher functioning individuals. Adding the head shake test to the mCTSIB adds sensitivity when measuring peripheral vestibular function. Testing visual motion sensitivity with post head trauma (VOR cancellation) is an effective indicator in concussion assessment. The purpose of this study was to develop a postural control balance assessment for baseline and post-concussion testing which actively stimulates the vestibular system using force plate technology. This study focused on defining normal ranges of balance function with vestibular stimulation for athletes by age group.

Number of Subjects : 634

Materials/Methods : This is a retrospective study involving 411 males, 223 females, ages 12-34, all of whom participated in sports. The test includes eight conditions: 1-4 on firm and 4-8 on compliant surface. Four conditions are performed in static conditions (mCTSIB), two are with eyes closed with head shaking at 85deg/sec (on firm and foam), two with eyes open on a fixed target with trunk rotation at 45deg/sec (VOR cancellation firm and foam). The sway scores calculated from the force plate were taken for two trials on each condition. Percentiles were calculated for each condition for each of 3 age groups (10-13, 14-17, 18-34).

Results : Two Conditions (head shake eyes closed on foam and VOR cancellation in CR on foam) resulted in the highest mean sway scores. There was not a significant difference in sway scores between genders. The mean sway score for each of the two conditions improved (sway decreased) with increasing age and stabilized at age 19 and above. 76% of all subjects had no errors on either of the two conditions.

Conclusions : This study provides ranges of sway scores on two conditions using portable force plate technology with active vestibular stimulation. These scores can be utilized to determine normal postural control with vestibular stimulation at both baseline and post-concussion testing.

Clinical Relevance : Currently, baseline balance testing is performed using measures that do not focus on actively stimulating the peripheral and central vestibular system. These scores may provide clinicians with normative data on balance function while actively stimulating the vestibular system at a pre-morbid level that can be used to assess recovery following concussion.

TITLE: Community Mobility After Stroke: A Systematic Review

AUTHORS/INSTITUTIONS: S.A. Wesselhoff, C.C. Evans, T. Hanke, Department of Health Sciences, Midwestern University, Downers Grove, Illinois, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Stroke is the leading cause of severe disability in older adults and many stroke survivors report having long term physical or cognitive impairments years after their stroke. These long term impairments can impact stroke survivors' ability to achieve full mobility and participation in their community. The objective of this systematic review was to determine the extent to which chronic stroke survivors achieve community mobility (CM), using validated stroke rehabilitation outcome measures.

Number of Subjects : 1478

Materials/Methods : This review used rehabilitation relevant participation level outcome measures as an objective way to determine CM in chronic stroke survivors. Studies were located using the following databases: MEDLINE, CINAHL, Pubmed, PEDro and the Cochrane Collaboration. The criteria for a study to be included in this review were as follows: 1) utilized one of the validated CM-related outcome measures from the StrokEDGE (American Physical Therapy Association, Neurology Section, StrokEDGE Taskforce) 2) analyzed chronic (>3 months post) stroke survivors 3) was a randomized controlled trial, observational or cohort study and 4) was published after 2001. Each study's CM related outcome data was extracted and analyzed to address the review objective.

Results : Fourteen total studies were found to meet all of the inclusion criteria. The results demonstrated that even stroke survivors who were generally considered to be high functioning have impaired CM as demonstrated by values of 30.0-83.1% of full CM based on the respective outcome measures. As time post-stroke increases, CM improved slightly; however, stroke survivors even 2-4 years post-stroke scored significantly lower on CM outcome measures when compared to age-matched cohorts. Factors which appeared in multiple studies or were moderately/highly correlated with the CM related outcome measures were age, level of education, general well-being, emotional state, motor function, motor coordination, ability to independently accomplish activities of daily living, balance, endurance and driving status.

Conclusions : Even in this relatively high functioning cohort, stroke survivors have limited CM. As time post-stroke increases, small improvements in CM may occur; however limitations are still present up to 2-4 years after incident. Additionally, stroke survivors have a significantly lower level of CM when compared to healthy age-matched samples. Furthermore, the level of CM a stroke survivor can achieve is dependent on a multitude of physical, personal and environmental factors.

Clinical Relevance : Physical therapy rehabilitation for stroke survivors that addresses motor function, coordination, independence in activities of daily living, balance and endurance is important in helping stroke survivors achieve CM. Also, given the interaction between physical and contextual factors and sustained low levels of CM post-stroke, an increased emphasis on the comprehensive management of barriers to CM in the acute and chronic periods is warranted.

TITLE: Intensity and duration of physical activity during acute rehabilitation for traumatic brain injury
AUTHORS/INSTITUTIONS: L. Rachal, S. Driver, Baylor Institute for Rehabilitation, Dallas, Texas, UNITED STATES|C. Swank, Texas Womans University, Dallas, Texas, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Repetition and intensity are key components for improved outcomes during inpatient rehabilitation following traumatic brain injury (TBI). However, little is known about the intensity and duration of activity completed by patients post TBI undergoing rehabilitation. Evidence from the stroke literature suggests that activity levels are very low and contribute to poor long-term outcomes. Therefore, our purpose is to report on initial data collected with accelerometers to describe the activity levels of individuals with TBI during acute inpatient rehabilitation.

Number of Subjects : 21

Materials/Methods : Participants were ages 18-70 and ≤ 3 months post moderate to severe TBI. Participants wore an Actiwatch 2 on their least involved upper extremity from consent until discharge (M=8 days). The Actiwatch captured data in 60 second epochs to measure activity counts (AC), sleep/wake time, mobile/immobile time, average length of mobile/immobile bouts. This data was then divided into 3 categories reflecting the daily rehabilitation schedule (therapy time, non-therapy time, and sleep time).

Results : Individuals completed an average of 161.4 AC during therapy time, spent 711.9 min/day immobile (including sleep) and 727.6 min/day mobile (50.5% of 24 hour period). The average length of mobile bouts was 9.0 min. Based on population level normative values, 16 participants were considered sedentary (<100 AC/min) and 5 inactive (100-499 AC/min). Results are comparable to acute stroke studies that reported individuals spent up to 94% of the day inactive.

Conclusions : Activity levels during acute rehabilitation are very low. Generally individuals are considered inactive, even during therapy time, and inactive/sedentary during non-therapy time.

Clinical Relevance : These low activity levels are not reflective of recommendations for intensity during acute recovery following TBI. Intensity and repetition are key factors in recovery of function. Clinicians may need to identify ways to increase the dosage of activity provided during inpatient rehabilitation.

TITLE: Gait speed beyond the clinic: the impact of environment on gait speed in people with acquired brain injury.
AUTHORS/INSTITUTIONS: G. Fulk, Physical Therapy, Clarkson University, Potsdam, New York, UNITED STATES|
C.D. Nirider, A. Kalpathi, Rehabilitation, Touchstone Neurorecovery Center, Conroe, Texas, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Gait speed is commonly used in people with acquired brain injury (ABI) to assess walking performance. The purpose of this study was to explore the impact of different environments on gait speed in people with ABI.

Number of Subjects : 26 participants with ABI, mean age of 50 (15.2) and mean MMSE of 27.2 (2.1).

Materials/Methods : Gait speed was measured under 4 conditions: 1) comfortable gait speed during a 10m walk in the clinic, 2) gait speed while performing the Walking and Remembering Test (WRT) in the clinic, 3) gait speed measured while participants walked 10m outdoors on the campus of a post acute rehabilitation center, and 4) gait speed while participants walked 10m in a big box store in the community while shopping. Participants did not know they were being timed while walking in conditions 3 and 4. The difference in gait speed under the 4 conditions were compared using a repeated measures ANOVA, and the agreement in gait speed under the 4 conditions were analyzed using ICC2,1 and the Bland Altman method.

Results : Mean gait speed in the clinic was 1.26 m/s (0.30), gait speed during the WRT was 1.24 m/s (0.39), gait speed on the campus 1.18 m/s (0.22), and gait speed in the big box store was 1.17 m/s (0.24). The repeated measures ANOVA revealed no significant difference in gait speed among the different environments, $p > 0.05$. The ICC2,1 between the different environments were all below 0.70 with the exception of gait speed on campus and in big box store, which was 0.84. The other ICCs ranged from 0.54 (gait speed with WRT and in big box store) to 0.68 (gait speed in the clinic and in big box store). The mean difference in gait speed among the different environments ranged from 0.004 m/s (limits of agreement: -0.26 to 0.27) (gait speed on campus – in big box store) to 0.089 m/s (limits of agreement: -0.32 to 0.50) (gait speed in clinic – in big box store).

Conclusions : There was no statistically significant difference between gait speed in the different environments, although there was considerable variability among the participants. However, there was not strong agreement between participants' gait speed in the different environments. Gait speed was slowest in the two community environments possibly reflecting greater requirements for walking in these two open environments. A limitation of our study is that the participants were relatively high functioning and small sample size.

Clinical Relevance : Gait speed measured in the clinic may be reflective of walking speed in the community in high functioning people with ABI.

TITLE: Effects of Whole Body Vibration on People with Post-Polio Syndrome

AUTHORS/INSTITUTIONS: C.P. Da Silva, L. Szot, School of Physical Therapy, Texas Woman's University, Houston, Texas, UNITED STATES|Y.M. Pu, Physical Medicine and Rehabilitation, Baylor College of Medicine, Houston, Texas, UNITED STATES|N. deSa, Physical Therapy, TIRR - Memorial Hermann Rehabilitation and Research, Houston, Texas, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of this study was to determine the feasibility of whole body vibration (WBV) as a means of weight bearing exercise in people with post-polio syndrome (PPS) by assessing its effects on walking speed (10 meter walk test) and endurance (2 minute walk test), pain severity and interference (Brief Pain Inventory), sleep quality (Pittsburg Sleep Quality Index), fatigue (Fatigue Severity Scale), leg muscle strength (manual muscle testing and hand-held dynamometry), and muscle cramping (patient reported written logs).

Number of Subjects : 21 individuals were recruited from the TIRR-Memorial Hermann out-patient post-polio clinic and area support groups. 15 completed the study, with withdrawals due to non-study related reasons.

Materials/Methods : Each person participated in 8 sessions of WBV over 4 weeks on 2 different WBV platforms in a crossover experimental design with treatment order randomized. Each person stood on the platform with knees slightly bent and weight as evenly distributed, as possible. Subjects did not wear their orthoses during sessions. People who were unable to stand sat in a wheelchair/chair next to the platform with feet on the platform, leaning forward. Each person started with 1 minute standing with vibration on, 1 minute sitting down with no vibration, repeating this sequence 10 times for a total of 10 minutes of vibration time per session gradually increasing to 20 total minutes. The low intensity protocol of 4 weeks occurred on the Soloflex at its lowest setting, and the higher intensity protocol of 4 weeks occurred on the Power Plate Pro5 at settings of 35 vibrations per second, low amplitude. When measured with a separate accelerometer, the total amplitude of the Power Plate was 8.82 millimeters and the Soloflex was 4.53 millimeters. The g forces were 2.76 on the Power Plate and 2.21 on the Soloflex. A physical therapist blinded to treatment order performed pretest, post-test, second pretest after 2 week wash-out period, second post-test, and follow-up test after 2 weeks. Descriptive statistics, cross-tabulations, and Mann-Whitney U tests were performed to determine differences between intervention groups for the demographic variables. Wilcoxon signed-ranks tests were used to study changes over time by intervention group.

Results : There were no study-related adverse events. Subjects improved in walking speed ($p = 0.018$), pain severity ($p = 0.049$) and pain interference ($p = 0.055$) after Power Plate vibration intervention, regardless of treatment order. No significant changes were found after the low intensity vibration or in other outcome measures.

Conclusions : The biggest study limitation was small sample size. Strengths included blinded testers and randomized treatment order. Further research needs to be done to study long term use in people with PPS and other neurological conditions, particularly in reducing barriers to participation to promote the physical aspects of health and wellness.

Clinical Relevance : WBV appears to be a safe, tolerable, and feasible type of weight bearing exercise for people with PPS.

TITLE: Focused Stepping Training Improved Balance, Gait and Quality of Life in a Person with Chronic Severe Stroke

AUTHORS/INSTITUTIONS: N. Pederzoli, V. Miller, J. Freund, Elon University, Elon, North Carolina, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : Persons with severe stroke benefit from rehabilitation although functional gains are fewer and slower. Preliminary research by Hornby et al. indicates focused stepping training in variable contexts is feasible and results in functional improvements in individuals post stroke. The purpose of this case report is to describe the effects of focused stepping training in variable contexts in an adult with chronic severe ischemic stroke.

Case Description : The patient was a 57 year old male who 8 months prior sustained an ischemic stroke with resultant infarcts of the right occipital lobe and bilateral superior cerebellar and pontine areas of the brain with a primary motor deficit of left-sided hemiparesis. He used a power wheelchair for mobility, but could walk very short distances with a knee-ankle-foot orthosis and rolling walker with left hand support. The patient participated as a volunteer in a local university physical therapy course for 10 one hour sessions over 4.5 weeks. The primary intervention was challenging, high-repetition stepping training over ground in various directions, surfaces and with cognitive tasks and forward stepping on a treadmill with partial body weight support. The patient was within 40%-60% of his heart rate reserve throughout the stepping bouts. The patient's daily step activity was monitored and reported to the patient weekly.

Outcomes : Outcome measures that improved pre to post-intervention are as follows: self-selected gait speed (0.06 m/s, 0.21 m/s), Berg Balance Scale (BBS) (11/56,19/56), 6 Minute Walk Test (6MWT) (20.17 m, 78.5 m), Function in Sitting Test (FIST) (44/56, 49/56), unsupported standing time (1 min 14 sec, 3 min 4 sec), sit-to-stand transfers and gait assistance (moderate, contact guard), average steps per day (837, 2,293), Stroke Impact Scale (SIS) [emotion 22.2%, 44.4%, activities of daily living (ADL) 14%, 24%; mobility 28.9%, 40%]. The patient had no reported falls during the intervention period.

Discussion : Focused stepping training in variable contexts resulted in functional improvements in an individual with chronic severe stroke. The patient's outcomes exceeded the minimal detectable change for the BBS and the minimal clinically important difference for self-selected gait speed, 6MWT, and SIS ADL and mobility subscales. Forward stepping on a treadmill with partial body weight support allowed for a gait training speed 10 times faster than his initial over ground walking speed and increased steps per session. The variable contexts of over ground stepping training provided progressive gait challenges. Both over ground and treadmill stepping training also provided a moderate intensity aerobic challenge. Additionally, wearing the step activity monitor encouraged the patient to increase walking at home. Focused stepping training in variable contexts may be effective in improving balance, gait and quality of life in individuals with chronic severe stroke.

References: Must include 5 current references (less than 10 years old): 1. Pereira, S., Graham, J. R., Shahabaz, A., Salter, K., N., F., Meyer, M., & Teasell, R. Rehabilitation of individuals with severe stroke: synthesis of best evidence and challenges in implementation. *Top. Stroke Rehabil.* 2012;19(2), 122-1312. Hornby GT, Holleran CL, Leddy AL, et al. Feasibility of focused stepping practice during inpatient rehabilitation poststroke and potential contributions to mobility outcomes. *Neurorehabil Neural Repair.* 2015 Feb 26.Epub ahead of print.3. Holleran CL, Straube DD, Kinnaird CR, Leddy AL, Hornby TG. Feasibility and potential efficacy of high-intensity stepping training in variable contexts in subacute and chronic stroke. *Neurorehabil Neural Repair.* 2014; 28(7):643-51. 4. Holleran CL, Rodriguez KS, Echaz A, Leech KA, Hornby TG. Potential contributions of training Intensity on locomotor performance in Individuals With chronic stroke. *J Neurol Phys Ther.* 2015;39(2):95-102.5. Straube DD, Holleran CL, Kinnaird CR, et al. Effects of dynamic stepping training on nonlocomotor tasks in individuals poststroke. *Phys Ther.* 2014;94:921–933.

TITLE: Describing Cognitive and Physical Characteristics of Transit Plus Riders in Milwaukee County

AUTHORS/INSTITUTIONS: S. Runingen, K. Pettis, L. Bauer, K. Zalewski, Kinesiology-IHCP, University of Wisconsin-Milwaukee, Milwaukee, Wisconsin, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Transit Plus (TPlus) is a transportation service for people with a disabling illness or condition that prevents them from using mass transit. Currently, there is no body of literature evaluating the essential physical, cognitive, and sensory functions necessary to ride the bus. This is a preliminary examination of TPlus applicant assessments for older adults in the Milwaukee County Transit System (MCTS). The purpose of this study is to describe the physical and cognitive characteristics of people rated as unconditionally eligible (UC) or conditionally eligible (CO) for TPlus in Milwaukee County.

Number of Subjects : 92 applicants to the TPlus program who live in adult residential and supported living facilities in Milwaukee County were assessed between September 1 and December 31, 2014.

Materials/Methods : Applicants provided demographic data and TPlus and county buss ridership history. Cognitive ability was assessed with the Mini Mental State Examination (MMSE); functional performance was assessed using comfortable and fast gait speed, and 2 Minute Walk Test. Based on these findings, applicants were classified as UC (N=64) or CO (N=28). UC applicants are unable to ride the bus under any conditions; CO applicants are able to ride the bus under some conditions. Descriptive statistics and T-tests are used to examine group differences on the dependent measures.

Results : The UC group is older than the CO group (mean=73.73 years, SD=12.74), ($t(90)=-3.07$, $p<0.05$). In addition, those in the UC have a lower MMSE score than the CO group (mean=22.0, SD=6.731; $t(84)=3.62$, $p<0.05$). Although the UC group has a higher mean comfortable gait speed, there is no significant difference between the two groups (UC mean=1.12 m/s, SD=0.70; CO mean=0.97, SD=0.34; $t(18)=-0.59$, $p=NS$). There is no significant difference between the two groups fast gait speed ($t(16)=-1.75$, $p=NS$) or 2 Minute Walk Test for people ambulatory ($t(26)=1.28$, $p=NS$) or completing with a self-propelled manual wheelchair ($t(18)=1.10$, $p=NS$).

Conclusions : Based on these preliminary findings it appears that cognition is more predictive of the need for full access to TPlus program rather than physical ability. This is not surprising as functional capacity is more easily accommodated than cognitive ability. Results are preliminary and cautious as sample sizes are relatively small and limited to those who reside in residential facilities. However, the information provides support for a streamlined functional assessment to assist in determining eligibility for the TPlus program, with a focus on developing assessments to consider judgment, memory, and pathfinding in the assessment process to further describe the essential functions of mass transit.

Clinical Relevance : Physical therapists can and should be part of the assessment process for active participation in mass transit.

TITLE: Addressing Postural Instability with Proximal Stability and Visual Integration in a Patient with Essential Tremor and Prolonged Deep Brain Stimulation: A Case Study.

AUTHORS/INSTITUTIONS: K. Sims, E. Ulanowski, Norton Healthcare, Louisville, Kentucky, UNITED STATES|M. Danzl, Bellarmine University, Louisville, Kentucky, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : Essential Tremor is the most common movement disorder and is a progressive neurological disease. Currently, there is no pharmaceutical solution to fully address the impairments of tremor, postural instability, decreased gait speed, and ataxia associated with Essential Tremor. Many patients opt for Deep Brain Stimulation (DBS) surgery to address the disabling tremors. Research indicates, however, that optimal DBS settings do not improve postural instability and gait impairments. Anecdotally, the specificities of postural instability and gait impairments in those with Essential Tremor appear to mimic cerebellar dysfunction. These impairments may improve with physical therapy interventions established in the literature as efficacious for treating individuals with diagnoses of cerebellar dysfunction. The use of physical therapy interventions, aimed at addressing impairments traditionally associated with cerebellar dysfunction, for individuals with Essential Tremor and prolonged DBS has not been described in the literature. The purpose of this case study is to describe such an approach.

Case Description : An active 61 year-old male with a diagnosis of Essential Tremor and Prolonged Bilateral DBS, performed nine years prior, participated in Outpatient Physical Therapy two times per week for 8 weeks. Patient is currently not using an assistive device for mobility and is independent with his activity of daily living. His chief complaints were increasing balance concerns with more frequent loss of balance in the posterior direction and reports of one fall a week. He also noticed worsening tremors over the past several years. This patient was referred to Outpatient Physical Therapy to address his postural instability and gait impairments. The physical therapy intervention chosen aimed to improve proximal stability with patient awareness and visual integration.

Outcomes : Pre-, mid-, and post-data were collected with the following outcome measures: Functional Gait Assessment (FGA), Berg Balance Scale (BBS), 10 meter walk test, and 5 times sit to stand (5xSTS). Post-measures indicate a decreased risk of falls, improved gait speed (1.13 m/s to 1.3 m/s), and clinically meaningful improvements in all outcome measures (BBS improved from 44/56 to 56/56, FGA increased from 13/30 to 25/30, 5xSTS decreased from 18 to 12.9 seconds).

Discussion : This case study describes a physical therapy approach for an individual with postural instability and gait impairments due to Essential Tremor and following prolonged DBS. The plan of care aimed to improve patient deficit awareness, proximal stability and visual integration, using common interventions for individuals with cerebellar dysfunction. This patient demonstrated a clinically significant change in falls risk and gait speed after performing interventions of proximal stability and visual integration in the outpatient physical therapy setting. Further research examining this approach is warranted

References: Must include 5 current references (less than 10 years old): 1.Benito-Leon, J., Louis, E. (2006). "Essential Tremor: emerging views of a common disorder." *Nature Clinical Practice* 2 (12):666-678.2.Earhart, G., Clark, B., et al. (2009). "Gait and Balance in Essential Tremor: Variable Effects of Bilateral Thalamic Stimulation." *Mov Disorder* 24 (30): 386-3913.George, R., Nutt, J., et al. (2010) "A Meta-regression of the long-term effects of deep brain stimulation on balance and gait in PD." *Neurology* 75 :1292-1299.4.Gironell, A., Kulisevsky, J. (2009) "Diagnosis and management of essential tremor and dystonic tremor." *Ther Adv Neurol Disord* 2 (4) 215-222.5. Tassorelli, C., Buscone, S., et al. (2009) "The role of rehabilitation in deep brain stimulation of the subthalamic nucleus for Parkinson's disease: A pilot study." *Parkinsonism and Related Disorders* 15:675-681.

TITLE: Effects of Dual Task Training on Balance and Mobility in Persons with Parkinson's Disease: A Systematic Review

AUTHORS/INSTITUTIONS: B. Cipriano, P.E. Fleagle, V. Nguyen, A. Studwell, R.M. Hakim, Physical Therapy, University of Scranton, Scranton, Pennsylvania, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of this systematic review was to determine the effects of dual task (DT) training on balance and/or mobility in adults with Parkinson's Disease (PD).

Number of Subjects : N/A

Materials/Methods : A literature search was conducted using MEDLINE/PubMed, CINAHL, ProQuest, ScienceDirect and hand-searching. Search terms included (dual task* OR multiple task* OR multi task* OR secondary task* OR concurrent task*) AND (Parkinson*). Search limits: peer-reviewed studies (2005-2015), English and human subjects. Selection criteria required adults at least 18 with PD, DT training, balance and/or mobility outcomes, and a control or comparison group. Two reviewers independently assessed each article for methodological quality and came to consensus using PEDro guidelines.

Results : A total of 311 articles were screened for eligibility and 6 articles met selection criteria. PEDro scores ranged from 5 to 9/10 (avg=6.7). Samples ranged from 12 to 223 participants (409 total) with mild to severe PD (H&Y stages I-IV). All DT training included simultaneous performance of a motor (e.g., walking, video gaming) and a cognitive task (e.g., math). Program parameters varied widely from 1 to 30 sessions (30-60 min) over 1 day to 10 weeks duration for 2 to 5 times/week. Outcome measures assessed balance (e.g., BBS, BESTest), gait (velocity, step length, cadence), PD-specific function (UPDRS, PDQ-39), and cognition (e.g., MOCA, SCOPA-COG, BADS, GAS). All studies found statistically significant improvements in balance and/or mobility after DT training. Four of 6 studies found DT training outcomes were significantly better than a control or comparison group, while 2 studies found significant within-group gains; however, no between-group differences were found for Nintendo Wii Fit DT training compared to standard balance training and for fixed attention versus variable priority DT training. Four out of 6 studies showed significant gains in PD-specific functional outcomes after DT training. One study found that combined multimodal cognitive and motor DT training resulted in significant improvements of cognition and goal attainment (e.g., planning, decision-making, recall) compared with cognitive or transfer training alone.

Conclusions : There is moderate evidence in support of both short (one session) and longer term (3-10 weeks) DT training to improve balance and/or mobility in patients with mild to severe PD. Limitations included small samples, varied protocols/measures and a lack of long-term follow up. Future RCTs should focus on determining the optimal mode and parameters for DT training.

Clinical Relevance : Clinicians should consider use of DT training in patients with PD to improve balance and mobility during increased cognitive load. Instructions to prioritize attention (take big steps) or to divide attention (between postural control and a cognitive task) can provide task-specific training under DT conditions. DT training is feasible and easily implemented in the clinic or home setting to better prepare persons with PD to meet real world functional demands.

TITLE: Kinematic Adaptations during Walking using a Wearable, Bionic Exoskeleton in Healthy Individuals

AUTHORS/INSTITUTIONS: S. Galen, V.M. Pardo, A. Devour, Physical Therapy, Wayne State University, Detroit, Michigan, UNITED STATES|C.A. Larson, L. Berndt, K. Larsen, H. VanDerWeele, L. VanStrien, Physical Therapy, University of Michigan - Flint, Flint, Michigan, UNITED STATES|M.J. Denes, Center for Spinal Cord Injury Recovery, Rehabilitation Institute of Michigan, Detroit, Michigan, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Wearable, bionic exoskeletons are enabling individuals with spinal cord injury (SCI) to attempt walking after they have sustained either a complete or incomplete injury. The purpose of this study was to examine the kinematic patterns in individuals without pathology while they walked over-ground with full assistance of an exoskeleton as compared to walking without the exoskeleton device. Since the exoskeleton is intended to be a rehabilitation device, the hypothesis was that the kinematics (joint range of motion (ROM) and temporal pattern) would be the same in both conditions: walking with and without the exoskeleton.

Number of Subjects : Ten healthy participants (4 females, 6 males; mean age: 24.7±1.8 years)

Materials/Methods : Lower extremity (LE) kinematics were recorded using the Optotrak Certus 3D motion capture system (NDI, Waterloo, Canada). A cluster marker system was used to record the kinematics. Each individual completed 6 trials of over-ground walking while wearing the exoskeleton (EksoTM, Ekso Bionics, Richmond, CA) and using loftstrand crutches and 6 trials while walking without the exoskeleton/crutches at a self-selected walking speed. The LE skeleton was reconstructed using a previously validated model.¹ C-motion visual 3D software (C-Motion, Inc., Germantown, MD) was used to compute the LE kinematics. Kinematic data from a single stride was recorded for each walking trial and then averaged. Comparisons were made of the averaged hip, knee, and ankle ROM throughout the gait cycle generated in the two conditions.

Results : When walking while wearing the exoskeleton, the hip and knee ROM remained comparable; however, the temporal pattern of cycling from flexion to extension in both the hip and knee were greatly altered. The mid-to-terminal swing phase (80-100%) was characterized by rapid hip and knee flexion and there was a prolonged stance phase duration while walking with the exoskeleton. The ankle ROM during the entire gait cycle was reduced to 10 degrees (dorsiflexion to plantarflexion) while walking with the exoskeleton.

Conclusions : Using the default settings and 100% exoskeleton assistance when healthy individuals walked over-ground, hip and knee ROM was comparable with and without the exoskeleton. However, ankle ROM and hip/knee temporal kinematic patterns were considerably altered throughout the gait cycle.

Clinical Relevance : While the exoskeleton allows individuals with SCI to walk over-ground, using the default settings does not precisely retrain typical gait patterns. Further exploration of individualizing the exoskeleton parameters such as step length and duration is needed to see if more typical gait patterns will emerge. If not, then individuals with SCI will need to re-adapt their kinematics when transitioning from exoskeleton-assisted-walking to over-ground walking without the device.

TITLE: The Validity of the Supine Hip Extensor Test (SHET) for Strength Testing in Individuals After Stroke

AUTHORS/INSTITUTIONS: J. Cormack, K. DeMars, K.N. Ederer, Physical Therapy, California State University, Long Beach, Long Beach, California, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of the study is to determine if the SHET is a valid measure of hip extensor force production in individuals with Upper Motor Neuron (UMN) disorders. We hypothesized that the SHET would not be a valid hip extension strength test for subjects without selective movement, but it would be valid for those who have selective movement.

Number of Subjects : Twenty-six individuals with a history of UMN pathology were recruited from local neurologic physical therapy clinics. Participants ranged in age from 23-78 years old, and time since onset was 6-127 months.

Materials/Methods : Subjects were tested for selectivity using the lower extremity (LE) portion of the Fugl-Myer (FM) and split into 2 cohorts: nonselective motor control (score of 1-14); selective motor control (score of 15-22). Force production of the hip extensors was assessed via Manual Muscle Testing (MMT) and Hand-Held Dynamometry (HHD) in modified prone, sidelying, and supine positions. HHD was performed simultaneously with MMT and SHET. Each measure was performed 3 times, and the best scores for each was used for data analysis.

Results : Data Analysis was performed using SPSS Version 22. Spearman's Rho was used to determine correlations between the LE FM, MMT, HHD, and SHET. Medians were compared between groups using the Mann Whitney U test. The SHET correlated with all measures of force production: MMT ($r=0.679$, $p=0.00$), prone HHD ($r=0.52$, $p=0.02$), sidelying HHD ($r=0.68$, $p=0.00$), supine HHD ($r=0.72$, $p=0.00$). The SHET also correlated with the LE FM ($r=0.59$, $p = 0.002$). When analyzed by FM cohort, non-selective and selective groups were significantly different in MMT ($p=0.003$), sidelying HHD ($p=0.049$), supine HHD ($p=0.000$), and SHET ($p=0.003$).

Conclusions : Results of this study support the hypothesis that the SHET is a valid measure of hip extensor force production in a population of individuals with UMN pathology with selective movement. Contrary to our hypothesis, the SHET also correlated with HHD and MMT in the non-selective cohort, indicating it may be valid for that population as well. The SHET may therefore be clinically useful in determining strength of the hip extensors for this population. Additionally, MMT and sidelying/supine HHD were valid measures of force production. HHD and MMT were able to discriminate between individuals with selective motor control and those with non-selective motor control. Further study is indicated to determine if MMT and HHD are valid measures for force production for patient with upper motor neuron pathology in other muscle groups.

Clinical Relevance : The SHET is a valid measure of force production of the hip extensors in individuals with UMN pathology. This test does not require prone positioning or selective movement in hip extension thus making it clinically feasible for most patients with UMN pathology. The SHET is a clinically useful test to identify deficits in force production that may be contributing to functional limitations.

TITLE: FEASIBILITY AND MINIMUM DETECTABLE CHANGE OF THE LOWER EXTREMITY FUGL MEYER ASSESSMENT IN ACUTE STROKE

AUTHORS/INSTITUTIONS: V.M. Pardo, M. Bendewald, C. Casanova, K. Kelly, M. Rekowski, S. Galen, Physical Therapy, Wayne State University, Detroit, Michigan, UNITED STATES|A. Goldberg, Physical Therapy, University of Michigan Flint, Flint, Michigan, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : The Fugl-Meyer Assessment Scale (FMA) is a standardized quantitative outcome measure that assesses motor function following a stroke. The lower extremity subscale (FMA-LE) has been studied in chronic stroke and found to have good reliability and concurrent validity. The feasibility of using the FMA-LE in an acute stroke population has not been studied to date. The purpose of this study was to determine the feasibility (patient tolerance, duration of testing) and the minimum detectable change of the FMA-LE in individuals with acute stroke in an inpatient rehabilitation setting.

Number of Subjects : Forty-three patients with acute stroke (mean 20.9 days post-stroke) resulting in unilateral hemiparesis were recruited from an inpatient rehabilitation setting in the Metro Detroit area.

Materials/Methods : Participants were assessed using the FMA-LE, twice on the same day with at least a 5 minute rest in between assessments. The duration of each FMA-LE assessment was recorded. Blood pressure, heart rate, oxygen saturation, rate of perceived exertion (RPE) and pain were measured before, during the 5 minute rest, and after the two trials. The intraclass coefficient (ICC 2,1) was computed to assess the relative reliability of each test. Standard error of measurement (SEM), which quantifies measurement error in absolute values, was calculated as the standard deviation (SD)* $\sqrt{(1-ICC)}$. MDC at a 95% confidence level (MDC95) was calculated as $z*SEM*\sqrt{2}$ where $z=1.96$.

Results : The mean time to complete the FMA-LE for each trial was 8.99 (SD 2.12) and 8.68 (SD 2.25) minutes. Mean changes in vitals were very small. Mean FMA-LE was 22.97 (SD 8.36, range 4-34) out of a possible 34 points, with an ICC of 0.98 (SEM was 1.32, MDC95 was 3.66). Measurement error and MDC95 expressed as a percentage of mean FMA-LE were 5.7% and 15.9% respectively.

Conclusions : The amount of time necessary to perform the FMA-LE (less than 9 minutes) in the acute stroke population demonstrates that this is an outcome measure that can be incorporated into the initial assessment of the inpatient rehabilitation population. The minimal changes in vitals, pain and RPE demonstrate that the FMA-LE is tolerated well by the acute stroke population in the inpatient rehabilitation setting. The high ICC for the FMA-LE suggests high agreement between assessors. The low SEM% is suggestive of low measurement error and good absolute reliability. The low MDC95% suggests that this test may be able to detect real change in physical performance in patients with acute stroke.

Clinical Relevance : This study has demonstrated that it is feasible to perform the FMA-LE in patients with acute stroke in an inpatient rehabilitation setting. Real change was computed to be > 3.66 points, which will assist clinicians and researchers in interpreting whether real change has occurred when comparing repeated measures of the FMA-LE. These preliminary results should be used to encourage clinicians to use the FMA-LE when assessing motor recovery in the acute stroke population.

TITLE: Aerobic Exercise and Dietary Fat Impact Myelin in the Adult Spinal Cord

AUTHORS/INSTITUTIONS: A.D. Kleven, Physical Therapy Doctoral Program, Mayo Clinic, Rochester, Minnesota, UNITED STATES|H. Yoon, A.R. Paulsen, P. Starski, I.A. Scarisbrick, Department of Physical Medicine and Rehabilitation, Mayo Clinic, Rochester, Minnesota, UNITED STATES|F. Gomez-Pinilla, Department of Integrative Biology and Physiology, UCLA, Los Angeles, California, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Growing evidence suggests that myelin, like synaptic structure, can be influenced by functional interactions with the environment. Here we test the hypothesis that dietary saturated fatty acids alone, or in combination with exercise training, can influence myelin homeostasis in the adult spinal cord.

Number of Subjects : 10 in each group for protein and RNA quantification, 6 in each group for histopathology (n = 64)

Materials/Methods : To test this hypothesis, 9 week old adult C57BL6/J male mice were fed a diet enriched in fat (60% total fat, 20% from saturated fat) for a period of 7 weeks, provided access to free wheel running for a corresponding period, or provided access to both lifestyle interventions in combination. We used quantitative Western blot, real time PCR and immunohistochemical approaches to quantify myelin proteins, oligodendrocyte progenitor cells (OPCs), mature oligodendrocytes, associated growth factor systems, and signaling cascades in the lumbosacral spinal cord of mice under these conditions compared to those with a sedentary lifestyle.

Results : Results demonstrate that the abundance of the major myelin membrane proteins, proteolipid (PLP) and myelin basic protein (MBP), as well as NG2, a marker for oligodendrocyte progenitor cells (OPCs), were significantly elevated in the spinal cord after 7 weeks of exercise training in combination with high dietary saturated fat. Expression of MBP and PLP RNA, as well that for Myrf1, a transcription factor regulating oligodendrocyte differentiation, were also differentially increased with exercise and/or high dietary saturated fat. In conjunction with these findings however, consumption of a high fat diet alone resulted in a reduction in the number of NG2 or Nkx2.2-OPCs present in the spinal cord white matter of adult mice. A parallel decrease in mature CC-1+-oligodendroglia and those labeled for the pan-OPC and oligodendrocyte marker Olig2 was also seen with consumption of high fat in the context of a sedentary lifestyle.

Conclusions : Exercise in combination with high dietary saturated fatty acids unleashes a pro-myelination program that supports myelin homeostasis in the adult spinal cord.

Clinical Relevance : Of potential clinical significance, 7 weeks of exercise training completely reversed the potential deleterious effects of a high fat diet on OPC and oligodendrocyte numbers. Exercise and dietary fatty acid-induced changes in myelinogenesis occurred in parallel with increases in the expression of spinal cord IGF-1 and IGF-1 receptor. Parallel increases in phosphorylated-AKT, a signaling intermediate known to be involved in the myelinogenic effects of IGF-1, was also observed in response to consumption of high levels of saturated fat alone or in combination with exercise. Together these data support a model in which aerobic exercise in combination with increased dietary fat may promote myelin plasticity. These results provide important considerations for rehabilitative programs designed to enhance patient function particularly in cases where myelin repair is a key concern.

TITLE: Interventions for Concussion: An Evaluation of the Evidence

AUTHORS/INSTITUTIONS: L. Braun, H.A. Frimenko, S. Husted, J. Tier, M.A. Jeanfavre, L. Ledbetter, A. Goode, M.P. Reiman, R. Clendaniel, Physical Therapy, Duke University, Durham, North Carolina, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Rest has been accepted as the standard approach for concussion rehabilitation. Aerobic exercise, vestibular therapy, and manual therapy techniques have been advocated as alternative approaches. The purpose of this study is to systematically search and synthesize the literature investigating interventions for treatment of concussion.

Number of Subjects : 1721 subjects in 19 articles.

Materials/Methods : We searched PubMed, CINAHL and EMBASE for literature relevant to concussion rehabilitation. Inclusion criteria were 1) human patients diagnosed with concussion or mild traumatic brain injury, 2) patients managed with aerobic, vestibular, manual therapy or rest, 3) English language, 4) mean age of subjects >12 years, and 5) peer reviewed. Exclusion criteria were 1) intervention used as an assessment rather than a treatment, 2) editorials, commentaries, or position statements, or 3) patients with moderate to severe traumatic brain injuries. Screening, eligibility and inclusion of citations was conducted with a duplicate process. Disagreements were resolved by consensus. Included citations were organized by intervention into Rest, Vestibular, Manual, Aerobic, or Multimodal. Articles were ranked for level of evidence (I – V) and grades of recommendation, utilizing Grading of Recommendations Assessment Development and Evaluation (GRADE), ranging from A, preponderance of level I and/or II studies supporting the recommendation to F, expert opinion.

Results : 3,684 unique citations were identified, and 19 articles met eligibility criteria. Five articles on rest were identified, including 2 RCTs, a prospective cohort study, 2 retrospective studies, and a case study (level II, III, and IV) showing conflicting results for the benefits of rest, yielding GRADE D. Three articles on vestibular therapy included a retrospective analysis and 2 prospective patient registry studies (level III and IV). Effectiveness of vestibular therapy was shown, however low level studies without controls or randomization led to GRADE C. One RCT on manual therapy supports vertebral mobilizations, but lack of multiple studies led to GRADE C. Five articles on aerobic exercise included a case control study, 2 case series, and 2 retrospective studies (level III and IV). Although all studies demonstrated benefit, a GRADE C was assigned due to lack of high-level studies. Three studies on multimodal interventions included an RCT, a systematic review, and a case study (level I, II, and IV). All affirm benefit from a combination of aerobic exercise, manual, and vestibular therapy compared to rest (GRADE B).

Conclusions : Studies investigating rest demonstrate conflicting evidence regarding benefit, suggesting caution with its utilization and insufficient evidence to support its exclusive use for treatment. A multimodal approach to the treatment of concussion has the greatest support in the literature.

Clinical Relevance : Physical therapists are tasked with the rehabilitation of patients with concussion. As such, it is important that physical therapists are equipped with the most effective interventions to treat this condition.

TITLE: The effects of an 8-week maximal strength training program on measures of gait and balance in persons with Multiple Sclerosis: A Pilot Study

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ABSTRACT BODY:

Purpose/Hypothesis : Clinicians who treat gait and balance impairments in persons with MS (pwMS) frequently use resistance training as a treatment intervention. Typically, the type of resistance training done utilizes relatively low loads, with the implicit assumption that higher intensity training may not be well tolerated due to neurogenic fatigue. Recent evidence has suggested that using maximal strength training (MST) in pwMS may result in increased Central Nervous System (CNS) activation. Additionally, the use of MST in other CNS has resulted in improvements in gait and balance. However, the effect of MST on gait and balance in pwMS has not been examined. The purpose of this study was to examine whether an MST program in pwMS would result in improvements in gait and balance measures. A secondary goal was to assess whether such a program will be well tolerated in this population.

Number of Subjects : 7 participants with Multiple Sclerosis

Materials/Methods : A single-group pretest-posttest design was used. The exercise program entailed participants completing a 2x/week program for 8 weeks where they performed 4 sets of 4 repetitions of leg presses separately on each leg, at a weight equal to 85-90% of their 1-repetition maximum(1RM), as determined by ACSM guidelines. Data from the 6-minute walk test (6MWT), the Berg Balance Scale (BBS), and the MSIS-29 were collected from participants at baseline and upon completion of the exercise program. Participants' 1RM lift for a seated hip extension was also determined for the right and left legs at baseline and upon completion of the program.

Results : Five females and 2 males with mild MS (EDSS $x = 3.75$) completed the study. None of the subjects reported any adverse effects. Results from a repeated-measures MANOVA with bootstrapping showed that participants' maximal right leg press increased significantly from pretest ($M = 146.07$, $SD = 93.36$) to posttest ($M = 228.93$, $SD = 95.98$), $p = .004$. Participants' maximal left leg press also increased significantly from pretest ($M = 142.86$, $SD = 100.87$) to posttest ($M = 215.00$, $SD = 114.07$), $p < .001$. BBS scores significantly improved from pretest ($M = 44.29$, $SD = 8.34$) to posttest ($M = 49.57$, $SD = 5.83$), $p = .008$. Scores for the 6MWT also showed significant increases from pretest ($M = 1040.04$, $SD = 429.25$) to posttest ($M = 1190.73$, $SD = 579.95$), $p = .045$.

Conclusions : Subjects increased in left and right maximal leg press strength, BBS scores, and 6MWT distance following the MST intervention. The MST was well tolerated by all subjects. MST may provide an additional means of improving mobility in pwMS. Discerning the mechanism of its effectiveness requires further examination.

Clinical Relevance : Clinicians who work with pwMS may be reluctant to utilize heavier weights due to concerns about fatigue. This results of this study suggests that not only is resistance training using maximal loads well tolerated in this population, but may result in significant improvements in gait and balance.

TITLE: Functional performance and quality of life in transtibial amputees is influenced by the type of prosthesis

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ABSTRACT BODY:

Purpose/Hypothesis : Lower limb amputees may receive a prosthetic limb based on their functional ability. The centers for Medicare and Medicaid categorize prosthesis by amputee functional ability, known as a K-level, ranging from least functional, K0 to most functional K4. The purpose of this study was to evaluate effects of two types of prosthetic feet on balance, walking performance and quality of life in transtibial amputees classified as either K2 or K3.

Number of Subjects : Three males and one female, aged 63 to 69 years old with transtibial amputations due to peripheral neuropathy or type II diabetes have completed the study; enrollment is ongoing.

Materials/Methods : Study participants are transtibial amputees secondary to diabetes, trauma, or vascular disease currently ambulating with either a K2 or K3 prosthesis. Quality of life was established using SF 36 and the Reintegration to Normal Living Index. Clinical tests: Timed Up and Go, Short Physical Performance Battery, Dynamic Gait Index and Activity Specific Balance Confidence Scales were administered. The V-gait CAREN system measured standing balance sway, gait speed, walking kinematics and kinetics on level ground and on a 4.8 degree ramp. The Physiological Cost Index was calculated for level and ramp walking. Participants wore a K2 and a K3 foot during these test to determine immediate effects of switching prosthesis type. Participants were then randomized into groups for a 2-week trial period to evaluate prosthetic foot that are either at, above or below their current functional level. Results were analyzed with paired t-tests.

Results : Baseline quality of life, balance, and gait measures for participants currently ambulating with a K2 vs K3 were significantly lower ($p<0.05$). The Physiological Cost Index increased 20% from level ground to ramps. Preliminary results indicate that switching from a K3 to K2 resulted in increased sway during standing balance, decreased functional limits of stability, decreased gait velocity on level ground, increased compensatory hip motions and moments and SF-36 scores significantly decreased ($p<0.05$). Preliminary results indicate that switching from a K2 to a K3 significantly improved standing balance, increased gait velocity, and SF-36 scores increased ($p<0.05$). Results also indicate that after a 2 week trial period, patients wearing a prosthetic foot above their initial functional level improved walking kinematics, performed ramp trials and reported increased quality of life.

Conclusions : Preliminary results suggest that K3 prosthetic feet lead to greater quality of life and functional performance. A higher functioning prosthesis for lower functioning amputees may lead to less injuries and falls due to improved balance and coordination, and it may also improve cost effectiveness. Therefore, transtibial amputees must be prescribed the proper prosthetic.

Clinical Relevance : Lower limb amputees often experience diminished mobility, balance, and quality of life; therefore, it's important to determine the most efficient and safest prosthesis despite their current K-level.

TITLE: Reducing the Incidence and Progression of Pressure Ulcers Using a Uniform Interdisciplinary Approach with Visual Aides in the Inpatient Neurological Population

AUTHORS/INSTITUTIONS: F. Bronstein, Inpatient Rehabilitation, NYULMC RUSK Rehabilitation, New York, New York, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Whether patients are being admitted to a neurological inpatient rehabilitation unit with pressure sores or developing skin breakdown during the hospital stay, pressure ulcers are both a large financial and physical burden on a facility(1,3,5). In 2013 each full thickness pressure ulcer, added up to \$70,00 in costs to a patient's hospital stay(4,5). Due to the increasing number of physically dependent patients and time restraints in implementing a comprehensive plan of care within a shorter length of stay, staff do not always have the opportunity to provide an individualized program for skin needs(2). Currently nursing at NYULMC RUSK Rehabilitation use the Braden Scale to identify patients at risk for skin breakdown but as an interdisciplinary team, we are lacking uniformity and interdisciplinary communication on how to prevent pressure ulcers in high risk neurological patients. Although patients and family members are often educated on the importance of skin protection, there is no consistent information method distributed for low level neurological patients. The use of a uniform visual aide across all disciplines will help provide consistency of care and empower patients and their families.

Number of Subjects : 63

Materials/Methods : Neurological patients at high risk of pressure ulcers are flagged by nursing using the Braden scale and by therapists based on mobility level (mod/max assist for bed mobility) within the first 3 days of admission. Pressure mapping by OT(if indicated) and initiation of an interdisciplinary discussion with PT/OT/Nursing regarding positioning plan occurs within 3-5 days of admission. Based on the discussion and pressure mapping results, a positioning plan is developed using pictures of individualized pressure relieving positions with written instructions on how to properly position patients. Pictures will be posted bedside and patient/family/interdisciplinary team is educated on positioning plan and turning schedule.

Results : Currently 63 patients have been placed on a positioning protocol, 53 in the "high risk group" and 10 in the "existing group". All patients in the existing group have shown full healing or a significant improvement by discharge. Since initiation of the protocol in June of 2014 there has been one new incidence of pressure ulcer on the unit and no new incidences of pressure ulcers for patients on the positioning protocol.

Conclusions : The significant reduction in pressure ulcer incidences suggest that the use of an interdisciplinary visual aide is a cost effective and time efficient way to reduce the risk of pressure ulcers for the inpatient neurological population. The tool has been most effective in empowering patients and family members to advocate for themselves and as an education tool to continue proper positioning upon discharge.

Clinical Relevance : Finding a cost effective and interdisciplinary technique to reduce the incidences of pressure ulcer and provide better patient education in the neurological population.

TITLE: Stroke navigation as part of the discharge plan to support community reintegration of individuals with stroke living in Appalachian rural communities

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ABSTRACT BODY:

Purpose/Hypothesis : Multiple studies have shown a high incidence of readmission within the first 12 months post discharge from inpatient rehabilitation following stroke and have indicated the need for follow-up care. Isolation from the healthcare system can result in limited or no awareness of services in rural communities, decreased support, and lack of access to information. Superimposed on this the established health disparities, low health literacy, and persistent poverty in many Appalachian rural communities. This previous work, in addition to work conducted by our group supports the need for navigation during community reintegration for survivors of stroke. The purposes of this study were to 1) determine the effectiveness of providing community health navigation to facilitate continued communications with healthcare providers as well as linkages to services and community resources and 2) determine the barriers to and opportunities for improving long-term support for survivors of stroke in Appalachian rural communities.

Number of Subjects : 11 individuals (3 male and 8 female) discharged from acute rehabilitation following stroke and their caregivers.

Materials/Methods : Our stroke navigator coordinated with the acute rehabilitation discharge team to support patient transitions. Individuals were supported for at least 6 months. The data collected included: 1) access to healthcare, insurance, medical equipment (DME), and medications, 2) need for follow-up education, and 3) re-hospitalizations. The stroke impact scale and caregiver burden scales were collected at 1 and 6 month post-discharge to home and semi-structured interviews were conducted at the end of the study to assess quality of life (QoL).

Results : The primary areas of support required by participants included: 1) communication between the patient and healthcare providers, 2) insurance support (e.g. enrolling in a proper insurance plan, covering gaps in health care due to lack of coverage, obtaining medication coverage, obtaining DME coverage, and obtaining additional PT, OT, speech visits) , 3) follow-up education on medical management of their health conditions, the stroke process, and transfers and mobility, and 4) connecting with community resources. Overall there was an improvement in participant and caregiver QoL. In addition, there were no stroke-related 30 day emergency department or hospital readmissions.

Conclusions : Results indicate: 1) the need for support navigating the insurance process following discharge to home, 2) the need to integrate therapy and navigation discharge planning processes to improve home/community transition, 3) the need for follow-up education, and 4) support in accessing DME.

Clinical Relevance : For individuals returning to rural communities following a stroke, there remains a need to provide and adapt follow-up therapy educational processes/materials to provide multiple formats to support differing levels of health literacy. There is also a need for support in navigating the healthcare system and accessing essential resources.

TITLE: Reliability, Validity, and Responsiveness of the Balance Evaluation Systems Test (BESTest) in Individuals with Multiple Sclerosis

AUTHORS/INSTITUTIONS: K. Potter, L. Anderberg, D.M. Anderson, B.A. Bauer, M. Beste, S. Navrat, Physical Therapy Education, Rockhurst University, Kansas City, Missouri, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Individuals with Multiple Sclerosis (MS) demonstrate balance impairments for various reasons (such as, increased sway in quiet stance, delayed responses to perturbations, and reduced ability to move toward their limits of stability). This may indicate that they have impairments of various systems underlying postural control, which can be measured via the Balance Evaluation Systems Test (BESTest). Limited data exists to support the use of the BESTest in persons with MS. The purpose of this study was to determine the test-retest reliability, internal consistency, minimal detectable change (MDC), validity, and ceiling and floor effects of the BESTest in persons with MS.

Number of Subjects : 21

Materials/Methods : Individuals with MS were recruited through the Mid America Chapter of the MS Society. In the first session, demographic data was collected, and each subject completed a disease severity (Expanded Disability Status Scale {EDSS} equivalent) questionnaire and the BESTest. One week later at the same time of day, subjects returned and the same examiner administered the BESTest.

Results : 21 ambulatory subjects with MS (mean EDSS = 3.3; range 1-6) participated in this study. Test-retest reliability was excellent for the total BESTest score (ICC = 0.938) and good to excellent for subsection scores (range = 0.656 for Sensory Orientation to 0.933 for Dynamic Gait). Internal consistency for total BESTest was Chronbach's alpha = 0.968; subsection scores ranged 0.792 for Sensory Orientation to 0.965 for Dynamic Gait. MDC scores ranged 2.25 – 2.62 points for Biomechanical, Stability Limits, Transitions/Anticipatory, and Sensory Orientation; 4.49 and 4.58 points for Reactive and Dynamic Gait, respectively; and 9.47 points for total BESTest. The relationships of individual subsection scores with each other were weak to moderate (Pearson coefficients range = -0.018 – 0.743). With the exception of the Stability Limits subsection, the relationship of BESTest total score to subsection scores was statistically significant with moderate to strong relationships (Pearson correlation coefficients range = 0.579 – 0.949). Correlations between BESTest total and subsection scores to EDSS, and to fall and loss of balance frequency, were weak to moderate. No significant floor effects were found. Ceiling effects were found for Biomechanical (38%), Stability Limits (29%), Reactive (24%), Sensory Orientation (62%), and Gait (24%).

Conclusions : The BESTest is a reliable test in persons with MS. Weak to moderate correlations among individual subsection scores indicate that each assesses a unique underlying aspect of balance control, supporting its construct validity. The ceiling effect could be due to the relatively high functioning participants.

Clinical Relevance : The BESTest is a reliable, valid, and responsive measure for use in ambulatory individuals with MS. Total BESTest scores demonstrated higher reliability and a lack of a ceiling effect as compared to subsection scores, suggesting that clinicians use the BESTest in its entirety.

TITLE: Task-Oriented Ankle and Foot Training for Improving Gait, Balance and Strength in Individuals with Multiple Sclerosis: A Pilot Study

AUTHORS/INSTITUTIONS: K. Jackson, J. Barrios, J. Gordon, E. Stewart, L. Samuelson, C.P. Schumann, Physical Therapy, University of Dayton, Dayton, Ohio, UNITED STATES|C.M. Rodrigues, L. Laubach, Health and Sport Science, University of Dayton, Dayton, Ohio, UNITED STATES|K.E. Bigelow, Mechanical and Aerospace Engineering, University of Dayton, Dayton, Ohio, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Weakness of distal leg muscles is common in individuals with multiple sclerosis (MS) and may be associated with impaired gait and balance. The purpose of this pilot study was to investigate the effects and feasibility of a task-oriented ankle and foot exercise program on gait, balance and strength.

Number of Subjects : 6

Materials/Methods : Six individuals with MS who had mild to moderate disability participated an 8-week task-specific home-based ankle and foot exercise program. Outcome measures included stance phase ankle joint torque and power, limits of stability, isometric and isokinetic ankle strength, gait speed and the 12-item Multiple Sclerosis Walking Scale (MSWS-12).

Results : Five participants completed the 8-week intervention. Following training, there were significant increases in ankle power during early (38.1%) and late (11.8%) stance, limits of stability (6.1%), and isokinetic dorsiflexion (26.4%) and plantar flexion (15.0%) strength. There were no differences in isometric strength, gait speed or the MSWS-12.

Conclusions : A task-oriented home-based ankle and foot exercise program may improve select measures of gait, balance and muscle performance in individuals with MS who have mild to moderate disability and appeared safe and feasible. Further research with a larger randomized sample may be warranted.

Clinical Relevance : Task-oriented exercises for the foot and ankle may improve impairment level measures of gait and balance and be an important component of a comprehensive rehab program. However, the exercised performed in this study may not have been task-specific enough to translate into improvements in activity or disability level outcomes and should be considered when designing future interventions.

TITLE: Individuals with Multiple Sclerosis: A Comparison of Perceived Rehabilitation Needs and Experiences Based on Patient Determined Disease Steps (PDDS) Score

AUTHORS/INSTITUTIONS: K. Mitchell, S. Tseng, K. Raabe, N.K. Purcell, Physical Therapy, Texas Woman's University, Houston, Texas, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Few studies have assessed the needs and experiences of individuals with MS regarding Physical Therapy (PT). Rehabilitation programs are individually tailored but not typically based on evidence of what needs should be addressed at various stages of the disease process. The purpose of this study was to better understand the clients' perceived needs and experiences in rehabilitation so a needs-based approach to PT can be explored. Research questions include: What are the perceived rehabilitation needs and experiences of individuals with MS, and are PTs meeting those needs? Do they differ based on PDDS score? What interventions are being used in PT, and do they meet the needs of individuals with MS? Do individuals with MS perceive the time spent in PT to be sufficient, and is that time worth their perceived change in function?

Number of Subjects : 56 individuals with MS (F=52, M=4)

Materials/Methods : Nationally recruited participants completed an online survey regarding their perceived needs and experiences in rehabilitation. Participants were divided into three groups based on PDDS score for data analysis: Ambulators (A) (n=6), Limited Ambulators (LA) (n=35), and Non-Ambulators (NA) (n=15).

Results : LA reported the highest agreement for "Perceived Needs Met." The highest rated goal for each group was: A = Fatigue, LA = Walking Ability, and NA = Strength. A significant difference was found in Walking Ability importance between the LA and NA group ($p=0.009$). The A group reported the greatest overall change in function. The most improvement was reported in Fatigue in the A group, Walking Ability in LA, and Strength in NA. A significant correlation between "Perceived Importance of Goals" and "Perceived Change in Function" was found in the LA group within the constructs of Walking Ability ($r_s=0.386$, $p=0.029$) and Spasticity ($r_s=0.395$, $p=0.025$). The most reported interventions were stretching, strengthening, and balance. All of the A group reported time in PT was "Just Right," 41% of LA and 53% of NA reported "Not Enough." LA reported the greatest agreement with "Improvement in Function Worth Time Spent in PT."

Conclusions : Most participants agreed their rehabilitation needs were met. The trend shows PTs may be more effective at meeting the needs of moderately affected individuals with MS. Participants' most important goals did not always align with their perceived improvement, which may be due to individuals setting unrealistic goals or PTs not prioritizing patient goals. Participants believe their improvement in function was worth the time spent in PT; however, therapists should consider advocating for more treatment time.

Clinical Relevance : PTs are adequately meeting the needs of individuals with MS, yet there is room to improve. Due to the highly variable nature of MS, PTs should continue to incorporate the individual's goals and not solely rely on disease stage when creating a plan of care.

TITLE: Increasing Gait Velocity in Patients Following Stroke: Single vs. Multi-intervention Approach

AUTHORS/INSTITUTIONS: J. Layman, D. Emond, D. Ewing, K. Goff, D. Vu, Physical Therapy, Southwest Baptist University, Bolivar, Missouri, UNITED STATES]

ABSTRACT BODY:

Purpose/Hypothesis : To determine if multi-intervention approach versus single-intervention approach resulted in increase gait-velocity among stroke patients as an indicator of improved ability to ambulate in the community.

Number of Subjects : 245 post-stroke patients were given physical therapy treatment to improve gait speed (velocity). Each of these patients participated in either a single focused intervention (n=131) or a multi focused intervention (n=114).

Materials/Methods : Eleven articles were critically analyzed, utilizing the AACPDm methodology, which utilizes a series of questions to determine the level and quality of each article. Out of the eleven articles this analysis tool qualified eight of them to be at a strong level, and three of them to be a medium level study. The main measurement analyzed for this systematic review was gait velocity (m/s) because it is one of the leading predictors of walking ability and is a primary goal for a majority of stroke patients. Gait velocity data was extracted from each article and a weighted percent change was determined for the single and multi-intervention approaches. The single and multi-intervention approaches were compared to determine which approach was the most effective for increasing gait velocity.

Results : This review identified that single-focused interventions had an average initial gait speed of (0.358m/s) and increased to (0.423m/s) at the end of treatment. While multi-focused interventions had an average initial gait speed of (0.346m/s) and increased to (0.513m/s) at the end of treatment. A calculation of the total percent weighted change showed an average of 17.2% increase in gait velocity for single-intervention approaches, while the multi-intervention approaches showed a 48.2% increase in gait velocity.

Conclusions : The results of this systematic review indicate a multi-intervention approach is more effective in increasing gait velocity when compared to single-intervention approach for stroke patients. The multi-intervention approach had a greater percent weighted change in gait velocity and therefore should be utilized to improve gait speed in stroke patients.

Clinical Relevance : Gait velocity is a determinant of community ambulation for stroke patients. A stroke patient must reach a gait velocity of 0.42 m/s in order to ambulate within the community safely. This systematic review found a more than two times greater increase in the gait speed of the multi-intervention group compared to the single focused intervention group. Therefore, clinicians should consider utilizing a more generalized treatment approach to improve gait velocity in stroke patients and improve their overall community ambulation ability. More research is warranted to incorporate dose and intensity of therapeutic interventions that may affect gait velocity outcomes.

TITLE: EFFECTS OF ALTER-G ANTI-GRAVITY TREADMILL AMBULATION ON BALANCE AND BALANCE CONFIDENCE IN THE OLDER ADULT

AUTHORS/INSTITUTIONS: J.F. Brewer, D.B. Castro, J. Johnson, C. Morison, E. Pafumi, Hardin-Simmons University, Abilene, Texas, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : (1) To determine the immediate effects on (1) static and dynamic balance, and (2) activity specific balance confidence after use of the AlterG anti-gravity treadmill.

Number of Subjects : Ten (M=4, F=6) elderly residents (x = 84.5 years) from assisted living (AL) and independent living (IL) facilities (AL=5, IL=5).

Materials/Methods : Physician approval was obtained for each subject who also completed an informed consent, a Mini-Cog exam, medical history, and Par-Q risk assessment. The Activity-specific Balance Confidence (ABC) scale and a Berg Balance Scale (BBS) test were administered on each subject followed by a familiarization session of treadmill ambulation with progressively increased body weight support (BWS) to 40%. After fitting of the compression garment, subjects were assisted into the AlterG and the percentage of BWS (40% or 0%) randomly assigned with self-selected walking speed for an 8-minute walking session. Blood pressure, heart rate, respiratory rate, and oxygen saturation (SaO₂) levels were obtained prior to, during, and one minute following each AlterG treadmill session. Before, during, and after the AlterG session, at 2 minute intervals, subjects balance confidence was assessed using the 0-100% ABC scale. Following the session, a 5-minute break was given, the compression garment removed, and the BBS was administered again. A second testing session occurred within 7 days, and the same procedure was followed with the opposite percentage of BWS (0 or 40%). Repeated Measures Multivariate ANOVA analyzed the differences between pre and post ABC and BBS scores. Alpha level was set at p=0.05. Pearson correlations between the BBS and ABC for partial versus full body weight were determined.

Results : The average self-selected speed on the AlterG was 0.34 (±0.24) at 0% BWS and 0.58 (±0.61) at 40% BWS for the AL subjects, and 1.86 (±0.82) at 0% BWS and 1.74 (±0.85) at 40% BWS for the IL subjects. Average heart rate on the AlterG was 90.06 (±20.12) at 0% BWS and 80.91 (±14.74) at 40% BWS. No significant differences were found between pre and post test BBS and ABC scores using the AlterG. Average BBS score changes pre / post AlterG were 0.67(±2.45) at 40% BWS, and -0.22 (±2.72) at 0% BWS; whereas average ABC score changes were 5.83 (±3.65) at 40% BWS and 4.41 (±2.01) at 0% BWS. A high correlation was found between the BBS and ABC at 40% BWS (r=0.917) and 0% BWS (r=0.872).

Conclusions : Although there was a linear increase in the ABC from 0% BWS to 40% BWS between AL and IL subjects, this was not enough for a minimal detectable clinical change (13%). A strong correlation, however, was found between ABC and BBS for the AlterG in both full and partial BWS.

Clinical Relevance : Results failed to detect a significant change in balance and balance confidence status post AlterG walking sessions among the elderly. From this, we infer that in the AL and IL populations, fall risk neither increases or decreases after an 8-minute AlterG anti-gravity treadmill locomotion session and appears safe regarding the subject's measured and perceived balance.

TITLE: Fall status and balance performance on the four square step test

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

ABSTRACT BODY:

Purpose/Hypothesis : The Four Square Step Test (FSST) is a measure of dynamic standing balance involving turning and stepping over four single-point canes placed on the floor in a cross-configuration. A single study published in 2002 by the FSST inventor reported that the instrument accurately distinguished between non-multiple fallers and multiple fallers in community-dwelling older adults. No one has yet determined whether the instrument accurately distinguishes single fallers from non-fallers or multiple fallers, an important consideration given that a single fall can result in serious injury. In addition, the FSST inventors proposed a 15-second cut-off score to classify a subject as a multiple or non-multiple faller. The purpose of this study was to determine whether performance on the FSST differs among older adults with a history of no falls, a single fall, or multiple falls, and whether the instrument's threshold score accurately identifies multiple from non-multiple fallers in a sample of community-dwelling older adults.

Number of Subjects : Subject inclusion criteria were: age 65 or older, live independently, able to walk inside the home without help from another person, and able to provide informed consent.

Materials/Methods : Subjects reported the number of falls they had experienced in the past 12 months, and performed the FSST. Those with a 12-month history of no falls were classified as non-fallers, those with a single fall were classified as single fallers, and those with 2 or more falls were classified as multiple fallers. For other analyses, subjects with a history of only one fall or no falls were classified as non-multiple fallers and compared to multiple fallers. Independent t-tests, Chi-Square, and one-way ANOVA were calculated using SPSS v 21.0.

Results : Forty-six subjects ($x=84$ years) participated in this study. There were no significant differences between groups in age, gender, ethnicity, assistive device use, or number of medications used. Results of one-way ANOVA revealed significant differences between FSST scores of multiple fallers ($x=22.8$), single fallers ($x=12.0$), and non-fallers ($x=14.2$) ($F=3.90$, $p=0.03$). Post hoc analyses showed a significant pairwise difference between multiple fallers and non-fallers only ($p=0.04$). The 15-second threshold score appropriately distinguished between multiple fallers and non-multiple fallers ($p=0.02$).

Conclusions : In a sample of community-dwelling older adults, performance on the FSST differed between multiple fallers and non-fallers, with worse scores in multiple fallers. Surprisingly, single fallers scored slightly better than non-fallers in this study, though differences were not significant. We confirmed that the fall risk cut-off score of 15 seconds accurately distinguished multiple fallers from non-multiple fallers.

Clinical Relevance : Study findings benefit the physical therapy community by confirming the FSST's usefulness as a measure of balance performance, particularly in multiple fallers. However, the instrument may not be sensitive enough to distinguish between single fallers and non-fallers when used with well older adults.

TITLE: Identifying fallers and predicting falls using the activities-specific balance confidence scale

AUTHORS/INSTITUTIONS: K.K. Cleary, Eastern Washington University, Spokane, Washington, UNITED STATES|E. Skornyakov, Washington State University, Spokane, Washington, UNITED STATES|C. Henderson, Aegis Therapies, Tacoma, Washington, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Multiple outcome measures exist to assess functional mobility and balance performance, which are important factors relative to fall risk in older adults. Psychological factors like fear of falling are also associated with fall risk, yet can be difficult to measure and are often overlooked. The Activities-specific Balance Confidence Scale (ABC) asks individuals to rate their balance confidence on a scale from 0 (“no confidence”) to 100 (“completely confident”) on 16 functional tasks without actually performing the tasks. The purpose of this study was to compare ABC scores based on fall history, and determine whether the ABC predicted future falls in a sample of community dwelling older adults. An additional purpose was to determine whether ABC scores differed between subjects with and without a fear of falling.

Number of Subjects : Forty-six subjects ($x=84$ years) participated and met the following criteria: age 65 or older, able to walk inside the home without help from another person, live independently, and able to provide informed consent.

Materials/Methods : Subjects completed the ABC and were classified into one of three groups based on the number of falls reported in the last 12 months: multiple fallers (≥ 2 falls), single fallers (1 fall), or non-fallers (0 falls). Following baseline testing, interviews were conducted every 3 months for one year to determine the number of falls experienced in the most recent 3 months. Independent t-tests, 1-way ANOVA, and regression analyses were calculated using SPSS v 21.0.

Results : There were no significant differences in ABC scores between multiple fallers ($x=58.5$), single fallers ($x=72.3$), and non-fallers ($x=73.8$) ($p=0.17$). While multiple fallers tended to have poorer ABC scores than non-multiple fallers ($p=0.06$), the difference in ABC scores between fallers and non-fallers was not significant ($p=0.13$). The overall regression model was statistically significant, where ABC scores predicted falls at 3 months ($F=8.54$, $p=0.006$, $\beta=-.41$, $R^2=0.17$) and 12 months ($F=12.23$, $p=0.02$, $\beta=-0.34$, $R^2=0.12$). Subjects who reported a fear of falling scored significantly poorer on the ABC ($p\leq 0.05$).

Conclusions : There were no significant differences in ABC scores between fall groups in this study. However, the difference in mean scores between multiple fallers ($x=58.5$) and non-fallers ($x=73.8$) may be clinically meaningful. The mean score for multiple fallers was lower than the 67% cut off score (published in 2004) for fall risk and prediction of future falls. While ABC scores did significantly predict future falls, the regression model accounted for only 17% and 12% of variation at 3 and 12 months, respectively.

Clinical Relevance : Results of this study suggest that ABC scores may not identify all fallers in a sample of community dwelling older adults. However, the ABC did significantly predict future falls. While measures of balance confidence should not replace those of balance performance, psychological factors are an important component of fall risk and warrant inclusion in comprehensive balance assessments.

TITLE: Methods to Promote Exercise Adherence in Adults with Multiple Sclerosis: A Systematic Review

AUTHORS/INSTITUTIONS: S.E. Page, K. Hunsicker, N. Reale, K. Townsend, R.M. Hakim, Physical Therapy, University of Scranton, Scranton, Pennsylvania, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of this study was to determine the most effective method to promote exercise adherence in adults with Multiple Sclerosis (MS).

Number of Subjects : N/A

Materials/Methods : A literature search of PubMed, PsycINFO, CINAHL, ScienceDirect, and ProQuest was conducted using search terms: Multiple Sclerosis AND (physical activity or exercise or rehabilitation) AND (program adherence or compliance or exercise adherence or adherence or motivation). Search limits: English, human subjects, peer reviewed, and RCTs. Selection criteria: adults 18 and over with diagnosis of MS, intervention included physical activity and an outcome measure of adherence. Two reviewers independently assessed each study for methodological quality and came to consensus based on PEDro guidelines.

Results : A total of 3,169 articles were screened for eligibility. Following detailed appraisals, 6 RCTs met the criteria. PEDro scores ranged from 5 to 7 with a mean of 6.3. Sample sizes ranged from 13 to 130 subjects (331 total). Treatment parameters varied widely with durations ranging from 8 to 14 weeks in clinical and home-based settings. Outcome measures of adherence included: attendance, diary entries, Health Promotion Lifestyle Profile-II (HPLP) Physical Activity Subscale, or the Godian Leisure-Time Exercise Questionnaire (GLTEQ). Three of 6 studies found statistically significant increases in exercise adherence using an interactive website based on a health behavior theory (i.e., Social Cognitive Theory/SCT; 12 wks) or Motivational Interviewing (MI)/phone counselling (5 x 30 min over 12 wks). Efficacy enhancement workshops using SCT (2x weekly x 12 wks) showed a nonsignificant, positive trend of increased exercise adherence. Programs applying SCT and encouragement to set higher goals resulted in greater activity adherence. An 8 week exercise program with the addition of in-person MI (30-60 min sessions x 3) and high intensity task-oriented exercises (2 hrs, 5x weekly x 2wks) with HEP/diary follow-up (x3 mo) were not more effective than exercise alone or a control group, respectively, at improving exercise adherence.

Conclusions : There is moderate evidence in support of methods using phone contact or an interactive website to increase exercise adherence in adults with MS. Successful programs included MI or written and video content on exercise, peer forum, video coaching and activity monitoring (via pedometer) with application of SCT. Further research is needed to determine the most optimal methods and parameters to promote long-term exercise adherence in adults with MS.

Clinical Relevance : Overall, there was greater success in increasing exercise adherence in adults with MS using methods that were not provided in person (i.e., internet or phone contact). The typical clinical approach of using an activity log with a HEP was not sufficient to promote adherence to exercise at home. Based on the evidence, clinicians should consider use of the internet or phone contact combined with application of health behavior theory and active goal setting to encourage exercise adherence in adults with MS.

TITLE: A rare brain tumor that can mimic symptoms of Benign Paroxysmal Positional Vertigo and Migraine: a case report

AUTHORS/INSTITUTIONS: A.D. Youssefnia, Vestibular Physical Therapy, NYU Langone Medical Center-Rusk Rehabilitation, New York, New York, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : Benign Paroxysmal Positional Vertigo (BPPV) is one of the most common vestibular disorders in adults; symptoms (sx) are caused by displaced free floating otoconia in one of three semicircular canals. Change in head position relative to gravity can cause vertigo and nystagmus. Patients may also have complications of imbalance with ambulation, nausea, and difficulty concentrating. Anterior canal (AC) BPPV comprises about 3% of all BPPV cases. Migraine is a complex condition with a wide range of sx; severe headache (h/a) is the most common. Other sx may include visual disturbances, photo/phono sensitivity, nausea, dizziness/vertigo and nausea/vomiting. These sx can also occur without h/a. Migraine is 3x more likely in patients with BPPV than in the general population. The purpose of this case study is to report the uncommon characteristics of a rare brain tumor, an ependymoma, that may mimic sx of BPPV and migraine.

Case Description : Patient is a 39 year old male presenting to vestibular therapy with the diagnosis (dx) of BPPV. He reported brief episodes of vertigo with rolling over in bed, looking up and looking over shoulder; subsequent nausea and imbalance with ambulation. He was diagnosed by an otolaryngologist and treated by a community physical therapist with minimal relief. Past medical history included 2 episodes of ocular migraine without h/a, depression and anxiety. Family history included migraine and BPPV. Positional tests were suggestive of bilateral AC BPPV: right >left. There was resolution of sx and nystagmus in right Dix-Hallpike position within 1 session. Patient was treated for 4 more sessions to address classic sx of fatiguing vertigo and nystagmus consistent with left anterior canal BPPV with minimal relief. Different treatment (tx) methods were completed, including canalith repositioning tx, deep head hanging maneuver and Brandt Daroff habituation exercise. Brandt Daroff exercises significantly increased pt's complaints of nausea and were discontinued. During the course of tx, he reported an increase in ocular migraine frequency with onset of h/a and was immediately referred to neuro-ophthalmology for migraine management.

Outcomes : Neuro-ophthalmology concurred with BPPV and ocular migraine dx and referred patient for a brain MRI as standard procedure. Test revealed a brain tumor in the fourth ventricle with extension through the foramen of Magendie and moderate obstructive hydrocephalus. Initial impression favored ependymoma.

Discussion : While ependymomas are relatively rare in adults, accounting for 2-3% of primary brain tumors, they can mimic sx of BPPV and/or migraine. This case highlights the importance of physical therapists to recognize when tx is not working and make appropriate referrals.

References: Must include 5 current references (less than 10 years old): Anagnostou, E., Kouzi, I., & Spengos, K. (2015). Diagnosis and Treatment of Anterior-Canal Benign Paroxysmal Positional Vertigo: A Systemic Review. *Journal of Clinical Neurology* Armstrong, T. S., Vera-Bolanos, E., Bekele, B. N., Aldape, K., & Gilbert, M. R. (2010). Adult ependymal tumors: Prognosis and the M. D. Anderson Cancer Center experience. *Neuro-Oncology*, 12(8), 862-870. doi:10.1093/neuonc/noq009Bhattacharyya et al. (2008). Clinical practice guideline: benign paroxysmal positional vertigo. *Otolaryngol Head Neck Surg*, 139(5 suppl 4):S47-81Brevem, M. V., Radtke, A., Clarke, A. H., & Lempert, T. (2004). Migrainous vertigo presenting as episodic positional vertigo. *Neurology*, 62(3), 469-472. doi:10.1212/01.wnl.0000106949.55346.cdEggers, S., Neff, B., Shepard, N., & Staab, J. (2014). Comorbidities in vestibular migraine. *Journal of Vestibular Research*, ;24(5-6):, 387-395. doi:10.3233/VES-140525Faralli, M., Cipriani, L., Del Zompo, M., Panichi, R., Calzolaro, L., & Ricci, G. (2014). Benign paroxysmal positional vertigo and migraine: Analysis of 186 cases. *B-ENT*, 10(2), 133-139Fife et al. (2008). Practice parameter: therapies for benign paroxysmal positional vertigo (an evidence-based review): report of the Quality Standards Subcommittee of the American Academy of Neurology. *Neurology*, 70(22):2067-74Furman, J. M., & Balaban, C. D. (2015). Vestibular migraine. *Ann. N.Y. Acad. Sci. Annals of the New York Academy of Sciences*, 1343(1), 90-96. doi:10.1111/nyas.12645Hornibrook J. (2011). Benign Paroxysmal Positional Vertigo (BPPV): History, Pathophysiology, Office Treatment and Future Directions. *International Journal of Otolaryngology*, Article ID 835671, 13 pages, 2011. doi:10.1155/2011/835671Meurs L. , Mossman S., Luxon L. (2005). When BPPV is not benign. *Journal of the Neurological Sciences*, 238. doi:10.1016/s0022-510x(05)81298-5Nuti, D., Mandalà, M., & Salerni, L. (2014). Benign Paroxysmal Positional Vertigo and Migraine. *Vestibular Migraine and Related Syndromes*, 143-157. doi:10.1007/978-3-319-07022-3_12Stefano, A. D., Kulamarva, G., & Dispenza, F. (2012). Malignant paroxysmal positional vertigo.

Auris Nasus Larynx, 39(4), 378-382. doi:10.1016/j.anl.2011.07.008Uneri, A. (2004). Migraine and benign paroxysmal positional vertigo: an outcome study of 476 patients. Ear, Nose, & Throat Journal, 83(12), 814-815

TITLE: Supraspinal changes following incomplete spinal cord injury contribute to altered activation strategies during dynamic contractions

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ABSTRACT BODY:

Purpose/Hypothesis : Recent studies have shown subjects with incomplete spinal cord injury (SCI) generate greater central motor drive of both the knee extensors and plantarflexors during lengthening maximal voluntary contractions (MVCs) than during isometric or shortening MVCs (1, 2). This unique pattern of activation sharply contrasts the either similar or decreased activation demonstrated by uninjured adults during lengthening contractions as compared to during other contraction types (3). In the case of subjects with SCI, several lines of evidence link their gains in motor output during lengthening contractions to spinal mechanisms. The current study's aims were to investigate contributions of supraspinal changes following SCI to altered activation strategies during dynamic contractions.

Number of Subjects : 8 males with incomplete SCI, 8 uninjured males served as controls

Materials/Methods : Single-pulse transcranial magnetic stimulation (TMS) was used to probe modulation of motor evoked potentials (MEPs) and cortical silent period (CSP) durations during lengthening and shortening contractions of the tibialis anterior muscle (TA). Primary analyses were performed on responses evoked at stimulation intensities equivalent to 150% of each individual's active motor threshold (AMT).

Results : AMTs during low-level contractions (10-30% MVC) were higher in subjects with SCI than controls ($46.5 \pm 10.5\%$ vs $31.4 \pm 14.6\%$ of maximum stimulator output; $p < 0.05$). Subjects with SCI demonstrated smaller TA MEPs (normalized to maximal M-waves) than controls during submaximal (75% MVC) lengthening (0.41 ± 0.24 vs $0.66 \pm .21$ for SCI and controls, respectively; $p < 0.05$) and shortening contractions ($0.36 \pm .20$ vs 0.64 ± 0.16 ; $p < 0.01$). Contraction type-dependent differences in modulation of MEPs were not detected within either group. However, there was a trend for larger lengthening than shortening MEPs in the SCI group ($p = 0.07$). Subjects with SCI demonstrated similar CSP durations during lengthening and shortening submaximal contractions (140 ± 29 and 152 ± 34 ms for lengthening and shortening, respectively; $p > 0.05$). In contrast, controls demonstrated significantly shorter CSPs during lengthening than shortening contractions (187 ± 79 vs 210 ± 85 ms; $p < 0.05$). Similar comparisons of CSPs were observed during MVCs.

Conclusions : Subjects with SCI demonstrated an overall decrease in corticospinal excitability compared to controls. Differences in modulation of CSPs across contraction types between subjects with SCI and controls also indicate specific cortical changes post-injury which may alter normal patterns of neural drive (4, 5). In the context of recent findings, the current study suggests changes at spinal and supraspinal levels following SCI alter the neural activation strategies used to control dynamic contractions.

Clinical Relevance : Increased understanding of unique activation strategies utilized by individuals with SCI during dynamic contractions will hasten development of more targeted interventions for improving strength and function.

TITLE: The impact of self-efficacy on steps taken during participation in a treadmill based intervention for those with chronic stroke.

AUTHORS/INSTITUTIONS: J.E. Collins, N.E. Oddo, Physical Medicine and Rehabilitation, Johns Hopkins Hospital, Baltimore, Maryland, UNITED STATES|D. Reisman, Physical Therapy, University of Delaware, Newark, Delaware, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Previous literature has shown a relationship between self-efficacy, as measured by the Activities Specific Balance Confidence Scale (ABC), and average steps taken per day in those with chronic stroke. The purpose of this study was to extend those findings by examining the relationship between an individual's baseline self-efficacy and the changes in steps per day outside of training during an intervention aimed at improving real-world walking activity after stroke. We hypothesized there would be a positive relationship between baseline self-efficacy and improvements in steps per day throughout the intervention period.

Number of Subjects : Individuals greater than 6 months post stroke (n=43)

Materials/Methods : Subjects completed walking training at their fastest possible speed on the treadmill (30 minutes) and overground 3 times/week for 12 weeks. This also included a step activity monitoring program with daily step monitoring, goal setting, and identification of barriers to activity and strategies to overcome barriers. Balance self-efficacy was measured using the ABC (Pre-ABC) and steps per day outside of training were measured using the StepWatch activity monitor. The relationship between Pre-ABC and average steps taken outside of training throughout the intervention period was examined using Pearson's correlation in SPSS v 22. The relationship between baseline steps and Pre-ABC scores was also assessed.

Results : Pearson correlation analysis showed that Pre-ABC score was significantly correlated to steps taken outside of training throughout the entirety of the intervention($r=0.806$, $p=0.001$). The correlation between baseline steps and Pre-ABC neared significance ($r=0.542$, $p=0.056$). The correlation between pre-ABC and the % goals obtained during the last 4 weeks of training approached significance ($r=0.504$, $p=0.095$).

Conclusions : These results extend previous findings suggesting a relationship between self-efficacy (ABC) and steps taken per day after stroke. Our results demonstrate that not only are self-efficacy and steps per day related at a single point in time, but baseline self-efficacy is strongly related to improvements in steps per day during an intervention aimed at improving real-world walking after stroke.

Clinical Relevance : These results reinforce the importance of assessing self-efficacy to determine a patient's potential responsiveness to an intervention. In this study greater improvements in steps per day were observed in participants with greater self-efficacy prior to the start of the intervention.

TITLE: The Relationship between Mobility Measures at Discharge from Inpatient Stroke Rehabilitation and Six-Month Follow-up

AUTHORS/INSTITUTIONS: H. Batistick-Aufox, J. Lebduska, D. Gall, M. O'Dell, Rehabilitation Medicine, New York Presbyterian Hospital/Weill Cornell, New York, New York, UNITED STATES|M. Taub, Rehabilitation Medicine, Weill Cornell Medical College, New York, New York, UNITED STATES|J. Toglia, School of Health & Natural Sciences, Mercy College, Dobbs Ferry, New York, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Endurance has been established as an important predictor of community integration. The validity and reliability of the Six Minute Walk Test (6MWT) has been established in the stroke population as a measure of endurance. Compared with other mobility measures, we hypothesize that endurance measured at discharge from inpatient stroke rehabilitation will demonstrate the strongest correlation with community participation and self-reported activity limitation at six month follow-up.

Number of Subjects : 45 subjects were taken from a larger database of 178 discharges from inpatient stroke rehabilitation at an urban academic medical center. Subjects included those who had completed all discharge and follow-up measures and who were ambulatory with minimum assistance or less. The mean age (standard deviation)= 67.2 years (15), mean rehab length of stay=14.1 days (6.6), mean National Institutes of Health Stroke Study score = 6.2 (5.3), mean days post-stroke upon admission to rehab= 11.4 days(13.7), 77.7% ischemic stroke, 62.2% male, 64.4% white, 60% college-educated.

Materials/Methods : Under an IRB approved protocol, discharge mobility scores (DMS) included: 6MWT, Berg Balance Scale (BBS), 10 Meter Walk Test (10MWT), Timed Up and Go Test (TUG), Lower Extremity Motricity Index (LEMI), and Functional Independence Measure- motor subscore (FIM-M). Six month follow up data included: Stroke Impact Scale Participation Domain (SIS-P) and Activity Measure for Post-Acute Care-Basic Mobility Scale (AM-PAC/BM). The relationships between DMS and the SIS-P and AM-PAC/BM at six months were determined using the Spearman's rho.

Results : Spearman's rho between 6 month SIS-P and DMS: 6MWT = .504, TUG= -.496, 10MWT= .462, FIM-M=.427, LEMI = .285, BBS=.255. Correlations between 6 month AM-PAC/BM and DMS: 10MWT =.613, BBS=.606, 6MWT =.588, TUG=-.568, FIM-M= .414, LEMI =.348.

Conclusions : Our hypothesis was only partially supported in this sample of ambulatory stroke survivors. 6MWT at discharge demonstrated the strongest correlation with 6 month SIS-P, however discharge BBS showed the strongest correlation with the AM-PAC/BM. Moderate correlations were found between the 6MWT and the SIS-P, and moderate correlations were found between the 6MWT, BBS, 10MWT, TUG and the AM-PAC/BM. Limitations include a small sample size and drop outs lost to follow-up.

Clinical Relevance : As expected, discharge endurance showed a strong relationship with participation in the community at 6 months after discharge from inpatient rehabilitation. Compared to the other measures, balance showed the strongest relationship with a measure of self-reported basic mobility.

TITLE: Reliability of VirtuBalance: Analysis of Sway and Functional Reach

AUTHORS/INSTITUTIONS: S. Tippet, K. Dodge, R. Lynch, Physical Therapy and Health Science, Bradley University, Peoria, Illinois, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Purpose: To determine the reliability of the VirtuBalance 3d-motion analysis system for measuring balance with the Functional Reach Test and the modified Clinical Test of Sensory Integration on Balance (mCTSIB). Hypothesis: The VirtuBalance analysis system is a reliable clinical tool to assess sway and functional reach in healthy subjects.

Number of Subjects : Thirty-one subjects between the ages of 18 and 41 years.

Materials/Methods : The data collection procedures and informed consent document were approved by the Institutional Committee on the Use of Human Subjects in Research. All subjects provided informed consent. Exclusion criteria included any neurological or vestibular issue that would impede the individual's ability to safely balance on a noncompliant surface with their eyes closed for 30 seconds, the required use of any prosthetic limbs or assistive devices, issues of past or present cardiac conditions, and any individual who had undergone a recent (less than 6 months) orthopedic injury or surgery. Data were collected simultaneously via the VirtuBalance and the AMTITM Forceplate while participants performed two trials of the mCTSIB to determine analysis of sway. Data were also collected simultaneously for three trials of the Traditional Functional Reach test via the VirtuBalance 3d-motion analysis system and visually by a researcher.

Results : Data for the Functional Reach Test were normally distributed. No statistically significant differences were found between trials on the VirtuBalance (15.50+2.54; 15.75+2.49; and 16.05+2.73) and Traditional Functional Reach test (15.83+2.59, 15.74+2.45, and 16.08+2.65). Correlation between variables ranged from $r = .861$ to $r = .964$ ($p = .01$). Data for the VirtuBalance average sway were normally distributed and demonstrated correlations ranging from $r = .628$ to $r = .752$ ($p = .01$).

Conclusions : The VirtuBalance is a reliable tool in assessment of Traditional Functional Reach in normal subjects within 2 inches (average standard deviation) and for total sway as assessed by the modified Clinical Test of Sensory Integration on Balance.

Clinical Relevance : The VirtuBalance can be used to assist clinicians in assessing patient performance of two commonly used tests by the physical therapist. The real time assessment provides not only immediate feedback to the patient but the VirtuBalance also stores a video file of patient performance that can be used as a baseline measure for future comparison. Finally, video analysis of extremity and trunk motions as recorded by the VirtuBalance can assist the physical therapist in specific analysis of patient movement patterns.

TITLE: Functional Electrical Stimulation in Combination with Treadmill Training to Improve Gait in Adults with Stroke: A Systematic Review

AUTHORS/INSTITUTIONS: M. Balcon, E. Forsberg, E. Mossler, J. Shackles, J. Schwartz, R.M. Hakim, Physical Therapy, University of Scranton, Scranton, Pennsylvania, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : The combination of treadmill training (TT) and functional electrical stimulation (FES) has emerged as an effective training method for recovery of mobility after stroke. The purpose of this systematic review was to determine the effectiveness of the combination of FES and TT on improving gait in adults with stroke.

Number of Subjects : N/A

Materials/Methods : A literature search of PubMed, CINAHL, ProQuest, ScienceDirect, and Cochrane Library was conducted using the search terms: (stroke OR cerebrovascular accident OR CVA) NOT spinal cord injury) AND Functional electrical stimulation OR electrical stimulation OR FES OR Neuroprosthesis AND treadmill train* OR treadmill AND gait OR walking OR ambulation OR locomotion OR mobility. Selection criteria: subjects older than 18 with diagnosis of unilateral stroke, intervention using both FES and TT with or without body weight-support (BWS), RCT, and measurement of gait. Two reviewers independently assessed each study for methodological quality and came to consensus based on PEDro guidelines.

Results : A total of 74 articles were screened, and 3 studies fulfilled the criteria. The PEDro scores ranged from 8-9 (8.7 mean). Samples ranged from 30 to 53 subjects (115 total) who ambulated independently with or without assistive devices in inpatient rehabilitation or community-based settings. Outcome measures included: Gait Assessment and Intervention Tool (i.e., quality of gait), Tinetti gait scale, and temporal-distance gait characteristics (velocity, cadence, step and stride lengths). In 2 studies, intramuscular (IM)-FES was implanted in 8 lower extremity muscles in patients with chronic stroke (average 9 months post). One study used surface electrode FES solely on the tibialis anterior muscle on patients with subacute stroke (4 months post). TT velocity ranged from 0.4–0.894 m/s (0.697 m/s average). Interventions were performed 4-5 times per week (30-90 min/session) ranging 4-12 weeks in duration (8 week average). All 3 studies found statistically significant between group improvements in all primary balance and gait outcomes ($p= 0.45-0.001$). The greatest treatment effects were found with the use of IM-FES and longer duration of treatment (at least 12 weeks) in adults with chronic stroke.

Conclusions : There is a strong level of evidence to support the use of both TT and FES to improve gait among adults with subacute or chronic stroke. IM-FES and treatment of at least 12 weeks resulted in the greatest benefits in adults with chronic stroke. Limitations included disparate outcome measures and small sample sizes. Further research is needed to determine the most optimal training parameters to improve gait/balance in adults post stroke.

Clinical Relevance : Clinicians should consider the combination of FES and TT to improve gait and balance outcomes beyond what that would be expected with usual care. The results suggest the most effective protocol was 1.5 hour sessions, 4 times per week over 12 weeks using IM-FES.

TITLE: Changes in Standing Stability with Balance-Based Torso-Weighting in People with Cerebellar Ataxia: a Pilot Study

AUTHORS/INSTITUTIONS: N. Conley, S.A. Whiteford, J. Gee, A. Harrell, D.D. Allen, V. Block, Graduate Program in Physical Therapy, UCSF/SFSU, San Francisco, California, UNITED STATES|C. Gibson-Horn, G.L. Widener, Physical Therapy, Samuel Merritt University, Oakland, California, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Unsteadiness and decreased motor control during standing and gait put people with cerebellar ataxia at greater risk of falling and sustaining injuries. Strategic placement of light weights on the torso with balance-based torso weighting (BBTW) has improved gait velocity, cadence, standing stability, and fall rate in people with multiple sclerosis, some of whom have ataxia. This was the first study testing BBTW in people with cerebellar ataxia. Our purpose was to determine if BBTW could increase standing stability and functional movement during a single 1.5-hour session for people with ataxia and healthy matched controls. We hypothesized that people with ataxia would have improved measures of static standing and physical functioning with BBTW compared to no-weight conditions. We also hypothesized that healthy controls would show better standing stability and function compared to people with ataxia.

Number of Subjects : 10 participants with cerebellar ataxia, 10 healthy age- and sex-matched controls

Materials/Methods : Participants completed the Activity-Specific Balance Confidence Scale. People with ataxia were assessed using the Scale for the Assessment and Rating of Ataxia. Six accelerometers were attached to the torso and extremities. Participants were asked to stand on a firm surface for 30 seconds with eyes open then eyes closed, and stand on foam for another 30 seconds with eyes open then eyes closed. If balance was lost, number of seconds prior to loss of balance was recorded. Participants performed the timed up and go (TUG) test. A vest-like garment was donned and directional instability was assessed in standing using a methodical series of perturbations and resisted rotations at the shoulders and pelvis. Light weights (totaling 0.25-2 pounds) were strategically applied to improve reactive control to balance challenges. The standing and TUG tests were repeated with the weights on. Paired t-tests compared within-group differences with and without weights. Independent t-tests compared between-group differences.

Results : Healthy controls but not people with ataxia had a statistically significant decrease in number of seconds taken to perform the TUG when weighted ($p < .001$). The number of seconds that people with ataxia successfully stood on the firm or foam surface was significantly higher with weighting ($p=.003$); all healthy controls stood for the maximum time of 120s in weighted and unweighted conditions.

Conclusions : Strategic weighting improved standing stability with eyes open and closed but not necessarily gait velocity in people with ataxia. Future analyses will examine postural sway with and without weights and potential plasticity when weights are worn daily.

Clinical Relevance : Heavy weights to control ataxia may be unnecessary if very light weights can improve standing stability and reactive control to directional balance challenges. Increasing gait speed may not be the goal in ataxia. However, improved stability may provide the needed impetus for increased participation in exercise or physical activity in this population.

TITLE: Effect of Tai Chi Exercise Combined with Mental Imagery Theory in Improving Balance in a Diabetic and Elderly population

AUTHORS/INSTITUTIONS: A. Alsubiheen, J.S. Petrofsky, N. Daher, E.B. Lohman, A.K. Alotaibi, Physical Therapy, Loma Linda University, Loma Linda, California, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Diabetes mellitus (DM) is a disease that threatens the health of people worldwide due to its widespread prevalence and many complications, including loss of balance. Tai Chi as a form of exercise helps improve neuromuscular functions, such as joint stability, tactile acuity, posture control, and lower-limb muscle strength. This study was designed to further investigate the effect of 8 weeks of Tai Chi (TC) training combined with mental imagery (MI) on improving balance in people with type 2 diabetes and an age matched control group.

Number of Subjects : 29

Materials/Methods : A prospective study on a diabetic group and an age-matched control was conducted. The study's design was a pre- and post-test longitudinal design. Seventeen healthy subjects and 12 type 2 diabetic sedentary subjects ranging from 50-80 years of age with no history of TC exercise were recruited for this study. Balance was evaluated pre posttest using the following: The Activities-specific Balance Confidence (ABC) Scale, Functional Reach Test (FRT) and One Leg Standing Test (OLS).

Results : This study showed that both groups experienced significant improvements in ABC, OLS, FRT ($P < 0.01$) after completing 8 weeks of TC exercise with no significant difference between groups. There was no significant change in hemoglobin A1C for the diabetic group after completing the exercise program.

Conclusions : Combining TC with MI for 8 weeks resulted in an improvement in balance in the diabetic and the control groups; however, no significant difference between the groups was observed. Since the DM group had more problems with balance impairment at baseline than the control, the diabetic group showed the most benefit from the TC exercise.

Clinical Relevance : Fear of falling and impaired balance are two of the complications of diabetes and aging. Reflexes are generally more sluggish with older people and diabetics. This impairment can result from the pathology of the aging and diabetes. Based on this study's findings, physical therapists are encouraged to recommend TC exercise for diabetic and geriatric patients to improve balance. The results of this study suggested that teaching the patient to focus on MI theory while doing TC exercise is the best way to promote and accelerate the "re-learning" process in order to improve balance.

TITLE: A scoping review on the outcomes of implanted electrodes in individuals with spinal cord injury.

AUTHORS/INSTITUTIONS: B. Losak, S. Parlier, C. Ulses, Doctor of Physical Therapy, Duke University , Durham, North Carolina, UNITED STATES|R. Coeytaux, Community and Family Medicine, Duke University, Durham, North Carolina, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Implanted electrodes are often used to alleviate symptoms and improve physical function and mobility in individuals with spinal cord injury (SCI). The purpose of this review was to investigate the outcomes of implantable electrodes in patients with spinal cord injury within the concentrations of bowel and bladder, respiratory function, physical function, and functional movement, as well as to identify gaps in the literature.

Number of Subjects : 659

Materials/Methods : A computerized search of the databases Pubmed, CINAHL, and EMBASE was conducted using relevant key words. Two independent reviewers screened titles and abstracts. Researchers retrieved the full-text of eligible articles utilizing the inclusion criteria of: 1) spinal cord injury; 2) implanted electrodes; 3) adults; and 4) English language. Studies of external or surface electrodes were excluded. Data extracted from the articles included: number and characteristics of subjects; study design; outcomes measured; key findings; and type of implant used. Study quality was assessed for each included article.

Results : Results of bowel and bladder dysfunction studies suggest that sacral neuromodulation with percutaneous or anterior sacral root electrodes can enhance urinary and bowel continence, reduce urinary tract infections, and improve quality of life. For respiratory function, the majority of studies were prospective clinical trials that utilized intramuscular diaphragm electrodes or epidural electrodes. Results showed increases in inspired volumes and tidal volumes, and a decrease in the time patients spend on mechanical ventilation. For physical function, prospective clinical trials showed improved grasp, reaching, and independence with ADL's utilizing epimysial, intramuscular, and spinal nerve cuff electrodes. Studies on functional movement were predominantly prospective clinical trials analyzing epimysial, epidural, or intramuscular electrodes: these studies showed increased independence in ambulation and transfers.

Conclusions : Our findings suggest that bowel and bladder electrode systems increase quality of life and reduce incontinence, and that respiratory electrode systems decrease ventilator dependence and increase inspired volumes in patients with SCI. UE electrode systems can improve grasp and performance of ADL's, while LE electrode systems increase independence in ambulation.

Clinical Relevance : Knowledge about the state of the science of implanted electrodes may help physical therapists advise patients and colleagues about the potential role of this intervention for patients with SCI.

TITLE: In persons with Parkinson's Disease, is LSVT-Big therapy more effective than traditional therapy for improving Gait and TUG speed?

AUTHORS/INSTITUTIONS: W.H. Ballinger, K. Campanale, K. Critser, J. Elkafrawi, R.H. Salem, J. Sattler, J. Tucker, G.G. Fluet, Rehabilitation and Movement Sciences, Rutgers The State University of New Jersey, Newark, New Jersey, UNITED STATES|J. Lazaro, Outpatient PT/OT Department, JFK Medical Center, Edison, New Jersey, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Parkinson's disease impacts kinesthesia and motor planning in a manner that results in hypokinesia and bradykinesia. This dramatically decreases the effectiveness of gait and related mobility behaviors in this population. Self-cuing strategies related to the amplitude of movements to address these deficits have emerged in the past decade. This project tested the hypothesis that amplitude cuing treatments in general and the LSVT-BIG treatment system specifically, would have a larger impact on TUG and Gait speed scores for patients with Parkinson's disease than conventional physical therapy via a systematic review of the literature.

Number of Subjects : N/A

Materials/Methods : The following databases were searched: PubMed, Medline, Cinahl, and Cochrane Registry of Controlled Trials. Combinations of the following key words were used: Parkinson's, PD., LSVT-BIG, Lee Silverman Voice Treatment, BIG Exercise, Amplitude, Cue. Gait, Timed up and go, TUG and Sit to Stand. Inclusion Criteria were: Subjects diagnosed with PD and the use of LSVT-BIG or another amplitude scaling approach. Exclusion Criteria: Articles without TUG or Gait Speed outcome measures.

Results : Five articles met the inclusion criteria (Ebersbach et al. in 2010, Ebersbach et al. in 2014, Farley et al. in 2005, Lowry et al. in 2010 and Janssen et al. in 2014). Level of evidence varied from 1b-4. Each study had a population consisting of subjects with PD varying in severity between Hoehn & Yahr (H&Y) stage I to III. Mean participant age ranged from 58 to 70 years old. Three studies had participants stratified by H&Y score using an amplitude training method (LSVT), while the two other studies compared the LSVT protocol groups to other therapeutic methods. LSVT-Big training was found to be an effective treatment strategy for improving TUG and gait speed in patients with PD. Ebersbach et al., 2014 found that LSVT was comparable to similar methods of amplitude-oriented training for these outcome measures.

Conclusions : There is modest evidence that LSVT-BIG demonstrates a significant and clinically meaningful difference in improving TUG and gait speed in those with Parkinson's Disease. One of the two studies (Ebersbach et al., 2010) comparing LSVT-BIG to other forms of treatment showed that LSVT-BIG is superior to a conventional home therapy and Nordic walking program in both gait speed and TUG time. Evidence suggests that LSVT may not be more effective than other amplitude training protocols in improving TUG and gait speed. LSVT-BIG has shown greater effects on mild to moderately impaired individuals with Parkinson's Disease as evidenced by H&Y scores. Further research is warranted before implications can be made concerning the use of LSVT-BIG in severely impaired persons.

Clinical Relevance : Based on current evidence, amplitude-training appears to be a viable treatment for restoring functional movement in patients with Parkinson's Disease.

TITLE: Virtual reality-augmented rehabilitation in the acute phase post-stroke for individuals with severe hemiparesis: a feasibility study.

AUTHORS/INSTITUTIONS: J. Patel, G.G. Fluet, A. Merians, Q. Qiu, M. Yarossi, E. Tunik, Rehabilitation and Movement Sciences, Rutgers The State University Of New Jersey, Newark, New Jersey, UNITED STATES|S. Adamovich, Department of Biomedical Engineering, New Jersey Institute of Technology, Newark, New Jersey, UNITED STATES|S. Massood, Acute Rehabilitation Unit, St. Joseph's Hospital, Wayne, New Jersey, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Proportionally more stroke survivors are left with upper extremity disability than lower extremity (1). Chronically, hand control can be more impaired than proximal control (4). Many important activities of daily living require good hand function, therefore developing training protocols targeting this area is critical. Techniques such as cortical priming can rebalance inter-hemispheric excitability after stroke leading to improved outcomes (5,6). In humans most impairment based recovery after stroke occurs in the first 3 months (3). Despite this knowledge, the majority of studies using robotically facilitated virtual reality (VR) techniques are conducted in the chronic phase. Additionally, most of these studies enroll subjects with some active movement of the paretic arm. Rehabilitating individuals with severely affected upper extremities is difficult as there are limited therapeutic tasks they can actively participate in. Often compensatory techniques are taught that can lead to “learned non-use” possibly hindering impairment-based recovery (2). Our protocol trains the severely paretic hand acutely after stroke in hopes that robotically facilitated VR-based priming combined with a skilled hand task will be feasible and allow meaningful and active participation in distal motor training.

Number of Subjects : Three subjects within 2 weeks post-stroke. At onset, the UEFMA was $\leq 3/66$ and The Chedoke-McMaster Stroke Impairment Stage of the upper extremity was 1.

Materials/Methods : Subjects trained 5 days a week till discharge. Each session was 45-60 minutes in addition to their regular schedule. Training consisted of cortical priming consisting of visual mirror feedback and bilateral movement based training followed by a pinch force modulation task.

Results : Priming effects were suggested by increased maximal pinch force immediately after mirror training. Persons without discernable hand movement were able to actively engage in training as corroborated by the force traces and EMG recorded during the pinch trace task. Motor learning during this task was suggested by a decrease in Root Mean Square Error (RMSE). Finally, the benefits of objective, technology based measurement tools were demonstrated by the ability of the force sensor to detect small changes in hand function that could not be measured as effectively with a clinical scale of impairment.

Conclusions : Cortical priming combined with skilled distal training was feasible acutely after stroke and may have allowed for meaningful and active training in subjects with very little active motor ability.

Clinical Relevance : This feasibility study will hopefully lead to a future larger scale randomized controlled trial allowing us to better determine whether our unique treatment technique changes neural recovery and motor function differently as compared to the teaching of compensatory techniques and goal-directed hand activity that is delayed until active motor ability emerges. This could impact rehabilitation strategies for this underserved population.

TITLE: mHealth Technology Implementation is Feasible in Persons With Mild Dementia but Does not Increase Physical Activity

AUTHORS/INSTITUTIONS: E.D. Vidoni, J.M. Burns, C. Greer, A.R. Van Sciver, R. Graves, J. Black, S. Cooper, A. Nagely, L. Uphoff, J. Volmer, N. Zink, Neurology, Univ. of Kansas Med Center, Kansas City, Kansas, UNITED STATES|C. Rodriguez, Mathematics and Computer Science, Fort Hays State University, Hays, Kansas, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Evidence suggests that physical activity is effective for slowing cognitive and functional decline [1]. Individuals with dementia are more sedentary than their peers without cognitive change [2]. Recommending exercise is standard but clinical recommendations for exercise often lack specificity and individualization [3] and relatively few older adults adopt a more active lifestyle at the request of their healthcare provider. Therefore, we tested a mobile health (mHealth) technology-supported physical activity program [4-7], deployed in the clinic and monitored online in near real-time, for those with cognitive impairment. We hypothesized that mHealth monitoring would be feasible and would increase physical activity over 8 weeks.

Number of Subjects : We enrolled 20 individuals with cognitive impairment and 8 without cognitive impairment.

Materials/Methods : Enrollees were 65-85 years old, with mild dementia or no cognitive impairment and no clinically significant illness affecting adherence or safety to exercise. They were also sedentary or underactive and had a caregiver to help them comply with the study. A Fitbit Zip wireless-networked pedometer (Fitbit Inc.) was given to each enrollee. Participants were mailed an individualized written daily step prescription that increase the weekly goal by 20% from Week 1 until Week 6. Participants got bi-weekly phone calls for encouragement or more frequently if the online interface showed they were not wearing the pedometer. Change in weekly step count within diagnostic group was tested using parametric tests.

Results : Two individuals with dementia withdrew secondary to difficulty with setup or technology, 2 withdrew without caregiver support, 2 withdrew due to time or travel issues, 3 had safety concerns or injury and 1 was lost to follow-up. One individual without dementia withdrew due to travel. Three pedometers were lost (all by impaired participants). Individuals with cognitive impairment were not able to increase their physical activity over baseline. The individuals without impairment were able to increase physical activity over baseline (Fig.1).

Conclusions : The use of mHealth technology was feasible: 90% were comfortable setting-up and using the internet-connected pedometer, and only 3 pedometers were lost. However, even with bi-weekly phone calls and support from their caregivers, individuals with cognitive impairment did not increase their physical activity (the number of steps they took weekly, +522), and 50% withdrew from the program. Individuals without cognitive impairment were able to increase their physical activity (+2121 daily steps, $p=0.03$), though they did not achieve their target physical activity goals.

Clinical Relevance : Individualized activity prescription and near real-time mHealth monitoring are insufficient to encourage more active lifestyles in people with cognitive impairment. Additional support such as structured programs or incentivization may be necessary to increase physical activity.

TITLE: Diagnostic Accuracy of the Immediate Post Concussion Assessment and Cognitive Testing: Systematic Review

AUTHORS/INSTITUTIONS: D. Pechumer, K. Stockdale, B. Alsalaheen, Physical Therapy, University Of Michigan-Flint, Flint, Michigan, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of this review is to: 1) Review the reporting and methodological qualities for the diagnostic accuracy studies that examined the Immediate Post Concussion Assessment and Cognitive Testing, 2) Summarize the current evidence about the sensitivity and specificity of Immediate Post Concussion Assessment and Cognitive Testing in assessment of concussion, and 3) Provide a recommendation for the clinicians utilizing impact in diagnosis of concussion.

Number of Subjects : Nine studies were reviewed, the number of participants from each individual study ranged from 24 to 2152.

Materials/Methods : A systematic review of the relevant literature in PubMed, CINAHL and PSYCHINFO yielded 5,943 studies. After applying a predetermined inclusion and exclusion criteria, only nine studies examined the diagnostic accuracy. Studies were evaluated using the Standards for the Reporting of Diagnostic accuracy studies (STARD) statement and the Quality Assessment of Diagnostic Accuracy Studies (QUADAS-2) tool.

Results : Based on the Quality Assessment of Diagnostic Accuracy Studies many of the studies demonstrated high risk of bias with their index tests, reference standards and flow and timing. However, a low risk of bias was observed based on patient selection. Additionally, the studies did not have applicability concerns. The Standards for the Reporting of Diagnostic Accuracy Studies resulted in a wide range of scores from 11 to 18, reflecting moderate reporting quality. The studies sensitivity and specificity values ranged from 29.3% to 94.6% and 1.8% to 100%, respectively. The positive predictive values ranged from 29.3% to 100% while the negative predictive value ranged from 17% to 93.7%.

Conclusions : Given the wide variations in sensitivity and specificity values of the Immediate Post Concussion Assessment and Cognitive Testing across studies, clinicians should be cautious when using this ImPACT as a criterion to determine diagnosis and return to play after concussion. Clinicians must also consider the timing since concussion as a moderator for the diagnostic accuracy of ImPACT.

Clinical Relevance : Determining the sensitivity and specificity of the Immediate Post Concussion Assessment and Cognitive Testing is clinically important in order to properly diagnose and treat a concussion. When using ImPACT as a stand-alone instrument, clinicians must be aware of the odds of false positives and false negatives in assessment of concussion, and must utilize a multifaceted approach that incorporates other evaluative measures.

TITLE: Sensory Amplitude Electrical Stimulation via sock electrode during task-based exercise improves lower extremity function in individuals with chronic stroke

AUTHORS/INSTITUTIONS: K.M. Almdale, M.J. Bednarczyk, C. Clement, J. DelMonaco, N. Druktenis, S. Eid, R. López-Rosado, J.E. Sullivan, Physical Therapy & Human Movement Sciences, Northwestern University, Chicago, Illinois, UNITED STATES|A. Kimalat, Physical Therapy, Schwab Rehabilitation Hospital, Chicago, Illinois, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : The objective of the study was to determine if sensory amplitude electrical stimulation (SES) delivered via sock electrode during task-specific leg exercises improved gait speed, sensation, balance, and participation in individuals with chronic stroke. It was hypothesized that SES would enhance the effectiveness of exercise, resulting in reduced impairment and improved function in individuals with post-stroke hemiplegia.

Number of Subjects : 15 subjects (56.5 + 7.84 years old) with chronic stroke (8.21 + 4.36 years post) and unilateral lower extremity hemiparesis. Subjects were community ambulators.

Materials/Methods : Subjects completed 6 weeks of home-based SES delivered via sock electrode during task-specific lower extremity exercise for a minimum of 5 days/week for 30-minutes, twice daily. During the intervention period, subjects attended 2 sessions in the research lab to ensure optimal execution of the intervention. Outcome measures administered at pre-test, post-test, and 3-month follow up included: Berg Balance Scale (BBS), Stroke Rehabilitation Assessment of Movement – LE subscale (STREAM), 10 Meter Walk Test (10MWT), Activities-Specific Balance Confidence Scale (ABC), Stroke Impact Scale (SIS), and Monofilament testing.

Results : 13 subjects completed the study. At post- test there were statistically significant improvements ($p=0.043$) in the 10 MWT; BBS, STREAM, ABC, SIS and Monofilaments did not show significant differences. Changes were not maintained at follow-up. Younger subjects had greater changes in in self-selected ($r^2= -0.851$) and fast pace ($r^2= -0.754$) gait speed. Individuals with lower sensory capacity had less change in ABC ($r^2= -0.701$) and STREAM scores ($r^2= -0.867$). There were moderate effect sizes for changes in Monofilament (0.301), STREAM (0.5) and 10MWT (0.57) scores.

Conclusions : The use of home-based SES via sock electrode during leg exercises may improve gait speed in chronic stroke. Age and baseline sensory capacity may affect outcome.

Clinical Relevance : This study suggests that SES delivered by sock electrode during leg exercises may have beneficial effects on gait speed, motor function, and sensation in chronic stroke.

TITLE: Walking Speed during the Six Minute Walk Test Should Not Be Used as a Surrogate for Self-Selected or Fast Walking Speed in Individuals with Chronic Stroke

AUTHORS/INSTITUTIONS: D.M. Liuzzo, J.C. Stewart, S.L. Fritz, Exercise Science, University of South Carolina, Lexington, South Carolina, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : In order to reduce redundancy and improve efficiency, clinicians and researchers attempt to use the six minute walk test (6MWT) as a measure of walking speed in place of a shorter walk test. Strong correlations have been demonstrated between measurements of walking speed, but more rigorous studies are needed to discover any discrepancies between measurements. The purpose of this study was to determine if the 6MWT can be used as a surrogate for the Three Meter Walk Test (3mWT) in individuals with chronic stroke.

Number of Subjects : 68 individuals (mean age 66[12] years, 48 men, 20 women) with chronic stroke (68[48] months)

Materials/Methods : Participants performed 3 trials of the 3mWT under two conditions (self-selected pace and fast paced) and a single trial of the 6MWT. The sample was analyzed as a whole (AP) and in two subgroups based of level of gait function using 0.8 m/s as a cut off: community ambulators (CA) and limited community ambulators (LCA). Pearson Correlations, Intra-class Correlation Coefficients (ICC) and Bland-Altman plots (BA) were generated for the following comparisons: 1.) self-selected 3mWT vs 6MWT, 2.) fast-paced 3mWT vs 6MWT. Residual plots were also produced and inspected.

Results : Mean self-selected 3mWT: AP was .57(.26) m/s; LCA was .34(.14) m/s; CA was .75(.17) m/s. Mean fast paced 3mWT: AP was .81(.36) m/s; LCA was .47(.19) m/s; CA was 1.08(.21) m/s. Mean 6MWT walking speed: AP was .78(.41) m/s; LCA was .41(.18) m/s; CA was 1.09(.27) m/s. Self-selected 3mWT vs the 6MWT: AP exhibited Pearson R =.91 and ICC =.82 (confidence interval of .21-.93); LCA demonstrated Pearson R =.96 and ICC =.92 (.43-.95); CA were least correlated with Pearson R =.65 and ICC =.43 (-.21-.77). Fast-paced 3mWT vs the 6MWT: AP exhibited Pearson R =.92 and ICC =.95 (.92-.97); LCA demonstrated Pearson R =.94 and ICC =.94 (.55-.98); CA were least correlated with Pearson R =.69 and ICC =.80 (.60 -.90). Bland-Altman analysis gives a visual representation of agreement. If the variation seen between the two measures does not exceed the Meaningful Clinical Important Difference (MCID) then the two measures can be used interchangeably. Bland-Altman analysis revealed all group differences exceeded the MCID of .09 m/s (established by Perera 2006) expressing greater variation between the two measures; however, LCA scores for self-selected (precision of +/- .13) and fast-paced gait speed (precision of +/- .14) demonstrated the least variation. Residuals echoed the decrease in variability between measures for the LCA; however, there wasn't enough evidence to show the two measures can be used interchangeably.

Conclusions : While strong correlations are evident, the Bland-Altman plots reveal the 6MWT should not be a surrogate for the 3mWT for individuals with chronic stroke. These two tests should be used independently in this population.

Clinical Relevance : This new information establishes better outcome measure practice for clinicians to assess walking speed and endurance in individuals with chronic stroke.

TITLE: The Mobility Scale for Acute Stroke as a Measure of Functional Ability in the Acute Care Setting
AUTHORS/INSTITUTIONS: M. Beninato, Physical Therapy, MGH Institute of Health Professions, Boston, Massachusetts, UNITED STATES|M. Tinl, Rehabilitation Services, Brigham and Women's Hospital, Boston, Massachusetts, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : The Mobility Scale for Acute Stroke (MSAS) is a standardized outcome measure used to assess functional mobility after stroke. Although total scores from the MSAS have been validated as predictors of discharge home after acute stroke, the validity of MSAS as a measure of functional ability has not been examined. The purpose of this study was to determine: (1) if the MSAS presents with floor or ceiling effects, (2) the difficulty hierarchy of MSAS items, (3) the psychometric properties of individual MSAS items, and (4) if the MSAS represents a unidimensional construct.

Number of Subjects : 223 adults admitted to a tertiary care hospital with acute stroke who were referred to physical therapy (mean age 65.5 years +/- 14.8; 51.6% male)

Materials/Methods : Data from initial physical therapy exams were retrieved from 223 medical records. Rasch modeling of the MSAS was performed using the WINSTEPS software. Response categories for the MSAS were: Unable to perform task (1), Max assist of one or two (2), Mod assist of one (3), Min Assist of one (4), Supervision (5), and Independent (6). MSAS items include Bridging, Supine to Sit to Supine, Sitting Balance, Sit to Stand, Standing Balance, and Gait. Principal Component Analysis (PCA) was performed to test unidimensionality.

Results : MSAS Item scores on the Logit scale ranged from 2.98 for the most difficult item, Gait, to -0.75 Logits for the easiest to perform item, Sitting Balance. Person ability, however ranged from 9.09 to -7.45 Logits indicating a ceiling and floor effect. Most item locations on the difficulty hierarchy were consistent with clinical expectation. Psychometric analysis of individual MSAS items demonstrated that Gait and Sitting Balance showed variability consistent with Rasch model predictions (InFit Mean Square 1.28 and .76, respectively). The other four MSAS items either showed more (Bridging) or less (Supine to Sit, Sit to Stand, Standing Balance) variability than was predicted. PCA yielded 26.5% unexplained variance with an Eigen value of 1.6, suggesting there may be more than one construct represented within the MSAS.

Conclusions : The items contained within the MSAS measure abilities over a restricted range compared with those abilities represented in this sample of people with acute stroke. Adding more difficult and easier items may strengthen the construct, making the MSAS more applicable to patients acutely post-stroke. Item placement in the difficulty hierarchy and item variability may have been influenced to the use of the six level rating scale used for scoring and how that scale was applied. Future studies should include a rating scale analysis to determine if collapsing the scale to four or five levels improves the psychometric properties of the individual MSAS items. The MSAS may not represent a unidimensional construct and may measure more than one aspect of function.

Clinical Relevance : The MSAS may not be an appropriate measure for the range of functional abilities levels typically presented in people with acute stroke as it demonstrates marked floor and ceiling effects.

TITLE: An APTA Neurology Section Sponsored Clinical Practice Guideline on a Core Set of Outcome Measures for Neurologic Physical Therapy Practice: An Update

AUTHORS/INSTITUTIONS: J.E. Sullivan, K.D. Blankshain, Physical Therapy & Human Movement Sciences, Northwestern University, Chicago, Illinois, UNITED STATES|J. Moore, South Eastern Norway Regional Knowledge Translation Center,, Oslo, NORWAY|K. Potter, Department of Physical Therapy Education, Rockhurst University, Kansas City, Missouri, UNITED STATES|C. Chang, Rehabilitation Institute of Chicago, Chicago, Illinois, UNITED STATES|S.L. Kaplan, Rutgers Biomedical and Health Sciences , Rutgers, The State University of New Jersey, Newark, New Jersey, UNITED STATES|

ABSTRACT BODY:

Purpose : The Institute of Medicine defines Clinical Practice Guidelines (CPGs) as statements that “include recommendations intended to optimize patient care that are informed by a systematic review of evidence and an assessment of the benefits and harms of alternative care options.” Supported by the Neurology Section (NS) and funded by APTA, a taskforce is developing a CPG on a core set of outcome measures for neurologic physical therapy practice. This effort will be completed by December 2016. This presentation outlines efforts to date.

Description : A diverse expert panel of clinicians, researchers, and consumers of neurologic physical therapy (CNPT) was invited to help inform the CPG scope and process. CPG. To identify the purpose and scope, online surveys were distributed to CNPTs and NS members. 303 NS members and 215 CNPTs responded. The majority (59% CNPTs; 65% NS members) agreed it is very important or essential to use standardized outcome measures. Both CNPTs and NS members agreed that gait and balance are two key constructs to include. Other constructs including transfers and patient-stated goals were recommended by NS members. Using the survey results and expert panel feedback, the CPG team selected outcome measures that assess gait, balance, transfers and patient-stated goals from the list of 242 tools reviewed by the NS-sponsored EDGE groups. The CPG team first eliminated measures that could not be used across conditions (n=103) as well as those that were not recommended by the EDGE groups (n=13). Measures that captured constructs outside the CPG scope of balance, gait, transfers, and patient-stated goals (n=57) were eliminated, as were measures that could not be used to assess change over time (n=8) or did not have published responsiveness data (n=3). Further analysis of the items in each measure was done to ensure that at least 75% of the items address the CPG constructs. Finally, the measures were assessed for clinical utility. A reference librarian conducted a literature search on the remaining 36 measures. References were screened for inclusion in the systematic review.

Summary of Use : During the full-text review, articles will be examined for methodological quality and strength of the data related to reliability, internal consistency and responsiveness using a modified Consensus-based Standards for the Selection of Health Measurement Instruments (COSMIN). Measures meeting established criteria will be eligible for inclusion in the core set.

Importance to Members: Implementation of a core set of outcome measures will facilitate comparisons across patients, clinicians, facilities, and diagnoses; improve standardization of practice to avoid unwanted variability; and, ultimately, enable clinicians and researchers to better evaluate the efficacy of interventions. Each benefit is important to the development of best practice guidelines and advancement of the physical therapy profession.

TITLE: Tablet based Brief Kinesthesia Test is reliable in healthy adults

AUTHORS/INSTITUTIONS: A.E. Burgess, J. Stueve, S. Trame, A. Siles, A. Borstad, The Ohio State University, Columbus, Ohio, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Clinicians lack practical quantitative methods of measures of kinesthetic impairment. 1,2, 3, 4 The Brief Kinesthesia Test (BKT) has been studied in healthy individuals. For the BKT error in target reaching with vision occluded is used to evaluate upper extremity (UE) kinesthetic sense. 5 In adults 19-65 years (n=139), Dunn et al., found a mean (SD) of 2.7 (0.875) cm average error for the 4-item BKT. The test-retest reliability of the BKT was good (ICC=0.71). We developed a tablet-based version of the BKT (tBKT) that has 20 items for each UE. The purposes here was to: 1) compare the BKT and tBKT, 2) determine inter- and intra-rater reliability of the tBKT and, 3) examine the relationship between tBKT and the Wrist Position Sense Test (WPST). 6

Number of Subjects : 12 healthy adults (5 males) with a mean age of 35 ± 15 years.

Materials/Methods : Testing was performed at 3 time points, each 1 week apart. Each participant was tested bilaterally with 3 objective measures the BKT, tBKT and WPST. There were 3 raters, with the rater kept constant for the first 2 time-points. The measures were administered in a pseudo-randomized order with the dominant UE tested first. Goodness of Fit test determined normal distribution, two-tailed T-tests determine between group differences, Intraclass Correlation Coefficient examined reliability and Pearson Correlation Coefficient established the relationship between measures. Data were analyzed using JMP Pro 11.0.0.

Results : Data from the 3 measures at 3 time-points were normally distributed with the exception of tBKT-Trial 3 and WPST-Trial 1. The mean error across time points for the BKT was 1.77 (0.82) cm for the left UE and 2.34(0.77) cm for the right UE, they were statistically different $p < 0.003$. The mean error across time points for the tBKT was 1.39(0.36) cm for the left and 1.31(0.32) cm for the right, they were not statistically different ($p = 0.26$). The correlation between BKT and tBKT for the left and right were $r = 0.62$, $p = 0.03$ and $r = 0.23$, $p = 0.47$ respectively (Trial1). Intrarater reliability of the tBKT using two-way mixed model was $ICC = 0.63$, Interrater reliability two-way random effects model was $ICC = 0.63$. The correlation between tBKT and WPST was $r = -0.23$, $p = 0.29$ (Trial 1).

Conclusions : In this sample, participants had less error in vision occluded targeted reaching (BKT) than reported by Dunn. They had less error with the left UE on the BKT (2 items) but not on the tBKT (20 items). A left UE advantage on spatial tasks has previously been reported. There was a significant positive correlation between BKT and tBKT for the left UE only. Low variability in tBKT scores in this sample likely reduced the ICC suggesting inter and intrarater reliability may be higher than moderate agreement found here. The lack of relationship between tBKT and WPST suggests the ability to estimate wrist position does not translate to better performance in a UE targeted reaching task.

Clinical Relevance : Practical tests which quantify kinesthetic impairment will enable clinicians to more accurately target treatment interventions for the upper extremity.

TITLE: The Brief Kinesthesia Test is reliable in people with chronic stroke

AUTHORS/INSTITUTIONS: S.E. Alexander, A. Borstad, Division of Physical Therapy, The Ohio State University, Columbus, Ohio, UNITED STATES|L.V. Gauthier, Physical Medicine and Rehabilitation, The Ohio State University, Columbus, Ohio, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Clinicians need a practical quantitative measure of kinesthetic impairment. 1,2, 3, 4 The Brief Kinesthesia Test (BKT) was tested for inclusion in the NIH Somatosensory Toolbox. 5 It is reliable and sensitive to differences in healthy people across the lifespan. It is unknown whether the BKT is reliable in people with stroke. A tablet-based application of the BKT (tBKT) was developed to improve the test's reliability and sensitivity. The purposes of this study are 1) to evaluate the test-retest reliability of the BKT and the tBKT in person's with chronic stroke and 2) to describe the relationship between the BKT, tBKT, and Touch TestTM, 6 a common measure of touch perception.

Number of Subjects : Twenty individuals with chronic stroke and mild to moderate hemiparesis.

Materials/Methods : Twenty individuals with chronic stroke, 15 male, 8 right side affected, mean age 59.3(12.9) years, and mean chronicity 30.8(28.1) months, who met criteria of 30° shoulder flexion, 30° elbow flexion, 10° wrist extension, and 10° extension of at least two fingers participated. Both hands were tested, however not all participants were tested with all measures, thus the number of data points included in each statistical test are provided below. Intraclass correlation coefficient (ICC) was used to evaluate the test-retest reliability of the BKT. A paired t-test was used to evaluate the reliability of the tBKT. A Pearson's Product Correlation evaluated the relationship between the BKT and the tBKT. A One-Way ANOVA compared the BKT with classification on the Touch TestTM, and a Tukey's post-hoc test was used.

Results : The test-retest reliability of the BKT was good (n=19, ICC (3,k)=0.717, p<0.001). There was no difference in mean error on the tBKT across time points (n=6, Trial 1=2.50(1.15) cm, Trial 2=2.33(0.73) cm, (p=0.346). The mean error was 4.07(2.76) cm on the BKT and 3.03(1.82) cm on the tBKT. There was no correlation between mean error on the BKT and the tBKT (n=17, r=0.070, p=0.813). There were differences in mean error on the BKT based on classification by the Touch TestTM (n=39, p<.001). Post-hoc testing resulted in between group differences for 4 of 6 comparisons.

Conclusions : The BKT appears reliable in individuals with mild to moderate hemiparesis. In this sample, mean error on the BKT was correlated with performance on the Touch TestTM, suggesting a relationship between kinesthetic performance and touch perception. Additional research is required to support implementation of the tBKT in this population.

Clinical Relevance : The BKT, a quick, inexpensive, and reliable test, stands to inform clinicians of underlying somatosensory impairments that are difficult to measure in individual with chronic stroke.

TITLE: Non-Motor Symptoms in Parkinson's Disease: Relationships with Measures of Motor Performance

AUTHORS/INSTITUTIONS: R. Duncan, M.E. McNeely, G. Earhart, Program in Physical Therapy, Washington University, St. Louis, Missouri, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Non-motor symptoms (NMS) are a disabling feature of Parkinson disease (PD) and commonly unrecognized by clinicians evaluating individuals with PD. It is unclear if NMS are related to motor performance in people with PD. The purpose of this study was to determine the extent to which NMS severity is related to measures of motor performance in people with PD. We hypothesize that NMS severity will be related to motor performance in people with PD.

Number of Subjects : One hundred eighteen (mean age: 66.9 ± 9.2 years; 40% female) subjects with idiopathic PD.

Materials/Methods : Subjects completed the Movement Disorder Society-Unified Parkinson Disease Rating Scale subsection I (MDS-UPDRS I) as the measure of NMS severity. Additionally, subjects completed the following motor performance assessments: MDS-UPDRS II (subjective performance of activities of daily living (ADLs)) and III (motor severity), Mini-Balance Evaluation Systems Test (Mini-BESTest), Activities Balance Confidence (ABC) Scale, and Timed Up & Go (TUG). All motor performance measures were collected with subjects in the practically-defined off medication state (i.e. at least 12 hours since the last dose). Spearman correlation coefficients were used to identify the relationship between NMS severity and all motor performance measures ($\alpha < 0.05$).

Results : All motor performance measures were significantly correlated to the MDS-UPDRS I score such that worse motor performance corresponded with more severe non-motor symptoms. Motor severity and balance were weakly, but significantly correlated to NMS severity ($r=0.30$; $p=0.001$ and $r=-0.45$; $p<0.001$, respectively). Moderate, significant correlations were observed between the MDS-UPDRS I and the following measures: TUG ($r=0.58$; $p<0.001$), ABC ($r=-0.60$; $p<0.001$), and MDS-UPDRS II ($r=0.58$; $p<0.001$).

Conclusions : Motor performance is related to NMS severity. In particular, functional mobility, balance confidence, and subjective ADL performance have stronger relationships to NMS severity.

Clinical Relevance : Non-motor symptoms are prevalent and associated with motor performance in people with PD. Typically physical therapists treat people with PD who have more severe motor symptoms or balance impairments. As such, physical therapists should contribute to the comprehensive care of their patients by screening patients with significant motor impairment for the presence of NMS and referring to the appropriate practitioner when necessary.

TITLE: The Efficacy of Combined Therapeutic Protocol of Large-Amplitude Movement, Exercise, and Balance Training on Patients with Parkinson's Disease

AUTHORS/INSTITUTIONS: J.S. Gambino, M. Kim, P. Steinkraus, M. Therrien, J. Kume, Dept Physical Therapy, Touro College SHS, Bay Shore, New York, UNITED STATES|C. Burke, S. Trebing, South Shore Neurologic Associates, Patchogue, New York, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Parkinson's Disease (PD) is a neurological disease associated with several clinical symptoms which have been suggested to be ameliorated with intensively structured and varied exercise-based protocols. Traditional physical therapy treatment plans focus on improving strength, balance, and functional deficits.(1) In addition, studies reporting newer therapies incorporating large amplitude movements have been cited to be effective in restoring functional outcomes for these patients (2, 3), but with the caveat of requiring time-consuming scheduling protocols. The current study assesses the efficacy of a composite protocol utilizing traditional as well as some large movement therapies using a 2-3 times per week schedule that reflects traditional physical therapy regimens.

Number of Subjects : Subjects with PD receiving physical therapy in an outpatient neurologic clinic were recruited (N=9). Inclusion criteria included individuals who were cognitively able to comprehend simple directions and minimally ambulate 10 meters with no more than supervision. Exclusion criteria included patients who were not able to complete assessment due to change in medical status or other personal reasons. All patients were classified according to the Hoehn and Yahr Scale prior to the start of study, and written informed consent forms were collected. This study was approved by the Touro College Institutional Review Board prior to start of study.

Materials/Methods : Pre- and post- intervention measurement of the Berg Balance Scale, the Timed Up and Go (TUG) and gait characteristics (with GAITrite walkway system) were done using a 10-14 session paradigm consisting of large-amplitude movements, therapeutic exercise (including those emphasizing axial rotation), cardiovascular training, general balance and ambulation activities. Hoehn and Yahr (H&Y) stage assessments (Stage I, n=3; Stage III, n=6) were included to discern differences in outcome measures as a function of disease severity.

Results : Both gait velocity(cm/s) and cadence (steps/min) were significantly increased post-intervention for individuals in the H&Y stage III compared to those with stage I ($p<0.05$, Wilcoxon, two-tailed). No significant differences were noted in TUG, Berg, or left/right step length ratios (to assess one aspect of gait symmetry).

Conclusions : This pilot study suggests that significant improvements in gait characteristics may be obtained following a "combined protocol" intervention. Improvement was noted for more severely presenting individuals (H&Y Stage 3) as compared to those with more mild clinical presentations (H&Y Stage I).

Clinical Relevance : The current pilot study indicates that a multimodal approach utilizing traditional and newer, large amplitude protocols within a typical treatment schedule may be demonstrated to improve functional outcome measures in ambulation and balance for specific populations of individuals with PD. Importantly, this outcome has been indicated to substantially improve both quality of life as well as independence in ADLs. (4,5)

TITLE: Pain and Quality of Life Contribute to Exercise Responsiveness in Multiple Sclerosis

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ABSTRACT BODY:

Purpose/Hypothesis : Multiple Sclerosis (MS) is marked by declines in walking and balance. Individuals with MS receive physical therapy intervention many times throughout their disease course. However, exercise interventions have shown variable benefits, with some individuals experiencing robust improvement, while others experience little to no improvement. It is likely that a variety of factors mediate responsiveness due to disease heterogeneity, but this has not been well explored. The objective of this study was to understand the effect of pain, quality of life, and cognition on exercise responsiveness. We hypothesized that these factors would be important contributors to individuals who responded with improved strength or improved walking speed following a progressive resistance training program.

Number of Subjects : Twenty-six individuals with relapsing-remitting MS participated in this 12-week progressive resistance training intervention.

Materials/Methods : Quantitative assessment of hip strength and walking (walk velocity, Timed 25 Foot Walk, Timed Up & Go, 2 Minute Walk Test and Six Spot Step Test) as well as subjective assessment of quality of life (MS Quality of Life-54 and SF-36), pain (Brief Pain Inventory), and walking (MS Walking Scale-12) were collected at baseline and following training. Cognition was assessed with the Symbol Digit Modalities Test (SDMT). Backward stepwise regression with AIC criterion was utilized to determine predictors of change in strength and walking speed following training.

Results : Subjective assessment of pain, quality of life and walking explain >30% (adjusted R²=0.3018) of the variance in the change in strength and >6% (adjusted R²= 0.0638) of the change in walk velocity following progressive resistance training. Prediction of strength and walking responders is improved with the addition of quantitative measures of walking and EDSS score to the subjective measures. These combined models explain >68% (adjusted R²=0.6880) and >42% (adjusted R²=0.4214) of the variance respectively in change of strength and walking velocity following training.

Conclusions : Assessment of pain and quality of life along with quantitative measures of walking and strength improves predictions for strength and walking responsiveness with a progressive resistance training intervention. Future directions include assessment of MRI measures to understand the relationship of brain volume to pain, quality of life, and exercise responsiveness.

Clinical Relevance : Quality of life and pain at the outset of rehabilitation may mediate successful exercise outcomes. Clinicians should incorporate assessment of quality of life and pain into their evaluation and include these factors into their treatment planning and goal setting for individuals with MS. Furthermore, this preliminary data suggests that clinicians may be able to use these easily-measured subjective factors to improve prediction of training responsiveness.

TITLE: High-Level Mobility (HLM) Skill Acquisition to Improve Gait After Stroke: A Case Study

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ABSTRACT BODY:

Background & Purpose : Aggressive and challenging motor task prescription is becoming more prevalent in post-stroke rehabilitation. Error-exposure and augmentation to task-variable training has been shown to further progress mobility when compared to standard of care gait-training, which has shown no-better outcomes over non-walking exercise. Limited literature is available demonstrating the use of HLM training to improve quality and independence of gait and mobility without extensive and specific gait training. Motor skills shown to predict return to running such as bounding, toe-walking, and retro-step up, and the Hi-level Mobility Assessment Tool (HiMAT) are valuable clinical tools to facilitate and track this progress. The following case report illustrates application of HLM skill training in a patient recently post-stroke to improve functional mobility and independence in walking.

Case Description : A 48 year old male with diagnosis of left cerebrovascular accident with right-sided spastic hemiplegia and expressive-aphasia presents to physical therapy within 4 months of initial onset. At initial evaluation the patient presents ambulating <1 block in the community with a straight cane and posterior leaf spring orthosis. The patient was seen in an outpatient therapy setting for 16 sessions 60-90 minutes in length during a 13 week period. Exercises within sessions were biased towards single-leg use, non-support phase and force generation activities on the pilate's reformer transitioned to over-ground jumping, bounding and hopping exercise, and the use of treadmill training that was transitioned to over-ground walking up to 1.59 m/s.

Outcomes : 5-Times Sit-to-Stand improved from 23 sec to 9.72 sec from an 18" chair; Gait speed improved from 0.63 m/s to 1.19 m/s self-selected and from 0.95 m/s to 1.59 m/s fast-walking; HiMAT improved from 17/54 to 24/54; final L-Test performed 20.97 sec without an assistive device (AD); final Timed Up-and-Go performed 8.86 sec without an AD; at discharge, the patient ambulated unlimited distances without an AD or ankle bracing and reciprocated stairs without a hand-rail.

Discussion : This case study explores gait improvements made following HLM skills training. Consistent progressive motor learning was displayed using previously-guided research with focus on acquisition of gait speed requirements to run, followed by predictors of running and HiMAT skills practice. When available, horizontal non-support phase training and plyometric skill development was shown to be beneficial in expediting skill acquisition in this population to translate to weight-bearing scenarios. As this patient continued to progress along the spectrum of lower-level to higher-level mobility skills, ambulation quality and independence demonstrated marked improvements.

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TITLE: Quantifying balance and mobility impairments in secondary progressive multiple sclerosis with wireless inertial sensors

AUTHORS/INSTITUTIONS: I. Arpan, B. Fling, M. Mancini, F.B. Horak, R. Spain, Neurology, Oregon Health and Science University, Portland, Oregon, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Purpose: Multiple sclerosis (MS) is a chronic, neuro-inflammatory disease typified by balance and mobility deficits. Most people with relapsing-remitting MS transition to secondary-progressive MS (SPMS) characterized by both worsening mobility and brain atrophy [1,2]. We have previously demonstrated significant deficits in balance and gait of mildly impaired people with MS using body worn sensors [3,4,5]; however, limited information is available regarding mobility in SPMS. The current study investigated balance and gait impairments in people with SPMS and their associations with multiple volumetric measures of the brain.

Number of Subjects : 30

Materials/Methods : Twenty-three people with SPMS {55.5±5.6 yrs; EDSS = 4.5 (range: 3-6.5)} and seven age-matched controls (52.1±4.7 yrs) performed instrumented testing using wireless, inertial sensors during quiet stance (eyes open and closed; iSWAY) and gait (Instrumented Timed Up and Go, iTUG). Measures derived from iSWAY included: sway amplitude, dispersion, path length, and jerk. Measures derived from iTUG included: stride length, velocity, cadence, trunk range of motion (ROM), and turn duration. Finally, structural neuroimaging data including cortical thickness and volumes of white matter (WMV), grey matter (GMV) and whole brain (WBV) were collected for the SPMS group.

Results : Measures of sway amplitude and dispersion were higher in people with SPMS with eyes open (amplitude: $p \leq 0.01$; dispersion: $p \leq 0.05$; path length: $p = 0.02$; jerk: $p = 0.06$) and closed (amplitude, dispersion and path length: $p \leq 0.01$; jerk: $p = 0.06$) compared to controls. The SPMS group showed a differential increase in sway measures ($p \leq 0.05$) after closing eyes. During gait, people with SPMS had lower stride length and gait velocities ($p \leq 0.01$), and ROM of trunk in the frontal plane was greater ($p \leq 0.01$) than controls. Turning duration through 180°, number of steps during turn and duration of turn to sit were also longer ($p \leq 0.05$) in people with SPMS. Cortical thickness was associated with multiple measures of balance and gait [path length (r): -0.43; range (r): -0.49; root mean square (r): -0.48; stride length (r): 0.45, turn to sit duration (r): -0.62 and trunk ROM (r) = 0.47]. WMV, GMV and WBM were not associated with measures of balance and gait.

Conclusions : People with SPMS demonstrated severe balance and mobility deficits, suggesting worsening postural instability, bradykinesia, and reliance on visual feedback to maintain balance. The association with brain cortical thickness but not other tissue volumes suggested the importance of cortical input for balance control and locomotion in advanced MS.

Clinical Relevance : This work indicates that wireless, inertial sensors provide objective and quantitative mobility data in SPMS. Association of balance and mobility deficits with cortical thinning helps validate mobility measures as outcome measures in SPMS.

TITLE: Retraining Running Following Acquired Brain Injury in Young Individuals

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

ABSTRACT BODY:

Background & Purpose : Following acquired brain injury (ABI), high-level mobility including running is often impaired even in younger individuals. Previous research suggests faster self-selected walking speed (SSWS), achieving a non-support phase when bounding, maintaining single leg stance (SLS), stepping backwards on to a step, and walking on toes can help predict if retraining running is feasible. Research also links higher level mobility to higher quality of life. However, little research exists to guide retraining running after ABI. The purpose of this case series is to describe physical therapy interventions used to retrain running and evaluate their effectiveness in two individuals post ABI who met established criteria for retraining running.

Case Description : The first patient (P1) was a 21-year-old male who was healthy until 5 months prior to evaluation when he presented with right sided weakness. Imaging revealed a large left frontal hemorrhage with arteriovenous malformation. P1's goal was to return to playing soccer. On evaluation SSWS was 1.2 m/s, SLS on left lower extremity (LE) was 20 seconds and 10 seconds on right LE, and High-level Mobility Assessment Tool (HiMAT) was 32/54. The second patient (P2) was a 27-year-old female who sustained a traumatic brain injury due to a motor vehicle accident 24 months prior to evaluation resulting in left hemiparesis. At evaluation SSWS was 1.2 m/s, SLS on left LE was 15 sec and 20 sec on right, and HiMAT score was 16/54. P2's goal was to return to running. Interventions for both patients focused on strengthening plantarflexors, hip abductors, and core musculature as well as balance training and bodyweight support treadmill training.

Outcomes : Following 16 weeks of intervention, P1 improved the HiMAT by 8 points and SSWS by 0.5 m/s. After 12 weeks of intervention, P2 improved the HiMAT by 9-point and SSWS by 0.3 m/s. The improvement for P1 and P2 on both measures exceeds the established minimally clinically important difference for each test. Additionally, P1 and P2 improved SLS on bilateral LE to greater than 20 seconds on foam. Functionally, P1 was able to run on a treadmill for 3 minutes at 4.5 mph, while P2 was able to run for 1 minute at 4.4 mph. Despite continued deviations with running, P1 was able to play soccer for a limited amount of time due to fatigue; however, P2 reported minimal improvement in functional running.

Discussion : Both P1 and P2 improved on all outcome measures. P1 experienced improved functional running, while P2 did not. This difference is outside the scope of this case report, but it is possible that the chronicity of P2's ABI limited her progress and/or that her running was less efficient making it more challenging to perform. Despite limited running improvement in P2, both patients improved gait speed and functional mobility, speaking to the importance of training intensity to drive neuroplasticity. Additional research is needed to determine who is most likely to see improvement and to determine the best treatment plan and timing to return to high-level mobility.

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TITLE: A Tool to Guide Clinical Decision-Making for Individuals who are Post-Concussion

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ABSTRACT BODY:

Purpose : To present a clinical decision tool to guide the treatment and referral of patients with post-concussion syndrome.

Description : Concussion often presents with a variety of symptoms from different systems, including vestibular and oculomotor impairments as well as cognitive deficits. Research has proposed multiple clinical clusters or “trajectories” that individuals post- concussion may fall into. Based on previous research, and our clinical expertise, we propose eight clinical trajectories to classify patients based on the symptoms they experience. The trajectories we propose are: oculomotor, vestibular, anxiety, post-traumatic migraine, cervicogenic, mental fatigue, and cognitive. As clinicians, it is critical to determine the appropriate trajectories for the individual to guide treatment and to facilitate appropriate referrals. The tool starts with two central, subjective questions and guides the clinician’s interview. Each question is designed to discriminate between the clinical trajectories to reach an accurate classification.

Summary of Use : Once the subjective interview with the guidance of the decision tool is completed, the patient will be classified into one or more trajectories. Once identified, the clinician can make the appropriate referrals and/or initiate treatment. When more than one trajectory is identified, initiating referrals and treatment to address each trajectory is appropriate. It is also possible as impairments in one system improve deficits in other trajectories may present themselves. As a result, it is important to use the clinical decision tool every four to six weeks to reassess the patient’s symptoms. This tool is designed to be used by clinicians who do not have extensive experience treating and evaluating individuals post-concussion, clinicians treating a patient with a complex presentation, and/or clinicians treating individuals who are not responding to treatment as expected.

Importance to Members: Due to the complex nature of concussion, an interdisciplinary, team approach is vital to the success of treatment of individuals post-concussion. This tool will improve clinical decision making and help facilitate referrals to improve the use of the interdisciplinary team needed to provide optimal care for these complex patients.

TITLE: Computerized Sensory Organization Test as a measure of fall risk in people with multiple sclerosis

AUTHORS/INSTITUTIONS: M.M. Manago, Physical Medicine & Rehabilitation, University Of Colorado Hospital, Denver, Colorado, UNITED STATES|J.R. Hebert, Physical Therapy, University of Colorado Denver, Aurora, Colorado, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : The Sensory Organization Test (SOT) is a computerized dynamic posturography assessment that quantifies balance as a function of central sensory integration. SOT has been used as an outcome measure in people with multiple sclerosis (MS), and improvements have been seen following vestibular and balance training. However, there is limited knowledge on the ability of SOT to identify fall risk in people with MS. Therefore, the purpose of this study was to determine the sensitivity and the specificity of SOT to predict fall risk based on a valid patient reported outcome of fall risk, the Activities Specific Balance Confidence Scale (ABC), in people with MS.

Number of Subjects : 30 people with MS (27 female), mean age 43.2 ± 10.5 , median Patient Determined Disease Steps (PDDS) 3, PDDS range 0-6.

Materials/Methods : A secondary data analysis was performed from a cross-sectional study that recorded ABC and SOT scores on the same visit. The ABC was dichotomized to classify people at higher risk for falls ($< 67\%$) and at lower risk for falls ($\geq 67\%$). The receiver operating characteristics (ROC) curve was constructed, and the area under the curve (AUC) was measured. Cutoff points for SOT were determined based on ROC curve characteristics.

Results : The overall mean ABC score was $68.1 \pm 21.5\%$. The mean SOT score in the high fall risk group (51.4 ± 17.1) was significantly lower ($p = 0.002$) than the SOT score of the low risk group (69.8 ± 12.0). Comparing SOT scores to ABC scores, the AUC was 0.83 (95% CI: 0.68, 0.98). Based on ROC curve analysis, an SOT score of 66.5 had a sensitivity of 0.86 and a specificity of 0.75. Further analysis showed that an SOT cutoff of 71.5 had a sensitivity of 0.93, and a score of 44.5 had a specificity of 0.99.

Conclusions : Our preliminary study shows that SOT scores are able to identify fall risk in people with MS using the ABC as the measure of fall risk. The SOT cut-off value of 66.5 provides the greatest balance of sensitivity (0.86) and specificity (0.75) to identify fall risk in people with MS. An SOT score of 71.5 maximized sensitivity (0.93), while an SOT cutoff of 44.5 maximized specificity (0.99). Based on these findings, larger, longitudinal studies are needed to determine the validity of SOT to predict falls in people with MS.

Clinical Relevance : SOT is a useful outcome measure in people with MS, and has potential to identify those at risk for falls. While this study was limited by not having a prospective measure of falls, the data from this study provides preliminary evidence to guide clinical decision-making. People with MS who score less than 66.5 on the SOT might be considered at risk for falls, while those scoring below 44.5 are at an almost certain risk of falls, and those scoring 71.5 and above have a much lower fall risk. These cutoffs might be considered to improve goal setting with SOT and help to determine change in dynamic balance and fall risk.

TITLE: Vestibular rehabilitation in a person with multiple sclerosis and sensation of motion at rest: a case report
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ABSTRACT BODY:

Background & Purpose : Vestibular rehabilitation is a treatment approach that targets central sensory integration (CSI) of visual, somatosensory, and vestibular function. It has been shown to be efficacious in improving balance, fatigue and dizziness in people with multiple sclerosis (MS). Sensation of motion at rest is a symptom that is poorly understood, however is likely a manifestation of impaired CSI. Moreover, treatment approaches for sensation of motion at rest are not found in the literature. Additionally, it is unknown how sensation of motion at rest may alter the outcomes of vestibular rehabilitation. This case study reports the outcomes of vestibular rehabilitation using measurements of body functions and structure, activity, and participation for a patient with MS who had co-occurring sensation of motion at rest.

Case Description : A 55-year-old woman with MS who was ambulatory with assistance of a single point cane and presented with complaints of dizziness, fatigue, and problems with walking and balance. Of note in her evaluation was her report of a sensation of spinning while sitting with her eyes closed. Intervention consisted of 18 visits over 16 weeks and was based on an evidenced-based vestibular rehabilitation program customized to include somatosensory weighting designed to augment sensory input and manage symptoms of sensation of motion at rest.

Outcomes : Self-reported fatigue (Modified Fatigue Impact Scale – MFIS), dizziness (Dizziness Handicap Inventory – DHI), balance as a function of CSI (Clinical Test of Sensory Integration and Balance – CTSIB), gait speed (timed 25-foot Walk Test – T25FW) and self-reported participation (Patient Specific Functional Scale – PSFS) were assessed at the initial visit, at week 6, week 10, and at discharge (week 16). By discharge, the individual in this case made clinically meaningful improvements on the MFIS (improved 43 points from 50/84 to 7/84); the DHI (improved 49 points from 70/100 to 24/100); the T25FW (decreased 23% from 11.6 to 9.4 seconds); and the PSFS (average improvement of 3.5 points on 2 self-selected items). Her balance improved as measured by the CTSIB: by discharge she was able to maintain each of the 6 test positions for 30 seconds.

Discussion : In this case, an evidence-based vestibular rehabilitation program for people with MS was customized based on presenting symptoms of sensation of motion at rest. The results showed clinically meaningful improvements in balance (body structure and function), gait speed (activity), and patient-reported outcomes (participation). Addressing symptoms of movement at rest when present might facilitate improvements in vestibular rehabilitation. Somatosensory weighting might be an effective way to manage these symptoms. A better understanding of motion at rest is needed, including prevalence in people with MS. By doing so, more effective treatment approaches can be studied.

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TITLE: The Role of Paretic & Nonparetic Limbs to Arrest Forward Momentum after a Perturbation

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ABSTRACT BODY:

Purpose/Hypothesis : The purpose of this study was to quantify the braking impulse and ability of the paretic & nonparetic legs to control forward momentum following a postural perturbation. We hypothesized that the first step braking impulse would be significantly less in the paretic compared to the nonparetic leg and would be unable to stop forward momentum within a single step.

Number of Subjects : Six individuals post stroke (mean age 51.5 yrs, 4 males, 4 right side weak, 1-26 years post) participated in the study. All subjects were independent community ambulators with only one non-cerebellar stroke.

Materials/Methods : Subjects were tested without their ankle-foot orthosis and/or assistive devices & instructed to respond naturally to an anterior waist pull perturbation. Subject stood with their feet shoulder width apart in three weight bearing (WB) conditions: equal WB, 70% WB on paretic, 70% WB on nonparetic leg. A weight drop perturbation was initiated when the WB conditions was held for 250-1000 msec. Ten perturbation trials at 10% body weight (BW) for each WB conditions and 6 catch trials at 2% BW were randomly applied. Rest breaks were given after 18 trials. First step leg & number of recovery steps were identified. Trunk & lower limb kinematics and ground reaction forces were measured. Anterior-posterior impulse was calculated from heel strike of the first step to heel strike of the second step after the perturbation. Forward velocity was estimated using the trunk markers at heel strike of the first step. These two values were used to calculate the change in forward momentum during the first step.

Results : All subjects took multiple steps in the 10% BW trials. In 83.6% of the trials subjects stepped with the nonparetic leg. Two subjects stepped only with their nonparetic leg. No significant differences in anterior-posterior impulse ($F(2, .044)=3, p=0.13$) or change in momentum ($F(2, 485.3)=1.25, p=0.54$) were observed across the three WB conditions so they were combined. Stepping with the paretic or nonparetic leg did not result in a significant difference in the total number of steps taken or the forward velocity at first heel strike after the perturbation. There was a trend for a smaller braking impulse (-0.21 Ns/kg vs -0.37 Ns/kg), smaller change in forward momentum (-29.68 $\text{kg}\times\text{m/s}$ vs -52.11 $\text{kg}\times\text{m/s}$), and shorter duration (0.56s vs 0.79s) when the first induced step was made with the paretic vs the nonparetic leg but these trends were not significant ($z=-1.83, p=0.068$). The lack of significance is most likely due to small number of steps with both legs.

Conclusions : These results suggest that subjects post stroke were better able to decrease their forward momentum when using their nonparetic leg after a forward perturbation. This may explain the preference for stepping with the nonparetic leg even when the paretic leg was unloaded.

Clinical Relevance : Task specific perturbation-induced step training with the paretic leg may strengthen the ability to generate a braking impulse with this leg and allow individual post stroke the option to slow their forward momentum with either leg.

TITLE: Comparing Life Space Assessment scores between power and manual wheelchair users

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ABSTRACT BODY:

Purpose/Hypothesis : The Life Space Assessment (LSA) is a participation measure that quantifies actual environmental mobility. Increased spatial extent and frequency of mobility lead to a higher total score, interpreted as a larger life space, whereas two aspects seen as barriers, need for assistance and use of equipment, lead to a decrease in the score, or smaller life space. Since full-time manual and power wheelchair users require equipment (i.e. a wheelchair), the impact of that equipment on the LSA score is equivalent between groups. The purpose of this study was to determine if the life space of power wheelchair users is significantly different from that of manual wheelchair users when measured by the LSA. Since persons who require a power wheelchair likely have more disability than persons able to manually propel, we hypothesized that power users would have a smaller life space than manual users.

Number of Subjects : 25

Materials/Methods : Seventeen power wheelchair users and 8 manual wheelchair users attending seating clinic completed the LSA and Quebec User Evaluation of Satisfaction with Assistive Technology (QUEST). They were questioned about demographic information, accompanying symptoms, and their degree of satisfaction with mobility according to the spatial mobility levels of the LSA.

Results : Power wheelchair users had a significantly lower LSA score compared to manual users (33+/-13 versus 56+/-24, respectively, $p=0.04$). Power users were more likely to require assistance to 1) Leave the room in which they sleep (29% of power users versus 12% of manual users) and 2) Mobilize to areas requiring vehicular transportation, such as going into town or to areas outside of town (as many as 80% of power users versus as many as 25% of manual users). Extent and frequency of mobility in the environment were comparable between groups, as was satisfaction with equipment and mobility. Spasticity was significantly correlated with a lower LSA score ($p=.025$) but did not account for the difference in scores between power and manual wheelchair users.

Conclusions : In our sample, power wheelchair users did have a smaller life space than manual wheelchair users when quantified by the LSA. Power wheelchair users were more likely to depend on personal assistance for getting into the wheelchair in the morning, transferring into a motor vehicle for travel, and driving that vehicle. This dependence resulted in a smaller life space even though power users traveled as far into the community and as often as manual users. Both groups were equally satisfied with their mobility in the home and community.

Clinical Relevance : The need for assistance, which is seen as a barrier for mobility, did not cause power users to mobilize any less than manual wheelchair users; however, it did indicate a smaller life space when assessed using the LSA. When deciding whether or not to use the LSA as an outcome measure, therapists should be attentive to the factors behind the LSA score in order to decide whether or not chosen interventions would likely make a significant positive impact on the total score.

TITLE: A Case Series of a Brief and Intense Exercise Program Targeting Balance, Endurance, and Gait for Individuals with Parkinson Disease

AUTHORS/INSTITUTIONS: J. Readinger, K. von Nieda, M. Eastlack, K.L. Sawyer, A.J. Bromley, B. Buchanan, M. Cessnun, M. Chiu, E. DiFebo, PT, Arcadia University, Glenside, Pennsylvania, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : Parkinson disease (PD) is a progressive disease resulting in reduced amplitude of movement which contributes to deficits in posture, balance, and gait. Recent studies have shown that intensive exercise can significantly improve gait speed, balance, stability, and coordination but were done for persons with stroke or in the inpatient setting for persons with PD. The purpose of this case series was to evaluate both the feasibility and the effects of a community-based, week-long intensive exercise program on persons with PD.

Case Description : Five individuals with PD (Hoehn & Yahr stages 2-3) and medically cleared participated in the program. All participants were ambulatory and one used an assistive device. The primary goals were to improve gait, balance, endurance and upper extremity function. Interventions were provided for six hours/day: comprised of warm-up/down, mat activities, functional gait, balance, endurance and upper extremity activities. Outcomes measures included the 10 meter walk test at usual and fast speed, Mini-BESTest (balance), five times sit to stand (5xSTS, balance), six-minute walk test (6MWT, endurance), nine hole peg test (9HPT, upper extremity function), and the Unified Parkinson Disease Rating Scale (UPDRS-motor portion only).

Outcomes : All participants successfully completed the exercise portion of the program. Immediately post-intervention, 40-80% of the participants exceeded the standard error of measure (SEM) or minimal detectable change (MDC) in all measures. At 6 weeks post intervention, 40-100% of the participants exceeded the SEM or MDC in all measures. Minimal clinically important differences were noted at 6 weeks post intervention for the following measures: usual gait speed, mini-BESTest, 6MWT and UPDRS.

Discussion : Successful completion of a full-day, week-long intensive program suggests that this model is feasible for this group. Participants maintained or improved their gains suggesting that strategies learned in the program continued to be applied during the intervening 6 weeks. Based on the results it appears that intensive exercise programs for individuals with PD are beneficial for functional mobility, with both immediate and longer term benefits realized.

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TITLE: The impact of Kinesio taping® on gait parameters and pain in patients with Charcot-Marie-Tooth disease.

AUTHORS/INSTITUTIONS: R.M. Brown, C. House, L.M. Farrar, K. Weaver, Physical Therapy, Belmont University, Nashville, Tennessee, UNITED STATES|P.J. Powers, Pi Beta Phi Rehabilitation Institute, Vanderbilt University Medical Center, Nashville, Tennessee, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Charcot-Marie-Tooth (CMT) is one of the most common inherited neurologic disorders affecting 36 in 100,000 individuals resulting in progressive distal weakness, foot deformities and pain making walking difficult resulting in frequent falls. Common treatments include orthotics, serial casting and surgical correction of foot deformities. There is little research on alternative conservative management techniques. Kinesio taping® has been used with a wide variety of patients to promote normal function. However to date there have been no research studies that have examined the effectiveness of Kinesio taping® with individuals with CMT. Therefore, the purpose of this study was to examine the effects of Kinesio taping® on the gait mechanics and pain management of patients with CMT.

Number of Subjects : Adults with CMT with no fixed foot and ankle deformities or surgical intervention that resulted in fixed joints were recruited. Subjects had to be ambulatory. To date, 7 subjects (3 males, 4 females, average 33 year old) have participated. Three subjects had Type 1a, two had Type 2 and two subjects the type was not identified.

Materials/Methods : Subjects completed a screening, Foot Function Index, and pain scale. They were then asked to walk on the GAITRite four times and complete a 6-minute walk test. Each subject was kinesioted® based on their screening evaluation, both lower extremities were taped if appropriate. The subjects repeated walking on the GAITRite. Subjects returned every 4-5 days for re-application of the tape. After 2 weeks, the subjects repeated the Foot Function Index, GAITRite and 6- minute walk test. Subjective comments were noted.

Results : Preliminary data analysis indicated a statistically significant improvement in gait speed as measured on the GAITRite between the initial trial and after 2 weeks of kinesioteding. Subjects averaged an 11% increase in gait speed. There was no significant difference in the distance walked during the 6-minute walk test or the reported pain/functioning level on the Foot Function Index. Five of the seven subjects to date subjectively reported improvements in function and wanted to continue with taping. Subjective comments included: “ My calf did not tighten up as usual”, “I’ve taken less pain medication in the last 2 weeks than I have in the last 3 months”, “far less tingling and weird sensations”, and “more stable”.

Conclusions : Kinesio taping® may help to improve gait speed and perceived pain with walking in individuals with CMT. Data collection is continuing to increase the sample size.

Clinical Relevance : Kinesio taping® may provide a non-surgical intervention to improve function and decrease pain in individuals with CMT.

TITLE: Muscle Activation of Non-painful Shoulders in Individuals with Paraplegia while Performing a Home-Based Shoulder Exercise Program

AUTHORS/INSTITUTIONS: L. Riek, C. Greene, A. Houghtalen, K. Palcovic, G. VanGorden, E. Mix, Physical Therapy, Nazareth College, Rochester, New York, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Relying on upper extremities for function, shoulder pain presents in 70% of manual wheelchair users with paraplegia. A common cause of shoulder pain is altered muscle activation that may result in detrimental kinematics and shoulder impingement. Although functionally important, unopposed activity of the Middle Deltoid (MD), Latissimus Dorsi (LD), Upper Trapezius (UT), and Pectoralis Major (PM) may contribute to detrimental kinematics including superior translation of the humerus or glenohumeral internal rotation. Alternatively, Serratus Anterior (SA) and Lower Trapezius (LT) may reduce pain by promoting favorable biomechanics (scapular upward rotation, external rotation, and posterior tilt). A randomized controlled trial developed to mimic muscle demands during functional activities reduces but does not eliminate shoulder pain. Hypertrophy and endurance exercises were selected to target high force/short duration and low force/long duration activities, respectively. Yet, it is unclear if muscles were actually targeted to accomplish functional tasks and minimize detrimental kinematics. Our purpose is to evaluate muscle activation during four home exercises designed for individuals with paraplegia. We hypothesize 1) hypertrophy exercises will cause greater activation than endurance exercises; 2) SA will have decreased muscle activation during all exercises.

Number of Subjects : Convenience sample of 10 subjects (7M, 3F; ages 37-60; SCI levels T4-L2) with paraplegia and non-painful shoulders participated in this study.

Materials/Methods : Instrumentation: Zero Wire Multi-Channel Wireless Surface Electromyography System (Aurion) was used on six muscles: SA, UT, LT, PM, LD, and MD. Procedure: Individuals performed two 8-rep max hypertrophy exercises (pulldown and external rotation) and two 15-rep max endurance exercises (scaption and retraction) Analysis: Data were normalized using muscle activation reported as percent maximal voluntary isometric contraction (% MVIC). Maximal strengthening is defined as >40% MVIC.

Results : Listed as % MVIC (mean \pm σ) from greatest to least activation. Scaption: UT 42 \pm 14%, LT 40 \pm 14%, MD 35 \pm 15%, SA 28 \pm 12%, LD 8 \pm 4%, PM 6 \pm 5%; Retraction: LD 16 \pm 7%, SA 10 \pm 5%, UT 10 \pm 7%, MD 10 \pm 6%, LT 9 \pm 5%, PM 3 \pm 2%; Pulldown: PM 18 \pm 11%, SA 15 \pm 9%, LD 8 \pm 10%, UT 4 \pm 4%, LT 4 \pm 2%, MD 2 \pm 1%; External Rotation: LT 31 \pm 13%, UT 10 \pm 9%, SA 10 \pm 7%, LD 9 \pm 7%, MD 8 \pm 5%, PM 4 \pm 2%.

Conclusions : Endurance exercises displayed greater muscle activation than hypertrophy exercises and no exercises maximally activated SA defined as >40% MVIC. Considered kinematically favorable, the SA reached its highest activation during scaption (28% MVIC). However, this exercise also targets the UT and MD, which, if unopposed, may contribute to impingement.

Clinical Relevance : Home exercises reduce but do not eliminate shoulder pain. Changes to intensity and dosage of exercise may be effective to achieve improved activation in key muscles to address proper biomechanics, in addition to the use of biofeedback, modified positions, or alternative resistance methods.

TITLE: Visuomotor Integration in Atypical Development

AUTHORS/INSTITUTIONS: K.M. Crocker, N. Bugnariu, H.L. Miller, R. Patterson, Physical Therapy , University of North Texas Health Science Center, Fort Worth, Texas, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Children with Developmental Coordination Disorder (DCD) commonly present with impairments in both gross and fine motor functions, which could be attributed to abnormalities in visuomotor integration. These impairments negatively affect many aspects of function in children with DCD, including their ability to coordinate appropriate postural responses while interacting with the environment. It is unclear whether the visuomotor deficits seen in DCD individuals occur in attaining visual input, integrating visual information with other sensory inputs, or implementing a motor response to those inputs. Children with DCD present with impaired motor coordination development, without cognitive impairments found in Autism Spectrum Disorder (ASD), making the DCD group a pseudo-control for the ASD group. The purpose of this study was to determine how individuals with DCD, compared to those of typical development and eventually to those with ASD, integrate visual information from the environment to maintain postural stability while interacting with the environment.

Number of Subjects : Five boys, aged 8 to 11 years old, 4 with DCD and 1 control participated in this study. Enrollment is ongoing.

Materials/Methods : This study utilized a 12-camera motion-capture system, a Computer Assisted Rehabilitation Environment Network (CAREN), ETG 2.0 eye tracking system, a 180° wrap-around screen, and computers for controlling and integrating all components. Participants completed one or more visuomotor tasks. In the Disc Match task, participants displace their center of pressure in medial lateral direction to maintain overlap with a disc moving on the screen from left to right at 8 different frequencies. In the Shooting Ducks task participants select, aim, and shoot 24 virtual moving ducks. Data from force plates, motion analysis, and eye tracking glasses were collected for analysis. Percentage of overlap at each frequency and time of execution per target were analyzed with t-tests.

Results : Percentage of overlap time during the Disc Match task revealed overall trend of decreased scores with increased frequency, with the highest average score for 0.2 Hz ($\mu = 36.94$; $\sigma = 18.2$) and lowest average score for 0.6 Hz ($\mu = 13.28$; $\sigma = 3.81$). All participants completed the Shooting Ducks task within the allocated 2 minute trial, however difference in strategies used to select a target, track its movement across the visual field were identified between the DCD and controls. Time hovering around a particular duck until achieving accurate aim was longer for DCD participants.

Conclusions : Preliminary results for the Disc Match and Shooting Duck tasks demonstrate support for current view of impaired postural responses in children with DCD when visuomotor integration is required to organize and execute the appropriate motor program.

Clinical Relevance : While DCD affects a smaller percentage of the population, children with DCD present with motor impairments very similar to those seen in ASD. A more thorough understanding of motor development and function with these disorders will lead to earlier diagnosis and improved treatment of these individuals.

TITLE: Case Study Report: Bionic Leg Use as Adjunct to Customary Therapies for a Patient with Significant Single Limb Sensory Ataxia and Severe Motor Spasm

AUTHORS/INSTITUTIONS: C. Brimmer, Acquired Brain Injury, Shepherd Center, Atlanta, Georgia, UNITED STATES|E. Sasso, Spinal Cord Injury, Shepherd Center, Atlanta, Georgia, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : Ataxia, or incoordination of movement, is often seen in individuals with damage to the sensory or cerebellar systems. Sensory ataxia may result from damage to various parts of the nervous system including the afferent portions of peripheral nerves or the dorsal column of the spinal cord.

Case Description : This case describes a 64 year old male with severe sensory ataxia secondary to posterior epidural hematoma causing spinal cord compression. This Individual was admitted to inpatient rehabilitation where he received 6 weeks of traditional therapies in addition to bodyweight support treadmill training, vibration therapy, and functional electrical stimulation. Severe spasms and sensory ataxia of his right lower extremity significantly limited his ability to ambulate. A trial using the Bionic Leg which is an intention-based robotic limb knee orthosis manufactured by AlterG out of Freemont, CA was initiated.

Outcomes : The subject was treated for 3 weeks with the orthosis focusing on balance and gait. Total gait distances with orthosis improved from less than 100 feet to more than 1000 feet. After 3 weeks of treatment, he was able to ambulate 400 feet with a rolling walker and contact guard assist without the orthosis. His ataxia and spasms were dramatically reduced. Over the three week treatment course, his Tinetti Performance Oriented Mobility Assessment (POMA) score improved from 10/28 to 18/28. With the orthosis donned, his Tinetti POMA score changed from 15/28 to 27/28. He completed a pre and post-test 10 meter walk test (10 MWT). The pre-10 MWT time improved from 54.21 seconds without the orthosis to 21.13 sec with it. After 3 weeks of treatment, his 10MWT improved notably to 19.75 sec without the orthosis to 15.85 sec with it donned. This was an increase in gait speed from 0.11 m/s to 0.31 m/s.

Discussion : It is well documented that gait speed is correlated to functional abilities, falls, and balance. It also has the potential to be predictive of future health status. This individual increased his walking speed by 0.2 m/s. This is a notable change according to the minimal detectable change (MDC) for SCI of 0.13 m/s and the minimal clinically important difference (MCID) for SCI of 0.06 m/s. In addition to gait speed, the subject also demonstrated important improvements in overall balance. Although, according to the POMA, he did not advance from a high fall risk to a medium fall risk category, he did show notable balance gains. He was one point away from moving into the medium fall risk category. There is evidence to support treatment strategies for ataxia that reduce the complexity of movements by minimizing the number of moving joints or by stabilizing the limb's movement. The use of the Bionic Leg in this case may have promoted improvement in ataxia for both of these reasons. Reducing ataxic movement and facilitating normal movement over the course of 3 weeks of adjunct therapy with the Bionic Leg may have contributed to these clinically important changes.

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TITLE: A Balance and Vestibular Rehabilitation Quality Improvement Study

AUTHORS/INSTITUTIONS: M.A. ALMohiza, P.J. Sparto, A. Delitto, D.L. Miller, S.L. Whitney, School of Health and Rehabilitation Sciences, University of Pittsburgh, Pittsburgh, Pennsylvania, UNITED STATES|G.F. Marchetti, Rangos School of Health Sciences, Duquesne University, Pittsburgh, Pennsylvania, UNITED STATES|J.M. Furman, School of Medicine, University of Pittsburgh, Pittsburgh, Pennsylvania, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Variation in practice is one of the leading causes of sub-optimal outcomes in healthcare which can be minimized via quality improvement initiatives. However, quality improvement projects focus mostly on assessing the processes and less attention is given to their effect on clinical outcomes. For people with balance and vestibular disorders, the lack of well-established clinical practice guidelines may lead to variations in care. Therefore, an effective implementation of practice guidelines could improve healthcare for individuals with balance and vestibular disorders. The first aim of this study was to examine adherence to the clinical decision rules (CDRs) of physical therapists who treat persons with balance and vestibular disorders. The second aim of this study was to probe the effect of the quality improvement project on patients' clinical outcomes.

Number of Subjects : Twenty-three physical therapists who performed balance and vestibular rehabilitation in outpatient clinics participated in this study, and 454 completed patient evaluation forms had complete clinical outcomes for examination of discharge data.

Materials/Methods : The minimum data set (MDS) and CDRs were developed. Adherence to the CDRs were compared between two groups of physical therapists. Both groups received educational training and reminders regarding compliance to the MDS and adherence to the CDRs but at different time points during the study). Evaluation forms for persons with balance and vestibular disorders were divided as either being adherent or non-adherent to the CDRs. The clinical outcomes in our study were the Activities-specific Balance Confidence scale (ABC), the Dizziness Handicap Inventory (DHI), and the Global Rating of Change (GRC).

Results : The effect of the intervention was examined over the period of the study (16 weeks) to examine the effect of intervention on both groups. Adherence rates improved by 9 and 12% for the intervention and wait-listed groups, respectively ($p=0.008$). ABC scores increased by 9% in adherent forms and 14% in the non-adherent forms ($p = 0.4$). DHI scores decreased by 16 points in the adherent forms and 17 points in the non-adherent forms ($p = 0.3$). Median GRC scores at discharge were 5 and 4.5 for adherent and non-adherent forms, respectively ($p = 0.4$).

Conclusions : This quality improvement project was effective in increasing the adherence to the CDRs in both groups. Although both adherent and non-adherent evaluation forms showed improvement on the clinical outcomes, there was no additional benefit in the clinical outcome for adherent evaluation forms.

Clinical Relevance : Quality improvement projects aim to detect disparity in healthcare and aim to enhance clinical performance. There may be a need for establishing and implementing clinical guidelines for individuals with balance and vestibular disorders to decrease the variation in practice in this field.

TITLE: Identifying Biomechanical Gait Deviations in Persons with Multiple Sclerosis: A Systematic Review of the Literature

AUTHORS/INSTITUTIONS: S. Muth, T. Aaron, B. Friedman, L. Nguyen, M. Nieto, D. Prasad, Rutgers University, Stratford, New Jersey, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of this systematic review was to evaluate the differences in gait kinematics in persons with multiple sclerosis (MS) compared to their healthy counterparts.

Number of Subjects : Seven articles were included for review.

Materials/Methods : This systematic review was performed following the PRISMA Model. A search of 4 databases, PubMed, CINAHL, Ovid MEDLINE, and Cochrane Library, was performed between September and November of 2014. The search terms used included: "multiple sclerosis + biomechanics + gait". Studies included had to compare walking kinematics of people with MS to those of a matched healthy control group. The initial search yielded 65 articles. Multiple levels of screening yielded 7 articles for inclusion in this review. Each article was appraised by at least 3 reviewers using Sackett guidelines to assess level of evidence and the MacDermid Score for assessment of internal validity.

Results : Seven articles, all with a Sackett rating of 2b, were included in this systematic review. Three articles evaluated hip, knee, and ankle kinematics throughout the gait cycle, while two others assessed only knee and ankle joint kinematics. One of the remaining two articles assessed translation of center of mass, while the other assessed positive and negative work during gait. Of these seven articles, one article evaluated the effect of fatigue on joint angle variability and joint power variability at different times of the day. All studies employed motion capture systems to collect kinematic data. All seven articles found significant differences in gait kinematics between people with MS and healthy controls.

Conclusions : People with MS demonstrated increased variability in joint kinematics throughout the gait cycle compared to their healthy counterparts. Joint kinematics also differed with disease severity; thus, it is difficult to make broad generalizations regarding gait characteristics in people with MS; however, some patterns were detected. People with MS lacked hip extension in late stance and demonstrated decreased plantarflexion at toe-off. People with MS shifted their center of mass anteriorly earlier and used eccentric and concentric muscle control differently compared to their healthy counterparts. Larger controlled studies assessing gait biomechanics of people with MS with different disease severities are necessary to further identify gait characteristics.

Clinical Relevance : Directly addressing biomechanical gait impairments in this population can improve their ambulatory efficiency and function, thereby improving their quality of life.

TITLE: Variability in Stepping Training Improved Balance and Gait in a Person with Parkinson's Disease and a Deep Brain Stimulator.

AUTHORS/INSTITUTIONS: A. Kuzbary, J. Freund, Elon University, Elon, North Carolina, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : Stepping training on a treadmill is an effective intervention to improve gait in persons with Parkinson's Disease (PD). However, there is minimal evidence related to stepping training in persons with PD and a deep brain stimulator (DBS). The purpose of the case report is to describe the effects of a varied stepping intervention on the balance, gait and quality of life (QOL) of a high functioning individual with young onset PD and a deep brain stimulator (DBS).

Case Description : The patient was a 48 year old male diagnosed with PD for twelve years and a bilateral DBS of the internal globus pallidus implanted 6 months prior to this intervention. He walked independently without an assistive device but reported 3 falls in the past 6 months. He was a volunteer participant in a university physical therapy course and attended 9 one hour sessions over 5 weeks. Stepping interventions included stepping forward, backwards and sideways on a treadmill with and without cognitive tasks and playing a Microsoft X box Kinect timed stepping game. Treadmill stepping was performed wearing a safety harness. Treadmill speed and/or incline was increased each session. The Kinect stepping game consisted of one minute bouts of fast stepping to random virtual targets to accumulate points.

Outcomes : Outcome measures were assessed pre and post intervention. Outcomes which had a meaningful change from pre to post intervention were: The Mini BesTest (20/28 to 23/28), five times sit to stand (FTSST), (9.42 to 8.0 s), fast gait speed (2.08 to 2.5 m/s) and 6 minute walk test (6MWT), (587 to 636.3 m). Other pre to post intervention results were: self-selected gait speed (1.15 to 1.5 m/s) and PDQ-39 summary index (10.26 to 11.54%). He had no reported falls during the intervention period.

Discussion : Variability and progression in stepping training resulted in improved balance and gait in an individual with young-onset PD and DBS. The change in Mini BesTest score indicates decreased fall risk, as a score of ≤ 20 identifies those with postural response deficits. Although not exceeding the falls risk cut-off his pre-intervention FTSST time was greater than 2 standard deviations (sd) of the norm for his age and improved to within 1 sd at post-intervention. Fast gait speed improved greater than the minimal detectable change (MDC). 6MWT distance increased from 92.14% to 99.53% of the equation predicted distance for his gender, age, height and weight, although it did not exceed the MDC. Neither change in self-selected gait speed nor any of the PDQ-39 dimensions exceeded the MDC for persons with PD. Further study of progressive varied stepping training in persons with PD and DBS is indicated.

References: Must include 5 current references (less than 10 years old): 1.Tseng IJ, Yuan RY, Jeng C: Treadmill training improves forward and backward gait in early parkinson disease. Am J Phys Med Rehabil 2015; epub ahead of print. 2.Nadeau A, Pourcher E, Corbeil P. Effects of 24 wk of treadmill training on gait performance in Parkinson's Disease. Med. Sci. Sports Exerc., 2014;46(4),645–655. 3.Daneault JF, Sadikot AF, Barbat-Artigas S, et al. Physical activity in advanced Parkinson's disease: impact of subthalamic deep brain stimulation. J Parkinsons Dis. 2015;5(1):85-93. 4.King LA, Priest KC, Salarian A, Pierce D, Horak FB. Comparing the Mini-BESTest with the Berg Balance Scale to evaluate balance disorders in Parkinson's Disease. Parkinsons Dis. 2012;2012:375419. 5.Prithvi K. Shah YG, Shyu A, et al. Variability in step training enhances locomotor recovery after a spinal cord injury. Eur J Neurosci. 2012;36(1):2054–2062. 6. Yogev-Seligmann G, Giladi N, Brozgovic M and Hausdorff JM. A training program to improve gait while dual tasking in patients with Parkinson's Disease: a pilot study. Arch Phys Med Rehabil 2012;93:176-81.

TITLE: Retrospective case report describing the results of early placement of an intrathecal baclofen pump on Coma Recovery Scale-Revised scores and mobility in a patient who is minimally conscious

AUTHORS/INSTITUTIONS: A. Briley, PT, TIRR Memorial Hermann, Houston, Texas, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : Intrathecal administration of baclofen facilitates its action on GABA receptors, penetrates the blood brain barrier much more effectively than oral baclofen and has therapeutic effects at a much lower dose, causing fewer side effects like sedation. It has been hypothesized that dysautonomic episodes, spasticity, contractures and pain can impede awakening from a disorder of consciousness. The purpose of this case report is to describe the outcomes of early placement of an intrathecal baclofen (ITB) pump on the Coma Recovery Scale Revised (CRS-R) scores and mobility in a patient who is in a minimally conscious state.

Case Description : 14 year old female with no significant PMHx who was involved in an ATV collision w sustained a severe traumatic brain injury with initial GCS of 5 on the scene. Pt initiated acute inpatient rehabilitation 3 weeks after injury and received 3 hours of therapy including at least 1 hour of PT 5 days/week. Treatments included bed positioning including serial casting, standing program, sitting balance with focus on postural control and neurofacilitatory positions. Pt also received CRS-R testing 2x/week. Pt had ITB pump placed 7 weeks after starting rehab. After pump placement, the patient was better able to participate and PT focus was primarily on ambulation and functional mobility.

Outcomes : Pt's initial CRS-R score was 6 on week 1 of inpatient rehabilitation. During weekly CRS-R testing prior to pump placement, pt required the arousal protocol 3/10 days and scored 0 on communication scale on all tests but 1. Four days prior to pump placement, pt's CRS-R score was 11, pt was nonambulatory and total A for transfers. One day post pump placement, the pt's CRS-R score was 13, pt no longer required the arousal protocol and consistently scored 1 on communication scale. Five days post pump, the pump was running continuously at 125 mcg and the patient ambulated for the first time with total A of three people for 50'. Ten days post pump, the pump was titrated to 175 mcg and the patient ambulated with mod A of one person and no assistive device for 80'. Upon discharge, the pump was continuously running at 230 mcg and the patient ambulated with CGA for over 500'.

Discussion : During clinical practice, the question arises whether early placement of ITB pump may impede recovery after brain injury. The findings presented in this case report demonstrate that early placement of an ITB pump in the minimally conscious population may have implications for improving wakefulness and reducing negative side effects such as pain and spasticity, which can lead to improved function, improved likelihood of D/C home and reduced caregiver burden. Future studies could investigate the correlation between early ITB pump placement and its effect on pain symptoms and, in turn, patient's ability to participate in therapies.

References: Must include 5 current references (less than 10 years old): Posteraro F, Calandriello B, Galli R, et al. Timing of intrathecal baclofen therapy in persons with acquired brain injury: Influence on outcome. *Brain Injury*. 2013; 27: 1671-1675. Al-Khodairy A, Wicky G, Nicolo D, et al. Influence of Intrathecal Baclofen on the Level of Consciousness and Mental Functions after Extremely Severe traumatic Brain Injury: Brief Report. *Brain Injury*. 2014: Early Online: 1-6. Francisco G, Hu M, Boake C, et al. Efficacy of early use of intrathecal baclofen therapy for treating spastic hypertonia due to acquired brain injury. *Brain Injury*. 2005; 19: 359-364. Oyama H, Kito A, Maki H, et al. Consciousness Recovery Induced by Intrathecal Baclofen Administration After Subarachnoid Hemorrhage. *Neurological Medico-Chirurgica*. 2009; 50: 386-390. Sara M, Sacco S, Cipolla F et al. An unexpected recovery from permanent vegetative state. *Brain Injury*. 2007; 21: 101-103.

TITLE: Feasibility and clinical utility of an accelerometry-based command following paradigm in disorders of consciousness

AUTHORS/INSTITUTIONS: K.V. Day, K.L. Borgard, K. Poehlmann, Physical Therapy, Arcadia University, Glenside, Pennsylvania, UNITED STATES|J. Whyte, Moss Rehabilitation Research Institute, Elkins Park, Pennsylvania, UNITED STATES|

ABSTRACT BODY:

Purpose : After a severe brain injury, patients with disorders of consciousness (DoC) are often misdiagnosed as being unconscious when an underlying level of consciousness remains. Such misdiagnoses greatly limit one's access to interdisciplinary rehabilitation and opportunities for recovery. Thus, accurate assessments of consciousness are critical. Currently, clinical diagnostic approaches include standardized assessments and individualized quantitative behavioral assessments; however, both approaches rely on a clinician's visual judgment regarding the presence of movement to commands. The purpose of this report is to explore the feasibility and clinical utility of a command following paradigm using objective accelerometry to detect consciousness post-brain injury.

Description : Six persons with DoCs undergoing inpatient rehabilitation participated in this study. 3D accelerometers were positioned on the dorsum of the hands bilaterally with patients seated. Approximately 60 trials of commands to "move hands" or "hold still" were randomly administered with 10-second interstimulus response intervals. Continuous acceleration data were extracted into epochs and grouped by command type. The mean of 3D accelerations from each trial within each command type was calculated. Wilcoxon Signed Rank tests were performed to determine statistical significance ($p < .05$). The Coma Recovery Scale-Revised (CRS-R) also was conducted within two days of accelerometry testing to compare diagnostic findings.

Summary of Use : Overall, great heterogeneity was observed among patients. Of the three patients diagnosed in minimally conscious state on the CRS-R, one exhibited command following with accelerometry, consistent with the clinical diagnosis; however, two failed to reach significance suggesting that upper extremity impairments may have limited performance on this specific paradigm. Of the three patients diagnosed in vegetative state on the CRS-R, two showed command following with accelerometry. The third person did not, but data cannot confirm if he was unconscious or lacked upper extremity function. Importantly, those with evidence of command following did not show such behavior consistently across test sessions. Thus, even sensitive technologies using a large number of trials may not be able to solve the problem of inconsistency in DoCs. Furthermore, some individuals frequently exhibited large spontaneous movements, regardless of command delivered, as well as automatic motor responses targeted at the accelerometers. In those instances, significant differences could not be detected between commands, even if an individual was conscious.

Importance to Members: Physical therapists are vital team members in the diagnosis of consciousness as we seek continued rehabilitation efforts for recovery after severe brain injury. Although implementing accelerometers appears technically feasible, paradigms should be tailored to a person's motor capacity. Further studies are needed to determine how accelerometers are best used and for which patients.

TITLE: Assessment of Balance in Adults with Friedreich's Ataxia

AUTHORS/INSTITUTIONS: J.B. Stephenson, S. Kim, School of Physical Therapy & Rehabilitation Sciences, University of South Florida Morsani College of Medicine, Tampa, Florida, UNITED STATES|C.L. Gooch, I. Jahan, T.A. Zesiewicz, Department of Neurology, University of South Florida Morsani College of Medicine, Tampa, Florida, UNITED STATES|K.L. Sullivan, Department of Epidemiology, Georgia Southern University, Statesboro, Georgia, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Balance deficits are common sequelae of Friedreich's Ataxia (FA), yet, there are no standardized assessments to specifically assess balance in the FA population. Clinical rating scales for ataxia include balance items, but do not focus on balance assessment. Balance deficits are related to gait ataxia, and worsening balance and gait impairment may contribute to falls and loss of ambulation over time. The purpose of this study was to investigate changes in balance over time in adults with FA, utilizing balance specific assessments, including the Berg Balance Scale (BBS).

Number of Subjects : 16

Materials/Methods : A longitudinal research design was applied to investigate changes in balance in 8 subjects with genetically confirmed FA (29.4 ± 9.0 yrs.) utilizing the BBS and the Biodex Balance System's Limits of Stability (LOS) test at baseline, 6 months, 12 months and 24 months; 8 healthy, matched control subjects (29.6 ± 9.1 yrs.) underwent the same tests at baseline and 12 months. A linear mixed effect (LME) model was applied to determine whether FA subjects' BBS or LOS scores demonstrated a significant linear change from baseline to 24 months. Paired t-tests were conducted to assess whether control subjects' balance measures changed over 12 months.

Results : Average disease duration of FA subjects was 10 years (range 6-16 yrs.). Control subjects attained the maximum BBS score at baseline and this did not change at 12 months. Subjects with FA exhibited a decline in mean BBS scores of 7% at 12 months and 18% at 24 months, at which time the mean BBS score was 36. Six of 8 FA subjects self-reported at least one fall per month. In the FA group, the LME model revealed a significant linear change in BBS scores (0.27 average unit decrease per month, $\beta=-0.266$, $p=0.001$) and in LOS backward directional control scores (0.71 average unit decrease per month, $\beta=-0.713$, $p=0.024$) over 24 months. No significant change in either time to complete the LOS test or overall directional control scores were observed. In the control group, no significant changes in LOS scores were apparent, with the exception of an increase in the LOS forward directional control score ($t=-3.706$, $p=0.018$).

Conclusions : Adults with FA demonstrated a significant decline in BBS scores, with 5 of 7 subjects falling below the BBS cut-off score for high falls risk (40/56) by 24 months. Although subjects with FA did not show a significant decline in LOS overall directional control scores, they did demonstrate declining backward directional control scores indicative of a decreased ability to control center of pressure movement in a backward direction.

Clinical Relevance : Adults with FA demonstrate worsening balance and increased falls risk over time. In this study, the BBS proved to be a sensitive assessment to detect changes in balance in adults with FA. This information may benefit clinicians who examine balance in people with FA, prior to implementing interventions to prevent falls and activity limitations of balance.

TITLE: Effectiveness of Aerobic Training in Individuals with Chronic Stroke: A Systematic Review

AUTHORS/INSTITUTIONS: J. Baldwin, L. Plummer, S. Joshi, A.A. Sangave, Department of Physical Therapy, MGH Institute of Health Professions, Boston, Massachusetts, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Stroke is the leading cause of long-term disability in adults. Post stroke, individuals exhibit an extensive decrease in aerobic conditioning, resulting from the event and subsequent decrease in physical activity. Decreased aerobic fitness combined with the increased energy demands of mobility greatly affects an individual's ability to perform ADLs. Increased aerobic fitness post stroke has been associated with functional gains including increased mobility, decreased falls, and increased ability to perform ADLs. The purpose of this systematic review was to determine if aerobic training is effective in increasing endurance for individuals with chronic stroke and, if so, to identify the interventions that are most effective in increasing endurance for those individuals.

Number of Subjects : 9 articles

Materials/Methods : CINAHL, Ovid and PubMed databases were searched for articles published in English from Jan 2000-Jan 2014. Two independent reviewers evaluated the quality of studies using the MacDermid scale. Study eligibility: Eligible study criteria included: 1) subjects were six months or more post stroke; 2) subjects were older than 18 years; 3) included a non aerobic training comparison group and 4) one or more outcome measures of endurance PeakVO₂ or 6 minute walk test (6MWT) with reports of means and standard deviations.

Results : Nine articles were included and reviewed, 7 of which were randomized control trials. Subjects demonstrated mild-moderate motor deficits post stroke with the ability to ambulate independently with or without a device. Scores on the MacDermid scale ranged from 46 points (high quality) to 34 points (low quality). There was great variety in terms of intervention modes utilized. Treatment parameters including frequency (35 minutes-60 minutes, 3-5 times per week), duration (8 weeks-6 months) and intensity (40-80% HRR) also varied. All nine studies reported positive effects and statistically significant results compared to controls ($p < 0.05$) of aerobic training for both Peak VO₂ and 6 minute walk test. (6MWT).

Conclusions : There is good evidence supporting the effectiveness of a variety of modes of aerobic training for individuals with chronic stroke at an intensity of 70-80% HRR with duration of 40 minutes -1 hour, 3-5 times per week. The results of this systematic review should be applied cautiously and generalized to only individuals with chronic stroke having mild-moderate motor deficits. Further research is needed to determine optimal training parameters and long term effects of aerobic training in individuals with chronic stroke as well correlation between improvement in aerobic capacity and functional abilities. In addition, further investigation is also needed to determine optimal training parameters and their effects in individuals with the full spectrum of motor deficits.

Clinical Relevance : There is good evidence that individuals with chronic stroke can demonstrate improvements in aerobic capacity with continued intervention after the acute and sub acute phases of recovery.

TITLE: Comparison of clinical measures to determine their responsiveness to tDCS

AUTHORS/INSTITUTIONS: E. Dougherty, K. Chronister, K. McMullen, R. Parnell, L. Williams, C. Lairamore, Physical Therapy, University of Central Arkansas, Conway, Arkansas, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Transcranial direct current stimulation (tDCS) is a form of non-invasive brain stimulation that is a promising adjunct to rehabilitation for improving motor function for individuals with neurological injuries. However, there is no consensus regarding which clinical tests are most effective in measuring the immediate effects of tDCS. The purpose of this study was to determine if the effects of tDCS could be measured in a healthy population using readily available clinical tests.

Number of Subjects : Twenty-two subjects, recruited from a sample of convenience, participated in this study.

Materials/Methods : A randomized repeated measures design with two separate trials (tDCS stimulation and sham) was employed. Each trial was separated by one week to ensure any potential effects from tDCS were not carried over from the previous trial. For all trials, two electrodes (5cm x 5cm) were placed in the regions of C3 and C4 with the anodal electrode over the non-dominant motor cortex. In the active trial, the subjects received tDCS for 15 minutes at an intensity of 2.0mA. In the sham trial the stimulation was turned off after the first 30 seconds. Subject performance on finger tapping, grip force, and reaction time were assessed before and after tDCS and sham trials using a Biopac MP36. Additionally, performance on the Purdue pegboard (single and assembly tasks) was assessed pre and post tDCS and sham trials. During all testing subjects used their non-dominant hand to perform the tasks.

Results : Repeated measures ANOVAs were run for each dependent variable to assess the effects of tDCS. There were no significant differences found in the finger tapping task ($p= 0.992$), grip force ($p= 0.174$), reaction time ($p= 0.981$), nor the Purdue pegboard assembly task ($p= 0.104$). However there was a statistically significant difference for the Purdue pegboard single task ($p= 0.01$). Post hoc testing revealed a significant increase from pre to post testing on the Purdue pegboard single task for both the sham and tDCS trials and no difference between sham and tDCS sessions.

Conclusions : The clinical outcome measures selected did not demonstrate a responsiveness to the effects of tDCS that previous research has supported. Therefore, it is possible the clinical tests selected for this study do not effectively reveal the immediate effects of tDCS in a healthy population after receiving tDCS at 2.0 mA for 15 minutes with electrodes placed in the C3-C4 montage. While significant results were seen in the Purdue Pegboard single task, the fact that the increases were seen in both the experimental and sham trials reveal a potential learning effect present with the use of this task. One of the limitations to our study was the small sample size ($n=22$), and thus a larger sample size could further clarify and increase the power of these results.

Clinical Relevance : Simple clinical tests may not be sensitive enough to measure the immediate effects of tDCS in a healthy population.

TITLE: Trunk Muscle Endurance is Related to Gait and Postural Control in Persons with Multiple Sclerosis

AUTHORS/INSTITUTIONS: J. Freund, D.M. Stetts, S. Vallabhajosula, Elon University, Elon, North Carolina, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Multiple sclerosis (MS) is a chronic progressive disease of the central nervous system. Persons with multiple sclerosis (PwMS) commonly have impaired balance and gait with subsequent decreased mobility. Evidence of impaired trunk performance in PwMS suggests a relationship between trunk performance and functional disability. Trunk muscles provide stabilization for posture and mobility and when fatigued impair postural control in healthy persons. The purpose of this study is to determine the relationships between trunk muscle performance and muscle thickness, postural control, gait and step activity in PwMS and healthy controls.

Number of Subjects : 14 ambulatory PwMS (mean Patient Administered Expanded Disability Status Scale of 4.13 ± 3.53) and age and gender-matched healthy controls [mean age \pm SD (years), PwMS 51.13 ± 14.82 , Controls 51.06 ± 13.46 ; 13 females].

Materials/Methods : In one session each participant completed the following measures: abdominal drawing in maneuver with ultrasound (US) imaging of the lateral abdominal muscles, prone arm raise with US imaging of the lumbar multifidus, self-selected and fast 10 m walk tests (10MWT), 60s quiet standing to collect Center of Pressure (CoP) data, timed trunk flexion and extension isometric endurance tests, 7 days wearing a step activity monitor and MS Walking Scale (MSWS). Ratio of muscle thickness in contracted and resting state (CR) was calculated for imaged muscles. Pearson's Product moment and Spearman's rank correlation coefficients ($P \leq .05$ significance) were used to determine the relationships among the outcome measures for each group separately.

Results : PwMS who had lesser trunk flexion endurance time exhibited greater mediolateral (ML) CoP range, CoP path length, sway area (all $r = -0.56$, $P = 0.03$), ML CoP velocity ($r = -0.65$, $P = 0.009$), and MSWS ($r = -0.54$, $P = 0.039$). PwMS who had lesser trunk flexion endurance time also exhibited slower gait speed during both self-selected and fast 10 MWTs (both $r = 0.68$, $P = 0.005$) and average number of steps per bout ($r = 0.71$, $P = 0.005$). In PwMS, trunk extension endurance time positively correlated with antero-posterior CoP range ($r = 0.52$, $P = 0.049$). In Controls, trunk extension endurance time was positively correlated with trunk flexion endurance time ($r = 0.64$, $P = 0.011$), Total lateral abdominal CR was positively correlated with ML path length and ML CoP velocity ($r = 0.58$, $P = 0.03$).

Conclusions : Measures of trunk muscle endurance, particularly trunk flexion, but not thickness (US images) had moderate to high negative correlation with postural control, gait speed, self-reported walking and step activity in PwMS. A few measures showed opposite trend or no correlation in Controls.

Clinical Relevance : Due to the relationship between trunk muscle isometric endurance and postural control and gait, trunk endurance testing and training should be considered in PwMS. US imaging may not provide an effective evaluation of trunk performance in relation to postural control or gait in PwMS.

TITLE: The effect of vestibular therapy on dizziness and fall prevention in an adult patient with Chiari 1 Malformation

AUTHORS/INSTITUTIONS: E. JohnsonSiekmann, Physical Medicine and Rehabilitation/Arizona , Mayo Clinic, Scottsdale, Arizona, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : Little evidence exists regarding the effectiveness of vestibular rehabilitation for adult patients with Arnold Chiari 1 Malformation, although the literature does suggest that physical therapy has not been helpful in decreasing headaches and cervical pain associated with this condition. The purpose of this case study is to document that vestibular rehabilitation was effective in decreasing the patient's dizziness, gait imbalance, and history of falls.

Case Description : A 56-year-old morbidly obese female with a diagnosis of Arnold Chiari 1 Malformation, s/p posterior fossa craniotomy with C1 cervical laminectomy for decompression 9 years ago, reported a new onset of room-spinning dizziness lasting 1-2 minutes daily. She reported her dizziness on the visual analogue scale was 6-8/10, and she had sustained two falls and one near fall in the past 4 months.

Outcomes : The initial evaluation of smooth pursuit, saccades, convergence, vestibular- ocular reflex, and cover/uncover tests increased her baseline dizziness of 6/10 to 8/10 for several minutes after completion. Patient tolerated each vestibular- ocular test item in sitting for 2-4 seconds due to dizziness. She was unable to perform the Dynamic Gait Index due to her need for outside support of walls or furniture and safety concerns due to her morbid obesity. Static balance with eyes closed maintained for 3 seconds, and increased her baseline dizziness. The patient had 4 sessions of therapy and performed a daily home program consisting of vestibular, ocular and balance exercises. Greatest improvements occurred in the patient's ability to tolerate vestibular ocular motions for 1 minute repeatedly during a therapy session reporting a minimal increase in her baseline dizziness of 3/10. Her convergence improved from 12 inches to 6 inches. Her initial inability to score greater than 0/24 on the Dynamic Gait Index increased to 16/24 including safely walking with head motions without support. Static balance with eyes closed improved from 3 seconds to 45 seconds. She reported no falls or dizzy spells at the conclusion of her treatment. At 2 month follow up, the patient voiced no falls or dizzy spells. Her follow-up baseline dizziness was reported as 3-4/10.

Discussion : Chronic dizziness is a frequent complaint of adult patients with Chiari 1 Malformation. In this report, a daily vestibular therapy program reduced subjective dizziness while improving ocular motor, vestibular, static, and dynamic balance. Additional research is needed to determine if vestibular therapy would be beneficial in this population to decrease their subjective complaints of dizziness, increase their activity level, and decrease their fall risk.

References: Must include 5 current references (less than 10 years old): Shaffer N, Martin BA, Rocque B, et al. Cerebrospinal Fluid Flow Impedance is Elevated in Type I Chiari Malformation. *Journal of Biomechanical Engineering*. 2014;136(2):0210121-0210128. doi:10.1115/1.4026316. Vitkovic J, Winoto A, Rance G, Dowell R, Paine M. Vestibular Rehabilitation Outcomes in Patients with and without Vestibular Migraine. *Journal of Neurology*. 2013;260(12): 3039-3048. Mucha A, Collins MW, Elbin RJ, et al. A Brief Vestibular/Ocular Motor Screening (VOMS) Assessment to Evaluate Concussions: Preliminary Findings. *The American journal of sports medicine*. 2014;42(10):2479-2486. doi:10.1177/0363546514543775. Dye DC, Eakman AM, Bolton KM. Assessing the Validity of the Dynamic Gait Index in a Balance Disorders Clinic: An Application of Rasch Analysis. *Phys Ther*. 2013 Jun; 93(6):809-18. doi: 10.2522/ptj.2012016. Robertson EK, Stanley C. Type 1 Chiari Malformation *J Orthop Sports Phys Ther*. 2012; 42(5):483-483 Kumar A, Patni AH, Charbel F. The Chiari I Malformation and the Neurologist. *Otology and Neurotology*. 2002 23:727-735

TITLE: The Effect of Cognitive Manipulation and Gender on the Timed Up and Go (TUG) test

AUTHORS/INSTITUTIONS: R. Almajid, E.A. Keshner, Temple University, Philadelphia, Pennsylvania, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : The Timed Up and Go (TUG) is a simple test that is widely used in the clinical setting for the screening of fall risk [1]. However, it is usually done in a quiet room where there is no cognitive challenge to the performer. Recently, it has been suggested that the TUG should no longer be used to evaluate the risk of falling because it fails to test the cognitive and visual systems [2]. Cognitive tasks that require memory and executive function have been shown to affect functional mobility [3,4]. The purpose of this study was to determine if the TUG test could be modified to present attentional demands similar to those encountered in a real world situations, and to examine gender differences under these conditions. We hypothesized that (1) Modified TUG tests will be more sensitive in detecting the kinematic abnormalities more than the standard TUG, and (2) kinematic measures under dual tasking conditions will deteriorate more in males than in females.

Number of Subjects : 16

Materials/Methods : Five cognitive tasks were performed while seated and during the TUG test to determine effect size and gender differences in 8 healthy male and 8 healthy female adults (25.8 ± 4.9 yrs). Cognitive demands included verbal fluency, mental calculation, reaction time, auditory Stroop, and memory tasks. KINOVEA software (www.kinovea.org) was used to analyze the kinematic measures, which are: gait speed, number of steps, and cadence. The time of the tests and the response rates of the cognitive tasks were recorded.

Results : All subjects took significantly more time to complete the modified TUG ($p < 0.001$) than the unmodified TUG except during the reaction time task. Gait speed was slower in the modified TUG tests ($p = 0.003$) except during reaction time and auditory Stroop tasks. Subjects took significantly more steps ($p = 0.01$) with all but reaction time and mental tasks. Gender difference was found in cognitive performance both while seated and with the TUG. Women have faster response rates than men in a memory task when sitting ($p = 0.005$) and men are faster than women during the mental task in the TUG test ($p = 0.01$). Women had a significantly higher cadence than men ($p = 0.008$). Although not significant, it was observed that men took greater time via a slower gait speed and fewer steps during modified TUG tests.

Conclusions : TUG combined with cognitive tasks would present a more functional measure of gait performance than the standard TUG test. Cognitive tasks that produce mental interference were more detrimental to spatiotemporal measures of gait, with men being more affected than women.

Clinical Relevance : Dual tasking and executive functions performance are highly associated with the increased risk of falling [5]. Mortalities from falls are 49% higher in older men than older women [6]. This study contributes to our understanding of the attentional mechanisms causing gender differences while using a practical test such as the TUG.

Results suggest that the modified TUG test can be considered a more sensitive measure to be used in clinical settings for detecting kinematic dysfunction.

TITLE: Bridging the Gap between Therapy and Wellness: Yoga for Individuals with Neurologic Conditions

AUTHORS/INSTITUTIONS: A.Y. Schang, re+active physical therapy and wellness, Los Angeles, California, UNITED STATES|

ABSTRACT BODY:

Purpose : There has been a steady increase in the percentage of adults who utilize complementary health approaches in the United States. Approximately 80% of those who adopt movement-oriented modalities participate in yoga, illustrating the popularity of this ancient mind-body practice in our society today. There is emerging evidence that individuals with health-related conditions are more likely to explore complementary health approaches than their healthy counterparts. However, existing options for safe participation remain under-explored in the health and wellness community. In response to this perceived need, an all-ability yoga class was established in an outpatient neurologic physical therapy clinic to improve accessibility of yoga for individuals with neurologic conditions.

Description : The group yoga class began in June of 2013 as a weekly, hour-long session incorporating mindfulness, breath work, and asana practice. The program has since evolved into 4-week modules, taught once a week, with specific themes such as core stabilization, balance, and flexibility. This format of class delivery provides targeted movement practice and knowledge application, allowing for greater observed carryover and learning. A physical therapist with neurologic clinical specialty (NCS) and yoga instructor qualification (RYT 200) designs class sequences based on diagnosis-specific considerations, participants' functional levels, and number of participants. Emphasis is placed on present moment awareness and principles of progression/regression to develop confidence in self-guided practice.

Summary of Use : Yoga participants include individuals diagnosed with Parkinson's disease, cerebral palsy, dystonia, multiple sclerosis, stroke, anoxic brain injury, tumor resection, scapulohumeral muscular dystrophy, and accompanying family members. Typical class size ranges from 4-6 individuals, with functional independence varying from completely independent to requiring moderate assist to maintain standing balance. Per participants' feedback, yoga has a positive effect on their physical abilities, reduces stress, instills confidence, increases body awareness, and motivates them to participate in other activities that are important to them.

Importance to Members: Participation in yoga may improve overall sense of well-being and confidence in individuals with neurologic conditions. Research in this area is still in its early stages and while some demonstrate potential benefits of yoga, firm conclusions cannot be drawn due to clinical and methodological heterogeneity. Despite limited evidence at this time, interest in yoga continues to grow and yoga is widely accepted as a means to better health and well-being. Physical therapist are equipped with the training and knowledge to help our clients access wellness activities in a safe and therapeutic manner. As a profession, we should further examine how best to educate, intervene, and collaborate with clients and other healthcare/fitness providers to bridge the gap between therapy and wellness.

TITLE: Electrical Stimulation and Cycling in Stroke Rehabilitation: A Systematic Review

AUTHORS/INSTITUTIONS: S. Babiarz, K. Haynes, M.M. Mazich, H. Zhang, A. Goode, R. Clendaniel, Doctor of Physical Therapy, Duke University, Durham, North Carolina, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Cerebral vascular accidents are one of the leading causes of serious long-term disability in the United States, with hemiparesis being one of the most common clinical presentations. Current rehabilitation strategies include treadmill training for gait and electrical stimulation to improve muscle activation. Cycling could be a safe alternative to treadmill training for patients with hemiparesis. Studies combining cycling with electrical stimulation to the hemiparetic lower extremity are emerging. The purpose of our study is to evaluate the current evidence for the effect of cycling in combination with electrical stimulation on gait and balance in subacute stroke rehabilitation.

Number of Subjects : 149 subjects in 7 studies

Materials/Methods : This review was performed following the PRISMA guidelines. PubMed, CINAHL, Embase, Cochrane databases were searched for publications between 2005 and January 2015 with keywords related to stroke, cycling and electrical stimulation. Inclusion criteria were 1) subacute or chronic adult stroke patients, 2) lower extremity cycling with electrical stimulation as an intervention, 3) at least one primary outcome measure focusing on gait or balance, and 4) English language. The quality of each study was assessed using the PEDro Quality Assessment tool.

Results : Seven studies, four of good quality and three of fair quality, met the inclusion criteria. In five RCTs, patients who underwent FES cycling were assessed for gait improvements. The results were mixed. Two of the RCTs showed significant improvements in gait velocity. Two of the studies demonstrated no between group differences in gait velocity. In the fifth study, there was no significant difference between groups in gait speed: however, those that participated in the FES cycling intervention were better able to complete the 50 m walk test. Changes in balance were assessed following FES cycling. Significant improvements on the Trunk Control Test were demonstrated in one study, while another study found no significant between group difference. Significant improvements were demonstrated in the Berg Balance Scale and measures of postural control within groups, but no significant differences were noted between groups. There was a significant improvement in the leg subscale of the Motricity Index following the FES cycling intervention in one study at the post-treatment assessment..

Conclusions : FES with cycling appears to be an effective way to improve some aspects of gait and balance. At this point, the findings suggest that while FES with cycling is an effective treatment, it may not be more effective than traditional rehabilitation involving cycling without FES.

Clinical Relevance : These findings suggest that lower-extremity cycling in conjunction with electrical stimulation is an effective physical therapy intervention for aiding the recovery of gait and balance following subacute and chronic stroke. The use of cycling and electrical stimulation may accelerate the rate of recovery for patients with hemiparesis, and the gains in function are maintained during follow-up assessments.

TITLE: A Two Week High-Intensity Outpatient Therapy Program for Patients with Chronic Stroke: A Case Series
AUTHORS/INSTITUTIONS: C.A. Sullivan, C. Owens, A. Vernacchio, Therapy, Magee Rehabilitation, Philadelphia, Pennsylvania, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : High intensive therapy with a focus on achieving consecutive repetitions of a functional task has been shown to improve the functional status of chronic stroke patients. Since the average number of repetitions seen in traditional outpatient physical and occupational therapy sessions are less than what is required for functional change, the current delivery of reimbursable outpatient therapy for chronic stroke patients is inadequate to drive cortical reorganization. The purpose of this case report was to examine a novel reimbursable outpatient therapy program which would demonstrate functional changes over a short episode of care.

Case Description : Four participants at least 6 months post-stroke participated in an outpatient physical and occupational therapy program for 3 hours per day, 5 days per week over a 2 week period (30 hours). All participants were ambulatory, with 3 of the 4 using an assistive device at the time of pre-testing. All participants experienced hemiplegia, with 50% having right side involvement. The mean time since stroke was 16.0 +/- 8.0 months, and the mean age was 54.8 +/- 6.8 years. All participants completed 1 hour of physical therapy, 1 hour of occupational therapy, and a 1 hour group therapy session led by either a physical or occupational therapist on a daily basis for 10 sessions. Functional mobility was measured with the 10 Meter Walk Test (10MWT) and Timed Up and Go (TUG), upper extremity use was measured with the Fugl-Meyer Upper Extremity Assessment (UE-FMA), and quality of life was measured by the Stroke Impact Scale (SIS). Baseline measurements for the 10MWT, TUG, and UE-FMA were taken on day 1 of therapy and post-test measurements were assessed on day 10. Health related quality of life was assessed by using the Stroke Impact Scale (SIS) on day 1 of therapy and after 2-week follow up.

Outcomes : Three of the four participants showed a small meaningful change (> 0.06 m/s improvement) in gait speed, and two of the four participants surpassed the minimally detectable change for gait speed in this population. Two of the four participants demonstrated clinically significant improvements in TUG scores. Clinically significant improvements were also seen in the scores on the UE-FMA for two of the four participants and the remaining two participants scored within 3 points of the maximum score of the UE-FMA. All participants demonstrated a minimally clinically importance change in the strength domain of the SIS at 2-week follow up, and improved in at least one other domain.

Discussion : The outcomes of this case series suggests that 3 hours of outpatient physical and occupational therapy per day for 5 days over the course of 2 weeks (30 hours) is a viable option for patients in the chronic stage of their stroke recovery. More research needs to be completed to assess the functional gains of patients with chronic stroke who participate in this intensive outpatient program as compared to outpatient therapy 2 to 3 times per week for 2 hours per day.

References: Must include 5 current references (less than 10 years old): French B, Leathley M, Sutton C, McAdam J, Thomas L, Forster A, Langhorne P, Price C, Walker A, Watkins C. A systematic review of repetitive functional task practice with modelling of resource use, costs and effectiveness. *Health Technol Assess.* 2008 Jul;12(30):iii, ix-x, 1-117. Review.Lang CE, Macdonald JR, Reisman DS, Boyd L, Jacobson Kimberley T, Schindler-Ivens SM, Hornby TG, Ross SA, Scheets PL. Observation of amounts of movement practice provided during stroke rehabilitation. *Arch Phys Med Rehabil.* 2009 Oct;90(10):1692-8.Pang MY, Eng JJ, Dawson AS, McKay HA, Harris JE. A community-based fitness and mobility exercise program for older adults with chronic stroke: a randomized, controlled trial. *J Am Geriatr Soc.* 2005;53:1667-74.Sawyer K, Riley B, von Nieda K, Miller AH. Description of functional outcomes following a short intensive neurological clinic in rural Jamaica. Poster presented at: Combined Sections Meeting of the American Physical Therapy Association; 2013 Jan 21-24; San Diego, CA. Wolf SL, Winstein CJ, Miller JP, Taub E, Uswatte G, Morris D, Giuliani C, Light KE, Nichols-Larsen D; EXCITE Investigators. Effect of constraint-induced movement therapy on upper extremity function 3 to 9 months after stroke: the EXCITE randomized clinical trial. *JAMA.* 2006 Nov 1;296(17):2095-104.

TITLE: Efficacy of a composite exercise program to improve functional performance in children with ASD

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ABSTRACT BODY:

Purpose/Hypothesis : Children with autism spectrum disorder (ASD) often demonstrate difficulties in motor, social and communication skills. (1,2) Combined, these deficits can make it very difficult for these children to integrate effectively in typical activities of daily life (3, 4). The purpose of this study was to determine the efficacy of the Inclusive Sports and Fitness composite program in overall task-oriented motor performance.

Number of Subjects : Subjects (N=6) were recruited via snowball sampling to complete a 12 week after-school exercise program. Inclusion criteria required subjects were 6 – 16 years with an established diagnosis of ASD. Exclusion criteria precluded individuals who were unable to functionally ambulate independently 25 feet, were cognitively unable to follow simple two-to-three step commands, and/or had medical conditions preventing them from participating in program activities. Informed consents were collected from legal guardians/parents of all participants.

Materials/Methods : The program consisted of five composite activities including exercise, sports, yoga, social skills group, and a metronome training program offered twice a week for 1.5 hours per session. Just prior and following this program, children were assessed with the Bruinsky-Oseretsky Test of Motor Proficiency (BOT-2), a valid and reliable outcome measure often used for children with ASD (5). Data analysis using nonparametric testing (Wilcoxon Signed Ranks test, 95% probability) to compare post-test to pretest values for individual and combined standardized scores was done. This study was approved by the Touro College IRB prior to the start of the study.

Results : Overall total motor composite scores indicated a significant 13% increase in overall motor proficiency following participation of this program ($Z=-2.023$, $p<0.05$). Specific assessments of individual motor area performance indicated that manual coordination composite scores (assessing manual dexterity and upper-limb coordination) were significantly improved ($Z=-2.032$, $p<0.05$), as was the standardized score for strength and agility ($Z=-2.032$, $p<0.05$). Overall gross motor composite standardized scores were also significantly improved ($Z=-1.992$, $p<0.05$), suggesting that the changes on strength and agility scales were robust (as compared to body coordination scores which did not change significantly following the program participation).

Conclusions : In this pilot study, a composite program which provided varied types of structured group physical activities, metronome training, and social interaction significantly improved motor function for children diagnosed with ASD. Although overall motor proficiency was improved significantly, the particular areas that were most sensitive towards improvement were individuals' manual coordination as well as strength and agility.

Clinical Relevance : The current pilot study supports the hypothesis that composite exercise programs are an effective strategy for significantly improving overall motor proficiency performance in children with mild to moderate ASD.

TITLE: Physiological Complexity of Gait between Regular and Non-Exercisers with Parkinson Disease

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ABSTRACT BODY:

Purpose/Hypothesis : Physiological complexity represents the overall health of a system and its underlying capacity to adapt to everyday stresses. The primary purpose of this study was to determine if the physiological complexity of gait both ON and OFF anti-Parkinson medications differed between people with Parkinson disease (PD) who regularly participate in boxing exercise and those with PD who do not exercise on a regular basis. Based on previous evidence that complexity is reduced with age and disease, we hypothesized that complexity of gait would be significantly lower in the group of non-exercisers.

Number of Subjects : Seventeen participants with idiopathic PD, at Hoehn & Yahr stages 2-3, were enrolled in this cross-sectional study (regular exercisers n=10, mean age 66.1±7.0; non-exercisers n=7, mean age 61.9±6.7).

Materials/Methods : All participants completed two data collection sessions during a single visit, first after having undergone a 12-hour overnight withdrawal from anti-Parkinson medications (OFF) and then again one-hour after taking their anti-Parkinson medications (ON). During each session participants completed the motor subsection of the Movement Disorder Society Unified Parkinson Disease Rating Scale (MDS-UPDRS Part III) and a 2-minute walking task at their preferred pace around a level, indoor 30-meter course while wearing wireless inertial measurement units (IMUs) on each lower extremity segment (thigh, shank, foot) and pelvis. Multivariate multiscale entropy was calculated from the tri-axial accelerometer signals from the IMUs and converted to a complexity index score for analysis. Two-tailed, independent t-tests were used to examine differences between groups both ON and OFF medications. Paired t-tests were used to assess differences between ON and OFF states within each group ($p < .05$).

Results : Groups did not significantly differ in age, gender, time since PD diagnosis or MDS-UPDRS Part III scores ($p > .05$). Regular exercisers demonstrated significantly higher complexity indices in the most and least affected foot and shank (OFF) and in the least affected foot (ON), $p < .04$. Regular exercisers did not significantly differ in complexity between OFF and ON states, but non-exercisers demonstrated significantly lower complexity OFF at multiple segments ($p < .03$).

Conclusions : The higher complexity indices across distal lower extremity segments in regular exercisers compared to non-exercisers and the similarity in complexity of gait between ON and OFF states in the regular exercise group may indicate that regular exercise is a key ingredient contributing to health in persons with PD. Exercising on a regular basis with PD may enhance one's ability to adapt to barriers encountered during gait regardless of medication state.

Clinical Relevance : These results support the use of exercise by physical therapists for persons with PD in order to optimize health and potentially delay progression of the disease. Further research will be necessary to determine which type, duration and intensity of exercise best augments physiological complexity of gait in persons with PD.

TITLE: Feasibility and efficacy of gait training in people with Parkinson's disease who have mild cognitive impairment

AUTHORS/INSTITUTIONS: V.E. Kelly, M. Fayazi, S.H. Ludlow, R.L. Riley, E.L. McGough, A. Shumway-Cook, Rehabilitation Medicine, University of Washington, Seattle, Washington, UNITED STATES|J.B. Leverenz, Lee Ruvo Center for Brain Health, Cleveland Clinic, Cleveland, Ohio, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Increasing evidence demonstrates an association between cognitive dysfunction and gait impairments in people with PD [1]. Though gait training has been shown to increase walking speed in PD [2,3], individuals with cognitive deficits are often excluded or cognitive status is not well characterized. Thus, the efficacy of gait training for people with cognitive dysfunction is not well understood, despite the fact that up to 60% of the PD population has mild cognitive impairment (PD-MCI) and up to 20% has dementia (PD-D) [4]. The aims of this project were to compare the feasibility and efficacy of two approaches to gait training in persons with PD-MCI.

Number of Subjects : Participants (preliminary results: n=6; planned sample: n=20) were individuals with PD who had MCI diagnosed through neuropsychological assessment and consensus conference [5]. Eligibility criteria were: (1) ability to walk 400 m without assistance; (2) no neurosurgery; and (3) no vision or hearing problems. All participants were tested on-medication.

Materials/Methods : At baseline and post-intervention, walking was assessed using the modified Dynamic Gait Index and quantitative motion analysis of simple (self-selected speed) and complex walking tasks (turning, dual-task, fast walking), with gait speed as the primary outcome. Participants completed a 2-week gait training program (six 1-hour sessions; six 5-minute walking blocks/session) consisting of either overground (OG) training with verbal cues emphasizing large strides or treadmill (TM) training.

Results : Preliminary results are from six participants with PD-MCI, with mean (SD) age of 74.5 (8.1) years, disease duration of 10.7 (6.1) years, and MDS-UPDRS Motor Exam score of 35.8 (9.7). All participants completed the program with 100% attendance and no adverse events. All participants increased the speed at which gait training occurred over the six sessions. Self-selected gait speed increased in the TM group (n=2; pre=0.8 m/s, post=0.9 m/s) but decreased in the OG group (n=4; pre: 1.1 m/s, post: 1.0 m/s). Gait speed for all complex walking tasks decreased slightly for the OG group, but increased for the TM group during turning (pre: 0.7 m/s, post: 0.8 m/s) and fast walking (pre: 1.0 m/s, post: 1.1 m/s). Participants in both OG and TM training improved mDGI scores (OG: pre=45.3, post=51.0; TM: pre=44.5, post=48.5).

Conclusions : Gait training was feasible and safe for people with PD-MCI. While mDGI scores improved in both groups, increased gait speed during simple and complex walking tasks was observed only in the TM group suggesting a potential advantage of gait training that emphasizes implicit over explicit motor learning. These findings are limited by a small sample and the potentially insufficient dose of training.

Clinical Relevance : Determining optimal gait training approaches for people with PD-MCI is critical given the prevalence of cognitive dysfunction in PD. Further research is needed to understand the impact of cognitive dysfunction on motor learning and the response to gait rehabilitation in PD.

TITLE: Diagnostic Accuracy of the Active-Computerized Dynamic Visual Acuity Test: A Systematic Review and Meta-Analysis

AUTHORS/INSTITUTIONS: R. Schafer, A. Bloomberg, J. Hube, M. McCarty, A. Goode, R. Clendaniel, Duke University, Durham, North Carolina, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of this review is to systematically examine the literature regarding the diagnostic accuracy of the active computerized dynamic visual acuity (cDVA) test to assess vestibular hypofunction of the horizontal semicircular canals.

Number of Subjects : 84 subjects with vestibular pathology and 251 control subjects across 3 articles were examined.

Materials/Methods : PRISMA guidelines were used to conduct a systematic search across EMBASE, CINAHL and PUBMED. Articles were eligible for this study if they met the following inclusion criteria: 1) included dynamic visual acuity test, 2) provided diagnostic properties of the active, computerized dynamic visual acuity test 3) were available in the English language, 4) were conducted on adult human test subjects, and 5) were peer-reviewed journal articles. Excluded articles included any that 1) performed the DVA test passively, or 2) didn't include the diagnostic properties of the DVA test. The Quality Assessment of Diagnostic Accuracy Studies version-1 (QUADAS-1) tool was used to assess the quality of each study. Der-Simonian and Laid random effects models were used to produce summary estimates of sensitivity, specificity, positive and negative likelihood ratios, and diagnostic odds ratios.

Results : Of the 297 articles that were screened 3 articles met eligibility requirements. Of the three articles that met eligibility, two of the articles scored a 10 on the QUADAS-1 tool and one article scored a 7. The active cDVA as compared to the reference standard demonstrated a sensitivity of 86.9% (95% CI = 78.8% - 93.3%), and a specificity of 74.5% (95% CI = 68.6% - 79.8%). The positive likelihood ratio was 5.9, with a 95% CI = .73 – 47.94, and the negative likelihood ratio was 0.20, with a 95% CI = .07 - .64. The negative predictive value was 94% and the positive predictive value was 53%. The Quadas-1 tool, a quality measure that looks at potential bias, found that the findings of Herdman et al and Goebel et al had scores of 10 while the findings of Rine et al found scores of 7. The two articles that scored a 10 had less potential for bias within their studies.

Conclusions : The active cDVA demonstrated reasonable sensitivity and specificity. However, as the 95% CI for the positive likelihood ratio included 1.0 and the positive predictive value was close to 50%, the active cDVA may not be useful as a test to rule in vestibular hypofunction. The negative likelihood ratio was in a range to result in a substantial shift in post-test probability and the negative predictive value of 94% suggests that the active cDVA is better used as a test to rule out vestibular hypofunction.

Clinical Relevance : Given the analysis of the results of the included studies, the active cDVA is a better clinical test to rule out vestibular hypofunction.

TITLE: The role of hip positioning accuracy in post-stroke gait

AUTHORS/INSTITUTIONS: J.C. Dean, Health Professions, Medical University of South Carolina, Charleston, South Carolina, UNITED STATES|A.E. Embry, K. Stimpson, S.A. Kautz, Health Sciences and Research, Medical University of South Carolina, Charleston, South Carolina, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Post-stroke mobility is often limited by gait instability. While neurologically intact adults use a consistent gait strategy of adjusting their foot placement to account for their body's mechanical state [1], this strategy is disrupted in stroke survivors at risk for falls [2]. Stroke survivors are less accurate and more variable when stepping to targets [3-5], suggesting that an inability to accurately position the swing leg may contribute to disuse of the normal stabilization strategy. Here, we hypothesized that a post-stroke reduced ability to accurately position the hip in the frontal plane would cause reduced step accuracy and a preference for wider, more conservative steps.

Number of Subjects : This analysis focuses on the 23 of 35 enrolled stroke survivors with sufficient motor function (e.g. strength, range of motion) to actively move through a 20° hip ab/ad-duction range of motion in time with a metronome. 12 age-matched healthy controls served as a comparison group.

Materials/Methods : Participants performed a hip oscillation task while lying supine with one leg supported from a low-friction track. Vision of the leg was obscured, but visual feedback of the leg's ab/ad-duction angle was provided on a monitor. Participants moved their leg back and forth in time with a metronome (40 BPM), matching the movement to visual targets at amplitudes of 10°, 15°, or 20°. We quantified movement accuracy as the absolute error between the maximum abduction and adduction angles and the matching target angles. Participants also performed walking trials on a GaitRite in which they walked normally, or walked while matching their foot placement to parallel lines prescribing step widths of 10, 20, and 30 cm. We quantified average step width for normal walking, and mediolateral foot placement absolute error for trials with target lines.

Results : Stroke survivors were significantly less accurate than controls when positioning their paretic leg during the hip oscillation task ($p=0.009$). During normal walking, step width did not differ significantly between stroke survivors and controls ($p=0.51$). In contrast, targeted stepping accuracy was significantly lower in stroke survivors ($p<0.0001$), with larger errors during paretic steps than either non-paretic or control steps. Across stroke survivors, paretic leg hip oscillation errors were significantly correlated with step width during normal walking ($r=0.51$; $p=0.012$) and paretic foot placement errors during targeted walking ($r=0.50$; $p=0.016$).

Conclusions : The ability to accurately position the hip in the frontal plane influences post-stroke gait, with hip positioning errors predicting approximately 25% of the variation in post-stroke step width and in the ability to accurately step to mediolateral targets.

Clinical Relevance : Accurate positioning of the swing leg appears to be an important component of a stable walking pattern. Future work will investigate if increasing hip positioning accuracy (potentially through either training or enhancing sensorimotor function) improves post-stroke gait stability.

TITLE: Role of the cerebellum in implicit ankle motor sequence learning

AUTHORS/INSTITUTIONS: Y. Chen, T. Chang, P. Tang, School and Graduate Institute of Physical Therapy, College of Medicine, National Taiwan University, Taipei, TAIWAN| . Hsu, Graduate Institute of Medical Devices and Imaging System, National Taiwan University College of Medicine, Taipei, TAIWAN|J.O. Goh, Graduate Institute of Brain and Mind Sciences, National Taiwan University College of Medicine, Taipei, TAIWAN|J. Jeng, Department of Neurology, National Taiwan University Hospital, Taipei, TAIWAN|

ABSTRACT BODY:

Purpose/Hypothesis : The cerebellum has been shown to be involved in implicit motor sequence learning of upper extremity tasks. The role of the cerebellum in learning lower extremity motor sequence tasks remains largely unknown. This study was aimed to investigate the dynamical changes in activation intensity of the cerebellum before and after repeated and random ankle motor sequence learning in healthy adults. We hypothesized that the activation intensity of the cerebellum would show a greater increase after repeated sequence learning, compared to random sequence learning.

Number of Subjects : 9

Materials/Methods : Nine right-footed healthy subjects (mean age= 54.1±11.4 years) undertook a 7-day ankle motor sequence learning experiment. From Day 2 to Day 6, subjects practiced tracking random and repeated movement sequences by moving the left ankle to follow the movement trajectory of a cursor displayed on a computer screen. There were 6 blocks for each sequence and each block lasted 120 seconds on each day. Functional magnetic resonance imaging (fMRI) and ankle tracking performance (measured in root mean square error, RMSE) were acquired on Day 1 and Day 7. During fMRI acquisition, subjects underwent two runs of fMRI scan. Each run consisted of two repeated sequence blocks, two random sequence blocks, and 5 resting blocks (one at the beginning, one at the end, and three in-between the movement blocks in each run). The order of repeated and random blocks was counterbalanced. Subjects were not explicitly told the existence of the repeated sequence. The blood oxygenation level-dependent (BOLD) response during repeated and random sequence blocks in contrast to rest blocks were analyzed for data acquired on Day 1 and Day 7 using SPM8. Differences in BOLD responses between repeated and random sequence blocks were also analyzed for these two days.

Results : All subjects showed a significant reduction of RMSE for repeated (39.2% reduction, $p < 0.001$) and random (34.9% reduction, $p < 0.001$) sequences from Day 1 to Day 7. The results of fMRI data analysis showed that the cerebellum was not significantly activated for repeated or random sequence blocks on Day 1, but were significantly activated for random (left lobule IV, $t=5.03$, $p= 0.001$) and repeated (right Crus I; $t= 6.55$, $p < 0.001$; left lobule IV, $t=5.81$, $p < 0.001$) sequence blocks on Day 7. Furthermore, the left cerebellum (lobule VII, $t=2.65$, $p=0.014$; lobule III, $t= 2.34$, $p=0.023$) showed a significantly greater activation during repeated than random sequence blocks on Day 7.

Conclusions : Our findings showed an increased cerebellar activation while performing random and repeated ankle tracking tasks after the 5-day ankle sequence learning. The greater increase in cerebellar activation in repeated sequence supports the role of the cerebellum in implicit sequence learning. However, further studies with a larger sample size are needed.

Clinical Relevance : Understanding the role of the cerebellum in motor sequence learning may help clinicians design more appropriate training programs for patients with cerebellum lesions in order to improve their motor sequence control.

TITLE: Integrity of the frontostriatal tract is associated with learning an ankle tracking task

AUTHORS/INSTITUTIONS: T. Chang, Y. Chen, P. Tang, School and Graduate Institute of Physical Therapy, College of Medicine, National Taiwan University, Taipei, TAIWAN| . Hsu, Graduate Institute of Medical Devices and Imaging System, National Taiwan University College of Medicine, Taipei, TAIWAN|W. Tseng, Center for Optoelectronic Biomedicine, National Taiwan University College of Medicine, Taipei, TAIWAN|J. Jeng, Department of Neurology, National Taiwan University Hospital, Taipei, TAIWAN|

ABSTRACT BODY:

Purpose/Hypothesis : Motor learning ability is essential for people to learn new motor skills or regain motor function after brain lesions. Literature has shown that the integrity of corticospinal tracts (CST) is associated with motor function and that of frontostriatal tracts (FST) is correlated with cognitive function. This study was aimed to investigate the relationship between the integrity of these two white matter tracts and the motor performance after learning an ankle tracking task.

Number of Subjects : 16

Materials/Methods : Eight patients with chronic stroke (age= 54.9±14.7 years; post-onset time= 20.4±26.8 months) and eight age-matched healthy adults (age= 52.9±11.5 years) underwent a 7-day ankle tracking learning experiment. On each day of Day 2 through Day 6, subjects practiced tracking random and repeated movement sequences for 6 blocks each (120 sec/block) by moving the unaffected or non-dominant ankle to follow a cursor movement displayed on a computer screen. Diffusion spectrum image (DSI) of the brain and ankle tracking performance (measured in root mean square error, RMSE) were obtained on Days 1 and 7. Tract-specific tractography analysis was used to reconstruct the CST and FST using DSI Studio version 201102. Partial correlations, controlling for age for healthy adults and for age and post-onset day for patients, were used to investigate the associations between post-training tracking performance and pre-training CST and FST integrity, indexed by generalized fractional anisotropy of DSI (GFA_{CST} and GFA_{FST} , respectively).

Results : There were high negative correlations of post-training RMSE with pre-training GFA_{FST} ($r=-0.787$) and GFA_{CST} ($r=-0.793$) of the contralateral hemisphere in healthy adults and with pre-training GFA_{FST} ($r=-0.413$) of the contralateral hemisphere in patients for random sequence tracking. However, due to the small sample size, these correlations did not reach a significant level. Noticing the similar correlation trends between pre-training GFA_{FST} and post-training ankle tracking performance for random sequence in the two groups, we further performed multiple linear regression analysis using pooled group data. The results revealed that the pre-training GFA_{FST} value was an independent factor influencing post-training random sequence tracking performance and explained 42.4% of its variance, after controlling for age ($p=0.004$). These findings suggest that integrity of the pre-training FST was significantly associated with post-training performance in ankle random sequence tracking.

Conclusions : Our results suggest that fiber integrity of the FST is important for learning an ankle tracking task in healthy individuals and patients with chronic stroke. However, the role of the CST and the relative importance of CST and FST in learning this task need to be further studied by using a larger sample size.

Clinical Relevance : A better understanding of the structural white matter correlates of motor learning in individuals with stroke may help therapists more accurately predict the potential of patients to respond to physical therapy interventions.

TITLE: Ataxia and Body Weight Support Treadmill Training: A Case Study

AUTHORS/INSTITUTIONS: J. Jackson, B. Vandaveer, Moss Rehab Physical Therapy Neurologic Residency Program, Moss Rehab, Philadelphia, Pennsylvania, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : Body weight support treadmill training (BWSTT) has been shown to improve gait velocity, gait symmetry, and overall cardiovascular fitness in the spinal cord injury and stroke populations. Although no randomized controlled trials with outcomes related to gait in those with ataxia have been reported, case studies have shown that BWSTT improves quality of gait and symmetry, and fosters increased independence with functional activities. The purpose of this study was to determine the effect of body weight support treadmill training on a patient with an acquired brain injury presenting with truncal and limb ataxia.

Case Description : The patient was a 26-year-old male presenting to inpatient rehab three months status post encephalopathy resulting from a drug overdose. BWSTT was performed for 15-minute sessions, with three ambulation trials per session, 2-3 times weekly for 6 weeks for a total of 14 trials. Over the course of the study, treadmill speed was progressed from 1.2mph to 1.8mph; body weight support decreased from 10% to 5%; and ambulation time during each trial increased from three minutes with a two minute rest break to 3.5 minutes with 1.5 minute rest break. Progression of gait parameters were based on patient's improvements in gait speed and endurance. Assistance required during BWSTT decreased from three therapists, with one at the pelvis and each lower extremity, to one therapist at the pelvis only. BWSTT was performed along with traditional physical therapy interventions including balance, core strengthening, and functional mobility activities.

Outcomes : Ataxia was measured using the Scale for the Assessment and Rating of Ataxia (SARA), gait velocity measured with the 10 meter walk test (10MWT), and endurance measured with the 6-minute walk test (6MWT). Additional outcome measures included level of assistance and assistive device used. Measurements were taken prior to the beginning of the study, each week during the study, and at the conclusion of the study. The patient showed an improvement in 10MWT from 0.20m/s to 0.29m/s and 6MWT from 140ft to 275ft. There was a decrease in SARA scores from 30.5 to 19, demonstrating an improvement in the patient's ataxia. The patient progressed from requiring the use of an Arjo Walker with maximal assistance for gait, to at the end of the study, a rolling walker with minimal assistance.

Discussion : Ataxia, gait velocity, endurance, and independence with gait improved following BWSTT. The outcomes from this case study suggest that BWSTT can be an effective treatment method for patients with ataxia following a brain injury. Although positive outcomes were found, more research needs to be performed, preferably through randomized controlled trials or case series. BWSTT, used as part of a comprehensive treatment plan, can be useful in the subacute and chronic stage with patients presenting with ataxia to improve overall functional mobility.

References: Must include 5 current references (less than 10 years old): Cernak, K., Stevens, V., Price, R., Shumway-Cook, A. (2008). Locomotor training using body weight support on a treadmill in conjunction with ongoing physical therapy in a child with severe cerebellar ataxia. *Physical Therapy*, 88(1), 88-97. Freund, J.E., Stetts, D.M. (2010). Use of trunk stabilization and locomotor training in an adult with cerebellar ataxia: A single system design. *Physiotherapy Theory and Practice*, 26(7), 447-58. Freund, J.E., Stetts, D.M. (2013). Continued recovery in an adult with cerebellar ataxia. *Physiotherapy Theory and Practice*, 29(2), 150-8. Sartor-Glittenberg, C., Brickner, L. (2014). A multidimensional physical therapy program for individuals with cerebellar ataxia secondary to traumatic brain injury: A case series. *Physiotherapy Theory and Practice*, 30(2), 138-48. Virginia, D., de Carvalho Schettino, R., Rolla de Castro, T.R., Teixeira, V.R., Cavalcanti Furtado, S.R., de Mello Figueiredo, E. (2008). Treadmill training for ataxic patients: A single-subject experimental design. *Clinical Rehabilitation*, 22, 234-41.

TITLE: Are People with Parkinson Disease Adhering to National Guidelines for Exercise and Physical Activity?

AUTHORS/INSTITUTIONS: C. Colon-Semenza, T. Ellis, Department of Physical Therapy & Athletic Training, Boston University, Boston, Massachusetts, UNITED STATES|J. Wertheimer, Parkinson Alliance, Kingston, New Jersey, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Despite the known benefits of physical activity and exercise in the management of Parkinson disease (PD), it is unclear whether people with PD are engaging in physical activity and exercise at sufficient doses to realize the benefits. The purpose of this study was to identify if people with Parkinson disease were adhering to the guidelines for physical activity and exercise, set forth for older adults, by the United States Department of Health and Human Services. We hypothesized that individuals with PD would not be participating in strength, balance, aerobic exercise or walking activity at sufficient doses.

Number of Subjects : 1500 participants with Parkinson disease, representing 50 states within the United States and 22 international participants.

Materials/Methods : Subjects were recruited through the Parkinson Alliance (PA) to participate in a survey about exercise. Subjects were recruited from an existing database of persons with PD at the PA, advertisements at PD support groups, announcements in medical clinics, and through the PA website. The survey was mailed to potential participants and returned to the PA by mail, in stamped addressed envelopes. Survey questions inquired about attitudes and knowledge about exercise and current level of participation in balance, strengthening, aerobic exercise and walking activity. The percent of people meeting the minimum recommended dose, as proposed by the US Department of Health and Human Services, was determined for each mode of exercise and walking activity.

Results : Participants had a mean age of 70 years (range 38-95) and were 96% white (not Hispanic), 59% male and 62% with college or graduate level degrees. The majority (63.4%) of participants had a disease duration of ≥ 6 years. When asked about the importance of exercise for treatment of PD, 87% indicated "quite a bit important" or "extremely important". Among those that responded to the questions regarding exercise frequency ($n= 1448$), 23.5% were participating in balance exercises, 23.5% in aerobic exercise and 24.3% in strengthening exercises, 3-7 days/ week. Related to physical activity, 27.9% report that they walked for at least 30 consecutive minutes 3-7 times per week.

Conclusions : The results indicate that despite most participants with PD indicating that physical activity and exercise were important in the management of PD, the majority (72.1-76.5%) were not engaging in balance, aerobic or strengthening exercise or physical activity at the recommended frequency for older adults. Although more dose-response trials are needed to determine optimal exercise dosing for those with PD, it appears that most people with PD are exercising and participating in physical activity at insufficient quantities which may attenuate potential benefits.

Clinical Relevance : Physical therapists are well positioned to educate and engage persons with PD in exercise and physical activity at sufficient levels to meet minimum national guidelines.

TITLE: Dance May Improve Quality of Life But Not Gait in Individuals with Parkinson's Disease

AUTHORS/INSTITUTIONS: C. Moehlenbrock, C. Santella, S. Vallabhajosula, J. Freund, Elon University, Elon, North Carolina, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Parkinson's disease (PD) is a progressive neurodegenerative movement disorder affecting more than 1 million Americans. Exercise has been shown to increase gait speed and improve balance and quality of life in individuals with PD. Previous studies examining the effects of tango and other ballroom dancing showed improvements in balance. This study used the Mark Morris Dance for PD program as a template for dance classes to examine the effects of dance on gait, balance, and quality of life.

Number of Subjects : Eleven individuals diagnosed with mild to moderately severe PD (age range 65-88 years, 6 males) participated in the study.

Materials/Methods : All subjects took part in dance classes led by an instructor trained in Mark Morris Dance for PD once a week for 12 weeks. Participants were also encouraged to use the Mark Morris Dance for PD At Home DVD twice a week for 45 minutes. The dance classes consisted of a 20 min. seated warm up; a 20 min. supported standing portion focused on balance and strength exercises; and a 30 min. standing portion including partnered movements for swing, shag, and tango. Data were collected before and after the 12-week intervention. The dependent variables included spatio-temporal gait parameters (Protokinetics Zeno walkway), sway area (AMTI) force platform) during modified Clinical Test of Sensory Integration and Balance for 30 sec per condition, Mini-BESTest, and Falls Efficacy Scale (for balance), and the Apathy Scale and Parkinson's Disease Questionnaire-39 (for quality of life). A paired-samples t-test was performed.

Results : Participants had significant decrease in apathy (improvement in quality of life) following the intervention (Pre: 32.40; Post: 27.27; $P = 0.018$). A significant decrease in the percentage of the double support phase of gait indicated individuals spent less time with both feet in contact with the ground (Pre: 35.15; Post: 33.99; $P = 0.019$).

Conclusions : An instructor-led dance class based on the Mark Morris Dance for PD program given once per week for 12 weeks improved certain aspects of quality of life but not necessarily gait and balance in individuals with PD. Decreased apathy may be attributed to the music, creativity, or social interaction incorporated in the class. Decreased percentage of double support phase of gait may be attributed to the practice of dance steps with increased time in single leg support. Further research with increased frequency of supervised dance classes is indicated.

Clinical Relevance : Dance is a unique intervention for patients with PD that can complement formal physical therapy and provide continued activity within the community. Dance classes provide auditory cues which have been shown to improve some aspects of gait in individuals with PD. Dance as an intervention for only once a week for 12 weeks can improve quality of life for these individuals but may not be sufficient to improve gait and balance.

TITLE: Initiating regular exercise is associated with slower decline in quality of life in Parkinson's disease (National Parkinson Foundation Quality Improvement Initiative data)

AUTHORS/INSTITUTIONS: M.R. Rafferty, Department of Physical Therapy, Northwestern University, Chicago, Illinois, UNITED STATES|P. Schmidt, F. Cubillos, National Parkinson Foundation, Miami, Florida, UNITED STATES|C. Marras, Movement Disorders Centre, Toronto Western Hospital, Toronto, Ontario, CANADA|M. Guttman, Centre for Movement Disorders, Toronto, Ontario, CANADA|E. Nelson, Institute for Health Policy and Clinical Practice, Dartmouth, Lebanon, New Hampshire, UNITED STATES|T. Simuni, Neurology, Northwestern University, Chicago, Illinois, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Exercise has been associated with improved health related quality of life (HRQL). It is currently unknown whether patients who change their regular exercise behavior, outside of structured exercise interventions, can prevent long-term decline in PD-related HRQL as measured by the Parkinson's Disease Questionnaire-39 (PDQ-39) summary index. The purpose of this study is to determine whether increasing exercise to meet physical activity guidelines is associated with slower decline in HRQL in people with Parkinson's disease (PD).

Number of Subjects : 2940

Materials/Methods : The National Parkinson Foundation Quality Improvement Initiative patient registry includes 2940 patients from 20 sites who have data entered for over 2 years. The PDQ-39 summary index was measured at 3 visits: baseline, 1 year, and 2 year. At each visit, patients were classified as exercisers (E) if they exercised greater or equal to 2.5 hours per week as recommended by the Center for Disease Control and Prevention Physical Activity Guidelines (2008). They were classified as non-exercisers (N) if they exercised less than 2.5 hours per week. A subset of patients with moderately impaired HRQL (PDQ-39 = 15% to 30%), who all began the study as non-exercisers, were compared to determine the effect of starting to exercise on HRQL in patients who began the study at similar levels.

Results : Patients who exercised regularly at baseline and the following 2 years (EEE) demonstrated a 2.3% (95% CI \pm 0.7) increase (worsening) in PDQ-39 summary index from a baseline average of 18%. Patients who did not exercise regularly at any of the 3 evaluations (NNN) worsened by 4.1% (95% CI \pm 0.8) from a baseline of 27%. Patients who started to exercise after the first visit (NEE) had significantly less decline in HRQL over 2 years (1.4%) than those who started to exercise the following year (NNE) (3.2%; $p < 0.05$). The subset analysis revealed that the group who began to exercise after their initial visit (NEE) had significantly less worsening of PDQ-39 than non-exercisers (1.3% \pm 1.9% vs 6.2% \pm 1.3; $p=0.00005$).

Conclusions : Increasing physical activity to greater than 2.5 hours of exercise per week is associated with a slower decline in total PDQ-39 in people with PD. People who transitioned to exercising had an average decline in PDQ-39 (1.3) that was lower than the published minimally important change associated with feeling 'a little worse' (1.6). Failing to transition to exercise was associated with a decline in PDQ-39 that was over the standard error of measurement. The role of referral to PT for health and wellness of people with PD will be discussed.

Clinical Relevance : Transitioning to regular exercise participation was associated with slower declines in HRQL. The differences between groups in this large patient registry were clinically meaningful. This study, which did not control for type or intensity of exercise, demonstrates the importance of regular exercise habits in the absence of structured exercise interventions.

TITLE: Effects of Lower Extremity Robotic Assistive Technology Devices during Locomotor Training Post-stroke: A Systematic Review

AUTHORS/INSTITUTIONS: L.J. Barnes, K.J. Curbow Wilcox, B. Brownlee, M. Burns, H.L. Tiep, Physical Therapy, University of Mississippi Medical Center, Jackson, Mississippi, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Locomotor impairments including deficits in distance walked, gait speed, intralimb coordination and stability, and spatiotemporal abnormalities are common disabilities in adults post-stroke.^{1, 2} Locomotor training (LT) is an intervention utilized to improve gait kinematics which may be a goal in returning to maximal level of function within the community. Robotic devices supply sensory-specific input during LT which provides more coordination during gait.¹ The purpose of this systematic review is to explore the potential benefits of lower extremity robotic assistive technology devices during locomotor training to improve the parameters of gait in adults post-stroke.

Number of Subjects : NA

Materials/Methods : An electronic search of PubMed and CINAHL databases from 2004-2014 resulted in 14 articles. Following the title screen, abstract screen, and inclusion/exclusion criteria screen, 4 articles remained. The inclusion criteria consisted of patients with medical diagnosis of stroke and residual lower extremity deficits affecting gait. The exclusion criteria were upper limb intervention with robotic therapy and patients with spinal cord injury and/or brain injury. The articles were scored using the PEDro scale and CEBM scale. The PEDro scale measures the internal validity of randomized control trials in physical therapy research on a 10 point scale with 10 being strongest. The 2011 Oxford Centre of Evidence-Based Medicine (CEBM) score measures the study design on a scale of 1 – V with I being highest.

Results : After the screening process, 4 articles remained for review. The average PEDro score was 5/10 with each article scoring 5/10. Each article scored a II on the CEBM level of evidence scale. The results of article summaries showed that robotic assistive devices may be beneficial in locomotor training, but evidence did not indicate that robotic assistive devices are more beneficial than manual assistance by a physical therapist.

Conclusions : Robotic assistive devices in locomotor training may lead to increased gait speed and distance. Therapist-assisted locomotor training may also lead to increased gait speed as well as limb stability, with some evidence that manual assist may be preferable to robotic assistance. When using robotic assisted training, better results may be achieved when used in conjunction with virtual reality. Further research is needed to examine between-group differences in robotics vs. manually assisted locomotor training in patients post-stroke.

Clinical Relevance : Improvement in gait kinematics post-stroke may be achieved with robotic assistive devices as well as with manual assistance by a therapist, and some studies suggest that manual intervention may be more beneficial in improving gait speed.

TITLE: Healthy H.E.A.R.T.s (Health, Education, and Recovering Together)- Innovative Delivery of Secondary Stroke Prevention and Healthy Lifestyle Modification Education in a Group Setting Improves Physical Fitness and Decreases Risk for Secondary Stroke in Individuals who have Survived Stroke.

AUTHORS/INSTITUTIONS: A.M. Miller, C.A. Gunn, R. Kitchens, W. Brewer, E. Fonseca, Outpatient Rehabilitation Services, Harris Health System, Houston, Texas, UNITED STATES|

ABSTRACT BODY:

Purpose : To assess the impact of a secondary stroke prevention program on risk factor modification and physical fitness for individuals who have survived stroke. To identify the role of peer support in retaining and carrying over lifestyle modifications after preventative education provided in a group setting.

Description : The Healthy H.E.A.R.T.s program (health, education, and recovering together) was developed to provide secondary stroke prevention education to individuals who have survived a previous stroke. According to the American Heart Association, more than 795,000 people in the United States have a stroke each year. Nearly one in four of those have had a previous stroke. ¹ The goal of this program was to reduce the risk factors for another stroke by increasing knowledge: monitoring blood pressure, reduction of salt intake, and principles of physical activity. Preventative education is typically provided by physical and occupational therapists on a one to one basis; however it is both expensive and time intensive to deliver care in this manner. This pilot program recruited patients referred to our outpatient clinic post stroke. The program commenced after completion of their primary course of therapies. They were evaluated for risk of secondary stroke using the National Stroke Association's Stroke Risk Scorecard, physical performance measures (grip strength, six minute walk test) and self-report measures (Healthy Lifestyle Profile II, Medication Adherence IQ, Readiness for change). The program, delivered in a group format once a week for 12 weeks, comprised of education on prevention of secondary stroke through changes in diet, exercise, and risk factor re-education.

Summary of Use : Participants demonstrated a significant immediate and 6 month post-intervention improvement in physical performance and reported improvements in diet, exercise, and self-management of their own health conditions.

Importance to Members: With the ongoing changes to reimbursement, demand on therapist time, and emphasis on continual improvement of outcomes with fewer resources, our profession is challenged to be more innovative with delivering care. The efficacy of health care education and prevention delivered in a supportive group atmosphere as well as the effectiveness of wellness and prevention activities delivered by physical and occupational therapists has been demonstrated in the literature.^{2,3,4} This, coupled with the efficiency of delivering care outside of one to one treatment lends itself to a productive and effective means of preventing secondary stroke in our highest risk populations. ⁵ In addition, patients benefit from the support of a peer network that drives change beyond the endpoint of the class. This is an additional gain not provided by the traditional delivery of services in the one to one style.

TITLE: Validity of the Berg Balance Scale to Predict Falls in Individuals with Peripheral Vestibular Dysfunction

AUTHORS/INSTITUTIONS: R.R. Utzman, C.A. Mancinelli, T. Rice, Division of Physical Therapy, West Virginia University, Morgantown, West Virginia, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Impairment of the peripheral vestibular system is characterized by vertigo and imbalance, and is responsible for 40% of dizziness-related complaints. Dizziness related to vestibular impairment can lead to falls. Valid tools are needed to assess fall risk in people with vestibular dysfunction. The purpose of this study was to determine validity of the Berg Balance Scale (BBS) to predict falls in people with peripheral vestibular impairment.

Number of Subjects : Data were collected from medical records of over 300 patients referred by otolaryngologists for PT evaluation between January 2012 and November 2014 for complaints of vertigo and/or dizziness. Data were analyzed for 59 patients who were 18 years or older and had vestibular hypofunction or positional vertigo.

Materials/Methods : This retrospective study involved analysis of data extracted from medical records. Data extracted included demographic information, medical and PT diagnoses, medical history, fall history, and BBS score.

Descriptive statistics were used to screen data and identify general sample characteristics. Logistic regression was used to determine whether BBS score was related to history of falls. Receiver-operating characteristics (ROC) curve analysis was used to determine a BBS threshold for predicting falls; sensitivity and specificity values for this threshold were calculated.

Results : The average age of subjects was 59 years, ranging from 24 to 94. Sixty-three percent were female. Thirty-nine subjects reported a history of falls on initial examination. Logistic regression revealed an inverse relationship between BBS and history of falls ($p < 0.01$). Area under the ROC curve was 0.79. Using a threshold value of $< 46/56$, the sensitivity and specificity of the BBS to predict falls in this sample were 0.66 and 0.79, respectively.

Conclusions : The BBS was a moderate predictor of falls in this sample of adults with peripheral vestibular dysfunction. The BBS was developed for use with older adults. Due to the small sample size, we were unable to control for the broad range of ages in the sample. Future studies should investigate whether the BBS is a better predictor of falls in older vs. younger adults with vestibular impairments.

Clinical Relevance : Clinicians should assess fall risk in their patients with peripheral vestibular impairments. Given the preliminary nature of these results and the moderate sensitivity and specificity calculated from this sample, clinicians should use the BBS in combination with other performance-based and self-report measures of balance, gait, and mobility.

TITLE: The effect of early intervention on concussion management and time to return-to-play

AUTHORS/INSTITUTIONS: C.C. Beazley, L.B. Ahmed, A.H. Chan, M. Wilks, C.M. Withers, Physical Therapy - Hanover Neuro, Sheltering Arms Rehabilitation Hospital, Mechanicsville, Virginia, UNITED STATES|P. Pidcoe, VCU, Richmond, Virginia, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Return to sport following a concussion is a topic of study in current literature. In the early stages of recovery, oculomotor and vestibular impairments are common. In fact, oculomotor impairments are found in the majority of patients in the early weeks after concussion. These impairments adversely impact eye-head motion coordination and often result in motion sensitivity. Evidence suggests that treatments that include both vestibular rehabilitation and cervical spine interventions are effective, but there is limited data to suggest when treatment should begin. This study aims to evaluate the effect early vestibular intervention to determine if time to symptom resolution and return to play may be accelerated while still ensuring safe return to sport and previous activities as well as return of quality of life.

Number of Subjects : This study was a retrospective chart review selecting patients who had been referred to physical therapy for evaluation and treatment of symptoms associated with concussion secondary to a sports related activity. Only subjects who received intervention within two weeks of injury (early intervention group) were included and compared to subjects who began therapy later (late intervention group). Seventeen patients met the inclusion criteria. They ranged in age from 12 to 18 (5 males, 12 females).

Materials/Methods : Vestibular-Ocular reflex (VOR) VOR testing was used to determine the presence of abnormal saccades and dizziness with head movement. Dizziness Handicap Inventory (DHI) scores were used to objectify symptom severity.

Results : All subjects had abnormal saccades and dizziness with VORx1 at time of initial evaluation. The average time to symptom resolution for the early intervention group was 12.3 days. For the late intervention group it was 17.6 days. The early intervention group experienced no adverse outcomes to treatment. Pre-post treatment DHI scores from subjects suggest that outcomes were not impacted by symptom severity.

Conclusions : The early intervention group recovered more quickly than the late intervention group with no apparent relationship to initial symptom severity. In this study, most subjects recovered within 21 days.

Clinical Relevance : Recent research has demonstrated the benefits of physical therapy intervention related to identification, treatment, and symptom management of concussion. Findings suggest that vestibular physical therapy is an effective treatment. Additionally, an associated graded return to activity and/or play has been effective in safely returning patients to previous activities. (Alsalaheen BA, 2010). Physical therapists are uniquely qualified to help manage and treat patient who have suffered concussion. Early intervention may help return patients to unimpaired activities sooner than previously thought.

TITLE: Validity of Instrumented mCTSIB to Measure Postural Control in Persons with Subtle Impairments: A Pilot Study

AUTHORS/INSTITUTIONS: L. Freeman, M. Besch, Office of Research, Aegis Therapies, Sammamish, Washington, UNITED STATES|G. Dutta, L.A. King, F.B. Horak, Department of Neurology, Oregon Health and Sciences University, Portland, Oregon, UNITED STATES|M.T. Blackinton, PT Department, 3Nova Southeastern University, Tampa, Florida, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Abnormal postural sway related to aging and degenerative disease is associated with an increase in risk of falls that can lead to morbidity, mortality, and reduced quality of life for older adults. Instrumenting standardized clinical outcome measures using body-worn movement monitors is a low-cost alternative to motion analysis laboratories that can help clinicians improve diagnostic and discriminative accuracy. No studies have examined the clinometric properties of the instrumented modified Clinical Test for the Sensory Interaction on Balance (i-mCTSIB). The purpose of this study was to: 1) determine the concurrent validity of the i-mCTSIB with the Sensory Orientating Test (SOT); and 2) compare i-mCTSIB and SOT to differentiate between individuals with recent falls (within the previous 6 months). We hypothesized that i-mCTSIB would correlate significantly with SOT and better differentiate fallers from non-fallers.

Number of Subjects : 26 subjects with mild Parkinson's disease (PD).

Materials/Methods : All participants signed informed consent forms approved by the Oregon Health & Science University (OHSU) Institutional Review Board. SOT: Participants were tested under six sensory conditions, C1-6, in which the surface and visual surround are systematically modified. The SOT equilibrium score compares antero-posterior (AP) peak-to-peak sway during each trial to a theoretical sway stability limit of 12.5 degrees during each sensory condition. i-mCTSIB: Participants wore a wireless inertial sensor around the waist at L5. Sway data was collected under the 4 test conditions C1-4. The i-mCTSIB measure, RANGE is equivalent to the peak-to-peak measure used to calculate the SOT equilibrium score.

Results : The scores of i-mCTSIB correlated significantly with those of SOT: Composite $r = -0.634$ ($p = <0.01$), C1 $r = -0.432$ ($p = 0.028$), C5 and C4 $r = -0.543$ ($p = <0.01$). There was a significant difference in mean i-mCTSIB scores between fallers and non-fallers ($p = 0.041$). In contrast, the SOT scores revealed no significant difference between groups ($p = 0.308$).

Conclusions : Instrumenting mCTSIB with portable body-worn movement monitors can help clinicians' better quantify mild sway deficits, thereby overcoming ceiling effects, without the expensive and bulk of force plate technology. The results suggest that i-mCTSIB is a valid and clinically meaningful measure of sensory orientation in persons with PD, specifically those with mild postural sway. This study also suggests that the i-mCTSIB may be better than SOT in discriminating between those with and without history of recent falls.

Clinical Relevance : High functioning community dwelling older adults or those residing in post-acute care settings may present with abnormal postural sway that current clinical measures are not sensitive enough to detect. For these patients, therapists can use i-mCTSIB to improve the sensitivity of the measure to change. Clinicians can rely on i-mCTSIB to accurately measure sensory orientation and identify fall risk.

TITLE: Effect of fatigue on balance responses in people with multiple sclerosis and on people with no neurological diagnosis

AUTHORS/INSTITUTIONS: B.J. Baker, E. Breen, M. Kay, M. Kaiser, Physical therapy, Grand valley state university, Grand Rapids, Michigan, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Background and Purpose: Multiple sclerosis (MS) is a chronic autoimmune demyelinating disease affecting the central nervous system. Fatigue and impaired postural control are two common findings in people with multiple sclerosis. The purpose of the current study was to determine effects of cardiovascular fatigue on balance in people with MS as compared to individuals without a neurological condition

Number of Subjects : Forty-three participants, 22 with MS (3 males, mean age 52.7 ± 10 years), and 21 individuals without MS (2 males, mean age 52.0 ± 10 years) participated in the study.

Materials/Methods : Participants performed Sensory Organization Test, Motor Control Test, and Limits of Stability tests, on the Neurocom Equi Test System, before and after a step-test, to induce moderate cardiovascular fatigue.

Results : For the MS group, there was no statistically significant difference between results on the SOT ($p = 0.144$) or MCT ($p = 0.704$) before and after a fatiguing activity. There was a statistically significant learning effect for limits of stability ($p = 0.001$) after the fatiguing event. There was no difference in the amount of change on the SOT, MCT or LOS between the MS group and the control group before and after participating in a fatiguing activity. There was a significant difference between the MS group and the control group on the SOT, MCT and LOS both before and after the step test.

Conclusions : The present study confirms that individuals with MS have decreased balance as compared to those without MS at baseline and after a fatiguing event. However, the current study suggests that a moderate level of cardiovascular fatigue does not significantly negatively impact immediate balance performance on these measures of balance in the MS group and in the group without MS.

Clinical Relevance : It is evident from the findings that the MS group compared to the non MS group had more difficulty with all types of balance as measured on the Neurocom. Moderate cardiovascular fatigue was not sufficient to cause a change in balance in either group. A definite learning effect was seen on the LOS in the MS group. Also the data suggested that a learning effect occurred in the other two tests involved with the MS group. Based on the learning effect in individuals with MS on the LOS test, it could be suggested that people with MS are able to modify their movement strategy to improve performance.

TITLE: Single task vs dual task static balance in healthy younger adults

AUTHORS/INSTITUTIONS: N. Kirk-Sanchez, J.G. Moore, E.C. Baez, A.M. Carr, R.B. Holt, L.N. Lagaron, Physical Therapy, University of Miami, Coral Gables, , Florida, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Evidence suggests that balance has a cognitive component, and that in older adults, balance deteriorates when the individual is performing a cognitive task. The effect of a cognitive task in younger adults has not been well studied. The purpose of this study is to examine the relationship between age and static balance using the sensory orientation test in a young healthy adult population.

Number of Subjects : Subjects were 32 healthy adults, age 22-38, with an average age of 25.6 years, 53% female.

Materials/Methods : Subjects performed the Sensory Organization Test (SOT) using the Natus SMART Equitest system under two conditions (single task and dual task) on separate days at least 24 hours apart. A coin flip determined which condition would be performed first. In the single task condition, the subject stood on dual-force plates in a 3 sided surround. Anterior-posterior sway was recorded under 6 sensory conditions: 1. Eyes open (EO), firm surface (FS), 2. Eyes closed (EC), FS, 3.EO, sway referenced visual surround (SRVS), 4. EO, sway referenced support (SRS), 5. EC, SRS, 6. EO, SRS, SRVS. Each condition consisted of three 20 second trials during which the subject was instructed to stand quietly with hands to their sides. The dual task condition required the subject to perform the single task condition while simultaneously performing a cognitive task: backwards digits (subjects repeated a series of 3-7 numbers in reverse order from what the examiner read to them). For each subject, an average equilibrium score (the average center of gravity sway for each trial) for each sensory condition and composite score (weighted average of the six conditions) was calculated. Dual task cost was calculated as ((single task-dual task)/single task)*100. Pearson correlation statistics were used to examine the correlation between age and each of the six sensory conditions in the single and dual task trials and dual task cost.

Results : Age was not correlated to scores for any of the six single task conditions or the composite score. Age was moderately correlated ($P<0.05$) to scores for dual task conditions 1($r=-0.39$),3($r=-0.48$),4($r=-0.45$), and 6($r=-0.51$) and the composite score($r=-0.53$), but not correlated to scores for condition 2 and 5 or the cognitive task errors. Age was weakly correlated ($P<0.05$) to dual task cost for the composite score($r=0.36$) and condition 4($r=0.39$).

Conclusions : Even in a relatively young healthy population, static balance tends to deteriorate when the subject is performing a cognitive task. The difference between performance in a single task trial and dual task trial seems to increase with age. This effect was more apparent in conditions in which subjects were given inaccurate sensory input (conditions 3,4 and 6), suggesting the cognitive task may interfere with sensory weighting, leading to postural instability.

Clinical Relevance : Deterioration in balance during a cognitive task may begin to occur at a relatively young age, even early adulthood. More research is needed to examine whether dual task training can preserve dual task balance abilities across the lifespan.

TITLE: Conductive Education for individuals with chronic stroke symptoms: A pilot study

AUTHORS/INSTITUTIONS: R. OShea, R.D. Theiss, Physical Therapy, Governors State university, University Park, Illinois, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of this study was to investigate the impact of Conductive Education (CE) on adults with chronic stroke, replicating and expanding a study by Brown et al. We hypothesized that completing the CE program would improve function and change neural connectivity.

Number of Subjects : Four adult subjects, >1yr status post stroke

Materials/Methods : Our IRB approved, pre-test/post test study involved four adults with chronic hemiparetic sequelae, absent aphasia/cognition impairments, and not currently in PT or OT. Subjects participated in a group CE program involving 10 weekly 2 hour sessions led by a DPT and a CE Teacher. Sessions were videotaped for qualitative analysis. Quantitative pre-test and post-test measures included functional outcomes (Barthel, Timed up and Go (TUG), 10 meter walk test, Stroke Impact Scale (SIS), Community Integration Questionnaire (CIQ) and MRI/DTI imaging (focused on cortical structure, myelination and oxygen uptake). Awarded grants paid all costs.

Results : Compared to pre-test measures, clinically significant improvements post CE intervention were seen in several Functional Outcome Measures. Specifically, clinically significant improvements were seen on the Barthel (n = 2/4 participants) 10 meter walk test (n = 3/4), SIS ADL/IADL subscale (n = 2/4) and SIS hand function subscale (n = 3/4), also paired t-test statistically significant). Raw score improvements not reaching significance were seen in SIS subscales of strength (n = 2/4 subjects), memory (n = 3/4), emotion (n = 3/4), and social participation (3/4). No significant changes were seen in TUG speed or the CIQ. Imaging data showed increased neural connectivity. Pretest MRI/DIT imaging revealed individually varying location and severity of lesions. Likewise, the degree of improvement after CE also varied by individual.

Conclusions : The positive findings from our study support the Brown study findings. Additionally, our imaging results supported our subjects' functional improvements. The subjects reported improved quality of life and function around their home and community. For some patients with chronic stroke, a 10 week Conductive Education intervention may provide them with peer support and improved functionality.

Clinical Relevance : In the US, Conductive Education is not readily used in Stroke rehabilitation. The positive findings lend credence to using CE with patients with motor impairments following stroke.

TITLE: Effects of Postural Sway on Visual Acuity in Children with Vestibular Loss

AUTHORS/INSTITUTIONS: D.R. Givens, M.L. Thomas, K. Janky, Audiology, Boys Town National Research Hospital, Omaha, Nebraska, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of this study is to investigate how increased postural challenge affects visual acuity in children with vestibular loss. Vestibular deficits can affect postural stability, dynamic visual acuity (DVA) and gaze stabilization, which are needed to read, write and visually follow the teacher around the classroom (1,2,3). Postural control takes priority over cognitive tasks when the tasks are done together (4). Therefore, we hypothesized that increased postural challenge would decrease visual acuity in children with vestibular loss. The focus of this study is on children with cochlear implants (CCI), as approximately 50% of CCI have some degree of vestibular loss(6).

Number of Subjects : 16 adults with normal hearing (ANH), 8 children with normal hearing (CNH), and 2 CCI have participated to date. We anticipate 20 ANH, 30 CCI, and 30 age-matched CNH. CCI will further be separated into two groups, those with vestibular loss and those with normal vestibular function.

Materials/Methods : All subjects complete vestibular function testing, which consists of the ocular vestibular evoked myogenic potential (VEMP), cervical VEMP, video head impulse test and rotary chair test. Next, all subjects complete visual acuity testing while postural sway is simultaneously measured. Visual acuity is assessed in 4 postural conditions (sitting, standing, standing on foam, and tandem stance). Static visual acuity is measured in response to single-letter visual targets and a string of 5-letter visual targets. For DVA conditions, subjects wear a head mounted rate sensor canal (O-Navi, Vista, CA, USA)(5) and visual targets are presented when head velocities are between 120-180 degrees/second. Postural sway is measured by an accelerometer attached to a Velcro belt at the waist.

Results : All subjects tested to date had normal vestibular function. For static visual acuity with single letter targets, ANOVA suggest a significant main effect for condition, with visual acuity improving as the postural challenge increased. For static visual acuity with 5- letter targets, ANOVA suggest no significant differences between groups and across conditions. For postural sway, age negatively correlated with postural sway ($r = -0.365 - 0.793$, $p = 0.059 - 0.001$), suggesting greater sway with lower age. For DVA, ANOVA suggest no significant differences between groups and across conditions. For postural sway, age negatively correlated with postural sway ($r = -0.485 - 0.692$, $p = 0.014 - 0.001$), suggesting greater sway with lower age.

Conclusions : Age is related to postural sway. Findings are preliminary given the small subject numbers and that our CCI population had normal vestibular function. Data collection is ongoing and will include a group of CCI with vestibular loss.

Clinical Relevance : Understanding the effect of postural control on visual acuity is important as decreased visual acuity could compromise reading and learning for CCI with vestibular deficits. Knowledge of decrements could lead to development and earlier utilization of rehabilitation to improve visual acuity in children.

TITLE: Psychometric Properties of Gait Speed Reserve in People with Stroke

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ABSTRACT BODY:

Purpose/Hypothesis : The ability to adapt walking behavior based on environmental demands is an important aspect of walking function. Gait speed reserve (GSR), the difference between fastest gait speed and comfortable gait speeds, may be a useful tool to assess people's ability to adapt their walking behavior. The purpose of this study was to determine the test retest reliability and cross sectional construct validity of GSR in people with stroke.

Number of Subjects : 134 participants >3 months post stroke with foot drop, mean age (SD) 60.0 (11.3) years.

Materials/Methods : Cross sectional secondary data analysis from FASTEST trial. The following clinical measures were taken: comfortable gait speed (CGS), fastest possible gait speed (FGS), 6MWT, lower extremity Fugl Meyer motor score (FM), Berg Balance Scale (BBS), Timed Up and Go (TUG), Stroke Impact Scale-mobility (SIS-M), SIS-participation (SIS-P), and home and community walking participation measured using a Stepwatch Activity Monitor (SAM) worn for 7 consecutive days. Test retest reliability was assessed using ICC2,1 and convergent cross sectional construct validity was assessed by examining the relationship between GSR and the outcomes listed above using Spearman rho correlation coefficients.

Results : Mean (SD) gait speed values were: CGS 0.52 (0.29) m/s; FGS 0.62 (0.35) m/s; GSR 0.09 (0.10) m/s. Test retest reliability was strong: ICC2,1=0.90 (95% CI 0.88-0.93). Correlations (rho) for the relationship between GSR and the other outcomes ranged from 0.76 to 0.21 (CGS: 0.62, FGS: 0.76, 6MWT: 0.69, FM: 0.30, BBS: 0.54, TUG: -0.68, SIS-M: 0.28, SIS-P: 0.21, and walking participation: 0.44).

Conclusions : Among people with stroke, GSR demonstrated strong test retest reliability. Correlations ranged from strong to poor between GSR and other common stroke outcome measures . The moderate correlation between GSR and home and community walking activity (SAM) may indicate that the ability to adapt walking behavior is one component of an individual's ability to walk in their community after stroke. GSR in this cohort of people post stroke appears to be relatively small.

Clinical Relevance : GSR may be a clinically useful outcome measure to assess an individual's ability to adapt their walking behavior post stroke. Further research is needed.

TITLE: Psychiatric Medication Use is Associated with Increased Impairments in the Vestibular and Proprioception Systems

AUTHORS/INSTITUTIONS: T.A. Sando, S.A. Cohen, N. Bareis, Family Medicine and Population Health- Division of Epidemiology , Virginia Commonwealth University, Richmond, Virginia, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Psychiatric medications influence biochemistry in multiple brain regions including those involved in balance. The use of psychiatric medications is known to cause balance impairments and an increased fall risk in populations aged 65+. However, little is known about the influence of these medications on balance function, and fall risk, on those under the age of 65. This study sought to determine the influence psychiatric medications have on balance in the US population by age and gender.

Number of Subjects : This study examined 3267 adults over the age of 40 who participated in the Mobile Exam Center (MEC) balance component of the National Health and Nutrition Examination Survey (NHANES) and indicated current medications from 1999-2004.

Materials/Methods : The NHANES MEC conducted The Clinical Trial of Sensory Interaction and Balance (CTSIB) and this study utilized results from condition #5 (on foam, eyes closed). Failure of condition #5 indicates impaired vestibular and proprioceptive function and is associated with increased fall risk. Psychiatric medications were grouped according to families. Multiple logistic regression analyses, adjusting for demographic factors, were used to determine the association between failure of the CTSIB #5 and use of psychiatric medications by families and by the combined medication variable. Additional tests of effect modification by gender and age were conducted.

Results : Taking any psychiatric medication increases the odds of failing CTSIB #5 by 1.82 (95%CI: 1.38-2.40). Males aged 40-64 taking any psychiatric medications had 2.42 (95%CI: 1.55-3.77) times the odds of failing CTSIB #5 and women aged 65+ had 2.09 (95%CI: 1.06-4.09) times the odds of failing compared to those not taking psychiatric medications. Women aged 40-64 and men aged 65+ taking psychiatric medications had 1.44-1.48 times the odds of failing CTSIB #5. The use of antipsychotic medication increased the odds of failing CTSIB #5 by at least 2.3 in those aged 40-64.

Conclusions : The use of any psychiatric medications increases the odds of failing CTSIB #5 in men and women aged 40+. Men between the ages of 40-64 are at the highest risk of failure even when compared to populations aged 65+. The use of an antipsychotic medication places those aged 40-64 at a higher risk of failure than those aged 65+.

Clinical Relevance : Prior research has indicated that populations aged 65+ are at a high risk of balance impairments and falls related to the use of psychiatric medication. This study demonstrates balance impairments may be present in all populations over the age of 40 taking psychiatric medications with men aged 40-64 at the highest risk. As failure of CTSIB #5 indicates a dysfunction of the vestibular and proprioceptive systems and thus an increased risk for falls, it is imperative to screen clients on psychiatric medication over the age of 40 for these impairments. Those demonstrating impairments can then participate in physical therapy activities to reduce fall risk, reduce injury and improve quality of life.

TITLE: Impaired reciprocal inhibition of plantarflexor H-reflex correlates with level of dorsiflexor muscle activity post-stroke.

AUTHORS/INSTITUTIONS: J. Liang, R. Segal, Department and College of Health Professions, Medical University of South Carolina, Charleston, South Carolina, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : We reported previously in non-impaired nervous system, magnitude of reciprocal inhibition on plantarflexor (soleus, SOL) H-reflexes increased non-linearly with level of dorsiflexor (tibialis anterior, TA) muscle activity. The purpose of this study was to explore in stroke-impaired nervous system, the association between the magnitude of TA muscle activity and the concurrent SOL H-reflex amplitude in order to more completely examine the reciprocal inhibitory relationship between paretic TA activity and paretic SOL H-reflexes.

Number of Subjects : 3 non-impaired, 1 stroke-impaired

Materials/Methods : One stroke-impaired and 3 non-neurologically impaired individuals were seated with the knee flexed and feet strapped on a customized instrumented footplate with ankles in neutral position. At rest we elicited SOL H-reflex recruitment curve by increasing stimulus intensity in small increments until max H-reflex was obtained followed by attainment of max M wave. From the recruitment curve, we identified the stimulus intensity needed to elicit a SOL H-reflex slightly smaller than the maximal H on the ascending limb of the recruitment curve. We elicited 20 H-reflexes at this stimulus intensity. Then, with visual feedback, participants generated various magnitudes of TA contractions within specified windows of TA muscle activity that varied randomly in blocks of small to large magnitudes. When participants maintained the TA activity in the target window for 1 second, an electrical pulse was delivered, eliciting a SOL H-reflex. For each level of TA activity, 20 SOL H-reflexes were elicited. To ensure consistency of stimulations, we monitored the corresponding M waves and adjusted the stimulus intensity to keep the M wave in the desired range across all trials. TA EMG activity prior to electrical stimulus and peak-to-peak amplitudes of the baseline and SOL H-reflexes were analyzed offline. We explored various non-linear functions and the coefficient of determination (R^2) of the best fit was used to examine the percentage of the total variance in SOL H-reflex amplitude that could be explained by TA activity.

Results : In both stroke and non-impaired legs, we observed decrease in SOL H-reflex amplitude with TA activity that plateaued with further TA increase. The SOL H at maximal TA activity for the paretic leg (33.1% of SOL H with TA at rest) was less inhibited than non-impaired (10.4% of SOL H with TA at rest). When examining various non-linear functions, the best curve fit yielded higher R^2 in non-impaired (0.84 to 0.93) than stroke-impaired (0.71).

Conclusions : We observed impaired reciprocal relationship between paretic ankle muscles. Paretic SOL H-reflex amplitude is less well predicted based on magnitude of TA activity compared to non-impaired legs.

Clinical Relevance : Exploration of the modulatory relationship on the SOL H-reflex by the TA muscle potentially provides a more informative method to assess normal control of spinal interactions and to better characterize the reciprocal inhibitory pathway.

TITLE: Is an intensity based gait training program feasible and effective when implemented in a group model?

AUTHORS/INSTITUTIONS: S.M. Darnell, L. Lenhart, The Rehabilitation Institute of Chicago, Homewood, Illinois, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : Although intense gait training has been shown to demonstrate significant improvements in both gait and more basic functional mobility skills, it has yet to be determined if high intensity stepping training performed in a group setting at a decreased frequency can produce similar or superior results. The purpose of this study is to examine the effectiveness and feasibility of implementing a group based intensity protocol.

Case Description : 5 groups of 4 patients currently undergoing outpatient physical therapy (Day Rehab), with a variety of diagnosis including stroke, spinal cord injury, and brain injury participated in a 4 week intervention of high intensity stepping once per week. Pre-intervention measures of gait speed (10MWT) and gait distance (6MWT) were obtained and compared to functional outcomes at the end of the study. The group was split into two pairs each lead by a single physical therapist and alternated between over ground and treadmill training.

Outcomes : Significant improvements were in both outcome measures. The most significant improvement in gait speed was from 0.66m/s to 1.65 m/s and was achieved by a patient with a CVA. The most improved gait distance was also achieved by a patient with a CVA who improved her total distance during 6MWT from 450 feet to 1500 feet. All participants who completed the program without complication (one participant suffered fractured arm at home, one was unable to consistently attend therapies, and one demonstrating increasing cognitive deficits) demonstrated improvement.

Discussion : Gait speed as noted by the 10MWT and distance walked during the 6 minute walk test all demonstrated significant results following the group based gait intensity program. Furthermore this model was feasible to implement in a busy clinic environment without excessive cost or time.

References: Must include 5 current references (less than 10 years old): 1.Holleran, CL, et al. 'Potential contributions of training intensity on locomotor performance in individuals with chronic stroke.' , 39 (2): Journal of Neurologic Physical Therapy2015; 95 - 102. 2.Holleran, CL, et al. 'Feasibility and potential efficacy of high-intensity stepping training in variable contexts in subacute and chronic stroke.' , 28 (7): Neurorehabilitation and Neural Repairs2014; 643 - 651. 3. Hornby, TG, et al. 'Importance of specificity, amount, and intensity of locomotor training to improve ambulatory function in patients poststroke.' , 18 (4): Topic of Stroke Rehabilitation2011; 293 - 307. 4.Jorgensen, JR, et al. 'Effect of Intensive Outpatient Physical Training on Gait Performance and Cardiovascular Health in People With Hemiparesis After Stroke.' , 90 (4): Physical Therapy2010; 527 - 536. 5.Moore, JL, et al. 'Locomotor training improves daily stepping activity and gait efficiency in individuals poststroke who have reached a "plateau" in recovery.' , 41 (1): Stroke2010; 129 - 135.

TITLE: The Effect of an 8-week circuit training program on functional mobility with individuals with chronic stroke.

AUTHORS/INSTITUTIONS: J. Mowder-Tinney, E. Clark, D. Friend, S. Schuhmann, J.A. Adams, B. Denicola, A.S. Bartlett, M. Vore, Nazareth College , Rochester, New York, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : An overwhelming number of stroke survivors have gait deficits and are discharged from rehabilitation before meeting a desirable level of function. Individuals affected by stroke commonly demonstrate reduced gait speed and impaired balance, increasing their risk of falling. Current research is limited on appropriate interventions that achieve aerobic intensity while providing a frequency and duration appropriate for the clinical setting. The purpose of this study was to assess the feasibility and efficacy of a functionally-based, high-intensity circuit training program with individuals post-stroke on fall risk and functional mobility.

Number of Subjects : A sample of convenience of seven subjects, ages ranged from 36 to 70 years old, mean= 57 ±11 years with a diagnosis of a cerebral vascular accident (CVA) greater than one year (mean of 3 years) since diagnosis.

Materials/Methods : A pilot quasi-experimental study designed with a high intensity, 5-station circuit consisting of functional exercises was performed for 60 min, 2days/wk for 8 wk. Exercise intensity was modified (i.e. increased speed/resistance) to ensure each subject stayed within their target heart rate range (THRR) previously determined by submaximal VO₂ testing. Baseline functional outcome measures were taken at week 1, after the program week 8, and follow up 8 weeks later. Functional mobility outcome measures analyzed were: Dynamic Gait Index (DGI), 10 Meter Walk Test (10MWT) both comfortable and fast pace, and the 10 Meter Backward Walk – comfortable pace (BW).

Results : Paired T-Tests revealed statistically significant changes ($p<0.05$) in DGI and BW between Pre Test and Post Test while maintaining significance between Post Test and Follow Up. No statistically significant changes were obtained in 10MWT, however a positive trend was observed. At baseline testing, 100% of subjects were considered at risk for fall as per DGI. After completion of the 8 wk program, only 43% remained a fall risk. Mean time spent at target heart rate across all circuit stations was 68%.

Conclusions : Upon completion of this study we found that performing a high intensity, functionally based circuit-training program to be clinically feasible and successful in producing positive changes in functional outcome measures. Despite previous literature reporting it was difficult to maintain target aerobic intensity in an acute stroke population, our study was able to maintain the subjects within their target heart rate zones 68% of the time. In addition, 4/7 subjects moved out of the fall risk category according to the DGI even though specific balance stations were not included. In conclusion, significant changes in the DGI and BW gait speed was seen in this chronic stroke population by utilizing a high intensive circuit-training program.

Clinical Relevance : A high intensity functionally based circuit program can be safely utilized in the out-patient setting with the chronic stroke population to help reduce this populations' fall risk and increase their functional independence.

TITLE: Can a patient with Postural Orthostatic Tachycardia Syndrome, Concussion and Chronic Lyme Disease respond to vestibular therapy?

AUTHORS/INSTITUTIONS: Z.D. Langer, Physical Therapy , NYU Langone Medical Center- Rusk Rehabilitation , New York, New York, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : Vestibular treatment (tx) programs or specifically habituation and adaptation exercises are relatively well-defined to the specific type of vestibular dysfunction. Successful outcomes are expected in such primary vestibular dysfunction and matched treatment. However, the approach and response to treatment of vestibular dysfunction in a patient with co-morbidities is not clear. The purpose of this case study is to discuss the utilization of adaptation and habituation exercises, in order to decrease symptoms of dizziness and increase participation in a vestibular patient who presents with peripheral and central contributions, as well as autonomic dysfunction.

Case Description : Patient is a 33 year old male with history of Lyme Disease (LD), concussion, and Postural Orthostatic Tachycardia Syndrome (POTS) with complaints of severe dizziness and vertigo with head turns. Physician referral indicated exacerbation of LD. Videonystagmography (VNG) testing showed 54% right vestibular weakness, and clinical findings showed left beating nystagmus post head shaking test and 9 line difference on dynamic visual acuity testing (< 2 lines is normal) consistent with a peripheral vestibular problem. Additionally, central vestibular dysfunction was indicated by direction changing and upbeating gaze evoked nystagmus. Eight months of outpatient vestibular tx consisted of 45 minute sessions one time a week (32 sessions total), with focus on supervised habituation and adaptation vestibular exercises, a comprehensive home exercise program: vestibulo-ocular reflex exercises, ambulation with head turns and utilization of virtual reality videos for motion sensitivity training.

Outcomes : The Dizziness Handicap Index (DHI) improved from severe to mild "handicap" and the Activities-Specific Balance Confidence (ABC) scale improved from low to high "level of functioning". Somatosensory Organization Test (SOT) improved from 60 to 76 (normal value for age is >76) and the Balance Error Scoring System (BESS) test decreased from 30 to 15 (< 11 is normal). Initially he was unable to drive, or read > 10 minutes inhibiting him from working. At discharge he had improved tolerance for driving to > 3 hours and was reading more than 3 hours.

Discussion : This patient presented with both peripheral and central vestibular components, which can be complex to treat especially in the setting of POTS, which also contributes to dizziness. This patient had great success from a traditional vestibular tx program using habituation and adaptation techniques, a longer treatment duration due to the concussion, as well as considerations for orthostatic hypotension due to POTs. Findings were unexpected as this complex patient with blood pressure instability, peripheral and central contributions from the LD and a previous concussion, could pose a challenge to the clinician's tx approach. This illustrates that despite multiple co-existing disorders influencing the presenting problem, the patient responded very positively to vestibular therapy.

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Otorrinolaringologica (English Edition), 65(6), 339-345. 12. Whitney, S. L., Sparto, P. J. (2011). Principles of vestibular physical therapy rehabilitation. *Neurorehabilitation*, 29 (2).

TITLE: Transcranial Direct Current Stimulation for a Patient With Chronic Right Hemiparesis: a Case Report
AUTHORS/INSTITUTIONS: A. Hodge, SHARE Military Initiative, Shepherd Center, Atlanta, Georgia, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : To investigate the effectiveness of transcranial direct current stimulation (tDCS) on the improvement of right upper extremity motor control and tone on a patient 3 years post left hemispheric stroke resulting in right hemiparesis.

Case Description : A 24-year old male, marine core veteran, 3 years post left hemispheric stroke involving the left frontal, parietal, and temporal lobes resulting in right hemiparesis was treated in a multidisciplinary outpatient day program for veterans with mild to moderate traumatic brain injury and post-traumatic stress disorder.

Outcomes : The Modified Ashworth Scale and Upper Extremity Fugl-Meyer Assessment were used to assess tone and upper extremity motor function pre intervention, at weekly intervals during the use of tDCS, and at 1 and 4 weeks post intervention. tDCS was used at 2 ma for 20 minutes, 5 days a week, for 4 weeks directly prior to PT and OT sessions. tDCS was an effective intervention in the treatment of poor motor control and increased tone due to hemiparesis. In this case, the patient's Fugl-Meyer scores improved from 29 to 36 during the 4 week intervention period. One week post discontinuation of tDCS the client returned to 33 and at one month post the patient returned to his baseline Fugl-Meyer score. The patient also demonstrated decreased upper extremity tone during the course of treatment. His baseline Modified Ashworth scores were between 1 and 4 in his right upper extremity. Improvement was noted during and after treatment up to 4 weeks to 0 and 2.

Discussion : tDCS was an effective intervention in the treatment of chronic hemiparesis. The outcomes from this case suggest that motor control and tone can improve with the use of tDCS. Further research is needed to investigate the duration of use of this intervention for improved carry over and recovery of function. Also, future research using randomized control trials needs to be conducted. tDCS does appear to be a viable intervention to be used prior to physical therapy and occupational therapy sessions to improve motor function and reduce tone.

References: Must include 5 current references (less than 10 years old): 1. Tedesco Triccas L, Burrige JH, Hughes AM, Pickering RM, Desikan M, Rothwell JC, Verheyden G. Multiple sessions of transcranial direct current stimulation and upper extremity rehabilitation in stroke: A review and meta-analysis. *Neurophysiol.* 2015 May 4.2. Date S, Kurumadani H, Watanabe T, Sunagawa T. The effect of transcranial direct current stimulation on the expression of the flexor synergy in the paretic arm in chronic stroke is dependent on shoulder abduction loading.. 2015 Jun 10.3. Wu D1, Qian L, Zorowitz RD, Zhang L, Qu Y, Yuan Y. Effects on decreasing upper-limb poststroke muscle tone using transcranial direct current stimulation: a randomized sham-controlled study. *Arch Phys Med Rehabil.* 2013 Jan;94(1):1-8.4. Boggio PS, Castro LO, Savagim EA, et al. Enhancement of nondominant hand motor function by anodal transcranial direct current stimulation. *Neurosci Lett* 2006;404:232-6.5. Hummel F, Celnik P, Giraux p, et al. Effects of non-invasive cortical stimulation on skilled motor function in chronic stroke. *Brain* 2005; 128:490-9.

TITLE: Return to high level mobility in a 35 year old male athlete with Brown Sequard Syndrome

AUTHORS/INSTITUTIONS: K. Sheeran, Rusk Rehabilitation at NYU Langone Medical Center, New York, New York, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : The rehabilitation process after a neurological injury has traditionally focused on improving a patient's independence with ambulation, without considering return to higher level mobility (HLM). Return to HLM in people with neurological injury can improve quality of life, balance, cardiovascular health, assist in spasticity management and increase likelihood of return to work. The purpose of this case report is to describe interventions leading to successful return to HLM in a serious amateur athlete after incomplete spinal cord injury.

Case Description : A 35 year old male post-acute Brown Sequard Syndrome, secondary to a bicycle accident, presented with impaired balance, coordination, upper and lower extremity motor control, diminished left lower extremity sensation, trunk weakness, and right lower extremity spasticity. The patient required supervision to ambulate indoors with a cane and a right hinged ankle foot orthosis (AFO), and outdoors with a rolling walker less than 2 blocks. The patient's goals were to return to work, sports, and play with his toddler. The patient received 10 months of 60 minute individual physical therapy sessions and 30 minute therapeutic exercise classes 1-2 times per week for a total of 60 visits in a neurological outpatient setting. Initial sessions focused on balance, gait, and core and bilateral lower extremity strengthening. After the 27th session, treatment focused on plyometrics, high level balance training, treadmill training at high speeds with Functional Electrical Stimulation to right ankle, high level coordination, task specific exercises, and high velocity tasks.

Outcomes : On evaluation, the patient completed the Berg Balance Scale (BBS) [37/56], Timed Up and Go (TUG) [20.89 seconds], and 50 foot walk test [1.54 feet/second with right hinged AFO and a cane]. The High Level Mobility Assessment Tool (HiMat) [12] was assessed on the patient's 27th visit. Upon discharge, the patient scored BBS [54/56], TUG [9.15 seconds without an assistive device (AD)], 50 feet walk test [4.19 feet/second with soft ankle brace without AD] and HiMat [17]. Running speed was 7.44 feet/second with soft ankle brace. The patient ambulated indoors without an AD or right ankle support, outdoors greater than 10 blocks with a cane and right ankle support, jogged over ground independently with a soft ankle brace, played soccer with his daughter, and returned to work full time.

Discussion : HLM training is both safe and feasible in appropriate candidates with neurological injury. For patients who lived an active lifestyle prior to neurological injury, as well as patients who desire to return to work or care for their children, community ambulation is only the beginning of their recovery. Patients with neurological injury can achieve HLM goals and may improve quality of life with an extensive and intensive physical therapy program. Further research is warranted to determine which interventions and outcome measures are most successful at tracking progress and returning patients with neurological injury to HLM.

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Treadmill running protects spinal cord contusion from secondary degeneration. *Brain Res.* 2010;1346:266-278. Bosch PR, Harris JE, Wing, K. Review of therapeutic electrical stimulation for dorsiflexion assist and orthotic stimulation from the American Congress of Rehabilitation Medicine Stroke Movement Interventions Subcommittee. *ACRM.* 2014; 95: 390-396. Dugan SA, Bhat KP. Biomechanics and analysis of running gait. *Phys Med Rehabilitation Clin North Am.* 2005; 16:603-621. Eng JE, Tang PF. Gait training strategies to optimize walking ability in people with stroke: a synthesis of the evidence. *Expert Rev Neurother.* 2007; 1417-1436. Miller Ellen W, et al. Running training after stroke: A single subject report. *Phys Ther.* 2008; 88:511-522. Laufer Y, Hausdoff JM, Ring, H. Effects of a foot drop neuroprosthesis on functional abilities, social participation, and gait velocity. *Am. J. Phys. Med. Rehab.* 2009; 88: 14-20. Novacheck TF. The biomechanics and analysis of running. *Gait Posture.* 1998; 7: 77-95. Tiebin Y, Hau-Chan CWY, Li LSW. Functional electrical stimulation improves motor recovery of the lower extremity and walking ability of subjects with first acute stroke: a randomized placebo-controlled trial. *Stroke.* 2005; 80-85. Williams G, Goldie P. Validity of motor tasks for predicting running ability in acquired brain injury. *Brain Injury.* 2001; 15: 831-841. Williams G, Morris M. High-level mobility outcomes following acquired brain injury: A preliminary evaluation. *Brain Injury.* 2009. 23:3017-312. Williams G, et al. Lower-limb muscular strategies for increasing running speed. *J Orthop Sports Phys Ther.* 2014: 813-824. Williams G, Schache AG, Morris ME. Self selected walking speed predicts ability to run following traumatic brain injury. *J Head Trauma Rehabil.* 2013: 379-385. Williams G, Schache A, Morris ME. Running abnormalities after traumatic brain injury. *Brain Injury.* 2013: 434-443.

TITLE: The development and validation of the vestibular activities avoidance measure for people with vestibular and balance disorders

AUTHORS/INSTITUTIONS: K. Alshebber, P.J. Sparto, S.L. Whitney, Physical Therapy, University Of Pittsburgh, Pittsburgh, Pennsylvania, UNITED STATES|J.M. Furman, Otolaryngology, University Of Pittsburgh, Pittsburgh, Pennsylvania, UNITED STATES|G.F. Marchetti, Physical Therapy, Duquesne University, Pittsburgh, Pennsylvania, UNITED STATES|J.P. Staab, Psychiatry and Psychology, Mayo Clinic, Rochester, Minnesota, UNITED STATES|

ABSTRACT BODY:

Abstract Body : THEORY: Vestibular disorders cause physical and psychological symptoms that adversely affect individuals' activities of daily living (ADLs) and quality of life (QOL) 1,2 and place burdens on individuals, families, and the healthcare system 1,3. The disabling nature of vestibular disorders arises from physical symptoms of vertigo, unsteadiness, dizziness, and falls, as well as the psychological sequelae including panic attacks, agoraphobia, generalized and health anxiety, and depression 4 5,6. People with vestibular disorders may avoid activities or limit their movement because of their fear of provoking symptoms 1,6. These activities and environments are very important for compensation, and avoiding them can contribute to greater disability 6. Consequently, abnormal fear of provoking unpleasant symptoms may impact function and productive work life 2 7,8. Several existing self-report instruments quantify the effects of dizziness and vertigo on ADLs, work, social life, and leisure. None of these instruments specifically identify individuals who avoid activities, the extent of avoidance, or the rationale for these counterproductive behaviors. A specialized instrument designed to detect avoidance would help clinicians and researchers better understand avoidance behaviors and design more effective interventions. The purpose of this study is to describe the development of a self-report measure that identifies individuals with vestibular and balance disorders whose avoidance behavior may adversely affect recovery. BODY: Based on consensus of 5 experts in vestibular rehabilitation (a neurologist, psychiatrist, 3 physical therapists), 111 items were selected from eight valid and reliable instruments for the development of the Activities Avoidance Questionnaire. Items were selected from the following instruments: the Dizziness Handicap Inventory (DHI), the Patients Health Questionnaire (PHQ-9), the Patients Health Questionnaire (PHQ-15), the Generalized Anxiety Disorder Assessment (GAD-7), the Tampa Scale of Kinesiophobia (TSK), the Fear Avoidance Beliefs Questionnaire (FABQ), the Health Anxiety Inventory – Short Form (HAI-S), and the Multidimensional Scale of Perceived Social Support (MSPSS). Using the Delphi technique, 20 national and international experts on vestibular disorders were asked which items should be included in the questionnaire. CONCLUSION: The items to include in the Activities Avoidance Questionnaire were determined. The stem question and the response scale to be used with the newly developed measure were generated. We are in the process of determining the reliability and validity of the Activities Avoidance Questionnaire for persons with balance and vestibular disorders.

TITLE: Implementation of Motor Learning Principles in an Individual with Ideomotor Apraxia: A Case Report
AUTHORS/INSTITUTIONS: M. Higgins, J. Mowder-Tinney, Nazareth College, Rochester, New York, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : Impairments affecting multiple body systems are common after stroke. One such impairment is ideomotor apraxia. Rehabilitation for these individuals is difficult as there is a reported mismatch between what an individual wants to do/is told to do versus how they actually perform an activity. Interventions for ideomotor apraxia have traditionally been aimed at gesture training by targeting impairments or focusing on compensations for those impairments. Currently the use of motor learning principles in these individuals is being studied, which supports the use of task-specificity, utilization of feedback, and varying practice schedules. The purpose of this case report was to evaluate the impact of implementing motor learning based concepts into a plan of care on gait speed and balance for an individual with chronic left stroke and ideomotor apraxia.

Case Description : A 62-year-old female with chronic left stroke (17 months post) participated in outpatient physical therapy 1x/week (60 minute sessions) for 7 weeks of treatment. The primary impairment was ideomotor apraxia along with: weakness of the right gluteus maximus, gluteus medius, and plantarflexors, as well as abdominal weakness and increased risk for falls. Patient ambulated with contact guard assist using a wide based quad cane. Impairments were addressed with task specific interventions utilizing extrinsic feedback and a practice schedule combining distributed and random practice principles.

Outcomes : Gait speed (comfortable and fast) and Dynamic Gait Index were tested week 1 and week 7. Comfortable gait speed improved from .33m/s to .41 m/s meeting the small meaningful change (.06m/s) for chronic stroke, and moved the patient into the limited community ambulatory category (.4-.8m/s). Fast gait speed improved from .42m/s to .54m/s indicating a small meaningful change. DGI improved from 10/24 to 14/24 meeting the MDC for improvement in chronic stroke (2.6).

Discussion : This patient was only seen 1x/week for 7weeks of treatment however clinically significant and small meaningful changes were made. Employing a practice schedule combining distributed and random practice seemed to optimize treatment time, and allowed an appropriate amount of time to address patient fatigue and target multiple impairments in a session. In conclusion, results suggest implementing task specific interventions within the context of a random, distributed practice schedule, while providing extrinsic feedback can be effective in targeting patient specific impairments in an individual with ideomotor apraxia.

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TITLE: A High intensity exercise program on a patient with chronic cerebellar ataxia: A Case Report.

AUTHORS/INSTITUTIONS: S. Robinson, J. Mowder-Tinney, Nazareth College, Rochester, New York, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : Cerebellar ataxia is a challenging and complex diagnosis to treat and lacks evidence in effective treatment methods. Previous studies have hypothesized that training at a high level of intensity results in positive improvements. The purpose of this case report was to investigate the effects of a high intensity training program on functional performance and confidence in a patient with cerebellar ataxia.

Case Description : The participant was a 53 year old male with a primitive neuroectodermal tumor located between the brainstem and cerebellum and who underwent surgery for partial resection in 2006. He has had cerebellar ataxia for 9 years and currently uses his power W/C as his primary source of mobility throughout the community. He ambulates short distances throughout his home with bilateral PVC pipe railings and contact guard from his wife. Prior to this case report he was able to ambulate short distances with a platform walker and assistance from two therapists during therapy. He has participated in various forms of therapy prior to this case report with little functional improvement. During this case report, the patient participated in 7-weeks of high intensity therapy sessions one hour weekly. Exercise intensity was determined by the level of challenge the patient endured as measured by RPE, HR and O₂ saturation appropriate for 60-70% workload. Therapy sessions focused on cardiovascular conditioning, strengthening and functional task training all performed at a high level of challenge for the patient while incorporating multiple repetitions. Outcome measures to evaluate progress at initial evaluation and discharge consisted of standing balance including natural stance and feet together, five times sit to stands, 2MWT, and Scale for the Assessment and Rating of Ataxia (SARA).

Outcomes : Significant improvements were revealed in standing balance by improving his eyes open natural stance position from 6 seconds to 30 seconds without upper extremity support as well as sit to stand performance by decreasing his five-time sit to stand time by 10 seconds positively impacting his functional abilities. He decreased his score on the SARA by 2 and improved his distance on the 2MWT by approximately 4 meters. Although his score for the SARA and 2MWT did not meet MDC values, improvements were seen in the patient's overall confidence and ability to perform functional tasks including ambulation. In addition, he was able to ambulate with a 5-10lb weighted front-wheeled rolling walker with contact guard from one therapist for safety. The patient verbally reported increased confidence and ability to perform functional tasks at home.

Discussion : In conclusion, improvements in function and confidence were found after participating in a 7-week high intensity rehabilitation program. These findings offer insight and general guidelines when developing interventions when working with this population. Further research is needed to determine the long-term effects of high intensity training.

References: Must include 5 current references (less than 10 years old): 1. Ilg W, Brötz D, Burkard S, Giese M, Schöls L, Synofzik M. Long-term effects of coordinative training in degenerative cerebellar disease. *Movement Disorders: Official Journal Of The Movement Disorder Society*. October 15, 2010;25(13):2239-2246. 2. Ilg W, Synofzik M, Brötz D, Burkard S, Giese M, Schöls L. Intensive coordinative training improves motor performance in degenerative cerebellar disease. *Neurology*. December 1, 2009;73(22):1823-1830. 3. Keller J, Bastian A. A home balance exercise program improves walking in people with cerebellar ataxia. *Neurorehabilitation And Neural Repair*. October 2014;28(8):770-778. 4. Miyai I, Ito M, Nishizawa M, et al. Cerebellar ataxia rehabilitation trial in degenerative cerebellar diseases. *Neurorehabilitation And Neural Repair*. June 2012;26(5):515-522. 5. Gibson-Horn C. Balance-based torso-weighting in a patient with ataxia and multiple sclerosis: a case report. *Journal Of Neurologic Physical Therapy: JNPT*. September 2008;32(3):139-146.

TITLE: Promoting Automaticity through Dance Rehabilitation in the Older Adult Stroke Population: A Case Report

AUTHORS/INSTITUTIONS: C. Greene, J. Mowder-Tinney, Nazareth College, Rochester, New York, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : About 800,000 people suffer from stroke (CVA) each year in the United States, 75% of which are over 65 years of age. There is a vast amount of research on stroke rehabilitation; however, little of existing evidence can pinpoint a treatment of choice for those who suffer from attention deficits. Attention deficits are common in this population, which subsequently impairs their automatic movements (automaticity). A recent study has shown that automaticity is hindered when using internal cues, forcing clients to focus on performance. Without automaticity for simple daily tasks such as walking, one becomes a fall risk. Evidence has shown using dance as a dual-task activity in the CVA population results in improved gait and decreased fall risk. However, exercise parameters are not consistent throughout the research, nor is it known which patients would most benefit from this intervention type. The purpose of this study was to investigate effects of external cues (music) during a dance rehabilitation protocol on gait and balance outcomes in an older adult suffering from attention deficits post right CVA.

Case Description : The patient is male, 69 years of age, seven months status post right ischemic CVA. The client's major symptoms included attention deficits, impaired static/ dynamic standing balance, general deconditioning, as well as left-sided weakness and neglect. The client's social history included frequent dancing with his wife prior to the CVA. The patient is able to ambulate with close supervision up to 500', and navigate one flight of stairs with contact guard assistance before requiring a rest. The client participated in a eight week (one hour once per week) dance rehabilitation protocol that was aimed at improving static/dynamic balance, gait, and automaticity by focusing on constant changes in base of support. Challenges were added as tolerated, including altering music speed, incorporating un-even surfaces, decreased rest period and increasing resistive tools including weighted medicine balls.

Outcomes : Listed as pretest (week 1), posttest measures (week 10). Gait Speed: .949m/s, 1.14m/s (MDIC: small meaningful change; stroke population: .06m/s). Fullerton Advanced Balance Scale: 27/40, 32/40 (High fall risk cut-off; age >65: <25/40). Dual-Task Cognitive TUG: 13.33s, 10.41s (High fall risk cut-off; community dwelling elderly: 15seconds).

Discussion : Minimally detectable changes were observed in gait speed measurements, and noticeable changes documented with both the Fullerton and Dual-Task TUG. Although clinically significant changes were not met, this could be due to the fact that the client was only seen for eight treatment visits for one hour per week or because baseline measurements were high. In conclusion, improvements in gait and balance were found using dance rehabilitation in an individual with attentional deficits following stroke.

References: Must include 5 current references (less than 10 years old): 1. Johnson L, Burrige JH, Demain SH. Internal and external focus of attention during gait re-education: An observational study of physical therapist practice in stroke rehabilitation. *Phys Ther.* July 2013; 93(7): 957-966. 2. Krampe J. Exploring the effects of dance-based therapy on balance and mobility in older adults. *West J Nurs Res.* 2013; 35(1): 39-56. 3. Krampe J, Wagner JM, Hawthorne K, Sanazaro D, Wong-Anuchit C, Budhathoki C, et al. Does dance-based therapy increase gait speed in older adults with chronic lower extremity pain: A feasibility study. *Geriatr Nurs.* 2014; 35(5): 339-344. 4. Trombetti A, Hars M, Herrmann FR, Kressig RW, Ferrari S, Rizzoli R. Effect of music-based multitask training on gait, balance, and fall risk in elderly people: A randomized controlled trial. *Arch Intern Med.* 2011; 171(6): 525-533. 5. Wulf G, Shea C, Lewthwaite R. Motor skill learning and performance: A review of influential factors. *Medical education.* 2010; 44(1): 75-84.

TITLE: Retrospective Record Review: Comparison of Two Treatments for Dizziness Post-Concussion in an Active Duty Military Population

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ABSTRACT BODY:

Purpose/Hypothesis : The standard of care for treatment of dizziness after concussion/mild traumatic brain injury is vestibular rehabilitation therapy (VRT). VRT was utilized in the treatment of the concussed active duty military population who complained of dizziness from 2009 to 2011 at Brooke Army Medical Center (BAMC) Brain Injury Rehabilitation Service (BIRS) physical therapy (PT) clinic. Positive tests for cervicogenic dizziness were common. Cervical somatosensory retraining exercises with laser (CSRE-L) were initiated with good subjective results. These results created an impetus to perform a retrospective chart review.

Number of Subjects : 63

Materials/Methods : An IRB approved retrospective chart review of 285 active duty military patients who were diagnosed with concussion and seen for dizziness from 2009 -2013 in the BAMC-BIRS physical therapy clinic was performed. Of the initial 285 patients with concussion, 233 demonstrated at least one of three positive tests purported to identify cervicogenic dizziness (82%). These tests included the smooth pursuit neck torsion test (SPNT), the joint position error test (JPE), or the neck torsion nystagmus test (NTNT). One hundred seventy charts were eliminated due to lack of data or failure to fit cleanly into either VRT or CSRE-L cohorts. This left 63 charts from which the two cohorts were created. These cohorts included: (1) VRT group (n=28) who received VRT as well as soft tissue and joint mobilization (MT), (2) CSRE-L (n=35) who received cervical somatosensory retraining exercise with laser attached to the head and MT.

Results : Subjective report using a dichotomous outcome on symptom resolution demonstrated a significant effect of treatment ($p=0.00$) after analysis. Patients receiving CSRE-L were 22.2 times more likely than those receiving VRT to report alleviation of dizziness symptoms.

Conclusions : CSRE-L demonstrated significantly better subjective outcomes for dizziness complaints than did standard VRT in a military concussed population. Prospective, longitudinal studies should be initiated to investigate the effectiveness of CSRE-L in the treatment of post-concussive dizziness.

Clinical Relevance : The results of this retrospective review indicate that CSRE-L provides a positive impact on subjective complaints of dizziness post concussion. Prospective longitudinal studies are warranted.

TITLE: Influence of cueing, feedback and directed attention on cycling in a virtual environment: healthy older adults and people with Parkinson's disease

AUTHORS/INSTITUTIONS: R. Gallagher, W.G. Werner, Physical Therapy, New York Institute of Technology, Old Westbury, New York, UNITED STATES|H. damodaran, J.E. Deutsch, Rehabilitation and Movement Sciences, Rutgers Universtiy, Newark, New Jersey, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : With age and disease declines in function may result in barriers to participating in and adhering to an exercise program. Innovative, creative, and safe exercise programs that engage and motivate older adults and persons with PD may address these barriers. Specifically, evidence based virtual environments (VE) that incorporate motor learning and compensatory strategies such as feedback and cueing may promote activity as well as engagement and motivation. Although VEs have been used for exercise promotion in healthy people and people with stroke, its use for fitness in persons with PD has not been investigated. Further a specific understanding of embedding cueing and feedback in a VE is lacking. The purpose of this study was to determine if short-term changes in motor behavior can be achieved by embedding cueing, feedback, and directed attention in a cycling VE with the ultimate goal of promoting long-term changes in motor behavior to promote fitness.

Number of Subjects : 12

Materials/Methods : A cross-sectional design with 2 groups of subjects; healthy older adults (n=6) and persons with PD (n=6) were included. Participants were 50-85 years old, cognitively intact (MoCA \geq 24), and had no orthopedic or medical conditions that would preclude them from riding a stationary bicycle. Persons with PD were in stage 2 or 3 on the Hoehn and Yahr scale. The protocol included cycling on a stationary bicycle while interacting with a VE.. Participants cycled under 4 conditions; auditory cueing, visual cueing, feedback, and directed attention while pedaling rate was recorded. Data were analyzed using separate repeated measures factorial ANOVAs to determine between and within group differences. Post-hoc analyses were conducted using paired t-tests with Bonferroni correction.

Results : Between group differences were found in the visual (F=6.25, p=0.03) and feedback conditions (F=8.05, p=0.018). Within group differences were found in the visual (F=29.46, p<0.000), feedback (F=45.51, p<.000), and directed attention (F=9.63, p<.000) conditions for both groups, and for PD in the auditory condition (F=6.27, p=.017).

Conclusions : Embedding cueing, feedback and directed attention in a cycling virtual environment can be used to promote short-term changes in motor behavior.

Clinical Relevance : Our results suggest that motor learning and compensatory techniques may be used in rehabilitation to increase pedaling speed as a strategy to increase exercise intensity. Implementation of long-term programs for promoting safe, motivating, and engaging, exercise in persons with PD and older adults may benefit from the integration of a VE.

TITLE: Stroke-Related Ataxia: The Effect Of Coordination and Balance Training On A Patient with Acute Cerebellar Stroke

AUTHORS/INSTITUTIONS: I. Matejovsky, Physical Therapy, Rusk Rehabilitation at NYU Langone Medical Center, New York, New York, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : Ataxia is a classic and potentially disabling symptom of cerebellar injury. The prognosis for individuals with ataxia depends on the underlying cause. For those with degenerative cerebellar disease, research suggests that intensive coordinative training is beneficial in reducing ataxia symptoms. However, there exists a lack of evidence on the effect of intensive coordinative and balance training in individuals with stroke-related ataxia. Stroke research suggests that neuroplasticity occurs during stroke rehabilitation and facilitates functional recovery. The purpose of this case study report is to demonstrate the effect of physical therapy (PT) intervention on ataxia symptoms and functional balance in an individual with cerebellar stroke.

Case Description : The patient (pt) is a 74 y.o. male s/p bilateral (B) acute cerebellar infarcts. Prior, the pt was an independent, socially active businessman. At PT eval in the acute care setting, pt presented with BUE and BLE dysmetria, increased on L; BUE dysdiadochokinesia, increased on L; mild LLE weakness, and mild dysarthria. Gait was wide-based and staggering with inconsistent placement of L foot, decreased LLE clearance and decreased cadence. Pt ambulated without device with close supervision, and required a handrail to negotiate stairs; Pt was discharged home and received home-based PT in a gym setting for 1-hour sessions, 2x/wk for 6 wks. PT sessions incorporated research-based stroke and ataxia treatment principles. Sessions consisted of coordination and static and dynamic balance training including anticipatory and reactive postural control and dual motor/cognitive tasks, cardio, strength training, gait training, and stretching.

Outcomes : A series of ataxia and functional balance outcome measures was scored on the first and last day of 6-wk PT intervention. Scale for the Assessment and Rating of Ataxia (SARA) Baseline: 12/40, Post PT: 7/40; Dynamic Gait Index (DGI) Baseline: 18/24, Post PT: 21/24; Mini-BESTest Baseline: 18/28, Post PT: 23/28; Five Times Sit To Stand (FTSTS) Baseline: 10 sec (no UE use), Post PT: 6 sec (no UE use). The pt is now able to ambulate in near tandem without LOB and negotiate stairs reciprocally without a handrail, independently.

Discussion : After 6 wks of PT intervention, the pt demonstrated reduced ataxia as indicated by SARA score; improved dynamic balance and decreased risk of falls as indicated by gains in DGI and Mini-BESTest; improved functional strength as indicated by FTSTS, and increased independence in stair negotiation. The outcomes of this case study suggest that intensive coordinative and balance training as part of PT in individuals with acute cerebellar stroke may be beneficial in reducing symptoms of ataxia and improving functional balance. Further research should be conducted via randomized controlled trials in an effort to determine the rehabilitation potential of individuals with stroke-related ataxia and related balance and gait impairments.

References: Must include 5 current references (less than 10 years old): Bultmann, U., Pierscianek, D., Gizewski, E., Schoch, B., Fritsche, N., Timmann, D., . . . Frings, M. (2013). Functional recovery and rehabilitation of postural impairment and gait ataxia in patients with acute cerebellar stroke. *Gait & Posture*, 39(1), 563-569. doi:10.1016/j.gaitpost.2013.09.011Ilg, W., Brötz, D., Burkard, S., Giese, M., Schöls, L., & Synofzik, M. (2010). Long-term effects of coordinative training in degenerative cerebellar disease. *Movement Disorders*, 25(13), 2239-2246. doi:10.1002/mds.23222Ilg, W., Synofzik, M., Brotz, D., Burkard, S., Giese, M., & Schols, L. (2009). Intensive coordinative training improves motor performance in degenerative cerebellar disease. *Neurology*, 73(22), 1823-1830. doi:10.1212/WNL.0b013e3181c33adfLuft, A., Macko, R., Forrester, L., Villagra, F., Ivey, F., Sorkin, J., . . . Hanley, D. (2008). Treadmill Exercise Activates Subcortical Neural Networks and Improves Walking After Stroke: A Randomized Controlled Trial. *Stroke*, 39(12), 3341-3350. doi:10.1161/STROKEAHA.108.527531Mansfield, A., Inness, E., Komar, J., Biasin, L., Brunton, K., Lakhani, B., & McIlroy, W. (2011). Training Rapid Stepping Responses in an Individual With Stroke. *Physical Therapy*, 91(6), 958-969. doi:10.2522/ptj.20100212

TITLE: Electrical Stimulation Duration is Not Associated with Upper Extremity Motor Outcomes in Subacute Stroke
AUTHORS/INSTITUTIONS: K.B. Schaub, Physical therapy, The Ohio State University, Columbus, Ohio, UNITED STATES|A.C. Persch, S.J. Page, Occupational Therapy, The Ohio State University, Columbus, Ohio, UNITED STATES|J.S. Knutson, Cleveland FES Center, Cleveland, Ohio, UNITED STATES|R.D. Wilson, J. Chae, MetroHealth, Cleveland, Ohio, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : The optimal duration of neuromuscular electrical stimulation (NMES) at which the impact of upper extremity (UE) paresis is significantly reduced remains unknown in the rapidly growing stroke survivor population. The purposes of this study were to determine the association between electromyography-triggered neuromuscular stimulation (ETMS) duration with: (a) UE impairment; and (b) UE functional limitation.

Number of Subjects : 41 subjects in the subacute stage of stroke (24 males; mean age = 65 + 12 years; mean time post stroke onset = 92 + 52. 3 days) exhibiting mild, stable UE hemiparesis.

Materials/Methods : This was a secondary analysis of data obtained from a multicenter randomized control trial. After administering the UE section of the Fugl-Meyer (FM) and functional ability scale of the Arm Motor Ability Test (AMAT), ETMS was applied to subjects' paretic UE wrist and finger extensors during two 40 minute sessions per day, occurring 5 days/week, over an 8 week period.

Results : FM and AMAT scores each increased significantly from baseline to end of intervention (28.4 + 13.3 points at baseline to 35.8 + 16.1 at final testing on the FM {Z = -4.58, p<0.001}; 1.85 + 1.21 points at baseline to 2.45 + 1.47 points at final visit on the AMAT {Z = -4.41, p<0.001}). However, no association was found between total ETMS use and changes on either scale at end of intervention (FM {p = -0.072; p = 0.65}; AMAT {p = 0.079; p = 0.62}).

Conclusions : ETMS significantly reduces UE impairment and functional limitation, but the overall number of minutes for which it is administered appears less critical in the subacute phase.

Clinical Relevance : Finding the optimal duration of treatment interventions is crucial for treating the patient efficiently and effectively.

TITLE: Relationship between maneuverability and stability during lateral stepping in individuals with incomplete spinal cord injury

AUTHORS/INSTITUTIONS: J.H. Kahn, K.E. Gordon, J. Berke, K. Koczwara, J. Champion, E. Catlin, K. Conroy, M. Wu, Physical Therapy and Human Movement Sciences, Northwestern University, Feinberg School of Medicine, Chicago, Illinois, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : The ability to change direction is a necessary skill for community ambulation. For individuals with incomplete spinal cord injury (iSCI), maintaining dynamic balance during a maneuver can be challenging. The biomechanical strategies this population uses to stabilize during walking maneuvers have not been quantified. Our aim was to assess the kinematic strategies used by individuals with iSCI to stabilize their movements during a simple “lane-change” lateral maneuver. We hypothesized that individuals with iSCI would increase lateral margin of stability (MoS) during maneuvers compared to straight walking. Additionally, we expect that as impairment increases, passive methods of stabilization, (increasing MoS), will play a heightened role in maintaining balance. We anticipate that as hip abductor strength (HAS) decreases MoS will increase.

Number of Subjects : Five subjects with chronic iSCI ASIA Impairment Scale C/D (2 female, 3 male, 52-68 years old, 44-219 months post SCI participated).

Materials/Methods : Subjects participated in two sessions. Session 1) Clinical outcome measures of strength, balance and walking were collected. More impaired side was determined by hip abductor manual muscle testing. Session 2) Lower body kinematics were recorded during straight walking and lateral maneuvers. During maneuver trials subjects initially performed straight walking. Subjects received an unexpected auditory cue synchronized to initial contact of the outside limb. At the cue, subjects performed the maneuver as quickly as possible. Maneuver performance (time, number of steps) and MoS during maneuvers and straight walking were calculated.

Results : Overall, MoS decreased (mean 20.32%) in the leading limb during maneuvers compared to straight walking. Three subjects had a larger MoS in their leading limb when maneuvering to the more vs. less impaired side (difference between sides = 0.02, 0.02, 0.07m). One subject had a smaller MoS in the leading limb when moving to the more impaired side. The subject with equal HAS had a similar leading limb MoS moving in either direction. Three subjects required less steps and/or less time to complete the maneuver when moving to the more impaired side.

Conclusions : When performing a lateral maneuver, MoS tends to decrease in the direction of the maneuver compared to straight walking. This finding was contrary to the hypothesis indicating a less passively stable strategy during maneuvers and a potentially increased risk for falls. Less steps and less time with decreased MoS may imply a less controlled lateral step. It was difficult to find a consistent relationship between HAS and MoS due to limited sample size and bilateral weakness in all subjects. Despite strength asymmetries, bilateral weakness may affect maneuvers to both sides.

Clinical Relevance : Lateral maneuvers are challenging in individuals with iSCI. Decreases in MoS in the direction of travel suggests awareness should be directed to controlling lead limb placement.

TITLE: Effects of an Individualized Exercise Program on Psychosocial Factors in Individuals with Multiple Sclerosis: A Case Study.

AUTHORS/INSTITUTIONS: J. Lathrop, G. Poston, B. Reynolds, M. Peterson, B. Pratt, Physical Therapy, Bradley University, Peoria, Illinois, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : Multiple Sclerosis (MS) is a chronic neurological condition commonly resulting in symptoms such as fatigue, balance impairments, and psychological disorders. Individuals with MS commonly experience chronic pain from a variety of causes, such as neuropathy, musculoskeletal impairments like atypical posture and contractures, and spasticity. Studies published over recent years have supported the role of exercise in improving function and quality of life in individuals with MS with low-to-moderate disability. Much less is known of the role of exercise in individuals with greater disability, the impact of an individualized exercise prescription, and the management of chronic pain, specifically low back pain (LBP). The purpose of this case study is to describe an individualized exercise approach utilized to treat an individual with severe disability due to MS.

Case Description : The participant is a 48-year-old male (Expanded Disability Status Scale (EDSS): 6.0) with a diagnosis of relapsing-remitting MS and a primary complaint of chronic LBP. The participant elected to undergo an 8-week individualized exercise program with a primary focus of improving LBP symptoms and function. A multi-modal treatment approach was prescribed to treat the subject's chief complaints of LBP as well as weakness of the trunk and extremities. Interventions consisted of the following: core stabilization exercises, upper and lower body strength training in positions that did not exacerbate pain levels, manual traction, acquisition of a transcutaneous electrical nerve stimulation unit to use outside of the rehabilitation setting, and patient education on activity pacing techniques. Physical function was measured using the Berg Balance Scale (BBS), Timed Up and Go (TUG), 30-Second Chair Stand Test, and the 6-Minute Walk Test. Psychosocial measures, such as quality of life, function, self-efficacy, and fatigue were measured using the MS Self-Efficacy Scale, MS Impact Scale (MSIS), Fatigue Scale for Motor & Cognitive Function (FSMC), and the Physical Activity Enjoyment (PACES) scale.

Outcomes : The participant experienced improvements in all physical outcome measures consisting of: TUG (pre-intervention (pre): 11.1 seconds, post-intervention (post): 9.1 seconds), 30-second chair stand test (pre: 1, post: 7), BBS (pre: 36, post: 49), and the 6-minute walk (pre: 849ft., post: 900ft.). Of importance, a clinically meaningful improvement (MDIC: 6) was achieved on the BBS. However, all psychosocial measures declined over the course of the intervention period despite positive subjective reports.

Discussion : Based off of the results, an individualized exercise program resulted in positive improvements in physical function. However, a decline in psychosocial measures despite positive subjective reports is conflicting. A combination of stressors outside of therapy and the self-critical nature of the subject may have contributed to this discrepancy.

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TITLE: Prediction of Falls in People with Chronic Stroke

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ABSTRACT BODY:

Purpose/Hypothesis : Falls are a common adverse event among people with stroke. Previous studies investigating risk factors for falls after stroke have relied primarily on retrospective fall history, with inconsistent findings. A recent large, multi-site trial comparing the use of traditional ankle foot orthotics (AFOs) to foot drop stimulation orthotics in chronic stroke provided an opportunity to analyze falls prospectively. The aim of this secondary analysis was to identify contributing factors that lead to falls and to identify the most accurate balance assessment tools to predict falls in individuals with stroke.

Number of Subjects : A total of 197 subjects (age 60.61 ± 11.78 years) were recruited for the trial. Data from 16 subjects were removed from the analysis due to loss of follow up and data entry errors. Data from 181 subjects were analyzed.

Materials/Methods : Study participants completed baseline testing and were asked specifically about falls during each study visit over a 42-week intervention period. Fallers (i.e. reporting >2 falls during the study) were compared to non-fallers with regard to the following baseline factors: age, endurance (6 minute walk test, 6MWT), number of medications, motor control (Fugl-Meyer lower extremity score, FM), and cognition (Mini Mental Status Exam score, MMSE). The baseline balance assessment scores were also compared between groups: gait velocity (comfortable and fast 10 Meter Walk, 10MWT), Berg Balance Scale (BBS), Timed Up and Go (TUG), and Functional Reach Test (FRT). An independent sample t-test was used to compare factors between fallers and non-fallers, with $\alpha=0.05$.

Results : From the total of 181 participants, 24 (13.3%) subjects fell >2 times. As there was no difference in fall frequency in treatment groups (foot drop stimulation and AFO) these groups were combined for further analysis. Fallers and non-fallers were similar in age and 6MWT. Number of medications was significantly higher in fallers compared with non-fallers (10.12 ± 4.667 vs. 7.77 ± 6.141 ; $p=0.032$). No differences were noted between fallers and non-fallers in FM, MMSE, 10MWT, BBS, or TUG scores. FRT distance was significantly lower in fallers compared with non-fallers (18.38 ± 7.31 vs. 22.82 ± 8.03 ; $p=0.009$).

Conclusions : The results of this study indicate that fallers were taking more medications compared to non-fallers. In addition, FRT distance was the only baseline balance test that distinguished between future fallers and non-fallers. Surprisingly, no other between-group differences were found in other factors or balance tests.

Clinical Relevance : The participants in this study were receiving supervised gait training and a home exercise program, in some cases with a new orthotic, but this did not appear to significantly increase their risk of falls beyond what has been reported previously for people with stroke living in the community. The number of medications may be an interaction effect, or an indication of multiple co-morbidities, and further analysis of this issue is required. This study supports the use of FRT to assess fall risk in people with chronic stroke.

TITLE: Step Count Accuracy of Two Activity Tracking Devices in People with Stroke

AUTHORS/INSTITUTIONS: S.D. Schaffer, M.A. Weinand, P.R. Bosch, Physical Therapy and Athletic Training, Northern Arizona University, Phoenix, Arizona, UNITED STATES|S.D. Holzapfel, School of Nutrition and Health Promotion, Arizona State University, Phoenix, Arizona, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Sensor based activity monitors are effective for quantifying the amount of work a person completes in a set amount of time and are particularly useful for research if the participant will exercise independently. Many of these devices have been shown to have high accuracy for counting steps in healthy populations, but few have been validated for use in persons with stroke. Activity monitors such as the FitBit Zip (FZ) and the Garmin Vivofit (GV) are available at a relatively low cost, however the accuracy of these two devices for counting the steps of people with stroke has not been investigated in the literature. Therefore, the purpose of this study was to determine the accuracy of the FZ to identify steps taken by people with impaired walking from a stroke in comparison to the GV. The specific objective was to select the most appropriate device for counting steps during over ground walking in future investigations. We hypothesized that both devices would demonstrate >90% accuracy in identifying step counts.

Number of Subjects : Twenty-one community dwelling adults with a mean (SD) age of 52(13) years who had experienced a stroke and were medically stable were enrolled. Participants had to understand the evaluation procedures and be able to follow instructions to participate in all components of the study, and be able to walk with no more than minimal assistance with or without an ankle-foot orthosis and/or assistive device on level surfaces.

Materials/Methods : Participants completed two 6 minute walk tests (6MWT) as able, one at self-selected walking pace, and the other at fastest safe pace. During 6MWT, participants wore a FZ clipped on the waistband or pocket, and a GV on both wrists. The steps recorded by each of the devices during the 6MWT were compared to the actual number of steps taken by the participants during the tests.

Results : One-way ANOVA revealed no significant difference between the FZ and manual step count during the 6MWT ($P=.19$) and the measures had excellent intra-class reliability ($ICC = 0.87$). The Bland-Altman plot and regression analysis the FZ step count is significantly biased ($\beta_0 = -600$, $\beta_1 = 1.125$, $p < 0.001$). The GV count on the unimpaired arm ($p=.002$) and impaired arm ($p=.002$) differed significantly from manual step counts. ICC values were 0.80 and 0.85, respectively. The GV showed significant bias (unimpaired: $\beta_0 = -500$, $\beta_1 = 0.875$, $p < 0.001$, impaired: -400, $\beta_1 = 0.750$, $p < 0.001$). Visual inspection of the graphed data indicated that accuracy of both devices was reduced at walking speeds $<.42$ m/s. Both devices showed less than 90% accuracy during the 6MWT based on mean absolute percent error.

Conclusions : The FZ showed greater accuracy in counting steps than the GV. Both devices were less accurate for patients with slow walking speed.

Clinical Relevance : The FZ is the more reliable device for tracking steps and should be preferred for tracking steps during home exercise over the GV for people with impairments from stroke. Researchers and clinicians should keep in mind that the accuracy of the device is reduced at slower walking speeds.

TITLE: Combined Locomotor and Dynamic Trunk Training to Improve Ataxia, Balance, and Walking Function in a 17-year old with a Traumatic Brain Injury

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ABSTRACT BODY:

Background & Purpose : Trunk and limb ataxia are common impairments following traumatic brain injury (TBI) and cause severe deficits in balance and walking function. Rehabilitation interventions for ataxia often address trunk and limb control separately. However, standing balance and walking function require simultaneous control of the trunk and limbs. It is well established that task-specific practice and training intensity are critical components of rehabilitation. Locomotor training focuses on intense stepping practice and can improve trunk control. Dynamic standing activities can be incorporated to further challenge trunk and limb control. This training approach is beneficial post-spinal cord injury, but has not been established for individuals with TBI and ataxia. Therefore, the purpose of this case report is to describe the effects of combined locomotor and dynamic trunk training on ataxia, balance, and walking function in an individual with TBI.

Case Description : A 17-year old female, 2 months post-TBI, presented to outpatient rehabilitation with severe trunk and limb ataxia, limiting her standing and walking function. She participated in intense, combined locomotor and dynamic trunk training using a treadmill and partial body-weight support (BWS) (3x/week for 7 weeks; 60-minute sessions). Training included alternate bouts of stepping (7 minutes; 10% BWS) and standing dynamic trunk training (3 minutes; 0% BWS) at an intensity of $\geq 15/20$ (hard) on the Rating of Perceived Exertion Scale. Standardized assessments pre- and post-training included: Scale for the Assessment and Rating of Ataxia (SARA), Berg Balance Scale (BBS), and Trunk Impairment Scale (TIS). Spatiotemporal gait characteristics at her fastest-comfortable (FC) walking speed were measured using an instrumented walkway (GaitRITE®).

Outcomes : Post-training, she demonstrated reduced trunk and limb ataxia, as well as improved balance and walking function. Her SARA score decreased from 25 to 14/40; BBS increased from 5 to 32/56, exceeding the minimal detectable change, and; TIS increased from 11 to 18/23. Gait velocity increased from 0.54 to 0.93 m/s. Average stride length increased by 0.31m and double support time decreased from 0.42 to 0.20 s. Further, variability in her stepping pattern decreased as evidenced by reduced stride length variability (SD) from 12.7 to 1.3cm.

Discussion : Following combined locomotor and dynamic trunk training, a young woman with TBI and severe ataxia demonstrated improved upright balance and walking function. This approach emphasized intense task-specific practice by alternating bouts of stepping and dynamic trunk training. The goal of this approach was to simultaneously challenge trunk control while requiring limb coordination (stepping) or stabilization (standing). Outcomes from this case suggest that this training approach may be effective for reducing ataxia and improving function post-TBI. Future research should examine and compare the effects of this approach to current therapeutic strategies.

References: Must include 5 current references (less than 10 years old): 1. Sartor-Glittenberg C, Brickner L. A multidimensional physical therapy program for individuals with cerebellar ataxia secondary to traumatic brain injury: A case series. *Physiother Theory Pract.* 2014;30:138-148. 2. Ustinova KI, Chernikova LA, Dull A, Perkins J. Physical therapy for correcting postural and coordination deficits in patients with mild-to-moderate traumatic brain injury. *Physiother Theory Pract.* 2015;31:1-7. 3. Freund JE, Stetts DM. Use of trunk stabilization and locomotor training in an adult with cerebellar ataxia: A single system design. *Physiother Theory Pract.* 2010;26:447-458. 4. Forrest GF, Sisto SA, Barbeau H, et al. Neuromotor and musculoskeletal responses to locomotor training for an individual with chronic motor complete AIS-B spinal cord injury. *J Spinal Cord Med.* 2008;31:509-521. 5. Harkema SJ, Hillyer J, Schmidt-Read M, et al. Locomotor training: As a treatment of spinal cord injury and in the progression of neurologic rehabilitation. *Arch Phys Med Rehabil.* 2012;93:1588-1597.

TITLE: Game therapy improves walking ability in patients with Parkinson's Disease

AUTHORS/INSTITUTIONS: J. Deol, S. Pradhan, Rehabilitation Medicine, University of Washington, Seattle, Washington, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Evidence from animal models of Parkinson disease (PD) has suggested that exercising in an enriched environment may protect against the onset of Parkinsonian symptoms in rats that are exposed to 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine. An enriched environment is defined as an environment that is complex, physically and cognitively engaging, providing social interaction and multimodal feedback (visual, auditory and somatosensory). The purpose of this study was to determine whether exercising in an enriched environment (EE), will improve function and clinical disease severity compared to a traditional exercise (TE) program in individuals with mild to moderate PD.

Number of Subjects : 19 individuals with PD; two intervention groups: traditional exercise (TE) group (n=9) or the gaming intervention (EE) group (n=10).

Materials/Methods : Participants with PD were randomly assigned to one of the two exercise groups: TE group (based on the 'Be Active' Program of the American Parkinson Disease Association) or EE group using the XBOX-Kinect system. All subjects participated in an hour long supervised intervention session 3 times per week for 6 weeks. Gaming intervention (EE) included 3 different games challenging balance, speed of movement, multitasking and axial stability. Outcome measures of gait speed and walking ability were obtained at the initial visit and after the completion of the exercise intervention. Assessments were conducted by a physical therapist who was blinded to the group assignment. Time to complete 10-meter walk test at self-selected and fast walking speeds was used to calculate gait speed; and 6 minute walk test (6MWT) was utilized for assessment of distance covered in six minutes. Data was analyzed using a repeated measures ANOVA with a within subject factor of time (pre vs post) and a between subjects factor of exercise group (TE vs EE).

Results : Within subject factor was significant for 6MWT ($F=29.18$; $p<0.001$). There was a significant interaction of time and exercise group for self-selected walk test ($F=9.9$; $p<0.001$, EE mean change= -0.51 ± 0.23 s; TE mean change= 0.24 ± 0.06 s).

Conclusions : 6MWT showed significant difference between pre and post assessment in both the intervention groups. Compared to TE group, gaming group made significant improvement in the self-selected walking speed post intervention. Involvement in physical exercise programs has the potential to slow down the progression. Future studies should examine the long term benefits of participation in regular physical activity in this patient population.

Clinical Relevance : The use of gaming devices has the potential of being a valuable home based exercise mode that may provide a safe and enriched environment for physical activity in PD. In our study sample, individuals in the gaming therapy group showed improvements in gait speed and these gains were not observed in the traditional exercise group.

TITLE: The relationship between different ankle and foot sensation and gait/balance performance.

AUTHORS/INSTITUTIONS: C. Lin, S.A. Meardon, K.R. Sales, Physical Therapy, East Carolina University, Greenville, North Carolina, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Vision, somatosensory and vestibular information are critical elements for human balance control. However, the relationship between sensory inputs from the foot and ankle and postural control is not well-established. The purpose of this study was to investigate if any specific foot or ankle sensations relate to gait/balance performance.

Number of Subjects : Ten healthy young adults (mean age: 29 ± 1 y) were recruited in this study. All subjects were right handed and right leg dominant.

Materials/Methods : All participants completed screening examinations, including visual acuity, neurological examinations, vestibular evaluations, gait assessments (Dynamic Gait Index (DGI) and Functional Gait Assessment (FGA)), and the Activities-specific Balance Confidence (ABC) scale. After the subjects passed the above screening tests, ankle joint position sense, vibration threshold, and tactile sensitivity were measured. Ankle joint position sense was measured by using an isokinetic dynamometer (CSMI Cybex Norm, CSMI, Boston, MA) in dorsi-plantar flexion and inversion-eversion. A handheld bio-thesiometer (Bio-Medical Instrument Co, Newbury, Ohio, USA) was used to detect the vibration thresholds on six sites of plantar surfaces, plus lateral and medial malleoli on both feet. The six sites included big toe, 1st metatarsus, little toe, 5th metatarsus, middle arch, and calcaneus (heel). A set of monofilaments (Touch-Test Sensory Evaluator, North Coast medical Inc., Morgan Hill, CA) was used to assess the tactile sensitivity on the same locations listed above. Tactile sensitivity was determined by the smallest diameter of monofilaments that the subjects could feel at each site. Subjects also performed a Sensory Organization Test (SOT) (Neurocom, Clackmas, OR, USA) following the sensory tests. Kendall tau rank correlations were used to examine the relationship between different foot sensations and gait/balance performance scores.

Results : Right ankle inversion-eversion joint position sense was significantly correlated with ABC ($r = -.63$, $\alpha = 0.02$), SOT Condition 1 score ($r = .57$, $\alpha = 0.03$) and Condition 3 score ($r = .60$, $\alpha = 0.02$). Right 1st metatarsus tactile sensitivity was significantly correlated with DGI ($r = -.59$, $\alpha = 0.04$), FGA ($r = -.63$, $\alpha = 0.03$), and SOT somatosensory ratio ($r = .55$, $\alpha = 0.04$). Right 5th metatarsus vibration threshold was significantly correlated with SOT Condition 1 score ($r = .55$, $\alpha = 0.03$).

Conclusions : The results of this pilot study suggested that the inversion-eversion of ankle joint, 1st metatarsus and 5th metatarsus of the right foot may be related to balance performance in young healthy adults whom are right leg dominant. Further study should increase the sample size and investigate if similar relationships exist in different age groups and in people with balance problems.

Clinical Relevance : The results of this study may lead the development of a clinic based treatment that focuses on using these specific foot spots for balance training. This research shows preliminary results that some specific foot spots may be related to postural control.

TITLE: Understanding the Changing Healthcare Needs of Individuals Aging with Spinal Cord Injury

AUTHORS/INSTITUTIONS: L.N. Hunter, A. Lenzo, J.K. Alderfer, K. Nelson, S.V. Duff, Physical Therapy, Thomas Jefferson University, Philadelphia, Pennsylvania, UNITED STATES|D. Berzins, H. Riekema, D. Turoff, M. Andrews, J. Skaria, S.B. Kern, Occupational Therapy, Thomas Jefferson University, Philadelphia, Pennsylvania, UNITED STATES|R.J. Marino, Rehabilitation Medicine, Thomas Jefferson University Hospital, Philadelphia, Pennsylvania, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Individuals who sustain a traumatic spinal cord injury (SCI) after age sixty experience higher mortality rates. Within this age group, those with incomplete SCI and/or lower injury levels achieve higher levels of independence and overall good health. In addition, non-medical, environmental, and lifestyle factors influence SCI-related health conditions and impact participation, aging, and longevity. For individuals with SCI and their caregivers, facilitators and barriers to self-management also impact participation in daily life activities and can arise during the aging process even several years after acute rehabilitation. Maintaining health, maximizing function, and improving level of activity and participation constitute three major rehabilitation outcomes for people with SCI. The purpose of this qualitative study was twofold: to explore changing health care needs by individuals aging with SCI and their caregivers and to identify the environmental supports and barriers to achieving those long-term outcomes.

Number of Subjects : 33 total participants (individuals with SCI and their caregivers)

Materials/Methods : A convenience sample of individuals with traumatic, chronic SCI who were at least 60 years-old and caregivers were recruited for this phenomenological study. IRB approval for the study and full informed consent for all participants were obtained. Semi-structured interviews were conducted and continued until saturation was achieved. Thirty-three interviews have been conducted, audiotaped, transcribed, checked, and analyzed. A standard iterative data analysis was performed in which investigators (both individually and as a group for trustworthiness) identified, defined, and coded themes. Additional rigor was achieved by conducting individual member checks, multiple rounds of data analysis, and debriefing sessions.

Results : Ongoing analysis reveals seven emergent themes in two categories which are changes related to internal (personal) factors and external (non-personal) factors. Internal (personal) factors include health literacy, changes in health status, levels of participation, and future orientation. External (non-personal) factors include health services, and the physical & social environments.

Conclusions : This study contributes to the knowledge of the experience of living and aging with SCI. Health care teams need to first identify the individual's and caregiver's level of health literacy and their utilization of resources. This will facilitate empowerment to overcome barriers to participation through problem solving during the course of rehabilitation post SCI injury and throughout the aging process.

Clinical Relevance : As members of interprofessional rehabilitation teams, individuals' and caregivers' health literacy, knowledge of and access to resources need to be assessed at each encounter. Every phase of rehabilitation should include opportunities for patients and caregivers to express their concerns and empower them to use resources and solve everyday problems of participation in necessary and meaningful activities to improve their long-term health.

TITLE: Relationship between Subjective Visual Vertical and Balance in Individuals with Multiple Sclerosis

AUTHORS/INSTITUTIONS: B. Klatt, P.J. Sparto, S.L. Whitney, Physical Therapy, University of Pittsburgh, Pittsburgh, Pennsylvania, UNITED STATES|L. Terhorst, Occupational Therapy, University of Pittsburgh, Pittsburgh, Pennsylvania, UNITED STATES|S.J. Winser, School of Physiotherapy, University of Otago, Dunedin, NEW ZEALAND|R. Heyman, I. Zaydan, School of Medicine, Neurology, University of Pittsburgh, Pittsburgh, Pennsylvania, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Subjective Visual Vertical (SVV) deviations have been correlated to abnormal cerebellar function in individuals diagnosed with Multiple Sclerosis (MS). It has been shown that individuals with MS have increased incidence of SVV abnormalities, yet this is not routinely tested in this population during physical therapy evaluation. Two previous studies investigated SVV in individuals with MS, but comparison of balance was not comprehensive. Additionally, these studies did not investigate the SVV during static visual disturbances (Rod & Frame condition). The purpose of this study is to determine if there is a relationship between SVV and balance performance in people with MS who have cerebellar involvement. We hypothesize that individuals with greater SVV deviations will have worse balance performance.

Number of Subjects : 20

Materials/Methods : This study included 15 females and 5 males (n=20), mean age 54.5 years old (\pm 7.03 SD), with the diagnosis of MS and cerebellar involvement. Outcomes were the Barthel Index questionnaire, Berg Balance Scale (BBS), gait speed, International Co-operative Ataxia Rating Scale (ICARS), Scale for the Assessment and Rating of Ataxia (SARA), and Timed Up and Go (TUG) test. Computerized SVV testing was completed in 4 trials of Rod only condition, 4 trials of the Rod and Frame condition with the frame rotated clockwise (CW), and 4 with the frame rotated counter clockwise (CCW). All SVV trials were 30 seconds in duration and were completed seated with head stability maintained using a chin support. Statistical analysis was completed using IBM SPSS Statistics 22. Spearman's rho correlation was used as the assumptions for normality were not met.

Results : None of the 6 balance outcomes were correlated with the Rod only condition of the SVV testing. Because there was a difference in magnitude of results within the Rod and Frame condition, based on whether the frame was rotated CW or CCW, they were analyzed independently of each other. For all 6 of the outcomes there was a statistically significant moderate correlation with SVV deviations when the frame was tilted CCW: Barthel Index ($r=-.47$, $p=.018$); BBS ($r=-.59$, $p=.003$); gait velocity ($r=-.52$, $p=.010$); ICARS ($r=.56$, $p=.006$); SARA ($r=.62$, $p=.002$); TUG ($r=.58$, $p=.003$). Interestingly, the Barthel Index was the only outcome that had statistical significance with a moderate correlation ($r=-.66$, $p=.001$) when the frame was rotated CW.

Conclusions : Based on these results it appears that greater deviations during the Rod and Frame condition of SVV testing correlate with worse balance outcomes, especially when the frame was tilted CCW. Individuals with MS who demonstrate decreased balance performance may rely more heavily on visual backgrounds.

Clinical Relevance : Implementation of SVV assessment for individuals with MS may provide physical therapists valuable information to identify the best interventions to maximize outcomes for this patient population.

TITLE: Determining Long-term Effects of a Concussion on Static and Dynamic Balance in Collegiate Soccer Players: A Pilot Study

AUTHORS/INSTITUTIONS: R. Duncan, Program in Physical Therapy, Washington University, St. Louis, Missouri, UNITED STATES|S. Poteet, W. Hudson, K. Scherer, K. Reynolds, P. Jacobs, Physical Therapy Program, Maryville University, Saint Louis, Missouri, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Concussions are common in soccer and may cause short-term balance impairments. However, it is unknown whether balance impairments persist long-term (i.e.>30 days) in collegiate soccer players. The primary purpose of this study was to determine the long-term effects of concussion on static and dynamic balance in collegiate soccer players. We hypothesized that those with a long-term history of concussion will demonstrate impaired static and dynamic balance compared to participants without a concussion history. Interestingly, repetitive head balls can cause subconcussive trauma, which could affect balance performance. The secondary purpose was to determine the effects of varying head ball frequencies on static and dynamic balance in collegiate soccer players. We hypothesized that those who have higher head ball frequency will have greater static and dynamic balance deficits than those with lower head ball frequency.

Number of Subjects : 10 participants with a history of concussion (mean age 19.5 ± 0.85 ; 70% female), 11 participants without a history of concussion (mean age 19.0 ± 0.78 ; 73% female)

Materials/Methods : This study was a cross-sectional, non-experimental analysis of differences. Balance in those with a history of concussion greater than 30 days (n=10) was compared to those without a concussion history (n=11). Static balance was assessed using the Balance Error Scoring System (BESS). Dynamic balance was assessed using the High-Level Mobility Assessment Tool (HiMAT) and Star Excursion Balance Test (SEBT). For the secondary purpose, participants were grouped by self-reported average percentage of head balls (i.e. 0-25%, 26-50%, 51-75%, or 76-100%) performed in a game to determine the impact of head ball frequency on static and dynamic balance assessed using the aforementioned measures.

Results : There were no significant differences between those with a long-term concussion history and those without a concussion history for the BESS, HiMAT, and SEBT. For the secondary purpose, the 0-25% group had a significantly lower (i.e. better) mean BESS score than the 51-75% group ($p=0.01$). There were no differences in HiMAT or SEBT scores among head ball frequency groups.

Conclusions : Static and dynamic balance deficits do not appear to persist long-term following concussion in collegiate soccer players. For the secondary purpose, participants who reported more frequent heading had worse static balance than those who reported less frequent heading.

Clinical Relevance : Although static and dynamic balance do not appear to be impaired over the long-term in collegiate soccer players who have sustained a concussion, it has been reported that athletes may return to sport prematurely following concussion. Because a concussion can lead to short-term balance impairments, static and dynamic balance should be assessed by physical therapists to determine return to sport. Secondly, players who head the ball more frequently appear to have worse static balance. As such, physical therapists should monitor static balance in those heading the ball frequently.

TITLE: THE RELATIONSHIP BETWEEN FOOTWEAR, SOMATOSENSORY STATUS AND PERFORMANCE OF KEY COMPONENTS OF STATIC AND DYNAMIC BALANCE AS MEASURED BY INERTIAL MEASUREMENT UNITS (IMUS)

AUTHORS/INSTITUTIONS: S.N. Avanesian, M.J. Thompson, M.J. Rivera, K. Voelz, Physical Therapy, California State University Fresno, Clovis, California, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Postural control is influenced by somatosensory input from the feet. Somatosensation, such as plantar cutaneous and vibratory thresholds, decline with age and have been identified as a contributing factors to instability and falls in older adults. The purpose of this investigation is to better understand the interaction of footwear (on/off) on static and dynamic balance using more sensitive testing methodologies, in this case Inertial Measurement Units or IMUs. It is hypothesized that participants will demonstrate superior performance with shoes-on during static and dynamic balance tests.

Number of Subjects : A sample of convenience was drawn from a local fall risk screening (N=17, mean age 78.5 years, range 60-99; 70.6% female). The sample was considered to be an at risk community dwelling adult (CDA) population based upon Fullerton Advanced Balance (FAB) scores (mean=25.94) and Timed Up And Go (TUG) times (mean = 8.03 seconds). Participants were divided into three groups based upon sensory status: no sensory loss, one sensory modality loss and two sensory modalities loss.

Materials/Methods : Somatosensory status was quantified by Rydel-Seiffer® Semi-quantitative Tuning Fork (128Hz) and Semmes-Weinstein® Monofilaments. Movement variables were quantified using IMUs while each participant performed static and dynamic balance tests with and without footwear. The instrumented Clinical Test of Sensory Interaction on Balance (I-CTSIB) was selected as the static test, whereas the 25 ft. instrumented TUG (I-TUG) represented the dynamic test. Analysis included postural sway acceleration (I-CTSIB, m2/s4) and components of the I-TUG which may require somatosensory input for optimal performance, including sit to stand time, gait parameters, turn parameters, and test duration.

Results : With no regard to the sensory status of an individual, there is little difference in static or dynamic balance performance between groups with shoes on or off, consistent with existing literature. When sensory status is factored into the analysis, significant performance differences ($F(14,2) = 5771.9$, $p < 0.001$) are identified in all dynamic test variables. In addition, significant differences were noted in the eyes closed conditions (firm and foam) of static testing (CTSIB, $p < 0.05$.)

Conclusions : A highly complex relationship exists between footwear and balance. It is concluded that when somatosensory impairment is considered, footwear significantly ($p < 0.05$) influences performance on both static and dynamic balance testing in this sample of CDAs.

Clinical Relevance : In the clinic, many balance tests are performed with shoes-on for time/efficiency reasons. With identified sensory loss, balance testing should be performed with shoes-off to accurately identify balance impairment and fall risk. The results also highlight the importance of examination of multiple sensory modalities in the evaluation of older adults when establishing balance and fall risk status.

TITLE: Silent Cognitive –Somatosensory Impairments Impact the Motor Function Post Stroke: A pilot study

AUTHORS/INSTITUTIONS: P. Kaur, A. Borstad, D.S. Nichols-Larsen, School of Health and Rehabilitation Sciences , The Ohio State University, Columbus, Ohio, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Up to 89% of people post-stroke experience somatosensory deficits in the upper extremity, and 40-60% demonstrate mild cognitive impairment, including working memory impairment. Mild cognitive and somatosensory impairments may go undiagnosed in typical rehabilitation settings, but can affect functional independence, including the ability to perform ADLs. However, the impact and potential interaction of cognitive and somatosensory impairments on motor function needs further exploration. The purpose of this study is to further delineate the relationship between cognitive, somatosensory and motor function post-stroke.

Number of Subjects : 12 chronic post-stroke and 12 control subjects, matched on age, gender and handedness participated. All subjects were tested in a single behavioral session. Inclusion criteria: 1) single hemiparetic documented stroke; 2) aged 21-85; 3) hand movement sufficient to grasp and release objects; 4) ability to understand test instructions. Exclusion criteria: 1) prior diagnosis of cognitive, sensory or neurologic disorders; 2) Mini Mental Exam<24.

Materials/Methods : Both groups were tested on: 1) Sensory behavioral tests-Hand Active Sensation Test (HASTe), Manual Form Perception Test (MFP); 2). Cognitive tests -Paced Auditory Serial Addition Test (PASAT), Choice Reaction Test (CRT) and 3). Motor behavioral tests- Box and Blocks Test (BBT), 9 Hole Peg Test (9HPT).

Results : 2 sample t-tests showed significant differences between the affected hands of stroke subjects versus the non-dominant hands of the controls for somatosensory and motor measures: manual form perception ($T = -2.96$, $p = 0.014$), box and block test ($T = 4.33$, $p = 0.000$) and 9 hole peg test ($T = -2.55$, $p = 0.027$). The cognitive task, PASAT, also showed a difference between the stroke and control group ($T = 3.96$, $p = 0.001$). However, there was no significant group difference for other behavioral measures. Lastly, multiple linear regression analysis showed that both the MFP and PASAT are significant predictors for the box and block results across the group ($R = 0.799$, $R^2 = .639$, $F = 13.29$, $p = 0.000$).

Conclusions : The stroke group displayed poorer somatosensory, motor and cognitive function compared to the control group. Across the group, cognitive (PASAT) and somatosensory (MFP) measures predicted 63.9% of the variance in the BBT score. Notably, these subjects tested in the normal range on the MMSE and had not previously been diagnosed with a cognitive deficit. It suggests that somatosensory and cognitive functions directly influence the long term movement ability post-stroke but often go undiagnosed by common tests like the MMSE.

Clinical Relevance : The PASAT and MFP tasks require complex cognitive information processing, including working memory that may impact other testing measures and rehabilitation outcomes. The therapist should consider the need for cognitive testing beyond the MMSE and look to develop rehabilitation methods that augment cognitive function.

TITLE: The Identification of Fall Risk in Community Dwelling Older Adults (CDAs) on the mCTSIB Through Instrumentation with Wearable Inertial Measurement Units (IMUs)

AUTHORS/INSTITUTIONS: M.J. Thompson, P.R. Trueblood, M.J. Rivera, Physical Therapy, California State University Fresno, Clovis, California, UNITED STATES|A. Gill, Physical Therapy, San Joaquin Valley Rehabilitation Center, Fresno, California, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : There are a wide variety of clinical tools used to assess balance and fall risk, but very few effectively assess higher functioning CDA. The purpose of this investigation is to determine if the addition of IMU quantification of postural sway to the simple, highly utilized clinical tool (mCTSIB) would assess balance and effectively identify fall risk in high functioning CDAs.

Number of Subjects : A sample of convenience of seventy-two CDAs (mean age 76.17 ± 5.960) were recruited and classified as at risk to fall ($n=17$) and not at risk ($n=55$) using the Fullerton Advanced Balance (FAB) Scale. Mean FAB score (29.40/40), perfect temporal based performance on the mCTSIB, and mean BES score (85.36/100) suggest a higher functioning CDA sample.

Materials/Methods : Sway acceleration (measured in m^2/s^4) for each condition of the I-CTSIB was captured using an IMU placed at the COM and a composite score calculated from the average of the 4 conditions. The ability of the I-CTSIB to identify individuals at risk and those not at risk was determined using the Mann-Whitney U-Test. Receiver Operating Characteristic (ROC) and Area Under the Curve (AUC) analysis was used to determine the discriminative validity of each test condition and the composite score in the identification of fall risk. The closer the AUC value is to 1.0 (a 'perfect' test), the more effective the measure is in identifying fall risk; a value of 0.50 indicates a 50/50 chance.

Results : The eyes closed conditions (2, 4) and composite score of the instrumented mCTSIB (I-CTSIB) were able to identify fallers and non-fallers ($p<0.05$). ROC/AUC analysis determined only condition 4 (eyes closed) and the composite score to possess adequate discriminate power to identify fallers in this higher functioning sample (AUC 0.76 and 0.77, respectively).

Conclusions : Although the mCTSIB was never designed to assess fall risk, I-CTSIB condition 4 (eyes closed firm) and a composite score were able effectively discriminate fall risk in a high functioning CDA sample with good discriminate power. The results of this investigation suggest that in the identification of fall risk in a higher functioning CDA population, components of the I-CTSIB are effective when compared to the clinical, temporal based measures of the mCTSIB.

Clinical Relevance : The mCTSIB is a widely used clinical tool used to examine underlying sensorimotor system contributions to postural instability. The addition of IMUs to the mCTSIB to provide sway acceleration data, may yield valuable discriminate information about fall risk. It is possible that a single condition of the I-CTSIB may identify fall risk in high functioning CDA.

TITLE: The role of cortical inhibition in post-stroke walking function

AUTHORS/INSTITUTIONS: J.A. Palmer, S.M. Morton, S.A. Binder-Macleod, Physical Therapy, University of Delaware, Newark, Delaware, UNITED STATES|C. Gordon, Kinesiology and Applied Physiology, University of Delaware, Newark, Delaware, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Recovery of walking function is one of the primary goals of individuals with chronic stroke, yet the majority of patients do not recover walking function to allow for safe and effective community ambulation [1,2]. Cortical inhibition plays a crucial role in cortical plasticity that promotes functional motor recovery following stroke [3]. Developments in transcranial magnetic stimulation (TMS) technology have enabled us to investigate activity of inhibitory cortical GABAergic neurons through a measure of reduced motor output during an active muscle contraction, known as the cortical silent period (CSP) [4]. In the upper extremity, the lower the cortical inhibition from the lesioned hemisphere to the paretic arm and hand the better motor recovery [5-10]. However, the role of cortical inhibition in the lower extremity following stroke is poorly understood. Insight into the role of inhibitory mechanisms in post-stroke lower extremity motor recovery could lead to development of more effective rehabilitation strategies to address walking deficits. The purpose of this study was to examine the relationship between CSPs and walking function in individuals with chronic stroke.

Number of Subjects : Twenty subjects with chronic stroke (>6mo.).

Materials/Methods : TMS was delivered at 100% maximal stimulator output intensity over the optimal location for eliciting a motor response in the paretic tibialis anterior (TA). Participants maintained a light dorsiflexion contraction at 15% of the maximal electromyography (EMG) that they were able to produce volitionally during testing. CSP was measured as the duration of time from stimulus onset to the return of pre-stimulus EMG amplitude levels [11,12]. Comfortable and fastest walking speeds were measured as the average speed taken from 3 clinical 10-meter walk tests. A Pearson's correlation coefficient was used to quantify the relationship between CSP duration and walking speed.

Results : CSP durations were positively correlated to comfortable ($r = .56$, $p = .01$) and fastest walking speed ($r = .61$, $p < .01$). That is, participants with the fastest gait speeds had the longest CSPs.

Conclusions : Results from the present study indicate that, in contrast to research involving the upper extremity, greater cortical inhibition to the lower extremity is related to better walking function. Our data suggest that cortical inhibition may play a different role in motor recovery in the paretic lower versus upper extremity in individuals with chronic stroke.

Clinical Relevance : This is the first study to examine CSPs in the lower extremity in individuals post-stroke as it relates to walking function. Results of this study can be used to help us further understand the mechanisms underlying lower extremity motor function, cortical inhibition, and recovery following stroke. Together with future research, these findings may have implications for the development of effective rehabilitation strategies that empower clinicians to promote positive neuroplastic changes and maximize functional walking recovery.

TITLE: Does Virtual Reality Therapy Improve Functional Outcomes in Patients with TBI? A Systematic Review

AUTHORS/INSTITUTIONS: R. Robert, K. Love, K. Kozlova, R. Levine, N. Wood, J. Parent-Nichols, Physical Therapy, Franklin Pierce University, Manchester, New Hampshire, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : As the understanding of long term effects of traumatic brain injury (TBI) has increased, so has the exploration of effective and efficient treatments. TBI can result in a variety of impairments and functional limitations for patients. Recently, virtual reality technology (VR) has been integrated into treatment strategies for patients with TBI to evaluate and promote learning in a safe, realistic environment. Additionally, practice of meaningful skill with VR is purported to increase patient motivation, create salient opportunities for learning, and promote safe movement experiences. The purpose of this study was to determine if VR therapy improves functional outcomes in patients with TBI.

Number of Subjects : not applicable

Materials/Methods : A systematic review was conducted using the following data bases: CINAHL, PubMed, MEDLINE, and SPORTdiscus. Each database was searched using the following key words in all combinations: "Traumatic Brain Injury", "Virtual Reality", "Rehabilitation", "Recovery", "Physical Rehabilitation", and "Physical Therapy." Databases were each searched by two investigators and information on balance, gait, coordination, upper extremity (UE) function, and memory/cognition parameters were collected from articles that met the inclusion/exclusion criteria. Use of the PEDro scale provided information on the quality of the studies included in the review. The articles included in this review were: accessible and available in English, a research study (systematic or original research), and investigated VR in rehabilitation for TBI.

Results : PEDro scores for the articles included in this systematic review ranged from a 0-6/10. Each included article reported improvements over baseline in the areas of balance, gait, coordination, UE function, and memory/cognition. Limitations in the articles used in this review included variability of research design, type of settings, severity of TBI, inconsistencies of outcome measures and intervention methods, and limited sample size.

Conclusions : Positive trends were noted in balance, gait, coordination, UE function and memory/cognition after VR therapy. However, not all results reported met the set minimal clinically important difference (MCID) of the outcome tool used. Some results were not determined to be statistically significant. However, the positive trends indicate that VR therapy may be a promising tool for rehabilitation following TBI. Additional research regarding this topic may include use of consistent age groups, baseline status of participants, outcome measures, and VR systems used. .

Clinical Relevance : This systematic review revealed the possibility that VR promotes functional improvements in balance, coordination, UE function, and cognitive function. VR can provide a variety of realistic environments that enable a patient to repeat meaningful tasks while eliminating safety concerns that may exist in the true environment. Additionally, the VR environment could provide improved motivation, improved quality of life, improved emotional comfort and provide salient opportunities for practice.

TITLE: The Immediate and Long-term Effects of Weighted Arm Swing on Improving Gait Quality and Speed in a Patient with Parkinson's Disease

AUTHORS/INSTITUTIONS: M. Battsek, Physical Therapy , Rusk Rehabilitation at NYU Langone Medical Center, New York, New York, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : Gait impairments including reduced arm swing (AS), trunk rotation (TR), step length (SL), shuffled gait, and slow cadence are common in people with Parkinson's disease (PD). Goals for this population often focus on gait speed (GS) and gait quality (GQ). Studies have linked decreased AS to freezing of gait, decreased gait efficiency, and increased fall risk. Research states AS combines passive and active motion, and is controlled by central pattern generators. Studies show that the role of AS is to improve GS, optimize stability, and control posture. The pendulum motion of AS serves as momentum and inertia for gait, improving limb coordination and energy expenditure. Research on control groups has shown that restricting AS has decreased TR and GS. Studies on PD show that verbal cues for AS have improved GS and SL however there are limited studies on other methods to increase AS with PD. The purpose of this case study is to describe the positive effects on GS and GQ when using dumbbell (DB) weighted AS both immediately and long term and the potential benefits it has in reducing fall risk in this population.

Case Description : A 77 year old female with moderate PD since 2011 was treated in outpatient physical therapy (PT) for progressive decline in GS and GQ. Patient (pt) presented with shuffled gait, reduced SL, AS and TR. PT focused on balance, strengthening, and functional training. 3 weeks (wks) post evaluation therapy incorporated 2lb DB in hands while gait training. Pt also completed a home exercise program of walking with 2lb DB indoors 50ft x 4, 3 times a week.

Outcomes : Pt completed 4 months of PT, twice a week, for 30 minutes. Progression of GS (measured in ft/sec) and balance, using Dynamic Gait Index (DGI), was assessed at initial evaluation [3.52, 19/24], re-evaluations at wks 7 [3.6, 19/24], wks 11 [3.61, 3.65, 3.66 with DB 2, 3, 4lb respectively], and wks 15 [3.93, 20/24], and at discharge [4.77, 3.93 with 4lb DB, 20/24]. Immediate kinematic changes of increased SL, AS and TR were seen with DB walking. Improvements with GQ carried over intra- and inter-sessions and remained prevalent at discharge. In addition, pt satisfaction during and post DB training remained high, as indicated by pt.

Discussion : GS and GQ as well as dynamic balance improved following walking with dumbbells. These quantitative and qualitative effects were seen both during the activity and post activity demonstrating the positive effects of walking with weighted AS. Small differences were seen when varying DB weight; as weight increased, speed increased, and more research is needed to assess the relationship between DB weight and GS/GQ. This suggests that walking with dumbbells has potential to improve gait and fall risk with PD. This should be considered as an additional intervention to standard care in the clinic and at home.

References: Must include 5 current references (less than 10 years old): Meyns P, Bruijn SM, Duysends J. The how and why of arm swing during human walking. *Gait and Posture*. 2013;02(006):1-8. Ford MP, Wagenaar RC, Newell KM. Arm constraint and walking in healthy adults. *Gait and Posture*. 2007;26:135-141Huang X, Mahoney JM, Lewis MM, Guangwei D, Piazza SJ, Cusumano JP. Both coordination and symmetry of arm swing are reduced in parkinson's disease. *Gait Posture*. 2012;35(3):373-377. Barthelemy D, Nielsen JB. Corticospinal contribution to arm muscle activity during human walking. *J Physiol*. 2010;588(6):967-979.Nanhoe-Mahabier W, Snijders AH, Delval A, et al. Walking patterns in parkinson's disease with and without freezing of gait. *Neuroscience*.2011;182:217-224. Lewek MD., Poole R, Johnson J, Halawa O, Huang X. Arm swing magnitude and asymmetry during gait in the early stages of parkinson's disease. *Gait Posture*. 2010;31(2):256-260.

TITLE: Improving Hand Voluntary Control in Chronic Stroke Using A Novel Assistive System – ReIn Hand: A Case Series.

AUTHORS/INSTITUTIONS: C. carmona, J.E. Sullivan, J.P. Dewald, K.B. Wilkins, A. Moore, N. Parmann, S. Wojton, E. Lee, J. Yao, PTHMS, Northwestern University, Chicago, Illinois, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Approximately 75% of stroke survivors with moderate to severe impairments lose hand function, which impacts their ability to perform basic activities of daily living.^{1,2} Unfortunately, no methods to date have demonstrated be effective in significantly improving voluntary hand function in these individuals. One possible reason is that due to the loss of voluntary hand control, stroke survivors cannot participate in any intensive intervention with a functional task-oriented approach. This study utilized a repetitive and intense upper extremity training paradigm requiring grasp and release, while using a novel electromyography-triggered NMES system – ReIn-Hand. The system provides electrical stimulation for assistance of hand opening while the arm is used during reaching/retrieval tasks. We hypothesize that using the ReIn-Hand system during functional activities will help our target population to improve voluntary hand opening function.

Number of Subjects : 3

Materials/Methods : Three individuals with moderate to severe chronic stroke impairments completed 3 sessions/week for 6-8 weeks. Pre-intervention, subjects demonstrated decreased voluntary hand control, abnormal flexion synergy patterns, sensory impairments, increased muscle tone, and hand weakness. During each training session, subjects used the paretic arm to perform 20-30 trials of tasks involving reaching/grasping and retrieving/releasing objects of various sizes and loads with the assistance of ReIn-Hand. Active range of motion, Chedoke MacMaster (CMcM) (stroke-assessment hand portion), Semmes-Weinstein monofilament test (SWMT), the Nottingham Assessment-Stereognosis portion (NA), the Box and Block test (BB), and grip strength were assessed before and after the intervention

Results : Post intervention, subjects demonstrated improved sensation (SWMF and/or NA) and grip strength (change paretic/non-paretic ratio, mean increase = 0.039) voluntary index finger extension at the metacarpal-phalangeal joint (mean increase = 19°). One subject improved in CMcM (stage 2 to 3), and two subjects improved gross manual dexterity (BB from 0 to 3-6 blocks -last week of intervention-, and from 1 to 3).

Conclusions : These preliminary results suggest that using the ReIn-Hand during functional reach/grasp can improve voluntary hand control and sensory perception in individuals with moderate to severe chronic stroke impairments.

Clinical Relevance : Our results support the utility of ReIn-hand use in both research and clinical settings. Further investigation is needed to evaluate the effectiveness of the ReIn-Hand system in larger and more varied post stroke populations using additional quantitative measurements.

TITLE: Cortical Disconnection of the Ipsilesional Primary Motor Cortex is Associated with Gait Speed and Upper Extremity Motor Impairment in Chronic Stroke

AUTHORS/INSTITUTIONS: D.M. Peters, J.C. Stewart, J.D. Richardson, A. Middleton, J. Fridriksson, C. Rorden, T.M. Herter, R.D. Newman-Norlund, S.L. Fritz, University of South Carolina, Columbia, South Carolina, UNITED STATES|L. Bonilha, E. Gleichgerrcht, Medical University of South Carolina, Charleston, South Carolina, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Motor impairment and recovery after stroke can be quite variable. Brain regions and motor tracts beyond the infarction site may also exhibit structural abnormalities, contributing to behavioral deficits. Advances in neuroimaging have enabled the mapping of white matter connections across the entire brain (i.e. the brain connectome), allowing for a more thorough examination of the extent of white matter disconnection after stroke. The aim of this study was to examine the relationship between upper/lower extremity motor impairment and structural brain connectivity in individuals with chronic stroke.

Number of Subjects : Forty-three participants post-stroke [age: 59.7 (11.2) years; time since stroke: 64.4 (58.8) months]

Materials/Methods : All participants underwent MRI scanning and a comprehensive assessment of upper/lower extremity motor function and gait. Diffusion tensor imaging and probabilistic tractography were used to assess connectivity amid a subsection of the motor network. Nonparametric correlation analyses were performed to examine the relationship between structural connectivity and upper/lower extremity motor function. Multiple linear regression analyses were performed to examine the relationship between cortical necrosis and disconnection of the three main cortical areas of motor control [primary motor cortex (M1), premotor cortex (PMC), and supplementary motor area (SMA)] and motor function.

Results : Intrahemispheric connectivity between ipsilesional M1/SMA and the cerebral peduncle, thalamus, and red nucleus was significantly correlated ($P \leq 0.003$) with upper and lower extremity motor performance, with gait speed exhibiting the weakest correlations. Interhemispheric connectivity between M1-M1 was also significantly correlated with gross manual dexterity of the affected upper extremity [Box & Block Test (BBT), $r=0.46$, $P=0.001$]. Regression models composed of ipsilesional M1 lesion load and M1 disconnection explained a significant amount of variance in BBT score ($R^2=0.41$), grip strength ($R^2=0.36$), arm Motricity Index score ($R^2=0.41$), and gait speed ($R^2=0.35$). M1 disconnection was an independent predictor of motor performance while M1 lesion load was not.

Conclusions : Cortical disconnection, especially of ipsilesional M1, could significantly contribute to the variability seen in locomotor and upper extremity motor function and recovery in chronic stroke. Relying only on necrotic lesion data could underestimate the greater impact of stroke.

Clinical Relevance : Insight into the more salient, global effects of stroke could enhance our understanding of the mechanisms that support brain plasticity and motor recovery. Such information could improve motor recovery prognosis and help target therapeutic interventions, thereby improving the clinical management of chronic mobility impairments in this patient population.

TITLE: The Effect of TMS Conditioning of the H-reflex After Walking Interventions

AUTHORS/INSTITUTIONS: J.C. Chen, W. Gray, J. Smith, C. Wade, M.R. Borich, Rehabilitation Medicine, Division of Physical Therapy, Emory University, Atlanta, Georgia, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Transcranial magnetic stimulation (TMS) is a non-invasive approach to modulate the Hoffman reflex (H-reflex) to evaluate descending cortical influences on spinal reflex excitability. The H-reflex is modulated by treadmill walking paradigms in healthy individuals; however, cortical contributions to treadmill walking-induced H-reflex modulation have not been previously studied and may have clinical applications. The purpose of this study was to evaluate the effect of a single episode of 4 types of treadmill walking on measures of TMS-conditioned spinal excitability in healthy individuals.

Number of Subjects : Thirteen subjects (10 females, 3 males, ages 22-32 years) without neurologic or orthopedic conditions completed the study protocol.

Materials/Methods : In this repeated measures study, each participant completed 4 data collection sessions separated by a minimum of 24 hours. At each session, TMS-conditioned and unconditioned H-reflexes were collected prior to and following a single 20min treadmill walking intervention (level, upslope, downslope, or split-belt). TMS-conditioned H-reflex peak-to-peak amplitudes from the right soleus muscle were extracted and normalized to unconditioned H-reflex amplitudes to define the outcome measure of "TMS-conditioned H-reflex ratio". Two interstimulus intervals (ISIs) were used to condition H-reflexes elicited from posterior tibial nerve (PTN) stimulation: TMS applied 1.5ms after (short-latency facilitation, SLF) and 10 ms before (long-latency facilitation, LLF) PTN stimulation. Univariate and two-way repeated measures ANOVAs were performed (SPSS v.22) to evaluate walking intervention effects on the TMS-conditioned H-reflex ratio.

Results : A main effect of ISI was found with larger facilitation in the LLF condition compared to SLF ($2.285+1.083$ vs. $1.336+0.490$, $F=62.736$, $p<0.001$). A significant main effect of walking intervention or test (pre- vs. post-walking) was not noted for either SLF (interventions $F(1,366, 15.027)=0.722$, $p=0.433$; test $F(1,11)=0.160$, $p=0.697$) or LLF (interventions $F(3,33)=0.460$, $p=0.712$; test $F(1,11)=0.330$, $p=0.577$). A significant interaction effect between intervention and test was not observed for SLF ($F(3,33)=0.121$, $p=0.947$) or LLF ($F(3,33)=0.848$, $p=0.478$).

Conclusions : Results confirm previous literature suggesting that SLF and LLF utilize different descending neural pathways. Walking interventions were not found to significantly modulate TMS conditioning of the H-reflex, suggesting that treadmill walking-based modulation of spinal excitability may be primarily mediated at the spinal versus cortical level.

Clinical Relevance : Future work could use the described mechanistic paradigm to study the behavioral relevance of alterations in cortical influences on spinal excitability in participants with neurologic conditions (e.g. spinal cord injury, stroke, neurodegenerative diseases, etc.). Additional studies could investigate different types of treadmill walking as potential rehabilitation interventions for various neurologic clinical populations.

TITLE: Interdisciplinary Collaboration to advance Neurology Specialty Practice: The Schmidt Fellowship

AUTHORS/INSTITUTIONS: P. Ressler, J. Hershberg, A. Elder, [re+active] physical therapy and wellness, Los Angeles, California, UNITED STATES|A. Wu, L. Yang, University of California, Los Angeles, Los Angeles, California, UNITED STATES|

ABSTRACT BODY:

Purpose : The prevalence of movement disorders is expected to increase considerably as the population ages. As a result, individuals with movement disorders will be more frequently seen in outpatient physical therapy practice. The Schmidt Movement Disorders Fellowship was established to develop physical therapist experts in movement disorders through focused patient care, mentoring, didactic study, community service and collaboration with the University of California, Los Angeles (UCLA). A Research Electronic Data Capture (REDCap) database has been established as a way to further interdisciplinary collaboration between physical therapists and neurologists as part of the fellowship.

Description : Despite the growth of fellowship and residency programs, there are currently no accredited or developing fellowships dedicated to a neurology subspecialty of physical therapy. The Schmidt Fellowship was established at [re+active] physical therapy and wellness, to fill this need. The development of the fellowship occurred over a 9 month process including monthly online collaboration meetings with a group from the movement disorders neurology clinic at UCLA. In addition, Dr. Richard Schmidt, PhD, a prominent researcher in motor behavior, has assisted in the development of learning modules to advance the training of the fellow. The first Schmidt Fellow starts in July 2015.

Summary of Use : Interdisciplinary collaboration between physical therapy (PT) and neurology began formally via monthly web conference calls to discuss difficult patient cases and collaborate on research concepts. As the fellowship was developed, multiple routes were investigated to allow outside collaboration in the neurology clinic. A "Research Volunteer" position was pursued and attained so that the physical therapists could collaborate in the clinical setting. The fellow will participate in clinics two times per month with goals for shared knowledge, optimization of patient care and participation in research. We designed a RedCap shared database to collect longitudinal data on all movement disorder patients seen at both the PT site (PT-visits) and an academic movement disorders neurology clinic (neuro-visits). Initial pre-planned cohorts for analysis will contrast outcomes for patients who are seen by PT-visits alone vs neuro-visits alone vs joint-PT-and-neuro-visits for both clinical outcomes and economic modeling.

Importance to Members: With a growing number of people with movement disorders and a greater awareness for the role of exercise and therapy in their management, there is an increased need for physical therapy experts in this specialty. There is also an unmet need for effective interdisciplinary collaboration to develop evidence for treatment and demonstration of enhanced outcomes with treatment by a specialist. We have outlined the development of the first movement disorders fellowship program and an interdisciplinary program between neurology and physical therapy to help facilitate further growth of similar programs.

TITLE: Community mobility method selection in individuals with chronic motor incomplete spinal cord injury: A Qualitative Analysis

AUTHORS/INSTITUTIONS: C.L. Holleran, Sensory Motor Performance Program, Rehabilitation Institute of Chicago, Chicago, Illinois, UNITED STATES|J. Fogo, School of Occupational Therapy, University of Indianapolis, Indianapolis, Indiana, UNITED STATES|S.A. Combs-Miller, Krannert School of Physical Therapy, University of Indianapolis, Indianapolis, Indiana, UNITED STATES|T. Hornby, Department of Physical Therapy, Kinesiology and Nutrition , University of Illinois at Chicago, Chicago, Illinois, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : A primary rehabilitation goal for individuals with motor incomplete spinal cord injury (iSCI) is to regain walking abilities.(1) Clinicians must balance time spent on restorative walking therapies with preparing individuals for functional independence upon discharge. Little evidence exists outside of quantitative prognostic indicators to assist in forecasting future methods of community mobility. Therefore, the purpose of this exploratory qualitative study was to generate a theory explaining the decision process for community mobility method selection in individuals with iSCI.

Number of Subjects : Seven

Materials/Methods : Seven participants, 6 male and 1 female, participated in qualitative grounded theory interviewing in a private setting. Participants were purposefully selected from each of three functional gait categories (2) to include individuals of varying physical abilities with additional sampling considerations such as varied chronicity, level of injury, socioeconomic backgrounds, and location of residence. All data were audio recorded and transcribed verbatim after each interview and coded separately by two researchers. Constant comparative analysis was incorporated to allow the researchers concurrent data collection and coding for eventual theory generation. Member checking as well as data triangulation was performed to improve the credibility and confirmability of the data.

Results : Two themes emerged (with subcategories in parenthesis): (1) values and beliefs (acceptance, disability, awareness, and feelings about the purpose of walking); and (2) calculated planning [task (logistic requirements for completing the task), individual (personal characteristics at the time of the task), and environment (the characteristics of the environment in which the task was taking place)]. Individuals' narratives described foundational values and beliefs that underpinned their pursuit of either walking or wheeled mobility. The resultant mode of mobility emerged from the individual considering their values and beliefs in tandem with a process of calculating the task, individual characteristics, and environment when engaging in community mobility. Individuals varied in the frequency they performed calculated planning and participants' perspectives evolved as they progressed further from their injury.

Conclusions : These findings call into question quantitative cut-offs (3-5) for community vs non-community ambulators as many individuals in all functional walking categories utilized multiple modes of mobility.

Clinical Relevance : The insight gleaned from these participant's narratives can help clinicians and researchers gain a deeper understanding of the unique challenges that individuals with iSCI encounter in relationship to community mobility and provides peer perspective to other individuals with iSCI navigating community mobility method choices, which has demonstrated to be beneficial for individuals after SCI.(6-8)

TITLE: The use of LSVT BIG to improve balance confidence and perceived difficulty with walking in a patient with Parkinson disease.

AUTHORS/INSTITUTIONS: S. Simoes, K. Smith, Physical Therapy, Nova Southeastern University, Miami Shores, Florida, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : Parkinson disease (PD) affects mobility and balance increasing fall risk. Falls are costly to society, increase fear of falling (FOF) and reduce activity levels. FOF differs between PD non-fallers and healthy controls, PD fallers and non-fallers and is a predictor of recurrent falls. Patients in early stages of PD (ESOPD) may experience decreased balance confidence and FOF limiting activity. LSVT BIG (LSVTB) integrates the principles of neuroplasticity including complexity, salience and intensity while emphasizing amplitude of movement. Optimal results have been obtained for patients in ESOPD. This case report describes the use of LSVTB in the treatment of a patient in the ESOPD and the impact on his balance confidence and perceived difficulty with walking.

Case Description : 75 year old male, Hoehn & Yahr stage II, sedentary, community ambulator without device, no history of falls. Assessments were conducted at initial evaluation and after 16 sessions (4 weeks) including the Activities Balance Confidence Scale (ABC), mini Balance Evaluation Systems Test (Mini BESTest), Timed up and Go-motor (TUG-m) and the BIG-Functional task assessment of the patient's perceived level of difficulty (7 levels from "not difficult" to "unable") performing 9 self-selected tasks from a list of tasks. Intervention consisted of the LSVTB protocol with particular emphasis on progression, increased complexity of daily maximal exercises, and BIG walk drills varying the environmental demands.

Outcomes : Initial scores: ABC 73%; TUG-m 11.8s; Mini BESTest 23/28; and functional tasks rated from "minimally" to "very" difficult. Scores improved on all tests after 16 sessions. Final scores: ABC 99%; Mini BESTest 26/28; TUG-motor 8.5s; patient's perception of level of difficulty in performing tasks decreased by 1 or more levels with 4/9 tasks rated as "not difficult": walking, eating, carrying objects and stairs.

Discussion : A change of 26% in the ABC exceeded reported MDC (11.12-13%) and corresponded to the patient's perception of decreased difficulty with walking, which improved by 3 levels. Improvement in compensatory forward and backward stepping and dual-task TUG scores on the mini BESTest reflect the positive outcomes achieved by the LSVTB intervention on the patient's reactive postural control and walking. This case shows the positive impact of LSVTB intervention on a patient whose balance confidence was initially low despite being independent with ambulation. Improvements in patient's perceived level of difficulty with mobility and balance may promote a less sedentary lifestyle. Increase in patient's balance confidence yielded a shift away from the fall risk cut-off value (69%) for PD. This type of patient is unlikely to be referred to outpatient physical therapy due to high functional level. This case supports referral and early intervention for patients in ESOPD to sustain activity level and prevent falls. Further research is needed to assess the impact of increased balance confidence on community participation.

References: Must include 5 current references (less than 10 years old): Mak, M. K. and Pang, M. Y. (2009). Fear of falling is independently associated with recurrent falls in patients with Parkinson's disease: a 1-year prospective study. *Journal of Neurology*, 256(10), 1689-1695. Dal Bello-Haas, V., Klassen, L., et al. (2011). Psychometric Properties of Activity, Self-Efficacy, and Quality-of-Life Measures in Individuals with Parkinson Disease. *Physiotherapy Canada*, 63(1), 47-57. Steffen, T. and Seney, M. (2008). Test-retest reliability and minimal detectable change on balance and ambulation tests, the 36-item short-form health survey, and the unified Parkinson disease rating scale in people with parkinsonism. *Physical Therapy*, 88(6), 733-746. King, L. A. and Horak, F. B. (2009). Delaying mobility disability in people with Parkinson disease using a sensorimotor agility exercise program. *Physical Therapy*, 89(4), 384-393. Farley, B.G., Fox, C. M., Ramig, L.O. and McFarland, D. H. (2008). Intensive amplitude-specific therapeutic approaches for Parkinson's disease: Toward a neuroplasticity-principled rehabilitation model. *Topics in Geriatric Rehabilitation*, 24(2), 99-114. Mak, M.K.Y. and Pang, M.Y.C. (2009). Balance confidence and functional mobility are independently associated with falls in people with Parkinson's disease. *Journal of Neurology*, 256(5), 742-749.

TITLE: The Effect of Seasonal Variation on Physical Activity Level in Persons with Parkinson Disease

AUTHORS/INSTITUTIONS: J.A. Tschoepe, T.R. DeAngelis, K. Hendron, T. Ellis, N.A. Sullivan, Center for Neurorehabilitation, Boston University College of Health and Rehabilitation Sciences: Sargent College, Boston, Massachusetts, UNITED STATES|N. Latham, Boston University School of Public Health, Boston, Massachusetts, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Engagement in physical activity is associated with increased function, enhanced quality of life and reduced disease progression in persons with Parkinson Disease (PD). Sustained physical activity over the long-term is necessary to optimize the benefits. Seasonal variation may impact physical activity levels contributing to periods of sedentary behavior. The purpose of this study was to identify how physical activity level, as measured by daily steps, was affected by changes in season over a one-year period in persons with PD in the New England area. We hypothesized that significantly lower physical activity levels would be observed in the winter season in comparison to all other seasons.

Number of Subjects : Twenty community dwelling persons with mild to moderate idiopathic, typical PD who were independently ambulating in the community.

Materials/Methods : Twenty persons with PD were provided with pedometers and participated in a daily walking program in their local communities over a 12-month period. Mean steps per month were calculated and grouped by season. Independent t-tests were used to examine the differences between mean steps per season in the winter season in comparison to each of the other seasons independently and collectively.

Results : Data on 20 subjects with PD were included in the analysis. Participants included 10 males, had a mean age of 67 years (SD +/- 8.8) and were in Hoehn & Yahr stages 1.5 - 2.5. Average steps per season were 5213 (SD +/- 2382) in the winter, 6077 (SD +/- 2357) for spring, 6376 (SD +/- 2827) for summer and 5779 (SD +/- 2372) in the fall. Although lower physical activity was observed during the winter compared to other seasons, differences were not statistically significant.

Conclusions : These findings reveal that although physical activity levels in persons with PD were lowest in the winter season, differences between seasons was not significant. This suggests that persons with PD were able to sustain relatively consistent physical activity levels over a 12-month period. Limitations of this study include a small sample size.

Clinical Relevance : Persons with PD were able to engage in a daily walking program over a 12-month period despite variations in weather associated with changes in seasons.

TITLE: Changes in Balance, Gait, and Falls Efficacy Following Virtual Reality-Based Therapy in People with Parkinson's Disease

AUTHORS/INSTITUTIONS: Y. Kim, S. Kang, Department of Physical Therapy, Korea National University of Transportation, Jeungpyeong, KOREA (THE REPUBLIC OF)|S. Kim, School of Physical Therapy & Rehabilitation Sciences, University of South Florida, Tampa, Florida, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Virtual reality has been introduced as a potential therapeutic method for people with Parkinson's disease (PD). Studies show the benefits of using virtual reality for rehabilitation in people with neurological disorders. However, whether it can help improve functional ability such as gait or balance, and decrease fear of falling in people with PD has not been studied. The purpose of this study was to identify if virtual reality-based exercise was more effective than conventional therapy for balance, gait, and falls efficacy in individuals with PD.

Number of Subjects : 30

Materials/Methods : Thirty individuals with PD were randomly allocated to either the virtual reality-based therapy (VRT) group (72.1 ± 7.7 years, $n=15$) or conventional physical therapy (CPT) group (76.0 ± 9.5 years, $n=15$). The VRT and CPT groups received virtual reality-based exercises and conventional therapy, respectively, over 4 weeks (5 times per week). The subjects' balance was assessed using AMTI force platforms and a Korean version of Berg Balance Scale (K-BBS). Gait was evaluated using AMTI force platforms, Dartfish Video Analysis Software, and the 6 Minute Walk Test (6MWT). A Korean version of Falls Efficacy Scale (K-FES) was used to assess fear of falling. Wilcoxon signed-rank test and Mann-Whitney U test were used to examine within- and between-group differences following intervention, respectively.

Results : Both VRT and CPT groups exhibited a significant reduction of postural sway after intervention ($p < 0.01$), but no significant group difference. Both groups showed a significant increase in the K-BBS score ($p < 0.01$) and the change in the VRT group was significantly greater than that of the CPT group ($p < 0.01$). Both VRT and CPT groups also exhibited a significant increase in step length ($p < 0.01$) and vertical ground reaction force ($p < 0.01$) following intervention, while a significant group difference was shown in only vertical ground reaction force ($p < 0.01$). The distance to complete the 6MWT significantly increased in both groups after intervention ($p < 0.01$) and the increase in the VRT group was significantly greater compared with the CPT group ($p < 0.05$). In addition, both groups' K-FES scores significantly improved after intervention ($p < 0.01$) and the change was significantly greater in the VRT group than in the CPT group ($p < 0.01$).

Conclusions : People with PD showed significant improvements in balance, gait, and falls efficacy following VRT. Furthermore, the improvements were considerably greater compared with CPT. The findings suggest that VRT may be used as an effective intervention to improve functional ability and falls efficacy in individuals with PD.

Clinical Relevance : An intervention using virtual reality appears superior to conventional physical therapy for functional improvements in people with PD. It also helps significantly decrease fear of falling in people with PD. This study indicates that the use of virtual reality may have a meaningful impact on the quality of life of individuals with PD.

TITLE: Improvements in strength, walking, and participation following CoreAlign® training for a person with multiple sclerosis

AUTHORS/INSTITUTIONS: C.A. Lamb, M.M. Manago, Physical Therapy, University of Colorado, Denver, Colorado, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : People with multiple sclerosis (MS) commonly experience muscle weakness and difficulty walking. Strength training can result in improvements in force production for people with MS; however, evidence for strength training to improve gait performance is inconclusive. A close examination of the literature suggests that interventions that incorporate the trunk and lower extremities might result in improved mobility outcomes compared to strengthening the lower extremities in isolation using traditional progressive resistance training. The objective of this case report is to describe changes in strength, gait, and participation following a novel rehabilitation approach using a CoreAlign®. The CoreAlign® is a unique piece of equipment that is ideally suited for functional re-training of gait while also challenging strength and balance

Case Description : A 23 year-old woman with a 3-year history of MS, Patient Determined Disease Steps score of 3, presented to a hospital-based outpatient rehabilitation clinic. Her primary complaints were related to difficulty performing job duties involving standing, walking, and lifting; as well as general walking and running. Patient completed 7 sessions of CoreAlign® training over 8 weeks targeting lower extremity and trunk strength, flexibility, and motor control. She was seen once a week for 60 minutes. Outcomes were assessed prior to beginning treatment and again at 8 weeks. This program was supplemented with home exercises to practice motor control and improve strength.

Outcomes : Lower extremity and trunk strength were measured by hand-held dynamometry (HHD); walk endurance (2-Minute Walk Test - 2MWT) and speed (25-Foot Walk Test - T25FW); and self-determined participation (Patient-Specific Functional Scale - PSFS) measurements were taken pre and post intervention. Clinically meaningful improvements were found for gait speed (22% on T25FW), and participation (> 2 point mean change on the PSFS). Notable improvements were found for strength on the more affected side for ankle dorsiflexion (25%), knee flexion (8%), hip flexion (25%), and lateral trunk flexion (15%). Gait endurance also improved (18.73% in 2MWT).

Discussion : The results demonstrate the potential of CoreAlign® training to produce meaningful changes in important outcomes within each of the International Classification of Disability, Function, and Health (ICF) framework categories: impairment (strength), activity (gait), and participation (PSFS). Additional investigations are needed to study the effects of the CoreAlign® in larger groups of people with MS, and to compare with more traditional modes of resistance training.

References: Must include 5 current references (less than 10 years old): Latimer-Cheung AE, Pilutti LA, Hicks AL, et al. Effects of exercise training on fitness, mobility, fatigue, and health-related quality of life among adults with multiple sclerosis: a systematic review to inform guideline development. Archives of physical medicine and rehabilitation. 2013;94(9):1800-1828 e1803. Hobart J, Blight AR, Goodman A, Lynn F, Putzki N. Timed 25-foot walk: direct evidence that improving 20% or greater is clinically meaningful in MS. Neurology. 2013;80(16):1509-1517. Kjolhede T, Vissing K, Dalgas U. Multiple sclerosis and progressive resistance training: a systematic review. Multiple sclerosis. 2012;18(9):1215-1228. Freeman JA, Gear M, Pauli A, et al. The effect of core stability training on balance and mobility in ambulant individuals with multiple sclerosis: a multi-centre series of single case studies. Multiple sclerosis. 2010;16(11):1377-1384. Guclu-Gunduz A, Citaker S, Irkec C, Nazliel B, Batur-Caglayan HZ. The effects of pilates on balance, mobility and strength in patients with multiple sclerosis. NeuroRehabilitation. 2014;34(2):337-342.

TITLE: Bike Modifications to Allow Continued Competitive High Intensity Exercise With ALS: A Case Report

AUTHORS/INSTITUTIONS: J.R. Kear, K. Dieruf, Orthopedics/Physical Therapy, University of New Mexico, Albuquerque, New Mexico, UNITED STATES]

ABSTRACT BODY:

Background & Purpose : Current research on exercise and Amyotrophic Lateral Sclerosis (ALS) suggests that moderate aerobic and resistive exercises are potentially beneficial forms of treatment. Animal studies examining the intensity of exercise have shown positive results when comparing moderate and high intensity exercise to sedentary control groups. Additionally there is little evidence to show that there is a detrimental effect from vigorous exercise in this patient population. Clinical manifestations of ALS include progressive weakness of the trunk, neck and extremities, atrophy and fatigue. These impairments lead to functional decline and make riding a standard bike progressively more difficult.

Case Description : The participant was a 54 year-old male, whose initial symptoms started in 2006 and was diagnosed with bulbar onset ALS July 28, 2010. He was a competitive athlete prior to the diagnosis and remained active throughout the disease course. The focus of this case study was to document the modifications required to allow him to continue high intensity exercise and competition. This study is based on interviews, review of subject records and a blog that the subject posts at http://www.osohigh.com/LT_100_ALS_Blog.html.

Outcomes : Nearly five years after diagnosis and more than 9 years after onset of symptoms, the participant was still able to ride up to 16 miles on a reclining adapted tandem bike. With variable modifications over the years including head supports, positioning, and different styles of bikes, he has been able to participate in many competitive races including the Leadville 100 and the "Le Petit Tour de France" 292 miles over 10 days.

Discussion : High intensity exercise is controversial for people with ALS, but very important to some people. Creative modifications allowed this individual to participate in competitive intense activity throughout the course of his illness. The subject states "I have become convinced that the traditional standard of care for ALS patients, focused on conservation of energy, is misguided" and feels this level of physical activity has maximized his function, extended his life, and improved his quality of life. His experience and these adaptations should be available to other people who want to continue to be physically active with a progressive neurodegenerative diagnosis.

References: Must include 5 current references (less than 10 years old): De Almeida JPL, Silvestre R, Pinto AC, de Carvalho M. Exercise and amyotrophic lateral sclerosis. *Neurol Sci Off J Ital Neurol Soc Ital Soc Clin Neurophysiol.* 2012;33(1):9-15. doi:10.1007/s10072-011-0921-9. Lui AJ, Byl NN. A systematic review of the effect of moderate intensity exercise on function and disease progression in amyotrophic lateral sclerosis. *J Neurol Phys Ther JNPT.* 2009;33(2):68-87. doi:10.1097/NPT.0b013e31819912d0Majmudar S, Wu J, Paganoni S. Rehabilitation in amyotrophic lateral sclerosis: why it matters. *Muscle Nerve.* 2014;50(1):4-13. doi:10.1002/mus.24202Carreras I, Yuruker S, Aytan N, et al. Moderate exercise delays the motor performance decline in a transgenic model of ALS. *Brain Res.* 2010;1313:192-201. doi:10.1016/j.brainres.2009.11.051.Pupillo E, Messina P, Giussani G, et al. Physical activity and amyotrophic lateral sclerosis: a European population-based case-control study. *Ann Neurol.* 2014;75(5):708-716. doi:10.1002/ana.24150.

TITLE: The Effects of Dance on Backward Walking in Persons with Parkinsons Disease

AUTHORS/INSTITUTIONS: C. Santella, C. Moehlenbrock, J. Freund, S. Vallabhajosula, Elon University, Elon, North Carolina, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Parkinson's disease (PD) is a progressive neurodegenerative movement disorder affecting gait and balance with resultant increased fall incidence. Persons with PD as well as older adults with a history of falls have particular difficulty walking backwards. There is some evidence that dance may improve balance in persons with PD. This study used the Mark Morris Dance for PD program as a template for dance classes to examine the effects of dance on backward walking in persons with PD.

Number of Subjects : Seven individuals with mild to moderately severe PD (mean age 73.6 ± 7.9 years, 4 females) participated in the study.

Materials/Methods : All subjects took part in dance classes led by an instructor trained in the Mark Morris Dance for PD program once a week for 12 weeks. The dance classes consisted of a 20 min warm-up; a 20 min supported standing portion focused on balance and strength exercises; and a 30 min standing portion including partnered movements for swing, shag, and tango. Data were collected before (PRE) and after the 12-week intervention (POST). Participants were asked to walk backwards at their self-selected pace for 5 trials on a 16' Protokinetics Zeno instrumented walkway and spatio-temporal gait parameters were extracted. Dependent variables included absolute (average) and variability measures (standard deviation) of 5 trials. A paired-samples t-test was performed to compare the dependent variables.

Results : There were no significant differences for any of the dependent variables ($P > 0.05$). Mean \pm SE for the absolute measures: Gait speed in m/s (PRE, 0.53 ± 0.06 ; POST, 0.50 ± 0.06), cadence in steps/min (PRE, 108.54 ± 6.14 ; POST, 109.11 ± 4.63), step length in cm (PRE, 28.35 ± 1.87 ; POST, 27.34 ± 2.11), stride length in cm (PRE, 57.09 ± 3.66 ; POST, 55.05 ± 4.16), step time in s (PRE, 0.56 ± 0.03 ; POST, 0.56 ± 0.02), stride width in cm (PRE, 14.93 ± 1.14 ; POST, 15.41 ± 0.79). Mean \pm SE for the variability measures: step length in cm (PRE, 5.30 ± 0.48 ; POST, 5.68 ± 0.85), stride length in cm (PRE, 7.94 ± 0.38 ; POST, 7.66 ± 0.43), step time in s (PRE, 0.05 ± 0.01 ; POST, 0.05 ± 0.01), stride width in cm (PRE, 1.74 ± 0.15 ; POST, 1.65 ± 0.18).

Conclusions : The current study provides preliminary evidence that an instructor-led dance program for once a week may not be sufficient to improve performance in a task like backward walking that requires greater motor planning and control. This could also be attributed to insufficient task-specific training related to backward movement in the dance class.

Clinical Relevance : A structured dance program for persons with PD may have physical, psychological and social benefits. However, there is paucity of information on the dosage and content of such a dance program to maximize outcomes. Based on prior research in persons with PD and older adults backward walking may be an important outcome measure. The current study provides evidence that a dance program conducted once a week without focused task specificity is not sufficient to improve backward walking in persons with PD.

TITLE: Localizing the primary motor cortex as a target for transcranial direct current stimulation (tDCS): A comparison of the 10-20 Electroencephalogram (EEG) System and Transcranial Magnetic Stimulation (TMS) methods: Study in Progress.

AUTHORS/INSTITUTIONS: S. Groth, K. Kubat, J.J. Martin, T. Miller, S. Morse, K. Myhrman, A. Tobias, B.T. Gillick, Physical Therapy, University of Minnesota, Minneapolis, Minnesota, UNITED STATES|T.L. Rich, Rehabilitation Science, University of Minnesota, Minneapolis, Minnesota, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Transcranial Direct Current Stimulation (tDCS) is a type of noninvasive brain stimulation used to influence neuroplasticity in individuals with stroke. Hand function may improve in individuals with hemiparesis due to stroke using tDCS over the primary motor cortex (M1). Two methods exist to determine electrode location —1) The International 10-20 Electroencephalogram (EEG) system and 2) the Transcranial Magnetic Stimulation (TMS)-derived motor hotspot. The purpose of this ongoing study is to determine if there is a difference in M1 location using these two methods in typically developing children (TDC) and children with hemiparesis (CWH) due to stroke. We hypothesize there is no difference between locations within hemispheres in TDC but a difference exists within hemispheres in CWH.

Number of Subjects : 36 children age ranges: 8.1-18.6 years, (23 TDC, 13 CWH).

Materials/Methods : The M1 coordinates for each hemisphere (C3:left, C4:right) were located using the 10-20 EEG system measurements by a pediatric neurodiagnostician. The TMS hotspot was the location requiring the lowest intensity of stimulation to produce a 50 microvolt motor evoked potential from the contralateral first dorsal interosseus with a 70 mm figure-of-eight coil (Magstim Stimulator, Dyfed, UK) by a trained investigator. Stereotactic neuronavigation recorded coordinates from both locations (Brainsight, Rogue Research, Montreal, Canada). A Wilcoxon Signed Rank test was used for statistical analysis within hemispheres, alpha was set to <0.05 a priori. The intended sample size is 50 children for this ongoing study with recruitment continuing.

Results : In TDC, there was a statistically significant difference between C3-C4 coordinates and TMS hotspot within left hemispheres ($Z = 138$, $p < 0.0001$) and right hemispheres ($Z = 138$, $p < 0.0001$). In CWH, there was a statistically significant difference in C3-C4 coordinates and TMS hotspot location within the contralesional ($Z = 45.5$, $p < 0.0002$) and ipsilesional hemispheres ($Z = 27.5$, $p < 0.002$). The median intra-hemispheric differences to date are: 2.53cm in TDC left hemisphere, range: 0.7-5.24cm; 2.23cm in TDC right hemisphere, range: 0.98-6.43cm; 2.06cm in CWH contralesional, range: 0.29-13.92cm; and 2.40cm in CWH ipsilesional, range: 0.83-3.9cm.

Conclusions : With a sample of 36/50 children in this ongoing study, a statistically significant difference was found in locations between EEG and TMS derived M1 locations within hemispheres for both CWH and TDC groups. However, no conclusions can be made regarding if electrode placement at either location is more efficacious. Completion of remaining 14 children will allow for a thorough analysis, discussion and conclusions to be drawn.

Clinical Relevance : The results of this study may guide electrode placement for future tDCS interventions to maximize safety and efficacy in CWH.

TITLE: Effects of 4 weeks of balance training on functional reach and gait velocity in Parkinson's Disease

AUTHORS/INSTITUTIONS: G. Singh, Physical Therapy, The Sage College, Cohoes, New York, UNITED STATES|N.K. Sharma, Y. Colgrove, W. Liu, Physical Therapy and Rehabilitation Science, University of Kansas

Medical Center, Kansas City, Kansas, UNITED STATES|R. Pahwa, K.E. Lyons, Parkinson Disease and Movement Disorders Center, Neurology, University of Kansas Medical Center, Kansas City, Kansas, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Balance impairment is a well-known risk factor for falls in individuals with Parkinson's disease (PD). About 50-70% of people with PD fall at least once in a year. Balance impairment worsens with the progression of the disease and is associated with decreased mobility. To date, few studies have examined balance specific interventions, and none have utilized the Biodex Stability System (BSS) for training individuals with PD. The BSS is a commercially available device commonly used in rehabilitation of musculoskeletal injuries in physical therapy practice. The device has an unstable platform and can provide visual feedback for patients to reach guided target points, which can challenge balance beyond the patients' comfort levels. The purpose of this study was to evaluate whether a specific intervention using BSS can improve balance in individuals with PD to a greater degree than with standard balance exercises (non-BSS). A secondary goal of the study was to evaluate if changes in balance also translate to spatiotemporal gait parameters

Number of Subjects : 20 subjects (10 BSS group; 10 non-BSS group) with PD participated in the study

Materials/Methods : Participants completed 60 minutes of balance training on either BSS or balance exercises listed in the Fall Prevention Booklet from National Parkinson Foundation, 3 times a week for 4 weeks at the University of Kansas Medical Center. Balance was assessed before and after the completion of balance training using the Functional Reach Test (FRT) and gait velocity was measured with GaitMat.

Results : Significant improvement in FRT was found in both groups (BSS; pre and post intervention mean = 9.35 ± 2.1 , 13.18 ± 1.7 inch; $p = 0.005$ and non-BSS; pre and post intervention mean = 10.3 ± 1.2 , 12.43 ± 0.96 inch; $p = 0.01$). Gait velocity was also significantly improved in both groups (BSS; pre and post intervention mean = 0.98 ± 0.23 , 1.12 ± 0.15 m/sec; $p = 0.009$ and non-BSS; pre and post intervention mean = 1.02 ± 0.1 , 1.16 ± 0.1 ; $p = 0.02$). However, we did not find a significant difference in either outcome between groups.

Conclusions : Both balance programs (with and without BSS) resulted in improved balance and gait velocity but the magnitude of improvement, although not significant, was greater in the BSS group. Our results show that BSS can improve balance in people with PD. Additionally, improvement in balance had a positive impact on spatiotemporal gait measures such as gait velocity. To demonstrate the advantage of using BSS over standard balance exercise, however, will require a larger sample size.

Clinical Relevance : Gait and balance problems are common in PD and often result in falls. Specific training to improve balance and reduce falls in PD would be clinically beneficial. Our results indicate that balance specific training is beneficial for PD patients; however, larger, controlled trials with a long-term follow-up period are needed to determine if the BSS training provides additional benefit compare to more traditional balance exercises.

TITLE: Hand function limitations in prodromal and manifest Huntington Disease

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ABSTRACT BODY:

Purpose/Hypothesis : Huntington Disease is a progressive degenerative disorder that presents with impairments in hand movements [1-3]. Impairments such as bradykinesia, excessive grip force, increased temporal and force variability are seen in prodromal (pHD) and manifest Huntington disease (mHD) [2]. However, functional limitations that arise from these motor impairments are not well understood [4]. The manual ability measure (MAM) is a patient-centered task-oriented measure of hand function that has been validated for use in neurological rehabilitation [5]. The purpose of this study was to characterize the earliest functional limitations of the upper limb and examine the association between functional limitations and motor and cognitive function in Huntington's disease (HD).

Number of Subjects : Twenty healthy controls, 23 prodromal HD (pHD), and 20 manifest HD (mHD) subjects.

Materials/Methods : Hand function was assessed with the Manual Ability Measure (MAM), a task oriented, self-report questionnaire that contains 20 one-handed and two-handed upper limb functional tasks. Participants rated their functional ability on a 4-point scale, with higher scores indicating better function. General function was evaluated with the HD-Activities of Daily Living (HD-ADL), a 17-item self-report questionnaire. Items are rated on a 4-point scale (0-3) with higher scores indicating greater functional limitations. Motor function was assessed with the UHDRS total motor score and cognitive function was assessed with the Stroop task.

Results : pHD subjects were classified as "near onset" and "far from onset" based on the disease burden score. Hand function (MAM score) was significantly worse for pHD far from onset ($p<0.01$), pHD near onset ($p<0.003$) and mHD ($p<0.0001$) compared with controls. General functioning (HD-ADL) was worse for pHD near onset ($p<0.03$) and mHD ($p<0.001$) compared with controls. Item analysis revealed that the earliest functional limitations were seen in complex tasks such as handwriting, opening medicine bottle, wringing a towel, handling money and cooking. MAM was significantly correlated with motor ($r= -0.29$, $p<0.05$) and cognitive function ($r=0.63$, $p<0.003$).

Conclusions : The Manual Ability Measure is a sensitive instrument to assess early functional limitations of the upper limb in HD. Earliest functional limitations were seen in tasks that required bimanual control and the integration of cognitive and motor skills.

Clinical Relevance : This is the first study investigating hand functional limitations in prodromal HD before clinical diagnosis. Our study identifies a simple, sensitive patient-centered task-oriented questionnaire that can be administered in clinical practice.

TITLE: The Total Body Recumbent Stepper Submaximal Exercise Test is Reliable in Healthy Adults and in People during Inpatient Stroke Rehabilitation

AUTHORS/INSTITUTIONS: N. Seier, D.R. Wilson, A. Mattlage, J. Todd, B.G. Price, S. Billinger, Physical Therapy and Rehab Science, KU Medical Center, Kansas City, Kansas, UNITED STATES|R. Vardey, Physical Medicine and Rehabilitation, KU Medical Center, Kansas City, Kansas, UNITED STATES|E. Coughenour, Rehabilitation Services, KU Hospital, Kansas City, Kansas, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Submaximal exercise testing presents a practical alternative for measurement of cardio-respiratory fitness in a clinical setting where peak exercise testing may not be feasible. Previously, we developed and validated a prediction equation to estimate peak VO₂ using a total body recumbent stepper (TBRS) based on the Young Men's Christian Association protocol in healthy adults. We then validated this in older adults with various chronic conditions. However, to date no one has tested the reliability of the exercise response (predicted peak VO₂) to the TBRS submaximal exercise test in healthy people or individuals undergoing inpatient stroke rehabilitation. The purpose of the present study was to determine the reliability of the exercise response (predicted peak VO₂) to the TBRS submaximal exercise test in healthy adults and in people post-stroke participating in inpatient rehabilitation. We hypothesized that the predicted peak VO₂ (Time 1) would be strongly ($r > 0.85$) and significantly correlated to predicted peak VO₂ (Time 2).

Number of Subjects : 50 healthy adults and 9 of 25 people post-stroke

Materials/Methods : We recruited 50 healthy participants from the Kansas City Metro and surrounding area and 25 people participating in inpatient stroke rehabilitation. Eligible participants completed 2 TBRS submaximal exercise tests separated by a minimum of 24 hours and a maximum of 5 days at similar times of day. Data was analyzed using SPSS for test-retest reliability with an intraclass correlation coefficient (ICC) computation. P-values less than 0.05 were considered significant.

Results : Fifty healthy adults (36 M, 38.1 ± 10.1 years) participated in the study. We found a significant correlation between predicted peak VO₂ at Time 1 ($47.2 \pm 8.4 \text{ ml*kg}^{-1}\text{min}^{-1}$) and Time 2 ($47.7 \pm 8.5 \text{ ml*kg}^{-1}\text{min}^{-1}$); ICC 2,1 = 0.98, CI = 0.961-0.988, $p < 0.05$). We have collected data on 9/25 people post-stroke (5 M, 60.7 ± 8.5 years). Our preliminary data in people post-stroke shows a strong correlation for predicted peak VO₂ between Time 1 ($21.0 \pm 9.5 \text{ ml*kg}^{-1}\text{min}^{-1}$) and Time 2 ($22.0 \pm 12.9 \text{ ml*kg}^{-1}\text{min}^{-1}$); ICC 2,1 = 0.97; CI = 0.87-0.99), $p < 0.05$).

Conclusions : These results suggest that the exercise response in healthy adults and in people during inpatient stroke rehabilitation is reliable using the TBRS submaximal exercise test. Physical therapists and other healthcare professionals can be confident in using this submaximal exercise test with healthy individuals and people post-stroke.

Clinical Relevance : Physical therapists need standardized and reliable measures to assess cardiorespiratory fitness. This study addresses a gap in knowledge and has demonstrated that the TBRS submaximal exercise test can be used in healthy adults and in people during inpatient stroke rehabilitation.

TITLE: Safety and impact of functional electrical stimulation (FES) cycling in people with multiple sclerosis who are non-ambulatory

AUTHORS/INSTITUTIONS: D. Backus, L. Hawkins, E.M. Gonzales, Crawford Research Institute, Shepherd Center, Atlanta, Georgia, UNITED STATES|B. Burdett, C. Manella, MS Institute, Shepherd Center, Atlanta, Georgia, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : To evaluate the safety, as well as the effects of FES cycling on motor and cognitive impairments and perceived quality of life in people with moderate to severe MS.

Number of Subjects : Fourteen

Materials/Methods : We employed a quasi-experimental pre-post design for this pilot study in a non-profit rehabilitation hospital. Outcome measures were administered immediately before and after the intervention phase to assess spasticity (Modified Ashworth Scale, MAS), strength (manual muscle test, MMT), cognitive processing speed (Paced Auditory Serial Addition Test, PASAT; Symbol Digit Modalities Test, SDMT), and quality of life (MS Quality of Life Inventory, MS QLI). Data was also collected while cycling to assess performance while cycling, and after each training session to assess perception of fatigue, pain and spasticity. Participants trained on the RT-300 FES cycle (Restorative Therapies, Inc., Baltimore, MD) 2-3 times a week for 4-5 weeks. Each cycled at 35-50 rpm for 30 minutes, either with their own volition or with electrical stimulation for assist.

Results : Fourteen participants (8 male) with MS completed 12 sessions of FES cycling over 4-5 weeks. There were no adverse events or worsening of MS symptoms. All participants either maintained or increased the amount of time they could cycle. The seven participants who were able to cycle for 30 minutes were also able to increase the resistance while cycling. There was neither a significant increase nor decrease in MAS and MMT scores. PASAT scores increased significantly ($p<0.00$). In addition, there was a statistically significant decrease in the physical and psychosocial subscales of the Modified Fatigue Impact Scale ($p=0.01$ for both). Pain scores decreased significantly as measured by the MOS Pain Effects Scale, an MS QLI subscale ($p<0.02$). There was no significant change in the other subscales of the MS QLI.

Conclusions : FES cycling may be a safe rehabilitation intervention for people with moderate to severe MS who are non-ambulatory, and who have fatigue or pain. Further study is required to explore the potential benefits for optimizing function in people with MS, and to examine the parameters of FES cycling that are most effective for people with different constellations of MS symptoms.

Clinical Relevance : People with MS who are non-ambulatory require options for exercise to combat the impairments associated with MS. FES cycling may be an option for individuals who have weak or paralyzed lower extremities due to MS.

TITLE: Inter-rater Reliability of Ventilatory Threshold Determination in Chronic Stroke

AUTHORS/INSTITUTIONS: A. Franke, P. Boyne, D. Carl, J. Westover, D. Whitesel, C. Meyrose, K. Dunning, University of Cincinnati, Cincinnati, Ohio, UNITED STATES|D. Reisman, M. Brian, University of Delaware, Newark, Delaware, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Aerobic deconditioning is a major barrier to stroke recovery. Accurate measurement of aerobic capacity is critical for prioritizing interventions, optimizing exercise intensity prescription and assessing intervention effectiveness. The peak oxygen consumption rate at the end of a maximal-effort exercise test (VO₂-peak) is the most common measure of aerobic capacity across populations, including persons with stroke. However, research suggests that after stroke, an exercise test may be limited by motor function before an aerobic endpoint is reached, thus confounding VO₂-peak assessment. It has been suggested that VO₂ at the ventilatory threshold (VO₂-VT), a point associated with the lactate threshold, may be a more specific measure of aerobic fitness for persons with stroke. However, VO₂-VT determination requires some rater interpretation and its reliability has not been previously tested in this population. Therefore, the purpose of this study was to determine the inter-rater reliability of VO₂-VT determination for persons with stroke.

Number of Subjects : 61 exercise tests from 44 subjects.

Materials/Methods : Standardized methods of VO₂-VT determination were established using a combination of the V-slope and ventilatory equivalents graphs. These methods were then independently applied by two experienced raters, using treadmill exercise testing data from persons with chronic stroke obtained from two different laboratories. One laboratory used a constant speed exercise testing protocol with grade increases every two minutes, while the other laboratory used a constant grade protocol with speed increases every two minutes. VO₂-VT determinations were compared between raters with intra-class correlation coefficients (ICC).

Results : Subjects had a mean (SD) age of 59 (10) years and were 4.1 (3.4) years post stroke with a comfortable gait speed of 0.60 (0.35) m/s and a VO₂-peak of 16.0 (4.5) ml/kg/min. Mean VO₂-VT determination was 11.3 (3.4) ml/kg/min for rater A and 11.5 (3.3) ml/kg/min for rater B. Inter-rater ICC was 0.96 for the constant speed protocol and 0.94 for the constant grade protocol, yielding a combined ICC of 0.96 (95%CI: 0.94-0.98).

Conclusions : Inter-rater reliability of VO₂-VT determination for persons with chronic stroke appears to be excellent when using experienced raters and standardized methods, and the results did not appear to be affected by the exercise testing protocol (constant speed or constant grade). Further study is needed to evaluate other types of reliability.

Clinical Relevance : Concerns about the inter-reliability of VO₂-VT determination should not prevent the use of VO₂-VT measurement to assess aerobic capacity for persons with chronic stroke. Further, the use of multiple trained and experienced VO₂-VT raters should have minimal impact on the assessment.

TITLE: The relationship between sub-maximal knee extensor force regulation and function post stroke

AUTHORS/INSTITUTIONS: R. Berrios, A. Hyngstrom, Physical Therapy, Marquette University, Milwaukee, Wisconsin, UNITED STATES|M. Joshi, K. Keenan, S. Strath, Kinesiology, University of Wisconsin-Milwaukee, Milwaukee, Wisconsin, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Post stroke, leg function is limited by motor impairments that include a decreased ability to control sub-maximal forces. Many activities of daily living and postural responses involve sub-maximal (versus maximal) force regulation. Clinically feasible, quantitative measurements of motor impairments, such as sub-maximal force regulation, may improve patient evaluations and benchmarking progress during stroke rehabilitation. The quantification of sub-maximal force regulation may provide insight into a stroke survivor's resolution of control. To quantify the relationship between sub-maximal isometric force regulation of the paretic knee extensors and measures of clinical function.

Number of Subjects : 12

Materials/Methods : The coefficient of variation (CV) of force (standard deviation of force/mean force) was calculated from sub-maximal isometric contractions of the paretic knee extensors (20% of their maximal voluntary contraction, 3 trials at 10s/trial) in 12 individuals with chronic stroke (mean age: 62 ± 7 years). The CV determines the relative magnitude of force fluctuations and provides quantitative information on steadiness. The CV of the paretic knee extensors was correlated with the following clinical measures of function/impairment: the Ten Meter Walk Test, Modified Physical Performance Test, the Berg Balance Scale, the Dynamic Gait Index, and the 6 minute walk test.

Results : There were significant ($P < 0.05$) negative correlations between the knee extensor CV and the following: Ten Meter Walk Test ($r^2=0.49$), the Modified Physical Performance Test ($r^2= 0.39$), and 6 Minute Walk Test ($r^2= 0.38$). In addition, there was a strong trend between the knee CV and the Dynamic Gait Index ($r^2= 0.28$).

Conclusions : Individuals with larger knee extensor force fluctuations (i.e. less steady) performed worse on measures of walking speed, endurance, dynamic balance, and gross physical function.

Clinical Relevance : These data suggest that metrics of sub-maximal force regulation of the knee extensors (CV) are related to clinical measures of impairment and function and may be a useful quantitative measure of motor impairment post stroke.

TITLE: The Influence of Training Environment on Self-selected Gait Speed

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ABSTRACT BODY:

Purpose/Hypothesis : One of the many rehabilitative needs for individuals with neurological deficits is the recovery of independent gait. Gait training involves the manipulation of parameters such as speed, postural control, and endurance. Research has been conducted to explore strategies designed to improve these gait parameters in hopes of promoting normal gait recovery. The most heavily weighted outcome of these is gait speed. The emphasis on improving gait speed has resulted in multiple approaches that include treadmill and body weight support, over-ground strategies and robotics. When testing gait speed, it is classified into two major categories: comfortable and fast gait speed. The literature is void of published data on the influence of gait training environments on comfortable or fast gait speed. The presumed expectation is that an individual's self-selected comfortable gait speed (SSCWS) will be similar regardless of training environment (over-ground, treadmill or robotic). The purpose of this study was to investigate the influence of different rehabilitative environments on SSCWS for healthy individuals.

Number of Subjects : 20 healthy adults were recruited for participation. Subjects were an average age of 24 and had no prior history of lower extremity surgeries.

Materials/Methods : SSCWS was collected in 3 separate walking environments: over-ground walking (OGW) during a 6-minute walk test, Treadmill walking with body weight support (BWS), and walking over a treadmill while secured to an exoskeletal robot (Hocoma® Lokomat) (RW). Each participant was asked to walk at their comfortable walking pace. Overground walking speed was calculated using the average of three recorded 10 meter passes. OGW and RW speed were adjusted based upon subject preference.

Results : All subjects completed SSCWS recordings for all three conditions. A significant difference in self-selected gait speed ($F=211.36$, $p<.0001$) was found for within subjects comparisons across all three environments. Post hoc analysis revealed significant differences in mean scores for SSCWS for all conditions. The mean OGW speed was (1.42m/s) significantly faster ($p<.0001$) than the SSCWS average for BWS (1.13m/s). Subject SSCWS mean scores for RW (.86m/s) was significantly slower than both SSCWS on the BWS and OGW ($p<.0001$).

Conclusions : Significant differences in SSCWS were found when healthy adults transitioned between each training environment. Subjects had a significant decrease in the speed of training when external training modalities were added to walking. As the level of intrinsic speed management decreased so did subject mean SSCWS. The lack of ability to dynamically control the speed significantly influenced the subjects' perceived walking comfort.

Clinical Relevance : To create a neuroplastic gait change, patients need to train at a task that will enable them to function in society. RW and BWS, while effective at enhancing the repetitive gait motion, may not be ideal for impacting speed. These findings suggest that increased external influence on gait speed limited perceived comfort level making self-selected training impractical.

TITLE: Concussion Among Middle School Students: Incidence, activities, and symptoms

AUTHORS/INSTITUTIONS: S.G. Siegel, P. Finemore, S. Livingstone, A. Skillings, J. Tardiff, E. Veilleux, Physical Therapy, Husson University, Bangor, Maine, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Since high school students recover more slowly from concussion than do college students, it has been suggested that younger students may be even more vulnerable to the effects of concussion; however, little is known about concussion among middle school (MS) students. Our purpose was to describe the incidence, symptoms, and causal activities of concussions among MS students. We hypothesized that MS students would exhibit similar symptoms, but might have a higher incidence of concussion and longer symptom duration as compared to older students. We also expected to see a gender difference.

Number of Subjects : 428

Materials/Methods : Upon gaining approval from their respective superintendents, MS principals in Maine were contacted regarding this study. Those who were willing to take part received an electronic version of a survey to send to parents of MS students. Hard copy versions to send home with the students were also available. The survey asked whether one's child had experienced a concussion in MS, and then asked for additional details about the injury. Descriptive statistics were used to show the activities in which concussions occurred, and the number and duration of symptoms. Chi square was used to determine differences between genders for frequency data, and t-tests were used for parametric data.

Results : Fifteen percent of participants reported a concussion during MS, accounting for 31% of all reported injuries during that time. Incidences were similar for males and females. While the greatest number of concussions occurred during soccer and football, nearly half of all concussions occurred outside of organized sports. The most common symptoms were headache, photosensitivity, and alterations in sleeping patterns. The prevalence of individual symptoms was similar among males and females, except that significantly more females than males reported difficulty concentrating ($p = .014$), and feeling stunned, ($p = .005$). Symptom duration was similar among genders, with symptoms most commonly lasting from 2 days to 1 week. Of those students who had had a concussion, 21.5 had sustained multiple concussions during MS. These students had more symptoms, but the duration of symptoms was not significantly different from those who had just had one concussion. Of all students who were involved in sports, only 14.6% had undergone neurocognitive testing prior to their participation.

Conclusions : Concussions account for a substantial proportion of injuries among MS students. Many occur outside of organized sports, whereas most reported concussions in high school and college occur during sport activities. Both genders demonstrate similar incidences and symptoms following concussion, and their durations are comparable to those of older age groups. MS students who experience multiple concussions have greater numbers of symptoms.

Clinical Relevance : The large number of MS students who experience concussion suggests that all MS students should have baseline testing performed so that if a concussion does occur, deficits may be detected, and reasonable accommodations may be made in school.

TITLE: Early Mobilization of Patients at High Risk of Vasospasm in the Neurological Intensive Care Unit: A Case Report

AUTHORS/INSTITUTIONS: N. Khalil, K. Shah, RUSK Rehabilitation at NYU Langone Medical Center, New York, New York, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : Cerebral vasospasm is often associated and researched with patients who have had a subarachnoid hemorrhage(s) (SAH). It is considered an important determinant of delayed ischemic injury and is the leading cause for delayed mortality and morbidity following SAH. CV can also be caused by head trauma and for idiopathic reasons. The purpose of this case report is to explore the impact of an early mobilization program on outcomes of a patient in the neurological intensive care unit (NICU) at increased risk for CV status post resection of a large skull based meningioma.

Case Description : A 53 year old female was admitted to an acute care hospital with a history of vision loss. Workup revealed a large parasellar meningioma for which she underwent a craniotomy for tumor resection. Post-operatively her course was complicated by hypotension, left hemiparesis, severe recurrent right middle cerebral artery (MCA) vasospasms, cardiogenic shock, and subsequent infarcts in the right MCA territory. Medical management entailed vigilant monitoring and treatment including balloon angioplasty with intra-arterial verapamil, invasive monitoring of blood pressure, and cerebral blood flow, hypertensive drugs, hemodilution and hypervolemia. Physical therapy (PT) sessions were discussed daily with the neurocritical and neurosurgical teams, and incorporated close monitoring of the patient's hemodynamic status and neurologic exam. When the patient was experiencing cerebral vasospasms, patient was on complete bedrest. Upon initial PT assessment, the patient was lethargic, however, alert and oriented to person, place, and time. She presented with left hemibody weakness, with trace muscle activation in left lower extremity, and no muscle activation in left upper extremity. Functionally, she required maximal assistance of two therapists for bed mobility and transfers.

Outcomes : The patient made gains in functional mobility during her 27 day stay in acute care, 25 days of which were in the NICU. She initially required maximal assistance of two therapists for all bed mobility and transfers. She progressed to pre-gait and gait activities with minimal to moderate assistance of two therapists. Prior to discharge to acute inpatient rehab, the patient ambulated 15 feet with moderate assistance of two therapists.

Discussion : PT professionals are vital members in the interdisciplinary team providing care for patients at risk for CV in the NICU and in creating a safe discharge plan. Studies have demonstrated that early mobilization programs implemented in the NICU have been feasible and safe in patients with SAH. However, there is no evidence on the effectiveness of early mobilization programs in patients at risk for CV. This case study illustrated a safe and effective early mobilization program in a patient with CV following tumor resection. More studies with CV and early mobilization are indicated to promote a culture of mobility and enhance patient outcomes.

References: Must include 5 current references (less than 10 years old): Bederson JB, Connolly ES Jr, Batjer HH, Dacey RG, Dion JE, Diringer MN, Duldner JE Jr, Harbaugh RE, Patel AB, Rosenwasser RH. (2009). American Heart Association. Guidelines for the management of aneurysmal subarachnoid hemorrhage: a statement for healthcare professionals from a special writing group of the Stroke Council, American Heart Association. *Stroke*. 40:994–1025. Pluta RM, Hansen-Schwartz J, Dreier J, Vajkoczy P, Macdonald RL, Nishizawa S, Kasuya H, Wellman G, Keller E, Zauner A, Dorsch N, Clark J, Ono S, Kiris T, Leroux P, Zhang JH (2009). Cerebral vasospasm following subarachnoid hemorrhage: time for a new world of thought. *Neurol Res* 31:151–158. Olkowski BF, Devine MA, Slotnick LE, et al. (2013). Safety and feasibility of an early mobilization program in patients with aneurysmal subarachnoid hemorrhage. *Physical Therapy*. 93:208–215. Ropper A.H., Samuels M.A., Klein J.P. (2014). Chapter 34. Cerebrovascular Diseases. In Ropper A.H., Samuels M.A., Klein J.P. (Eds), *Adams & Victor's Principles of Neurology*, 10e. Sehba FA, Pluta RM, Zhang JH. (2011). Metamorphosis of subarachnoid hemorrhage research: from delayed vasospasm to early brain injury. *Molecular Neurobiology*. 43:27–40.

TITLE: Immersive Virtual Reality Using a Low Cost Head-Mounted Display: A feasibility test for individuals with Parkinson's disease

AUTHORS/INSTITUTIONS: A. Kim, N. Darakjian, J.M. Finley, Division of Biokinesiology and Physical Therapy, University of Southern California, Los Angeles, California, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : One of the major challenges for locomotor training in individuals with Parkinson's disease (PD) is to create safe environments where patients can practice the skilled behaviors needed for real-world walking. Recently, virtual reality (VR) has been explored as an addition to conventional rehabilitation to enable patients to practice challenging, real-world tasks in a safe environment. Recent technological advances have provided the ability to use low-cost, fully immersive environments (e.g. the Oculus Rift) for potential therapeutic applications. However, there is some concern that these devices may lead to adverse effects, such as simulator sickness, which may be more pronounced with age or pathology. Therefore, it is necessary to determine if extended walking in fully immersive environments causes adverse effects that may preclude the use of these technologies in the clinic. Our purpose was to evaluate if age and pathology (PD) affect the feasibility of using immersive VR using a head-mounted display for gait training. Feasibility was assessed by quantifying symptoms of simulator sickness, compromised balance, and stress.

Number of Subjects : To date, we have tested 11 healthy young adults (HY) and 5 individuals with PD.

Materials/Methods : Pre-Test: Baseline balance was assessed using center of pressure (CoP) sway area during quiet stance. For clinical assessments, we administered the unified Parkinson's disease rating scale, the Activity-specific Balance Confidence scale, mini-Balance Evaluation Systems Test (mini-BEST), and the Montreal Cognitive Assessment. Self-selected gait speed was measured using the 10-meter walk test, and lastly, a simulator sickness questionnaire (SSQ) and a stress arousal checklist (SAC) were completed by each participant. Exposure: Participants wore an Oculus Rift head mounted display projecting a virtual downtown scene and walked on an instrumented treadmill for 20 minutes in 5 minute intervals. Post-Test: The SSQ, SAC, presence questionnaire and a patient preference questionnaire were completed after the exposure. We also measured CoP sway area, the mini-BEST and a 10-meter walk test. For each dependent variable, a 2-way ANOVA was used to test for effects of group (HY, PD) and time (pre vs post).

Results : Overall, there were no significant adverse effects for either group. Specifically, there were no changes in symptoms of simulator sickness or stress after exposure to walking in the virtual environment. There were also no changes in dynamic or static balance as assessed by the mini-BEST and CoP sway area, respectively. Surprisingly, our virtual environment was more compelling than a previous study using a head-mounted VR display as measured by the presence questionnaire.

Conclusions : Our preliminary results suggest that immersive VR using a low-cost head-mounted display may be feasible for therapeutic use in individuals with PD.

Clinical Relevance : Future work will explore the efficacy of combining immersive VR with skilled gait training to improve walking function in individuals with PD.

TITLE: A Novel Approach to Exertion Testing in Patients after Concussion with Symptoms at Rest.

AUTHORS/INSTITUTIONS: J.L. Fay, T.V. Denham, Physical Therapy, NYU Langone Medical Center/Rusk Rehabilitation, New York, New York, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : After concussion, patients are prescribed cognitive and physical rest. Aerobic exercise is generally not recommended until symptoms subside at rest. Extended rest and activity avoidance can result in physiological deconditioning and metabolic disturbances. Leddy et. al has researched the Buffalo Concussion Treadmill Test (BCTT); a standardized assessment to establish safe exercise prescription for this population. One contraindication to performing the BCTT is a significant balance and/or visual deficit that represent a significant risk for using a treadmill (TM). We have found that a subset of patients is averse to the sensory stimulation provided by the TM. Therefore we developed a graded exercise test using a stationary bicycle (SB). The purpose of this case report is to describe a standardized, graded exercise test using a SB, as this may prove a safe way to diagnose metabolic dysfunction and to introduce activity earlier in a patient's course of recovery.

Case Description : Patient was a 17-year old male referred to vestibular rehabilitation (VR) 18 months following a concussion (with LOC and amnesia) while playing ice hockey. At initial evaluation he had not returned to school full time, reported difficulty with reading and concentration, and had not returned to any physical activity due to symptoms of dizziness and headache (HA) with exertion. He also endorsed dizziness and imbalance with busy environments, riding the subway and desired to return to sports. Ambulation on TM caused patient to report increased HA and dizziness at HR 120bpm or 60% of age predicted max HR. Patient was tested for symptom threshold (ST) on the SB and was able to reach HR 141bpm (70% of the age predicted max HR) after 14 minutes prior to reporting increased symptoms of dizziness and HA. He was instructed to maintain HR at 80% of ST for 20-30 minutes and increase HR by 5bpm every 2 weeks as long as his symptoms did not increase by more than 3/10. Standard VR exercises including VOR and balance retraining were provided to address dizziness with head movement and visual desensitization.

Outcomes : Baseline dizziness at rest decreased from 4/10 to 1/10. He was able to exercise on the SB at 65% of age predicted max HR for 30 minutes without symptom complaint. He no longer demonstrated imbalance while walking with head turns and he improved speed on the VOR from 43.3% of expected norm to 100% of expected norm with reduced dizziness from 4/10 to 1/10. He returned to school full time to finish his senior year and 6 months after discharge reported running again for 8-10 miles with no HA or dizziness.

Discussion : Aerobic exercise is safe in patients with symptoms at rest and the SB is an alternative to the TM for exertion testing in patients with dizziness and HA at rest. The SB was a useful modality to allow this patient to exercise aerobically without increasing dizziness and imbalance. VR and aerobic exercise on the SB allowed this patient to return to sports and school.

References: Must include 5 current references (less than 10 years old): 1.Valovich McLeod, T.C. and T.D. Hale, Vestibular and balance issues following sport-related concussion. *Brain Inj*, 2015. 29(2): p. 175-84.2.Leddy JJ, Willer, B. Use of Graded Exercise Testing in Concussion and Return to Activity Management. *Curr Sports Med Rep*. 2013; 12:370-6. 3.McCrory P, Meeuwisse W, Johnston K, et al. Consensus statement on concussion in sport, 3rd International Conference on Concussion in Sport, held in Zurich, November 2008. *Clin J Sport Med*. 2009;19: 185-200.4.Leddy JJ, Kozlowski K, Donnelly J.P., Pendergast D.R., Epstein L.H., Willer B. A preliminary study of subsymptom threshold exercise training for refractory post-concussion syndrome. *Clin J Sport Med* 20 (2010), 21-275. Alsalaheen, B.A., et al., Vestibular rehabilitation for dizziness and balance disorders after concussion. *J Neurol Phys Ther* 2010. 34(2): 87-93.

TITLE: Improvements in Functional Strength and Mobility following Power Training and Overground Walking for an Individual with Chronic Stroke Impairments: A Case Study

AUTHORS/INSTITUTIONS: J.A. Schaffer, S.D. Schaffer, P.R. Bosch, Physical Therapy and Athletic Training, Northern Arizona University, Phoenix, Arizona, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : Poststroke neuromuscular impairments can be attributed to decreased motor control and muscle power generation, resulting in a variety of functional mobility deficits. The purpose of this case report was to describe functional changes associated with power training and overground walking for an individual with chronic stroke impairments.

Case Description : The patient was a 58 year-old male who sustained a hemorrhagic stroke 11 months prior to initiating this intervention. Past medical history was insignificant and the individual had been physically active prior to the stroke. The patient's walking speed had not improved recently in spite of intensive treadmill walking, and he expressed a desire to walk faster, gain LE strength, and improve functional mobility. Based on the patient's goals and functional deficits, a 10-week program was implemented using power training and overground walking. The protocol consisted of one supervised 90-minute training session per week in a research laboratory, and two additional independent home workouts. Each supervised session consisted of 30 minutes of overground walking and 60 minutes of power training including body weight squats, squat jumps, step-ups, lunges, and kettlebell swings.

Outcomes : Fugl-Meyer Assessment of Motor Recovery (FMA) Lower Extremity Motor Score, 30 second sit to stand test, 10 Meter Walk Test, 1 repetition maximum (1RM) body weight squat with upper extremity support, the Stroke Impact Scale (SIS), and a submaximal VO₂ test were administered one week before and one week after the 10-week training intervention. Results: The patient completed 10 weeks of training with no adverse events. He improved in all outcome measures except the FMA. 10 Meter Walk Test speed improved from 0.690 m/s to 1.761 m/s for self-selected walking, and from 2.342 m/s to 2.732 m/s for fastest safe walking. 30 second sit to stand repetitions increased from 14 to 18 and use of upper extremity support during 1RM body weight squat was reduced from a peak force of 35 lbs to 10 lbs. Walking efficiency improved from 2.5 mph at 15% incline to 3.1 mph at 15% incline with no change in VO₂ or heart rate during the submaximal VO₂ test, and percent recovery on the SIS improved from 50% to 70%.

Discussion : These results support the use of engaging and challenging strength, power, and overground training strategies for adults who have chronic deficits from a stroke. The patient enjoyed the rigor and novelty of the exercises and expressed more confidence in navigating the community as a result of strength and mobility improvements. He reported improvement in self-stated goals including climbing stairs, getting in and out of the shower, getting up from soft surfaces, completing yard work, and walking outdoors, and noted he was also able to perform self-care activities in a more efficient and controlled manner.

References: Must include 5 current references (less than 10 years old): 1. Morgan P, Embry A, Perry L, Holthaus K, Gregory C, M. Feasibility of lower-limb muscle power training to enhance locomotor function poststroke. *J Rehabil Res Dev.* 2015;52(1):77-84. 2. Severinsen K, Jakobsen J, K., Pedersen A, R., Overgaard K, Andersen H. Effects of resistance training and aerobic training on ambulation in chronic stroke. *Am J Phys Med Rehabil.* 2014;93(1):29-42. 3. Brogårdh C, Lexell J. Effects of cardiorespiratory fitness and muscle-resistance training after stroke. *PM&R.* 2012;4(11):901-907. 4. Pak S, Patten C. Strengthening to promote functional recovery poststroke: An evidence-based review. *TOP STROKE REHABIL.* 2008;15(3):177-199. 5. Severinsen K, Jakobsen JK, Overgaard K, Andersen H. Normalized muscle strength, aerobic capacity, and walking performance in chronic stroke: A population-based study on the potential for endurance and resistance training. *Arch Phys Med Rehabil.* 2011;92(10):1663-1668.

TITLE: Using Symptoms to Dose Therapeutic Exercise for a Female with Multiple Sclerosis After an Acute Exacerbation: A Case Report

AUTHORS/INSTITUTIONS: A. Mielke, R.T. Lazaro, G.L. Widener, Physical Therapy, Samuel Merritt University, Oakland, California, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : There is limited evidence on the effect of exercise and appropriate dosage of interventions for a person with multiple sclerosis (MS) directly following an exacerbation of the condition. The purpose of this case report is to describe a short-term physical therapy plan of care using the patient's symptoms to guide intensity of interventions aimed at improving endurance with ambulation, lower extremity (LE) strength, and functional mobility for a patient following an acute MS exacerbation in an inpatient setting.

Case Description : The patient was a 30-year-old woman with a two-month history of MS who experienced an exacerbation resulting in bilateral LE weakness, inability to ambulate, and increased fatigue. The patient received physical therapy three weeks after the onset of her exacerbation. The primary interventions used were gait training, progressive resistance exercise, and functional mobility training. Onset of the patient's symptoms of general fatigue, LE pain, numbness and tingling, and blurring vision were used to dose her exercise threshold.

Outcomes : The patient was seen five days a week for two weeks. She improved in all outcome measures. The 2-Minute Walk Test (2MWT) demonstrated improved gait distance of 118 feet and increased gait velocity of 30%. Her level of disability improved on the Disease Steps scale from level six to level five. The patient's motor score on the Functional Independence Measure (FIM) improved by 45 points. Her score on the Multiple Sclerosis Impact Scale (MSIS-29) improved by 26 points and her score on the Modified Fatigue Impact Scale 5 Item (MFIS-5) improved by 10 points. The patient demonstrated improved gross strength of bilateral LEs with manual muscle testing. Results from initial examination ranged from 2- to 3+ out of 5 and on final examination she scored grossly 3+ to 4 out of 5. No adverse effects were noted throughout her episode of care.

Discussion : This case demonstrates how using a patient's symptoms of MS may be an appropriate method to dose the intensity of interventions to improve endurance with ambulation, LE strength, and functional mobility in a patient after an acute MS exacerbation.

References: Must include 5 current references (less than 10 years old): 1. Polman CH, Reingold SC, Banwell B, et al. Diagnostic criteria for multiple sclerosis: 2010 revisions to the McDonald criteria. *Ann Neurol.* 2011;69(2):292-302. 2. Dalgas U, Stenager E, Jakobsen J, et al. Resistance training improves muscle strength and functional capacity in multiple sclerosis. *Neurology.* 2009;73(18):1478–1484. 3. Bjarnadottir OH, Konradsdottir AD, Reynisdottir K, Olafsson E. Multiple sclerosis and brief moderate exercise: a randomised study. *Mult Scler.* 2007;13(6):776-782. 4. Smith RM, Adeney-Steel M, Fulcher G, Longley W. Symptom change with exercise is a temporary phenomenon for people with multiple sclerosis. *Arch Phys Med Rehabil.* 2006;87:723-727. 5. Dettmers C, Sulzmann M, Ruchay-Plössl A, Gütler R, Vieten M. Endurance exercise improves walking distance in MS patients with fatigue. *Acta Neurol Scand.* 2009. 120(4):251-257.

TITLE: Evaluating Utility of Muscle Architectural Parameters with Real-Time Ultrasound Imaging of Spastic Musculature in individuals Post Stroke

AUTHORS/INSTITUTIONS: G. Thielman, L. Journey , Physical Therapy , University of the Sciences, Philadelphia, Pennsylvania, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Accurate objective measuring of spasticity is important for a universal standard of diagnostic and treatment effectiveness post cerebrovascular accident (CVA). Increased practice of real-time ultrasound imaging in the physical therapy profession, has made it essential to evaluate the utility of its use post CVA. This study was designed to evaluate the relationship of spastic brachialis muscle architectural parameters (MAP) with measures of upper extremity function and spasticity. No significant relationship was expected between spastic brachialis muscle and patient function and no significant difference was expected between affected MAP and unaffected MAP.

Number of Subjects : 11 individuals post CVA with spasticity and moderate impairment of the upper limb

Materials/Methods : Brachialis muscle pennation angle (PA) and fascicle length (FL) were obtained in the affected and unaffected arm at rest. Involved side upper extremity Fugl-Meyer (FMA) and Modified Ashworth Scale (MAS) of the affected biceps muscle were collected. MAP of affected and unaffected brachialis muscles were assessed for a significant relationship (Wilcoxon Signed Rank Test, $p < 0.05$). MAP of affected brachialis muscles were compared to patient function, and MAS scores of affected biceps were compared to upper extremity FMA scores (Spearman's Rho, $p < 0.05$).

Results : Affected brachialis PA were found to be significantly greater ($p < 0.05$) than the unaffected side, and affected FL were found to be significantly shorter ($p < 0.05$) than the unaffected side. Higher PA of the affected brachialis muscle yielded a strong correlation with a higher biceps MAS score (.831 at $p < .05$). Higher FMA scores of the affected upper extremity were inversely correlated (-.808 at $p < .05$), with lower MAS scores. There was no significant correlation between FL and MAS or FMA.

Conclusions : The ability of a muscle to produce strength is affected by its architectural parameters; a higher PA means less muscular alignment and therefore the maximum force in the direction of action is less, while a lower FL leads to less force during a contraction. Decreased function post-CVA may be due to chronic shortening of muscle fascicles and increasing PA's. Our study further validates the use of real-time ultrasound imaging in post-CVA patients as we found a significant difference in MAP between affected and unaffected brachialis muscles.

Clinical Relevance : The MAS tests resistance to passive movement at a joint, with varying degrees of velocity. There are many limitations to this scale, including its poor interrater reliability and adequate intrarater reliability in individuals post CVA. Due to the shortcomings of the MAS, it is important to establish an objective method of quantifying muscular parameters in spastic muscles post-CVA. An objective method of quantifying spasticity would add to the body of literature in determining if functional gains made post-CVA are due to compensations in movement, or due to physiological changes at the muscular level.

TITLE: Motor unit activity and functional ability in spinocerebellar ataxia 6

AUTHORS/INSTITUTIONS: E.A. Christou, A. Casamento-Moran, N. Lodha, Y. Chen, M. Kwin, A. Snyder, D.E. Vaillancourt, Applied Physiology and Kinesiology, University of Florida, Gainesville, Florida, UNITED STATES|S.H. Subramony, Department of Neurology, University of Florida, Gainesville, Florida, UNITED STATES|J.B. Stephenson, School of Physical Therapy & Rehabilitation Sciences, University of South Florida, Tampa, Florida, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Spinocerebellar ataxia type 6 (SCA6) is a genetic disease that causes pure cerebellar degeneration^{1,2}, which significantly impairs individuals' postural control and gait^{3–5}. Despite this, little is known about the activation of the motor neuron pool in SCA6. We examine motor unit activation and how it correlates with impaired function in people with SCA6. We hypothesize that people with SCA6 and increased multi motor unit discharge rate variability will exhibit lower functional ability.

Number of Subjects : 16

Materials/Methods : Eight individuals diagnosed with genetically confirmed SCA6 (65.17 ± 8.61 yrs) and eight age-matched, healthy controls (64.8 ± 8.7 yrs) performed constant isometric contractions of the ankle joint. We examined the activation of the motor neuron pool by quantifying discharge characteristics of multiple motor units in the tibialis anterior muscle. The International Cooperative Ataxia Rating Scale (ICARS)⁶ was used to assess severity of ataxia and functional abilities of subjects with SCA6.

Results : Participants with SCA6 exhibited greater multi motor unit discharge rate variability than healthy controls (95.74 ± 3.7 vs. 92.62 ± 3.82 ; $P < 0.05$). Mean discharge rate and discharge rate variability were significantly correlated with SCA6 participant's ICARS scores. Specifically, SCA6 participants with lower discharge rate exhibited greater functional impairments as measured by ICARS kinetic score ($R^2 = 0.75$) and the ICARS total score ($R^2 = 0.46$). Further, SCA6 participants with greater discharge rate variability exhibited greater functional impairments on the ICARS kinetic score ($R^2 = 0.82$) and the ICARS total score ($R^2 = 0.64$).

Conclusions : SCA6 alters the activation of the motor neuron pool, which impairs functional ability. This is demonstrated by the relationship between ICARS scores and mean discharge rate and discharge rate variability of multiple motor units.

Clinical Relevance : For the first time, this study demonstrates that the degree of functional impairment in people with SCA6 is related to the activation of the motor neuron pool. These findings, therefore, suggest that rehabilitation protocols in SCA6 should primarily focus on decreasing the variability in the activation of the motor neuron pool.

TITLE: Complex motor skill learning benefits transfer to simpler functional tasks in patients with stroke

AUTHORS/INSTITUTIONS: S.S. Kantak, N. Zahedi, R.L. McGrath, MRRI, Moss Rehabilitation Research Institute, Elkins Park, Pennsylvania, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Motor skill training involves acquiring novel movement capabilities through practice that leads to an improvement in the speed-accuracy tradeoff function (SATF), akin to acquiring real-world skills. Skill learning is behaviorally and neuroanatomically distinct from the commonly studied motor adaptation and sequence learning. The purpose of this study was to investigate how motor skill is learned and if it is transferred to a different functional task following practice of the paretic arm in patients with stroke. We also examined the neural mechanisms of skill learning using transcranial magnetic stimulation (TMS).

Number of Subjects : 15 patients with mild-to-moderate (UEFM score 40-60) unilateral stroke

Materials/Methods : Participants practiced a complex motor task with a goal to navigate a cursor with their paretic arm through a virtual track as fast as possible without crossing the borders of the track. Performance changes during practice were characterized by accuracy improvements while practicing within the prescribed movement time ranges. Learning was indexed by changes in SATF measured at baseline, a day and approximately a month after practice ended. To assess the transfer to a non-practiced task, we examined the pre-post changes in goal-directed reaching to three different targets placed in front of the patient. Finally, we assessed the practice-induced change in TMS-evoked motor evoked potential (MEP) recruitment curve, contralateral silent period and transcallosal inhibition targeting the paretic triceps brachii.

Results : All patients improved their performance on the practiced task. Following practice, there were improvements in the SATF that were well-retained over a month. Importantly, there was a significant improvement in the performance and control of non-practiced functional reaching task as evidenced by reduced movement times, higher peak velocities and shorter time-to-peak velocities after practice. Improved motor control was also reflected in reduced submovements during the practiced as well as the non-practiced task. Neurophysiological data indicated an increase in the corticospinal excitability and decrease in transcallosal inhibition with training.

Conclusions : Patients with stroke learn and retain complex skills with their paretic arm following intense practice. This skill learning is accompanied by changes in the corticospinal and interhemispheric mechanisms. The most novel finding of our study is that learning of the complex task transferred to improved performance on an untrained task.

Clinical Relevance : Complex task practice may be helpful in driving performance and control improvements for simple tasks, particularly if the two (complex and simple tasks) share similar control processes. Corticospinal and interhemispheric changes likely underlie the efficient motor performance.

TITLE: Physical Therapists' Clinical Decision Making in Patients with Gait Impairments from Hemiplegia: A Qualitative Study

AUTHORS/INSTITUTIONS: J. Seale, C.J. Utsey, Physical Therapy, UTMB, Galveston, Texas, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Stroke is a common cause of disability, and results in altered gait patterns and limited walking in a majority of stroke survivors. During rehabilitation following stroke, physical therapists (PTs) employ many interventions to address these alterations, and may consider utilization of lower extremity orthotics as an intervention. Despite evidence that ankle foot orthosis (AFO) usage following stroke improves a multitude of gait measures and parameters, AFO usage remains controversial among PTs. Therefore, the purpose of this qualitative study was to investigate the current trends in PTs clinical decision making in assessing and managing gait in persons with hemiplegia.

Number of Subjects : 22

Materials/Methods : A qualitative study using a phenomenological approach for collecting data was conducted using a semi-structured interview protocol with focus groups. Participants consisted of expert PTs (PTs who have achieved APTA specialty certification in neurologic physical therapy) and novice PTs (PTs with less than 2 years of experience and no advanced certification) working in a neurologic rehabilitation setting. Participants were informed of the study and consent to participate was obtained prior to conducting the interview. Each participant completed demographic data. Demographic data was analyzed using descriptive statistics. Constant comparative qualitative analysis was used to analyze the qualitative data.

Results : A total of 22 PTs participated in five focus groups (2 novice and 3 expert groups). The average age was 26.75 for novice and 38.44 for expert PTs. The average years of experience for the novice group was 1.42 and for the expert group 12.64. From the analysis of qualitative data, five themes emerged: Novice and experienced clinicians 1) take a systematic approach to examination and evaluation of persons with hemiplegia; 2) are in agreement in common gait deficits found in persons with hemiplegia; 3) may differ in their approach to treatment based on the amount of experience of the clinician; 4) generally agree on the manner in which orthotics are used in the management of persons with hemiplegia; 5) demonstrate professional accountability to patients concerning the use of orthotic devices.

Conclusions : This qualitative study provided insight into the variability in PTs strategies for gait analysis, and their identification and interpretation of common deviations and impairments in persons with hemiplegia following stroke. Reluctance to utilize orthotics for patients with hemiplegia was a consistent theme across focus groups. Therapists expressed a desire to “maximize recovery”, and described using an AFO as “a last resort”.

Clinical Relevance : Results of this study indicate a need to investigate when strategies and philosophies for gait analysis and gait rehabilitation develop, and whether or not these are a product of education or mentoring. Further, there is a need to investigate the relationship and degree of collaboration between PTs and orthotists, and seek to determine what bearing this has on orthotic prescription.

TITLE: Effects of an 8-week functional circuit training program on aerobic capacity in individuals with chronic stroke

AUTHORS/INSTITUTIONS: M. Vore, L. Altman, J. Bliss, M. Higgins, J. Hogan, L. Jamieson, J. Santelli, A.S. Bartlett, E. Clark, J. Mowder-Tinney, Physical Therapy, Nazareth College, Rochester, New York, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Individuals with chronic stroke may present with an impairment of decreased aerobic capacity due to physical inactivity. Aerobic conditioning utilizing treadmill training has been shown to improve aerobic capacity in individuals post stroke. Participation in a high intensity circuit with functional activities has limited evidence. The purpose of this study was to examine the physiological effect (VO₂peak) of an 8-week, high intensity, functional circuit training program in individuals with chronic stroke.

Number of Subjects : A convenience sample of eight participants (4 female, 4 male); mean age: 57± 10.2 (range 36-70); months post stroke mean: 33± 21.4 (range 10-71) completed the study.

Materials/Methods : In this one-group pretest-posttest pilot study, subjects participated in a circuit that included five functional activities. The stations were sit to stand, supine to sit, resisted gait, stationary bike and a gait specific activity for a time of 10 minutes at each station. The circuit program was two times per week, one hour each session, for eight weeks. To determine exercising target heart rate subjects' VO₂peak was assessed (pre-test) using a graded exercise test protocol on the NuStep®, a modified total body recumbent stepper. Target heart rate (THR) was increased by 5% each week from 55% to 85%. VO₂peak was assessed one week after completion of the circuit program (post-test 1) and 10 weeks (post-test 2). Electrocardiograms were completed to assess any adverse cardiac events.

Results : Using SPSS 19, repeated measures ANOVA with Bonferroni adjustment revealed statistical significance in VO₂peak from pre-test to post-test 1 (p=0.041). No significant differences were found in VO₂peak between pre-test to post-test 2 (p = 0.356) nor post-test 1 to post-test 2 (p = 0.080). There was clinical significance in VO₂peak in seven subjects from pre-test to post-test 1 and five subjects from pre-test to post-test 2.

Conclusions : Individuals with chronic stroke were able to participate in high intensity functional activities when individualized THR was assessed and monitored. No adverse cardiac events were experienced throughout this high intensity program. In conclusion, individuals with chronic stroke can improve their aerobic capacity safely through participation in high intensity functional activities.

Clinical Relevance : A high intensity, functional circuit training program is an appropriate intervention for individuals with chronic stroke.

TITLE: Use of rhythmic auditory stimulation to improve the vestibulo-ocular reflex gain and dynamic gait in a patient with Parkinson's Disease

AUTHORS/INSTITUTIONS: A. Soto, Vestibular Rehabilitation, Rusk Rehabilitation- NYU Langone Medical Center, New York, New York, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : Early sub-clinical changes in the vestibular system are present in patients with Parkinson's Disease (PD), leading to impairments in the mediation of the vestibulo-ocular reflex (VOR) and the ability to dynamically alter posture. Systematic reviews support the use of rhythmic auditory stimulation (RAS) to improve components of gait in patients diagnosed with PD. Vestibular rehabilitation (VR) has been shown to be effective in preventing falls in patients with PD, although no studies to date have examined the role of RAS in conjunction with VR. The following case study details the use of RAS to facilitate completion of VR exercises to improve vestibular function in a patient with PD.

Case Description : An 85 year old male with a diagnosis of PD presented to VR to address imbalance. He experienced difficulty with components of the evaluation due to marked rigidity and bradykinesia effecting cervical and trunk movements. He exhibited a shuffling gait pattern, an average gait speed less than 0.4 m/s, and an inability to dissociate head movements to safely scan his environment when using a walker. His vertical and horizontal VOR measurements were below normal at 33 and 44 head turns per minute (HT/min) respectively. He obtained a low composite score of 56 on the Sensory Organization Test (SOT), with 4 falls during conditions 5 and 6, and sensory analysis indicated vestibular impairment and a visual preference. Throughout VR he did not take medication to address PD symptoms. He began a treatment program with RAS via a smart phone metronome application for all VOR and dynamic gait exercises. The speed of the metronome was progressed each session by an average of 5 HT/min for VOR activities. RAS was altered during gait training to a speed in which he exhibited safe foot clearance and appropriate trunk positioning relative to his walker. He progressed to ambulation with head turns in a variety of planes to stimulate the vestibular system. RAS was used during completion of his home exercise program.

Outcomes : With consistent use of RAS, he progressed to 90 HT/min with VOR activities. He was able to ambulate with head movements in all planes, negotiate objects with appropriate foot clearance, and demonstrated no loss of balance when turning. His average gait speed with RAS was greater than 0.7 m/s, and he demonstrated safe negotiation of intersections and crowded sidewalks. Reassessment via the SOT revealed a normal composite score of 72, one fall in condition 6, and he scored within normal limits for all sensory assessments.

Discussion : When using RAS during completion of standard VR exercises, he demonstrated improvements in VOR completion, gait speed, and scores on the SOT reached normal limits. These objective gains correlated to improved safety when ambulating in the community. The outcomes of this case indicate RAS can be a useful adjunct for PD patients receiving VR.

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TITLE: Use of an Evidence-Based Circuit Training Program for a Patient with Parkinson's Disease in the Inpatient Rehabilitation Setting: A Case Study

AUTHORS/INSTITUTIONS: M. Eikenberry, C. Kinney, Department of Physical Medicine and Rehabilitation, Mayo Clinic, Phoenix, Arizona, UNITED STATES|S. O'Neal, Physical Therapy, Midwestern University, Glendale, Arizona, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : People with Parkinson's Disease (PWP) typically experience a progressive, functional decline. An inpatient rehabilitation facility (IRF) can serve as an appropriate setting in order for these patients to receive daily, intensive skilled physical therapy. There is limited evidence exploring specific exercise interventions and practice schedules for PWP in the IRF setting. The purpose of this case study is to highlight a novel treatment approach designed to utilize the limited time in the IRF setting to optimize outcomes. The authors utilized an evidence-based circuit training (EBCT) program for a patient with Parkinson's Disease (PD) during an acute rehab stay.

Case Description : An 86 year old male with idiopathic PD was admitted into the IRF setting following an acute episode of an altered level of consciousness.

Outcomes : The patient participated in an interdisciplinary inpatient rehabilitation program over 15 days. Physical therapy (PT) consisted of an EBCT program using body-weight supported treadmill training (BWSTT), large amplitude movement exercises, forced-rate exercise utilizing a lower body ergometer, gait training utilizing visual targets, dynamic balance activities and boxing. These activities were organized as stations, which were varied, in order to maximize active participation and limit rest periods. The patient participated in 24 PT sessions for a total of 1,215 minutes. Outcome measure results were compared between admission and discharge. These measures included the Mini-BESTest, 10 Meter Walk Test (10MWT), Timed Up and Go (TUG) and the Functional Independence Measure (FIM) motor subscale. The patient demonstrated significant improvements across all outcome measures, exceeding the Minimal Detectable Change (MDC) values for PWP at rehab discharge. Mini-BESTest score improved from an 8/28 to a 16/28 (MDC = +17% change or 5.52 points), demonstrating a 100% change. Walking speed (10MWT) increased from 0.42 m/s to 0.61 m/s (MDC = +0.18 m/s), demonstrating a 31% change, and TUG time improved from 53.00 seconds to 39.27 seconds (MDC = 3.5 to 11 seconds), a 26% change. A step count was taken during the 10MWT which decreased from 45 total steps to 34 steps, a 24% change. Motor FIM scores increased from 18 to 41 (MDC = +17 points), demonstrating a 128% change.

Discussion : The results of this case study suggest that a patient with PD can benefit from participation in an EBCT program in the IRF setting. Due to the limited time in this setting, focus should be placed on interventions which are evidence-based and appropriate for the PD population. EBCT utilizes a massed practice schedule and blocked practice order, which can increase intensity as well as promote retention and generalizability. Clinicians treating patients with PD in the IRF setting may consider this treatment approach in order to improve function and reduce burden of care.

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TITLE: Serial Casting Followed by Functional Rigidity Casting of the Ankle to Improve Range of Motion, Balance and Functional Mobility in Patients with Neurologic Impairment: A Single Case-Study.

AUTHORS/INSTITUTIONS: A.B. Gillen, H.E. Knight, Physical Therapy, Creighton University, Omaha, Nebraska, UNITED STATES|C. Carlson, Madonna Rehabilitation Hospital, Lincoln, Nebraska, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : Decreased ankle range of motion (ROM) is common in patients with neurologic injury due to impairments such as foot drop and hypertonicity. Decreased ankle dorsiflexion ROM can contribute to balance and gait impairments, limiting functional mobility. Prevalent physical therapy interventions for ankle ROM deficit and spasticity management include serial casting, passive range of motion (PROM), electric stimulation and ankle foot orthotics. A newer method to improve ankle ROM includes serial casting followed by application of a custom fabricated splint, called a Functional Rigidity Cast (FRC), which has shown promise in producing positive clinical results. Currently, there is no research documenting this specific combination of intervention techniques for improving ankle ROM.

Case Description : A 59-year-old male with multiple sclerosis was diagnosed with an ischemic left middle cerebral artery stroke and admitted to an acute rehabilitation unit three days after onset. The patient spent a total of 14 days in acute rehabilitation. The patient presented with decreased ankle ROM due to foot drop from his neurologic injuries. Serial and functional rigidity casting were completed to increase ankle dorsiflexion ROM for improved balance and gait.

Outcomes : Ankle dorsiflexion PROM, balance as measured by the Berg Balance Scale (BBS), and functional mobility as assessed by the Functional Independence Measure (FIM) were recorded upon hospital admission and discharge. The patient received one round of serial casting four days after admission. The cast was donned on a Friday to prevent limiting mobility during weekday skilled therapy sessions using conventional techniques. After three days, the cast was removed and an FRC was applied and worn nightly until discharge. Ankle dorsiflexion PROM improved from lacking five degrees on hospital admission, to three degrees beyond neutral after serial casting, and maintaining three degrees beyond neutral at discharge. A total improvement of 8 degrees was seen with serial casting and FRC use in combination. BBS score improved from 29/56 at admission to 36/56 at discharge. FIM scores improved from 84 at admission to 105 at discharge.

Discussion : The results of this case study suggest that serial casting to provide prolonged stretch on the ankle during non-therapy times, followed by application of an FRC to maintain the improved ankle ROM and allow for full participation in conventional therapies, may be effective in improving ankle ROM, balance and functional mobility in patients with drop foot due to neurologic impairment. Further studies using larger sample sizes and a control group are needed before conclusive statements can be made on the relative efficacy of combining serial casting and a FRC in the management of patients with foot drop. Also, future studies utilizing this method to address ROM deficits due to hypertonicity in patients with neurologic impairment would be beneficial.

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stimulation on walking speed, functional walking category, and clinically meaningful changes for people with multiple sclerosis. *Arch Phys Med Rehabil.* 2015;96(4):667-72.

TITLE: Test-retest reliability of the NeuroCom Limits of Stability Test when used with college athletes

AUTHORS/INSTITUTIONS: T.E. Leahy, T.J. France, E. Kreil, L. Trevor, J.R. Tanner, Doctor of Physical Therapy, Lynchburg College, Lynchburg, Virginia, UNITED STATES|T.G. Bowman, Athletic Training, Lynchburg College, Lynchburg, Virginia, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Current concussion management practices promote formal assessment in 3 domains: symptoms, cognition and motor, both pre-season and post-injury. Motor function is traditionally assessed with tests of postural steadiness which are insufficient for identifying effects of injury beyond 3-5 days. Studies using more complex postural control measures have identified deficits for longer periods of time, but clinical usefulness of such tests is limited by availability and portability of testing equipment. The portable Limits of Stability (LOS) test assesses complex postural control and provides objective data on variables pertinent to athletic performance. Test-retest reliability needs to be determined as a first step in ascertaining the usefulness of the LOS as part of the concussion assessment battery. The purpose of this analysis was to determine test-retest reliability of the LOS for trials performed at 2 different time frames: immediately back to back and pre & post a 3-4 month sport season.

Number of Subjects : 62

Materials/Methods : Volunteer NCAA Div. III lacrosse and soccer athletes (32 women, 30 men) underwent pre and post season LOS testing with NeuroCom VSR Sport as part of a larger study. Subjects performed 2 trials of the LOS at each testing session. None had prior experience on the LOS and no practice trials were performed. The LOS requires subjects to move their COP as quickly and accurately as possible to one of 8 target positions from a central position at an audible and visual cue. Reaction time (RT), directional control (DCL), movement velocity (MVL), and endpoint excursion (EPE) were measured and compared across trials. Data from subjects who sustained an injury during the season were removed from analysis. Pearson correlations and paired t-tests were completed for variables between trials for the remaining 56 athletes.

Results : Strong relationships ($r = 0.44-0.8$, $p < .01$) were found across trials for all variables. However, there were also significant changes in the values for MVL, DCL & EPE from trial 1 to 2. Athletes were observed to be trying different movement strategies for the novel task in the 2 preseason trials resulting in improved speed, directional control and proximity to the target. RT had the weakest relationship between trials of all the variables ($r = 0.44 - 0.66$) with the correlation increasing with trial repetition. No significant difference in RT was found between trials.

Conclusions : The LOS test demonstrates acceptable test-retest reliability. However, improvements in performance between trials indicate a need for clinicians to provide a pre-season practice session and to establish a baseline.

Clinical Relevance : Need exists for an objective measure of complex balance control to improve the current concussion assessment battery for athletes. Establishing test-retest reliability of the LOS with college athletes is the first step in determining usefulness of this tool. Further testing is required to determine the effect of pre-test practice on test-retest consistency, and to determine the sensitivity of LOS to identify concussion.

TITLE: Do the physical therapist's words really matter?: The effects of enhanced and decreased expectations on balance performance in those with and without Parkinson's disease

AUTHORS/INSTITUTIONS: M.R. Landers, J. Blood, J. Ostrander, G. Parrish, Physical Therapy, University of Nevada, Las Vegas, Las Vegas, Nevada, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : It has been reported that individuals perform well on a task when enhanced expectancy was provided prior to task performance. It has also been reported that people with Parkinson's disease (PD) are especially susceptible to pre-task cueing and the placebo. Moreover, previous research has demonstrated improved balance performance with enhanced expectancy in older adults. Thus, the purpose of this study was to determine if individuals with PD, who are known to be especially susceptible to cueing and the placebo, would have a larger response to enhanced and decreased expectancy prior to balance tasks compared to age- and gender-matched peers.

Number of Subjects : Forty-nine participants (20 females and 29 males, Age 72 ± 7 years), including 24 with idiopathic PD (9 females, Age 73.0 ± 6.6 ; 15 males, Age 73.0 ± 7.2) and 25 healthy controls (11 females, Age 70.3 ± 4.7 ; 14 males, Age 71.9 ± 8.9) were enrolled.

Materials/Methods : All participants were tested in their homes or community center using the portable BioSway Balance System from Biodex Medical Systems. Each received 3 different pre-performance verbal expectancies (enhanced expectancy (EE), decreased expectancy (DE), and no expectancy (NE)) across 3 different, randomly ordered balance training tasks (Limits of Stability, Maze Control, and Random Control).

Results : A between group comparison of the three instructions (EE, DE, NE) using Kruskal-Wallis analyses were conducted for each of the three balance tasks (Maze Control, Random Control, Limits of Stability) for both the PD group and the age- and gender-matched control group. There were no statistically significant differences among the three expectancies (EE, DE, NE) for each of the three balance tasks for both the PD and the control groups for both the overall accuracy score and for a calculated ratio (accuracy score divided by time to complete task): Limits of Stability ($p \geq 0.291$), Maze Control ($p \geq 0.054$), and Random Control ($p \geq 0.050$). For the between task comparisons (within subject), data from each of the three balance tasks were converted to a z score and then analyzed using a Friedman's ANOVA; there was no significance across the three expectancies, $p = 0.132$.

Conclusions : Our study demonstrated that neither the enhanced or decreased expectancy instructions used in the present study were sufficient enough to influence changes in balance performance for individuals with or without Parkinson's disease. Despite the literature suggesting that enhanced expectancy may improve performance, our results indicate that enhanced expectations do not improve balance performance and decreased expectations do not degrade balance performance in PD or older adults.

Clinical Relevance : Our results suggest that pre-task balance expectancy instructions with the intent to influence balance performance are not as straight forward as the literature would suggest. In light of our findings, future research in this area is warranted.

TITLE: Recovery in Function and Mobility after Treatment of Benign Paroxysmal Positional Vertigo in People with Type 2 Diabetes.

AUTHORS/INSTITUTIONS: L. D'Silva, P. Kluding, Physical Therapy and Rehabilitation Science, University of Kansas Medical Center, Kansas City, Kansas, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : The prevalence of benign paroxysmal positional vertigo (BPPV) is higher in people with type 2 diabetes (T2D). The influence of T2D on recovery of patients with BPPV is unknown. The purpose of this study was to examine change in function and mobility after treatment of BPPV in people with and without T2D. Our hypothesis was that people with both BPPV and T2D (BPPVDM) may not recover to the same extent as those with BPPV only.

Number of Subjects : Thirty- eight patients, 25 with BPPV and 14 with BPPVDM.

Materials/Methods : Patients with unilateral posterior canal BPPV canalithiasis diagnosed by Dix-Hallpike testing participated, mean age 60.18 ± 9.9 . Patients with neurological diagnoses and any musculoskeletal problems that would affect mobility were excluded. All patients completed the Dizziness Handicap Inventory (DHI) and the Functional Gait Assessment (FGA), before and after treatment with the canalith repositioning maneuver (CRM). Patients came for follow –up visits after 7-10 days, and the maneuver was repeated if patients were symptomatic or had nystagmus with Dix-Hallpike test, until complete resolution of symptoms. CRM was considered effective if there were no complaints of vertigo or signs of nystagmus with the Dix-Hallpike test, which was confirmed with videonystagmography. Two-way ANOVA (group X time) examined differences between groups pre and post treatment.

Results : No differences were seen in pre-treatment FGA scores ($p=0.6$), or DHI scores ($p=0.8$). Both groups improved significantly with treatment; FGA change in the BPPV group was 22.27 to 26.5 ($p<0.001$), and 21.43 to 24.5 in the BPPVDM group ($p=0.001$). DHI change in the BPPV group was 42.4 to 10.9 ($p<0.001$), and from 42.4 to 16.1 in the BPPVDM group ($p=0.001$). No differences were seen in post-treatment FGA scores ($p=0.11$), or DHI scores ($p=0.47$) between groups. Post-treatment, 100% of patients in the BPPV group had FGA scores ≥ 19 , while 2/14 patients (14%) with BPPVDM had FGA scores <19 , which is considered higher fall risk.

Conclusions : Significant improvement in function and mobility were seen in patients with BPPV after the repositioning maneuver irrespective of the presence of T2D, which did not support our hypothesis.

Clinical Relevance : The FGA and DHI measures may not have been sensitive to show differences in recovery between patients with BPPV with and without T2D post treatment. Focusing on individual items on the FGA may provide more insight into recovery patterns in people with BPPV and T2D, instead of the overall score.

TITLE: Successful use of mobile health technology by older adults with Parkinson disease

AUTHORS/INSTITUTIONS: K. Hendron, T.R. DeAngelis, N.A. Sullivan, T. Ellis, Department of Physical Therapy and Athletic Training, Boston University, Boston, Massachusetts, UNITED STATES|C. Thomas, M. Saint-Hilaire, Department of Neurology, Parkinson's Disease and Movement Disorders Center, Boston University Medical School, Boston Medical Center, Boston, Massachusetts, UNITED STATES|N. Latham, School of Public Health, Boston University, Boston, Massachusetts, UNITED STATES|

ABSTRACT BODY:

Purpose : Older adults have been described as late or non-adopters of technology. Physical challenges, hesitant attitudes, or difficulty learning new information may be barriers to adopting technology in older adults with neurological conditions. Given the potential benefits associated with integrating technology into healthcare, the purpose of this study is to describe the acceptability of integrating technology into a novel physical therapy intervention to improve physical activity among older adults with Parkinson disease (PD).

Description : An individualized home exercise program ('HEP') was administered to 22 patients with PD by a physical therapist (PT) using mobile health technology. Patients were instructed in strengthening and balance exercises administered using an exercise application ('Wellpepper') housed on a smart phone or tablet. Patients with PD were also instructed in a walking program using an activity monitor ('fitbit') worn on their waist providing real-time feedback on their activity level. Data from the activity tracker ('fitbit') was integrated into the exercise application wirelessly. Patients accessed their exercise program on the tablet or smartphone in the home setting. The exercise application also allowed remote communication between the patient and PT via a two-way text chat. The PT monitored adherence and remotely changed the exercises facilitating progression of the program in between physical therapy visits.

Summary of Use : Twenty-two patients with mild to moderate PD (UPDRS Part III 32, +/- 9.9) used the mobile health technology for 6-months. Fifty-five percent were male and the mean age was 67 y/o (+/- 5.2). Ninety-five percent lived with family. Education level included 83% with a college degree or higher. Fifty-percent were retired. Patients participated in one to two in-person sessions with a PT to establish a HEP and for training on proper use of the mobile health technology. Adherence to using the exercise application was 72% over the course of the 6-month intervention. Patients were surveyed at 6-months regarding their feedback in using the technology. In particular, 100% said they would like to continue to use the exercise program, 95% would recommend the program to others, and rated their overall satisfaction 8.4/10 (10 = highly satisfied).

Importance to Members: This report highlights the acceptability and success of using mobile health technology in older adults with Parkinson disease.

TITLE: The Role of Physical Therapy in the Management of a Complex Patient with Multiple Sclerosis after Tendon Lengthening Surgeries: from Dependent to Ambulatory, a Case Study

AUTHORS/INSTITUTIONS: I. Kedzierska, H. Battsek, D. Lotan, L. Perillo, Rusk Rehabilitation , NYU Langone Medical Center, New York , New York, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : Multiple Sclerosis (MS) is a neuro-inflammatory disease characterized by a wide variety of symptoms. These are variable and may include muscle weakness, fatigue, balance and gait impairments, cognitive impairments, and spasticity. Spasticity is estimated to affect 80% of people with MS. Due to hypertonia (spasticity, rigidity) equinovarus foot deformity may be a cause of disability in patients with MS. Treatments include physical therapy (PT), orthoses, botulinum toxin injections, and in severe cases, surgical interventions such as tendon lengthening. Approximately 50% of people with MS develop problems with cognition. These patients may be contraindicated for surgical intervention for correction of this deformity, decreasing their optimal functional level and increasing caregiver burden. The purpose of this case study is to provide clinicians with evidence of decreased caregiver burden and improved function in a patient with MS who underwent surgical intervention despite her cognitive impairments.

Case Description : A 52-year-old female was referred to PT with secondary progressive MS. At baseline the patient was wheelchair bound and used a hooyer lift for transfers, performed by her supportive caregiver. On initial evaluation, the patient presented with bilateral equinovarus deformities, limited communication and cognitive skills, gross deconditioning and weakness. Intervention initially focused on lower extremities (LE) strengthening, ankle range of motion, stretching, positioning and caregiver training. After one month of bi-weekly intervention, function continued to be limited secondary to foot deformity, despite LE strength > 3/5 and sufficient trunk control in sitting. Communication between the physical therapist and physician strongly advocated for LE surgical correction, which was performed bilaterally over the course of two years. Post-surgical intervention focused on functional and caregiver training.

Outcomes : Over a two-year course of PT, the patient progressed from non-ambulatory and dependent for all transfers to ambulating indoor short distances with a rolling walker (RW). After her first surgery, she progressed to being able to transfer sit to stand, and ambulate short distances with a RW and minimal assist. Currently she ambulates at a speed of 0.06 m/s for 50 feet and transfers with contact guard (CG) with a RW. She is able to negotiate four steps with CG and bilateral handrails.

Discussion : This case study highlights the importance of patient advocacy when communicating with the medical team, especially for the patient with severe cognitive deficits. This patient's initial presentation (MS with marked cognitive deficits, functional dependence and increased weight) made her a poor candidate for surgical intervention. Despite poor initial presentation, the physical therapist was able to advocate for surgery. Aggressive PT post-operatively led to a significant decrease in caregiver burden and increased independence.

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TITLE: High intensity tapering conventional balance training for decreasing fall-risk in chronic stroke survivors: Measuring improvement across different domains of balance control.

AUTHORS/INSTITUTIONS: J. vora, R. Varghese, P. Patel, T. Bhatt, Physical Therapy, University of Illinois at Chicago, Chicago, Illinois, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of this study was to examine the effect of six weeks of conventional balance training on two specific domains of balance control-intentional balance and reactive balance.

Number of Subjects : The study included eight chronic stroke survivors(> 6 months).

Materials/Methods : At baseline (Week 0), the intentional balance was measured using the Limits of stability test (LOS) administered by the SMART Equitest® Neurocom and the reactive balance was measured via the slip/trip perturbation test using the motorized treadmill, ActiveStep (Simbex). The Timed up and go test (TUG) was also recorded. Following the baseline assessment subjects underwent high intensity training for six weeks each session for approximately 90mins. Twenty sessions were distributed in a tapering manner, i.e. 5 days/week for the first two weeks, followed by 3 days/weeks for the next two weeks, and finally 2 days/week for the last two weeks. The training was tailored depending upon the performance of the subject on the Berg Balance Scale (BBS): low (28-36), moderate (36-44) and high (44-52) performing. The protocol design focused on four main constructs stretching, functional strengthening, balance and endurance. The exercises varied in frequency, intensity, duration and mode for each of the three groups. All the balance tests were performed post six weeks of training (Week 7).The gain in postural stability pre- and post-training was computed for each of the balance tests by recording COM excursion [(pre-stability-post-stability)/pre-stability]. In addition, behavioral outcomes (fall incidence and/or number of steps taken) on each test were also recorded. Paired t-test was used to compare the stability gain between the intentional balance and reactive balance.

Results : There was a significantly greater improvement in stability gain on the intentional balance test compared to reactive balance test ($p < 0.05$). Thus, although there was a decrease in the number of steps taken there was no change in fall incidence on the reactive balance test from pre to post training. However, the falls incidence decreased from 50% to 16% on the intentional balance test. There was also a significant improvement in the TUG.

Conclusions : The results demonstrate that conventional training improves balance in chronic stroke survivors, the effect is however significantly greater for intentional balance control with minimal gain in reactive balance control. Findings thus suggests the need for incorporating task-specific training to improve reactive balance control to facilitate transferability of balance gain to real-life like external perturbations.

Clinical Relevance : It is suggested that a combined training protocol inducing change in both domains of balance control might have the maximum impact in reducing fall-risk.

TITLE: The Effectiveness of the Stepping On Program for Reducing the Incidence of Falls in the Elderly

AUTHORS/INSTITUTIONS: M. Danks, B.J. Johnson, L. Yonker, J. Maddock, K. Breuer, Physical Therapy, University of North Dakota, Grand Forks, North Dakota, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of this study was to discover whether participant balance and confidence improved following the completion of the Stepping On program. Also, the study evaluated what balance tests could effectively be used as a community screen for fall risk of individuals and to assess if participating in the Stepping On program reduces fall risks.

Number of Subjects : 10

Materials/Methods : Ten participants were recruited from two Stepping On programs being offered in the local area. Baseline questionnaire and the Falls Behavior Scale (FaB) were collected from participants at the Week 2 and Week 7 sessions. Balance assessments were performed at Week 2 and Week 7 to determine fall risk of participants, including: the Five Time Sit-to-Stand (FTSS), Four-Stage Balance Test (FSBT), Timed Up and Go (TUG), and Gait Speed (via GAITRite electronic walkway). The Falls Efficacy Scale International (FES-I) was completed at Week 2, Week 7, and at the 3-month recheck to determine participants' confidence and perceived fall risk. Follow-up questionnaires assessing participants perceived benefits of the program and compliance of exercises were given at Week 7 and 3-month recheck.

Results : T-tests were performed comparing balance test scores from Week 2 to Week 7. There was a significant improvement in times on the TUG ($p = 0.015$). Also, a significant decrease was also found in the total number of tests that identified a participant's fall risk from Week 2 to Week 7 ($p = 0.034$). All the participants subjectively reported balance and confidence improvement following the Stepping On program.

Conclusions : Significance was found with improved times in the TUG from Week 2 to Week 7, demonstrating a decrease of participants' fall risk. These findings suggest that the TUG test can be used as a quick balance screening tool to help identify objective benefits from community-based fall prevention programs. The TUG could be an effective addition to fall prevention programs to help participants understand their perceived risk and strategize ways to help prevent falls. Participants' subjectively reported improved balance and increased confidence after participating in the Stepping On program. This in turn could improve the participants' willingness to move and stay active, avoiding the increase fear of falling and limiting of activity.

Clinical Relevance : Community fall prevention program such as the Stepping On program can have a positive impact on participants performance and confidence with daily activities. The TUG could be an effective addition to fall prevention programs to help participants understand their perceived risk and strategize ways to help prevent falls.

TITLE: Agreement Between Novice Versus Expert Physical Therapists in Identifying Nystagmus During Positional Testing and Diagnosing Benign Paroxysmal Positional Vertigo (BPPV)

AUTHORS/INSTITUTIONS: L. Kennedy-Rynne, A.K. Galgon, Physical Therapy, Temple University, Philadelphia, Pennsylvania, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of this study is to examine the agreement between novice and expert physical therapists (PTs) in identifying the presence and direction of nystagmus and diagnosing BPPV. A previous study (Galgon et al, 2015) showed excellent to almost perfect κ agreement between expert PTs for these clinical skills. There are currently no studies showing evaluative and diagnostic reliability between PTs of different experience levels.

Number of Subjects : 7 novice and 1 expert PT

Materials/Methods : The clinicians watched eye movement videos recorded during supine roll and Dix-Hallpike testing of 14 patients whom had complaints of positional vertigo. They recorded direction and duration of nystagmus with symptom intensity for each position and video and made a diagnosis. The novice clinicians completed a demographic questionnaire and experience survey. Kappa statistics (κ) were used to compare agreement between each novice to the expert, and the Krippendorff's alpha (α) and average percent agreement were used to analyze overall reliability of novice ability for the clinical skills.

Results : There was fair to almost perfect agreement ($\kappa=0.22$ to 1, average agreement 79-89%) between novices and in comparison to the expert in identifying nystagmus, and slight to almost perfect agreement ($\kappa=-0.02$ to 1, average agreement 71-74.5%) between novices and compared to the expert in diagnosing BPPV. There was moderate agreement between novices to identify nystagmus ($\alpha=0.58-0.65$, average agreement=80-83%) during positional testing and fair to moderate agreement to diagnose BPPV ($\alpha=0.38$ to 0.53, average agreement=64-74%). There were higher agreements in cases of typical BPPV presentations. Novices reported the task was difficult, but believe they had the necessary knowledge and needed more practice. Moderate to strong correlations ($r=0.76$ to 0.82) were seen between clinical experience with BPPV patients and lower perceived levels of difficulty.

Conclusions : Novice PTs are capable of identifying nystagmus and diagnosing typical BPPV cases with at least moderate agreement compared with expert vestibular PTs; however, novices may require more practice for diagnosing atypical BPPV presentations.

Clinical Relevance : Novice PTs may need additional clinical experiences to improve reliability of identifying nystagmus and making diagnoses of BPPV. The result of this study may not be generalizable for observations made without video recordings.

TITLE: Using Interprofessional Collaboration to Design Cognitive-Based Interventions for a Patient Following a Right Hemisphere Stroke: A Case Report

AUTHORS/INSTITUTIONS: S.S. Hausle, G.L. Widener, Physical Therapy, Samuel Merritt University, Oakland, California, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : Individuals recovering from stroke are often left with cognitive impairments that lead to significant long-term disability, decreased independence, and a decline in quality of life. The purpose of this case report is to describe the use of interprofessional collaboration in an inpatient rehabilitation setting to improve independent mobility and function for a patient with significant cognitive deficits resulting from a right hemisphere stroke.

Case Description : The patient, a 56 year-old male, experienced a right hemisphere ischemic stroke three weeks prior to admission to an inpatient rehabilitation facility where he received six weeks of care. His functional mobility improved significantly prior to admission, and severe cognitive deficits emerged as his primary barriers to returning to independence. His deficits included severely decreased attention and safety awareness, impulsivity, left neglect, impaired executive function and wayfinding skills, and communication difficulties. Collaboration with the patient's occupational therapist (OT) and speech language pathologist (SLP) was requested by the student physical therapist (SPT) after two weeks of care, and both therapists shared strategies for targeting cognitive deficits. Task-specificity, repetition, and dual-task activities were suggested to target attention deficits that were interfering with functional mobility, and to promote generalizability to daily function. Novel physical therapy interventions incorporating these strategies were used during weeks three through six for a total of 15 sessions, and addressed the patient's cognitive issues within the framework of functional mobility. Community ambulation and wayfinding tasks required the patient to navigate the 20 acre medical campus with minimal instructions, challenging attention to external stimuli, safety awareness, and gait endurance. Scavenger hunt activities were combined with these tasks and required the patient to locate specific items while navigating a described path, challenging executive function, navigation skills, and different forms of attention, such as multi-tasking and divided attention.

Outcomes : The patient demonstrated improved attention, wayfinding abilities, and safety awareness during community ambulation, largely resolved left neglect, and improved communication skills after six weeks. Outcomes were measured primarily by observation and consensus among therapists. Behavioral neglect was measured at baseline and after six weeks using the Catherine Bergego Scale (CBS), improving from 11/30 (moderate neglect) to 3/30 (mild or no neglect).

Discussion : Addressing cognitive deficits can be a challenge in a physical therapy setting. Using strategies from other disciplines to enhance physical therapy interventions helped address this patient's post-stroke cognitive deficits and led to improved functional outcomes. Future research could evaluate the efficacy of combining cognitive challenges with mobility training for individuals post-stroke.

References: Must include 5 current references (less than 10 years old): 1. Jehkonen M, Laihosalo M, Kettunen JE. Impact of neglect on functional outcome after stroke: a review of methodological issues and recent research findings. *Restor Neurol Neurosci.* 2006;24(4-6):209-215. 2. Barker-Collo SL, Feigin VL, Lawes CMM, Parag V, Senior H. Attention deficits after incident stroke in the acute period: Frequency across types of attention and relationships to patient characteristics and functional outcomes. *Top Stroke Rehabil.* 2010;17(6):463-476. 3. Kleim JA, Jones TA. Principles of experience-dependent neural plasticity: Implications for rehabilitation after brain damage. *J Speech Lang Hear R.* 2008;51:S225-S239. 4. Takeuchi N, Izumi S. Rehabilitation with poststroke motor recovery: a review with a focus on neural plasticity. *Stroke Res Treat.* 2013;2013:128641. doi: 10.1155/2013/128641. 5. Fritz NE, Cheek FM, Nichols-Larsen DS. Motor-cognitive dual-task training in persons with neurologic disorders: A systematic review. *J Neurol Phys Ther.* 2015;39(3):142-153.

TITLE: Effect of Mobility on Community Participation at 1 year Post-Injury in Individuals with Traumatic Brain Injury (TBI)

AUTHORS/INSTITUTIONS: I. Ward, N. Jasey, Kessler Institute for Rehabilitation, West Orange, New Jersey, UNITED STATES|A. Lequerica, N. Chiaravalloti, Kessler Foundation, West Orange, New Jersey, UNITED STATES|E.J. Donnelly, Kessler Institute for Rehabilitation, Saddle Brook, New Jersey, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : To examine the relationship between mobility and community participation in persons with TBI one year post-injury.

Number of Subjects : Patients admitted to an inpatient rehabilitation hospital with moderate (63.7%) or severe (35.9%) TBI (N=245). Mean age was 53.6±21.5 years-old. Approximately 33.1% of the sample was female. Cause of injury was due to a fall (46.5%), vehicular accident (41.6%) or other causes (11.8%).

Materials/Methods : This is an observational study using prospectively collected data from a TBI Model System center (Northern New Jersey Traumatic Brain Injury System). The sample was divided into two groups based on the FIM walking score obtained at one year post-injury. Those with a walking score of 6 (modified independent) or 7 (independent) were categorized as “independent” ambulators and those receiving a score of ≤5 (supervision to total assistance) or had a negative change in ambulation level between discharge and 1-year follow-up were classified as “dependent” ambulators. The following measures were used: Participation Assessment with Recombined Tools (PART), Disability Rating Scale (DRS), Supervision Rating Scale (SRS) and Satisfaction With Life Scale (SWLS). Using a median split, the sample was divided into two groups to examine whether the need for assistance with ambulation was associated with the frequency in which they were able “to get out of their house and go somewhere.” Descriptive statistics were generated and data were analyzed using one-way ANOVA and chi-square analysis.

Results : Of the 245 cases identified, 245 (100%) required assistance to ambulate at rehabilitation admission. By discharge, the number of patients who required assistance to ambulate was 149 (60.8%), and 36 (14.7%) continued to require assistance or regressed in their ability to ambulate at one year post-injury. “Dependent” ambulators had lower PART scores ($p<0.001$), higher DRS scores ($p<0.001$), higher SRS ($p<0.001$), lower SWLS ($p<0.05$) and 94.1%, [$X^2=22.0$, $df=1$, $p<0.001$] did not leave their home on a daily basis when compared to those who were “independent” ambulators at one year post injury.

Conclusions : Individuals dependent on someone’s assistance with walking were less likely to leave their homes and engage in community-based activities. They had a greater need for supervision, higher rates of disability and this may have contributed to their self-reported lower levels of life satisfaction.

Clinical Relevance : Dependence on assistance with ambulation influences a person’s ability to leave their homes and participate in the community. In individuals with TBI who continue to require assistance with walking, additional research should investigate interventions to improve independence with walking as well as identify environmental barriers that preclude community participation.

TITLE: Effects of Adaptive and Fixed Practice on Motor Learning of Narrow Beam Walking

AUTHORS/INSTITUTIONS: S. Barreyro, J. Gerbracht, H. Lyons, S. Tseng, J. Wood, B. Swanson, A. Domingo, Doctor of Physical Therapy Program, San Diego State University, San Diego, California, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : In rehabilitation settings, movement error is often reduced by manipulating the practice environment when teaching a difficult motor skill in order to improve performance. However, theoretical models of the nervous system suggest that learning is driven by movement errors, implying that errors should be experienced throughout task-specific practice until the goal movement is achieved. In very difficult motor tasks, it is unknown whether it is best to change the practice environment in order to maintain an optimal amount of error (adaptive practice) or to maintain specificity of practice by performing only the desired task. The purpose of the study was to compare the effectiveness of task-specific practice and adaptive practice on learning a difficult walking balance task. We hypothesized that greater motor learning would occur with task-specific practice than with adaptive practice.

Number of Subjects : 9 able-bodied subjects

Materials/Methods : Subjects' mean age was 25.5 years (SD=4.7). Participants were randomized into an Adaptive (n=4) or Fixed (n=5) practice group. The goal task was tandem walking on a treadmill mounted balance beam (beam-mill) that was 0.5-inch wide. Subjects performed 3-minute pre-training and post-training tests on the beam-mill. During the 30-minute training period, subjects in the Adaptive group walked on a 1.5-inch wide beam, then a 1.0-inch beam, and lastly a 0.5-inch beam. Progression to the narrower beam occurred after walking 20 consecutive steps on the beam-mill. Subjects in the Fixed group walked only on the 0.5-inch beam during training. A 5-minute retention test was performed on a second day of testing. Our outcome measures included the percent change in the average time of continuous beam walking, and whole body center of mass variability (standard deviation of lateral movement) to examine errors in motor control.

Results : Although the Fixed group showed greater improvement in the average time of walking ($80.7 \pm 15.6\%$, mean \pm SE) than the Adaptive group ($63.2 \pm 17.3\%$) after the training period, there were no significant differences between groups ($P=.48$) due to large variability between subjects. Improvements were more similar between groups for the retention trial (Fixed: $45.2 \pm 11.3\%$; Adaptive: $42.9 \pm 13.9\%$). Center of mass variability decreased more after training in the Adaptive group ($16.4 \pm 3.4\%$) than in the Fixed group ($9.2 \pm 5.8\%$), but the difference was not significant ($P=.35$).

Conclusions : Preliminary data suggest that subjects learn a difficult walking balance task faster when maintaining task-specific practice than when changing the practice environment to keep errors at an optimal level. More subjects should be tested to further elucidate differences between practice groups.

Clinical Relevance : This study will help determine the ideal way to set up practice environments when learning difficult walking balance tasks in therapy settings. Future studies should explore if these principles still hold for neurologic patients.

TITLE: The Effect of Interdisciplinary Spasticity Management in a Young Adult with Severe Traumatic Brain Injury: A Case Study

AUTHORS/INSTITUTIONS: K.N. Favara, Inpatient Physical Therapy, Kessler Institute for Rehabilitation, West Orange, New Jersey, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : An interdisciplinary approach to spasticity management is critical to successful outcomes when caring for the medically complex brain injury (BI) patient. In acute stages of healing, the physical therapist can play an integral role in spasticity management through involvement in a standardized evaluation and treatment approach via Interdisciplinary Spasticity Rounds. The therapist can assist in providing the most appropriate care plan through trialing serial casting, bracing, consistent assessment of impairments and functional mobility deficits, and collaboration with medical team for pharmacological intervention.

Case Description : One patient with severe BI presented to the acute rehabilitation in a vegetative state at one month post injury. Among other significant deficits, she presented with a primary impairment of severe hypertonicity, determined using the Modified Ashworth Scale, in her bilateral lower extremities and left upper extremity. She was evaluated and treated through the standardized approach to Interdisciplinary Spasticity Rounds at Kessler Institute in West Orange, NJ.

Outcomes : Over the course of 6 months, the selected patient received a variety of pharmacological and non-pharmacological interventions. Initially she presented in vegetative state with a JFK Coma Recovery Scale Score-Revised (CRS-R) score of 7 and progressed to full consciousness. Due to significant range of motion (ROM) restrictions in bilateral ankles lacking 25 degrees from neutral dorsiflexion, a trial of serial casting was performed. However, the patient demonstrated limited tolerance to the casting trial due to motoric restlessness, minimal skin irritation, and non-significant gains in ROM. The patient continued to present with limited ability to progress ambulation due to ankle ROM deficits and dynamic tone resulting in a scissoring gait pattern. Therefore, additional consultation was conducted through the Interdisciplinary Spasticity Rounds process. The patient then received Botox Type A injections at 7 months post injury, with positive results noted by gains of greater than 15 degrees of dorsiflexion bilaterally, and resultant improvement in ambulation ability.

Discussion : Due to the multifactorial nature of this patient's severe injury, traditional physical therapy interventions including serial casting did not yield expected improvements in the patient's ROM and functional mobility. With a consistent interdisciplinary approach, this patient was able to significantly benefit from coordination of the rehabilitation team and implementation of both pharmacological and non-pharmacological spasticity management.

References: Must include 5 current references (less than 10 years old): 1) Martin A, Abogunrin S, Kurth H, Dinet J. Epidemiological, humanistic, and economic burden of illness of lower limb spasticity in adults: a systematic review. *Neuroschiatr Dis Treat.* 2014 Jan 23; 10:111-1222) Bhimani R, Anderson L. Clinical understanding of spasticity: implications for practice. *Rehabil Res Pract.* 2014;2014:279175.3) Kinnear B, Lannin N, Cusick A, Harvey L, Rawicki B. Rehabilitation therapies after Botulinum Toxin-A injection to manage limb spasticity: A systematic review. *Phys Ther.* 2014; 94:1569-15814) McGuinness S, Hillan J, Caldwell S. Botulinum toxin in gait dysfunction due to ankle clonus: A case series. *NeuroRehab.* 2013; 32: 635-647.5) Farina S, Migliorini C, Gandolfi M, Bertolasi L, Casarotto M, et al. Combined effects of botulinum toxin and casting treatments on lower limb spasticity after stroke. *Functional Neurology*23.2 (Apr-Jun 2008): 87-91

TITLE: Coherence among motor units of flexion synergy muscles in individuals with chronic hemiparetic stroke

AUTHORS/INSTITUTIONS: S. Heinichen, M. McLerran, K.A. Rose, A. Winters, K. Schulz, J.P. Dewald, Physical Therapy and Human Movement Sciences, Northwestern University, Chicago, Illinois, UNITED STATES|C.K. Thompson, C.J. Heckman, Physiology, Northwestern University, Chicago, Illinois, UNITED STATES|F. Negro, D. Farina, Neurorehabilitation Engineering, University Medical Center Gottingen, Gottingen, GERMANY|L.C. Miller, Physical Therapy, Florida International University, Miami, Florida, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Abnormal muscle co-activation patterns often emerge in the arm after stroke, leading to a loss in independent joint control. One such pattern is the flexion synergy, consisting of shoulder abduction coupled with elbow, wrist, and finger flexion. The emergence of this pattern may be due to an increased influence of anatomically diffuse bulbospinal pathways. Coherence analysis of motor unit (MU) discharge, a measure of correlation of their frequency content, can characterize neural drive to a motoneuron pool. The frequency range over which coherence is found has been used to infer the source of neural drive. The goal of the study was to examine coherence among MU discharge in deltoid (DELTA), biceps (BIC), and finger flexors (FF) of post-stroke individuals compared with healthy controls to explore the frequencies at which coherence appears. We hypothesize that in the paretic arm, MU coherence would be increased in the common drive band (0-2 Hz, suggested to reflect non-cortical inputs) and in the low-beta band (~12-16 Hz, suggested to reflect the reticulospinal tract, a major bulbospinal pathway). MU coherence was explored during elicitation of the flexion synergy through shoulder abduction torque generation.

Number of Subjects : 10 participants with chronic hemiparetic stroke and 7 healthy controls.

Materials/Methods : Participants were seated with the arm attached to a 6 DOF load cell and finger torque sensor. 64-channel surface EMG grids were placed over the muscle bellies of DELTA, BIC, and FF. Participants performed 3-6 isometric trials in shoulder abduction at 10%, 25% and 40% of maximum voluntary torque. Coherence spectra were calculated and pooled across all torque levels for each participant group and then z-transformed and baseline corrected to enable comparison between participant groups.

Results : As hypothesized, for DELTA and BIC MU, coherence in the common drive band was substantially higher in the stroke group than in the control group (173 vs. 96 for DELTA and 137 vs. 72 for BIC). For the FF, however, the values were similar (139 vs. 135 for paretic and control, respectively). In the low-beta band, there was little-to-no significant coherence in the control group, but significant peaks emerged in the coherence spectra in the stroke group. In addition, coherence in the 3-10 Hz band was large in the control limb but virtually non-existent in the paretic limb, suggesting decreases in sensorimotor integration post-stroke.

Conclusions : Results show marked alterations in the coherence spectra of MU in the paretic arm, suggesting changes in the influence of descending and/or afferent inputs to the motoneuron pools. In addition, the presence of low-beta band coherence may suggest influence of the reticulospinal tract.

Clinical Relevance : Results support the theory of increased influence of alternative motor pathways post-stroke and provide insight into the neural mechanisms that may underlie the emergence of the flexion synergy. Increased understanding of these mechanisms will help inform the development of more effective physical therapy interventions.

TITLE: Effects of Self-Selected and Fastest-Comfortable Walking Speeds on Gait Asymmetries

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

ABSTRACT BODY:

Purpose/Hypothesis : Step length asymmetry secondary to post-stroke hemiparesis is related to propulsive force generation and may be indicative of underlying impairments and altered gait mechanics. Additional temporal measures are also linked with walking function, and use of the symmetry ratio, calculated as paretic parameter divided by the non-paretic parameter, is recommended to best describe gait asymmetries primarily due to ease of interpretation. Evidence suggests that different gait impairment information can be gained while patients walk at their fastest-comfortable walking speed (FCWS) as compared to self-selected walking speed (SSWS). Thus, observing gait at different speeds can serve to assist in the clinical analysis of gait and also guide treatment and rehabilitation of gait asymmetries. The purpose of this study was to examine the differences in kinetic and kinematic gait symmetry ratios at different gait speeds (SSWS and FCWS) in individuals post-stroke. We hypothesized that ambulating at an increased speed would exacerbate gait asymmetries.

Number of Subjects : 26

Materials/Methods : Participants, 16 males and 10 females, mean age 60.1 years old (\pm 11.9 SD), with chronic hemiparesis (greater than 6 months post-stroke), walked over an instrumented electronic walkway (GAITRite) and on an instrumented split-belt treadmill (Bertec) at their SSWS and FCWS. Spatiotemporal parameters and 3-D ground reaction forces were collected. Symmetry ratio was calculated by dividing the paretic variable by the non-paretic variable for the following spatiotemporal parameters: step length, swing time, stance time, double support time, and intra-limb swing time/stance time. Paretic propulsion, defined as the percentage of total propulsion generated by the paretic leg, was calculated by dividing the paretic propulsive impulse by the sum of the paretic and non-paretic propulsive impulses. Paired sample t-tests were used to assess changes between all ratio means at SSWS and FCWS.

Results : No statistically significant changes were found in any spatiotemporal gait symmetry ratios or paretic propulsion ratios with an increase in gait speed.

Conclusions : Our results demonstrate that walking at different speeds does not change spatial, temporal, or propulsive gait symmetry ratios. These data indicate that underlying impairments and mechanisms of gait are not changed when chronic stroke patients walk at higher speeds.

Clinical Relevance : As asymmetrical gait deficits were not exacerbated by increase in gait speed, it may not be advantageous for us to use this technique to gain additional impairment information during post-stroke gait analysis when examined in a cross sectional manner. However, since walking at faster speeds does not alter spatial, temporal, or kinetic asymmetries, rehabilitating gait function at a more challenging pace may assist in promoting capacity with minimal negative sequelae.

TITLE: Validating Ratings of Perceived Difficulty for Balance Exercises

AUTHORS/INSTITUTIONS: S.F. Alsubaie, D. Fear, S.L. Whitney, P.J. Sparto, Physical Therapy, University of Pittsburgh, Pittsburgh, Pennsylvania, UNITED STATES|J.M. Furman, Otolaryngology, University of Pittsburgh, Pittsburgh, Pennsylvania, UNITED STATES|K.H. Sienko, Biomedical Engineering, University of Michigan, Ann Arbor, Michigan, UNITED STATES|G.F. Marchetti, Physical Therapy, Duquesne University, Pittsburgh, Pennsylvania, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Balance exercises are a key component of vestibular rehabilitation (Hillier & McDonnell, 2011). Based on clinical experience, physical therapists intuitively progress the challenge of balance exercises during rehabilitation by using different combinations of vision, surface support, base of support, and head movements. However, exercise prescription may be further informed by using quantitative measures of balance or an individual's perception of balance. The aim of this study was to validate two scales of rating of perceived difficulty of balance exercises by comparing the scales with quantitative sway measures.

Number of Subjects : Six healthy young adult subjects (3 females and 3 males, mean age 23 ± 5.2 years old)

Materials/Methods : Subjects performed 24 static standing balance exercises, based on a full-factorial design of different modifying factors: vision (eyes open and eyes closed), surface (firm and foam), base of support (feet apart and semi-tandem), and head movements (head still, yaw, and pitch). Subjects maintained their posture during each exercise for 35 seconds. Subjects stood on a force platform, which recorded Center of Pressure (COP), and an inertial measurement unit was attached to their lower back that recorded trunk pitch angle and velocity. Subjects were asked to rate the perceived difficulty of each exercise they performed using two different scales. The first scale (Scale A) was a modified rating of perceived difficulty (Robertson et al., 2003) that ranged from 0 (extremely easy) to 10 (extremely hard). The second scale (Scale B) had five levels with verbal descriptors (Debbie E. et al., 2015) that ranged from "I feel completely steady" to "I lost my balance". For each subject, a Spearman's rank-order correlation tested the relationship between the subject's rating of perceived difficulty (Scales A and B) and postural measures (Root Mean Square (RMS) of COP in the anterior-posterior (AP) & medial-lateral (ML) directions, RMS of angular displacement of the trunk pitch angle, and RMS of trunk pitch velocity).

Results : There were strong, positive correlations between rating of perceived difficulty scales (Scale A and B) and RMS of COP in the ML direction, which were statistically significant in all six subjects' correlation tests (mean Scale A $r_s = 0.76$, $p < .003$; mean Scale B $r_s = 0.67$, $p < .005$). Additionally, there were moderate, positive correlations (.44 - .53) between the rating of perceived difficulty scales and RMS of COP in the AP direction, RMS of angular displacement of the trunk pitch angle, and RMS of trunk pitch velocity.

Conclusions : The ratings of perceived difficulty scales had moderate to strong correlations with quantitative postural measures demonstrating construct validity. The strong relationship between the scales and RMS of COP in the ML direction suggests that subjects may have based their rating of perceived difficulty on their sway in the medial-lateral direction.

Clinical Relevance : Additional development of these scales will allow clinicians to better prescribe the intensity of balance exercises.

TITLE: Slow Walkers Post-Stroke Need to Do More than Change Step Length Asymmetry to Improve Walking Economy

AUTHORS/INSTITUTIONS: G. Scronce, C.H. Braun, M. Lewek, Division of Physical Therapy, UNC Chapel Hill, Chapel Hill, North Carolina, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Spatiotemporal asymmetry and decreased speed during walking have negative effects on community mobility for people with stroke. Although changes in walking speed and in step length asymmetry are related to changes in energy cost, an interaction effect between these two independent measures suggests that gait speed is a significant moderator. The purpose of this project was to relate changes in spatiotemporal symmetry to changes in gait speed and energy cost of transport (COT) during overground walking in a group of lower functioning individuals with stroke. It was hypothesized that changing step length asymmetry in a group of slower walkers would not have the same previously observed relationship with changes in energy cost of transport.

Number of Subjects : 34 participants post-stroke with spatiotemporal gait asymmetry and mean gait speed of 0.38 ± 0.23 m/s

Materials/Methods : All participants completed a 6 Minute Walk Test (6MWT) with a portable metabolic cart for measurement of gas exchange and walked across a GAITRite mat for determination of overground spatiotemporal gait asymmetries and gait speed. Participants then completed 18 training sessions consisting of up to 20 minutes of treadmill walking followed by 15 minutes of overground gait training per session. During each session, subjects received feedback about either step length (N=20) or stance time (N=14) to address the more severe asymmetry. The 6MWT and overground gait testing were repeated following the completion of training sessions. Dependent measures included overground stance time and step length asymmetries, comfortable gait speeds, and COT collected during a 6MWT. Change scores were computed for each measure. Pearson correlations were calculated to identify significant relationships among variables ($\alpha=0.05$).

Results : A significant correlation was found between initial overground gait speed with a change in COT (mean: -0.051 ± 0.021 mL/kg/m) ($r=.347$, $p=.048$). The change in step length asymmetry showed no relationship with the change in COT ($r=-.060$, $p=.710$) in our sample. The change in stance time asymmetry, however, was correlated with a change in COT ($r=.501$, $p=.003$). Interestingly, the change in gait speed ($r=.177$, $p=.324$) was not significantly correlated to the change in COT.

Conclusions : Our data support the hypothesis that in a group of slower walkers, the change in step length asymmetry is not related to a change in COT. This is important because previous research has demonstrated this relationship but suggested that gait speed is an important modifier. In fact, our data suggest that slower walkers demonstrated greater improvement in COT as a result of training to improve spatiotemporal symmetry. However, a change in temporal asymmetry rather than spatial asymmetry was related to the change in energy COT.

Clinical Relevance : The relationship between spatiotemporal asymmetry and energy COT is dependent on starting walking speed. Focusing on step length asymmetry may have profound effect of COT in faster walkers post-stroke, but it does not appear to improve COT in slower walkers.

TITLE: Estimation of motor unit discharge characteristics in proximal and distal arm muscles in healthy controls and individuals post-stroke

AUTHORS/INSTITUTIONS: S. Heinichen, M. McLerran, K.A. Rose, K. Schulz, A. Winters, C.K. Thompson, C.J. Heckman, J.P. Dewald, Physical Therapy and Human Movement Sciences, Northwestern University, Chicago, Illinois, UNITED STATES|L.C. Miller, Physical Therapy, Florida International University, Miami, Florida, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Proximal and distal muscles work differently based upon functional demands. For example, proximal muscles are used for postural stability and distal muscles are used for fine motor control. Differences in neural inputs to these muscles likely exist but have not been studied extensively. Analysis of motor unit (MU) discharge can help elucidate neural organization to a muscle in both the healthy state and following neurological injury. However, until recently it has not been feasible to efficiently measure MU discharge in multiple muscles. High-density surface electromyography (EMG) is a novel approach for extracting MU discharge patterns that provides improved efficiency and automation. Here we present our findings on the number of MU extracted (MU yield) and MU discharge characteristics in proximal and distal arm muscles using this novel approach in healthy individuals and those with chronic hemiparetic stroke.

Number of Subjects : 10 healthy controls; 10 individuals with chronic hemiparetic stroke.

Materials/Methods : Participants were seated with the tested arm affixed to load cells to measure torque about the shoulder, elbow, and finger joints. 64-channel EMG grids were placed on the surface of the intermediate DELT, biceps (BIC), and finger flexors (FF). Participants performed isometric submaximal contractions of shoulder abduction, elbow flexion, and finger flexion at 10, 25, and 40% maximum torque. EMG data were decomposed into MU action potential spike trains. Mean MU discharge rate (MDR) was calculated and compared against the torque production to estimate rate modulation.

Results : The MDR was consistent across muscles in controls (DELT: 13.48 pps, BIC: 13.81 pps, FF: 13.59 pps). In individuals post-stroke, the MDR was lower overall, and it progressively decreased from proximal to distal (DELT: 12.48 pps, BIC: 11.2 pps, FF: 10.14 pps). Differences in rate modulation were also observed between groups. In controls, rate modulation was demonstrated by a positive relationship between MDR and torque in all muscles. Rate modulation was largest in FF and smallest in DELT. In stroke, however, there was virtually no rate modulation in any of the muscles. Analysis of MU yield demonstrated differences across muscles. For all participants, MU yield was highest in the FF and lowest in the DELT, and it was higher on average for the stroke participants than the controls in all muscles.

Conclusions : Results demonstrate that implementing high-density surface EMG in multiple UE muscles simultaneously is feasible. Application of this approach revealed that in the post-stroke group, there were decreases in MU discharge rate and rate modulation, as well as differences in the pattern of these metrics across proximal and distal muscles.

Clinical Relevance : Analysis of MU activity provides insight into the neural organization in proximal vs. distal muscles as well as mechanisms underlying strength deficits post-stroke. Further understanding of these mechanisms will help direct therapies aimed to restore function in this patient population.

TITLE: Clinical Measures Associated with Obstacle Crossing Performance in People with Stroke

AUTHORS/INSTITUTIONS: G. Scronce, L.A. Zukowski, P. Plummer, Division of Physical Therapy, UNC Chapel Hill, Chapel Hill, North Carolina, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Community ambulation is a highly complex skill that requires an ability to adapt to variations in task and environment. Community-dwelling adults with stroke have low levels of physical activity, largely due to limitations in mobility. Difficulties with attention-demanding gait tasks, such as obstacle crossing, may contribute to limited mobility among community-dwelling stroke survivors. The purpose of this study was to examine the relationships between clinical measures and obstacle crossing performance in people within 15 months of stroke.

Number of Subjects : 11 people (54±8 years old, 4 females), 6.6±3.6 months post stroke living in the community

Materials/Methods : All participants were assessed on the Six Minute Walk Test (6MWT), 10-m walk test, lower extremity Fugl-Meyer, Stroke Impact Scale, Activities-specific Balance Confidence Scale, Timed Up and Go test (TUG), Montreal Cognitive Assessment, and an obstacle-crossing task. In the obstacle-crossing task, participants stepped over an obstacle (15% of leg length; 5 trials). We measured obstacle crossing speed (m/s), vertical foot clearance (cm) and pre and post-obstacle distance (cm) of each limb using a motion capture system. Physical activity data averaged over two days (total steps per day, number of walking episodes per day, maximum and average steps per walking episode) were captured using a PAMSys physical activity monitor from 6 of the participants. Relationships between clinical characteristics and obstacle crossing measures were analyzed using Pearson correlation coefficients.

Results : Only one trial from one participant was omitted as a failed obstacle clearance. 10 of the 11 participants alternated spontaneously between leading with the paretic and non-paretic limbs during obstacle crossing. There were strong, significant relationships between obstacle crossing performance and 6MWT and TUG. Specifically, 6MWT (m) correlated with obstacle crossing speed ($r=.791, p=.006$), lead limb pre-obstacle distance ($r=.881, p=.004$), and trail limb post-obstacle distance ($r=.649, p=.042$). The TUG correlated with crossing speed ($r=-.884, p=.001$), lead limb pre-obstacle distance ($r=-.764, p=.006$), and trail limb post-obstacle distance ($r=-.744, p=.009$). Obstacle crossing speed was significantly related to number of walking episodes per day ($r=-.886, p=.019$). Vertical toe clearance (trail or lead) was unrelated to any patient characteristics. Usual gait speed did not correlate with any measures of obstacle performance or physical activity.

Conclusions : TUG and 6MWT are strongly related to obstacle-crossing performance in people within 15 months of stroke. Usual walking speed may not be a good predictor of performance in more attention-demanding real world mobility tasks or spontaneous physical activity.

Clinical Relevance : TUG and 6MWT may be better predictors of performance in gait tasks with greater postural and attentional demands than usual gait speed in community-dwelling adults with stroke. This should be explored in future research.

TITLE: The Upright Motor Control Test: A Systematic Review of Measurement Properties for Patients with Stroke
AUTHORS/INSTITUTIONS: E. Gorgon, Physical Therapy, University of the Philippines, Manila, Manila, PHILIPPINES|R.T. Lazaro, Physical Therapy, Samuel Merritt University, San Francisco, California, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Impaired muscular control in the affected lower limb is common following a stroke and impacts negatively on gait, balance, and functional independence. The Upright Motor Control Test (UMCT) has been used to assess functional strength of the hemiparetic lower limb at the hip, knee, and ankle in standing in adults with stroke [1]. To date, it has been included as an outcome measure in intervention studies yet it is not clear if there is sufficient evidence for its acceptability. For a clinical measure to be acceptable, it must demonstrate critical measurement properties such as reliability, validity, responsiveness to change, and clinical utility. This systematic review sought to synthesize the available evidence on the clinimetric properties of the UMCT for stroke rehabilitation.

Number of Subjects : Not applicable

Materials/Methods : The study design was guided by the PRISMA Statement. Electronic databases that indexed peer-reviewed literature were systematically searched from inception until February 2015 (week 2): PubMed, PEDro, Cochrane Library, Scopus, ScienceDirect, LILACS, DOAJ, and Google Scholar. Observational studies that explored any measurement property of the UMCT for adults with stroke were included. Studies were appraised and data were abstracted using the McMaster University Outcome Measures Rating Form [2].

Results : The search yielded 9 articles that described the use of the UMCT. Six articles were excluded because those did not investigate clinimetric properties but utilized the UMCT as an outcome measure in clinical trials (n=2), single-subject design (n=1), and observational studies (n=3). Only 3 studies have examined the UMCT's clinimetric properties [3-5]. All studies included patients with sub-acute stroke (30-180 days after stroke onset) and covered dimensions of validity (predictive and convergent). No published study has formally assessed the UMCT's reliability or responsive to change related to an intervention.

Conclusions : The UMCT is a highly practical measure of lower limb muscular control in standing in adults with stroke with some evidence for validity. However, for it to be acceptable, it must demonstrate reliability and responsiveness to change

Clinical Relevance : Although the UMCT is highly practical to administer, the insufficient evidence on its clinimetric properties limits its acceptability as an outcome measure in stroke rehabilitation. This key finding highlights the need to investigate further the tool's measurement properties. Specifically, without interrater reliability estimates, it is uncertain if UMCT measurements would be stable across different raters. Without estimates for its test-retest reliability and responsiveness to change, it remains to be known if UMCT measurements would be valuable in longitudinal assessment of intervention outcomes. On the basis of existing standards for acceptability of clinical measures [2], the UMCT still requires further standardization.

TITLE: Gait Training in a Body-Weight Supported Environment during Rehabilitation in a Patient with Guillain Barre Syndrome

AUTHORS/INSTITUTIONS: J. Canbek, J. Lombardi, D. Tadena, Nova Southeastern University, Fort Lauderdale, Florida, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : Guillain Barre Syndrome (GBS) is an acute inflammatory polyneuropathy which causes muscle weakness, balance deficits and poor exercise tolerance, leading to activity limitations such as difficulty walking. Moderate intensity exercise is recommended in GBS rehabilitation, but clinical trials are lacking. It is unknown whether exercise improves walking in people with GBS or which modes of gait training are most effective. Body weight supported treadmill training (BWSTT) has been evaluated in people with central nervous system injury, but rarely in people with peripheral nerve disorders such as GBS. The purpose of this case report is to describe the outcome of BWSTT to improve walking in a patient with GBS.

Case Description : 64 year old male with GBS; admitted to inpatient rehab (IP) 6 weeks after onset of GBS. Initial PT exam: MMT in legs $\leq 3/5$; Functional Independence Measure (FIM) scores: transfers 3 (slide board), walking 0, wheelchair 1; max assist x 3 to stand in parallel bars. Treatment: "usual" IP PT treatment 60-90 minutes daily, 6 days/week x 6 weeks, with addition of BWSTT and over ground training using body weight support device (BWS) device. Initial parameters: 100 feet at 0.5 mph (0.22 m/s), maximal body weight removed, patient's feet remained in contact with support surface. Parameters progressed to patient's tolerance; vital signs monitored; manual assistance provided to facilitate normal walking pattern and trunk alignment; pre-gait & standing balance exercises practiced in BWS device.

Outcomes : Discharge from IP: mod assist x 1 to stand in parallel bars for 2 minutes; unable to walk without BWS. Follow up during outpatient PT at 4 weeks post IP discharge: walking 20 feet, rolling walker, mod assist for balance, gait speed 0.22 m/s; and 10 weeks post IP discharge: walking 140 feet, rolling walker, supervision, gait speed 0.29 m/s.

Discussion : Task-specific gait training on a treadmill at speeds representative of normal walking appears to have a positive effect on long term walking ability in this pt, as evidenced by quick transition during outpatient therapy from physiological to household ambulator. Aligned with a similar case report, more steps were taken at faster speeds early in rehab using the BWS device, than with PT assistance alone. BWS device allowed for upright training in a dynamic environment, which is limited by other devices such as a standing frame and allowed the therapists' free hands to provide therapeutic facilitation. Task-specific strengthening of legs through BWSTT may decrease overuse weakness and fatigue during PT. Further evaluation of the efficacy of BWSTT to improve gait function in a cohort of people with GBS is recommended. Studies show adaptive reorganization occurs in the motor cortex and spinal cord after central nervous system injury and more recently, peripheral nerve injury. Further research is needed to understand the role of BWSTT in central reorganization in people with GBS.

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TITLE: The Use of Comprehensive HEPs to Address Multiple Impairments in the Patient with Combined Peripheral and Central Vestibular Dysfunction.

AUTHORS/INSTITUTIONS: M.K. Root, D. Malamut, Vestibular Physical Therapy outpatient department, NYU Langone Medical Center, New York, New York, UNITED STATES|

ABSTRACT BODY:

Background & Purpose : The standard practice in Vestibular Therapy is to address dysfunction by targeting vestibular reflexes through standard exercises such as VORx1 and VORx2, standing balance/ambulation with head turns, and habituation training. The repetition of these exercises encourages the adaptive response and subsequent reduction in vestibular symptoms. The progression of these basic exercises towards a more functional level has often neglected a patient sensitive incremental approach and lacked the multifactorial characteristics required to encourage full recovery. The super-tentorial aspects of vestibular recovery are often ignored or avoided. These higher functions can be addressed as components of a compact series of redundant movement sequences. These sequences must contain the spatial and temporal complexity, to return the patient to higher level functional and/or work related activities. The following case description presents the successful use of a series of compact, comprehensive HEPs to address multiple impairments in a patient with mixed peripheral and central vestibular dysfunction.

Case Description : A 40 year old male status post resection of a 4.1cm cerebellopontine angle acoustic neuroma compressing the cerebellum, presented to the NYU Vestibular Clinic with impairments including “dizziness”/motion sensitivity, impaired gaze stability, impaired balance and impaired left UE coordination. Initially, the patient was on disability from work as a neuro-ophthalmologist, and his primary goal was to once again perform surgery. This required coordination of all four extremities, use of a microscope, as well as the necessary endurance. In order to address all of the impairments in a concise but thorough HEP, each exercise had to be multifaceted. The following is an example of one such exercise that addresses balance, gaze stability and coordination; patient performed 180 degree turning every three steps walking forward and backward while fixating gaze and catching/tossing a ball from and to a therapist.

Outcomes : The patient consistently reported HEP compliance to a limited exercise prescription of 5-6 exercises at a time. The patient had a clinically significant improvement in VORx1 (quantified in head turns per minute) from ~43% of normal speed to ~97%, DVA improving from 8 to 5 lines, BESS test improving from 48 to 31, and DHI scores improving from 48 to 28. The patient was able to return to full time work as a doctor and surgeon, while resuming full participant in his family.

Discussion : The use of only a few multifaceted exercises effectively addressed all deficits in this patient with multiple impairments exhibited by clinical and functional improvements. The more concise and incrementally sensitive HEP, seemed to enhance the likelihood of patient compliance. This proposed approach can be applied to most patients with a combination of impaired balance, coordination, motion sensitivity, and gaze stability.

References: Must include 5 current references (less than 10 years old): Balaban, C., Hoffer, M., Gottshall, K.. Top-down approach to vestibular compensation: translational lessons from vestibular rehabilitation. *Brain Res.* 2012 Oct 30;1482:101-11. Braswell, J., Rine, R. Preliminary evidence of improved gaze stability following exercise in two children with vestibular hypofunction. *Int J Pediatr Otorhinolaryngol.* 2006 Nov;70(11):1967-73. Doidge, N. *The brain that changes itself, stories of personal triumph from the frontiers of brain science.* New York : Viking, 2007. Eagleman, D. *Incognito, the secret lives of the brain.* New York : Vintage Books, 2012. Giray M, Kirazli Y, Karapolat H, Celebisoy N, Bilgen C, Kirazli T. Short-Term Effects of Vestibular Rehabilitation in Patients With Chronic Unilateral Vestibular Dysfunction: A Randomized Controlled Study. *Arch Phys Med Rehabil.* Aug 2009; 90: 1325-1330. Hall, C., Heusel-Gillig, L., Tusa, R., Herdman, S. Efficacy of gaze stability exercises in older adults with dizziness. *J Neurol Phys Ther.* 2010 Jun;34(2):64-9. Kurzban, R. *Why Everyone (Else) Is a Hypocrite: Evolution and the Modular Mind.* Princeton, N.J.: Princeton University Press, 2010. Ramachandran, V. *The tell – tale brain, a neuroscientist’s quest for what makes us human.* New York : W.W. Norton, 2011.

TITLE: Neuromuscular electrical stimulation (NMES) on the anterior tibialis muscle and the effects on strength and gait mechanics on stroke patients: A systematic review.

AUTHORS/INSTITUTIONS: R. Boyles, C. Hampton, R. Milhem, K.M. Chan, Physical Therapy, University of Puget Sound, Tacoma, Washington, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Electrical stimulation is currently used in many forms to facilitate changes in muscle action and performance. Clinically, it can be used to improve muscle strength, increase range of motion, reduce edema, decrease atrophy, heal tissues, and decrease pain. Although there is evidence supporting Neuromuscular Electrical Stimulation (NMES)³, there is still an inconsistency in the results of the literature. Therefore, the purpose of this study is to determine the effects of Neuromuscular Electrical Stimulation (NMES) on the anterior tibialis muscle on improving gait mechanics on post stroke patients.

Number of Subjects : 7

Materials/Methods : A search of Pubmed, PEDro, CINAHL and Cochrane was performed between November 2014 and April 2015. Randomized control trials (RCTs) that met inclusion criteria were assessed for quality, by 3 raters, using the 11-point PEDro scale. Studies scoring 10-11 were deemed to be of “excellent” methodological quality, studies scoring 8-9 were deemed “good” quality and studies scoring 6-7 were deemed “fair” quality. Studies scoring below 6 were deemed “poor quality”.

Results : The initial search produced 21 total articles, yielding seven studies which met the selected inclusion criteria. The selected RCTs produced PEDro scores ranging from 6 to 9, with a mean score of 8.286, deeming “good” quality research for the reviewed articles.

Conclusions : Research regarding the use of NMES on the tibialis anterior for drop foot varies in its quality due to the amount of available subjects, the diverse presentations of symptoms following a stroke, and the difficulty in blinding therapists or patients due to both the external application and the sensory aspect of this type of modality. NMES has been shown to improve muscular function of the tibialis anterior following stroke including TA strength, spasticity of gastrocnemius and soleus, and both passive and active range of motion of the ankle. Furthermore, gait parameters--obstacle negotiation, step length, cadence, and velocity--were similarly improved by NMES. Improvements were also found on functional assessments, such as the Fugl-Meyer Assessment. While research supports the use of NMES for stroke patients, evidence differs on whether NMES is a better treatment than conventional rehabilitation programs or use of AFOs to reduce drop foot and improve gait mechanics. Overall, NMES can be utilized to improve gait and other parameters of movement following a stroke, but the evidence does not give consistent results supporting NMES as being more effective than conventional rehabilitation programs.

Clinical Relevance : This systematic review demonstrated that NMES is effective at improving functional movement in chronic stroke patients, however, this research shows that there is not currently a consensus on if NMES is more effective than other conventional rehabilitation interventions.

TITLE: Effects of POWER Training in Young and Older Adults Post-Stroke

AUTHORS/INSTITUTIONS: J.L. Hunnicutt, S.E. Aaron, A.E. Embry, P. Morgan, B. Cence, M.G. Bowden, C. Gregory, Health Sciences and Research, Medical University of South Carolina, Charleston, South Carolina, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : Stroke is a condition associated with advanced age. However, 35,000 strokes occur annually in individuals younger than 40. Aging results in decreased muscle power that negatively impacts mobility with stroke exaggerating these declines. Lower extremity muscle power training can improve post-stroke mobility, but data on potential adaptations in young vs. older adults are not available. The purpose of this study is to compare the effects of Post-Stroke Optimization of Walking Using Explosive Resistance (POWER) training on strength, power, and gait speed in young (<40 years) and older (>60 years) post-stroke subjects.

Number of Subjects : Fifteen young (n=6; 26.2 ± 5.3 years) and older (n=9; 64.8 ± 2.8 years) individuals with chronic (> 6 mos) post-stroke hemiparesis participated in this study.

Materials/Methods : Subjects completed 12 weeks (2-3 sessions/week) of training that included a series of progressive, intensive leg press and jump training exercises, sit-to-stands, step-ups, and calf raises. Exercises were performed unilaterally on both the paretic and non-paretic sides. Subjects also performed progressive overground fast walking (forward and backward) to emphasize the task-specific lower extremity power generation. Outcomes included self-selected (SSWS) and fastest comfortable walking speed (FCWS) measured using a GAITRite™ Portable Walking System. Maximum voluntary isometric contractions (MVIC) of the plantarflexors and knee extensors and peak isotonic power in the knee extensors were assessed on a Biodex isokinetic dynamometer. Clinical measures included Fugl-Meyer lower extremity motor score (FM-LE), Berg Balance Scale (BBS), and Dynamic Gait Index (DGI). Paired and independent samples t-tests were used to determine within and between group differences, respectively.

Results : There were no significant differences between groups at baseline for FM-LE, BBS, or DGI. Young and older subjects significantly improved FCWS and non-paretic knee extensor power. Older subjects increased their paretic knee extensor power and non-paretic knee extensor MVIC, while young subjects significantly improved SSWS. There were no significant differences between groups, though the majority (83%; 5/6) of the young subjects achieved clinically meaningful improvements (≥ 0.16 m/s) in SSWS while only 44% (4/9) of the older subjects reached this magnitude of improvement.

Conclusions : The data suggest similar benefits of POWER training in young and older post-stroke subjects. However, when observing within groups differences, older adults may attain more benefit in strength and power, while young subjects appear to achieve greater benefits in walking speed.

Clinical Relevance : Stroke is often considered exclusive to aging adults, but the prevalence in adults less than 40 years is alarming, as these patients are faced with the sequelae from stroke for decades to come. It is essential to provide evidence-based therapies that address their particular needs, offering unique challenges to clinicians treating young stroke patients.

TITLE: The Short-Term Effects of Incline Treadmill Walking on Braking, Propulsion, and Ankle Power in Individuals with Chronic Spinal Cord Injury

AUTHORS/INSTITUTIONS: C.J. VanDerwerker, C. Gregory, M.G. Bowden, Department of Health Sciences and Research, Medical University of South Carolina, Charleston, South Carolina, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : In order to ambulate, an individual must successfully move the body anteriorly utilizing force production. This anterior progression can be analyzed by assessing anterior-posterior ground reaction forces (AP GRF) and the ankle power contributing to these forces. In healthy controls, incline walking has been associated with several changes in biomechanics, including increased propulsion and plantarflexor moments. The purpose of this study was to assess short-term effects of inclined treadmill training on propulsion (GRF), braking (GRF), and ankle power in individuals with chronic incomplete spinal cord injury (iSCI).

Number of Subjects : 7

Materials/Methods : Seven participants, 5 females and 2 males with chronic iSCI (ASIA D) were enrolled. Average ASIA LE motor score was 43.7 + 6.40, median Walking Index for Spinal Cord Injury was 20 +2.65, and mean self-selected walking speed (SSWS) was 0.46 +0.24 m/s. All seven participants were instrumented with a modified Helen Hayes active marker set (PhaseSpace) and walked on an instrumented treadmill (Bertec) at SSWS for 30 seconds on a zero degree incline. The participants then walked on the treadmill, inclined to 8 degrees, for 5 minutes. After 5 minutes, the participants returned to zero incline and ambulated for an additional 2 minutes at SSWS. Post-intervention data was collected during the last 30 seconds of the 2-minute walk. Outcome variable of interest included GRF (propulsion and braking) and ankle power.

Results : A positive percent change in bilateral lower extremities (LE) for maximum and minimum GRF values and also propulsion and braking impulses (1.43%-8.18%) was found. The largest percent change (8.18%) was noted for the propulsion impulse for the weaker LE. For ankle power, a negative percent change was noted for both maximum value (-14.19%) and positive area under the curve (-6.39%) for the weaker LE, but a positive percent change was noted on the stronger LE, 8.48% and 9.98% respectively. Effect sizes for all variables ranged from 0.03 to 0.27.

Conclusions : While 5 minutes of incline treadmill training at 8 degrees increased propulsion and braking impulses and peak values, it promoted decreased ankle power on the weaker LE and increased ankle power on the stronger LE. These changes indicate that additional variable(s), such as hip power or hip extension angle, must have contributed to impulse change.

Clinical Relevance : This study demonstrates that in individuals with chronic iSCI, biomechanical changes in walking can be seen after a 5-minute, 8-degree incline treadmill-training session. These results are limited by the brief 5-minute bout on the treadmill, necessitated by the high degree of impairment of the sample, and 5 minutes may be insufficient to see effective gait adaptations. Future studies need to focus on determining other factors that contributed to impulse changes and on the use of incline treadmill training for individuals with chronic iSCI as a possible training paradigm.

TITLE: Alterations in gait kinematics following intensive variable stepping training as compared to conventional therapy interventions in individuals post-stroke.

AUTHORS/INSTITUTIONS: G.B. Mahtani, M. Connolly, P. Hennessy, J.L. Woodward, G. Brazg, T. Hornby, Locomotor Recovery Lab, Sensory Motor Performance Program, Rehabilitation Institute of Chicago, Chicago, Illinois, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : The purpose of the study was to evaluate changes in gait kinematics following intensive variable stepping training that promotes repetitive kinematic variability in movement patterns in individuals post-stroke as compared to a control group receiving conventional therapy

Number of Subjects : n=26

Materials/Methods : Individuals 1-6 months post-stroke were randomized and received 10 weeks of up to 40 sessions of either high intensity stepping training or a conventional intervention, consisting of multiple practiced tasks and therapeutic exercises based on previously observed data. Non-randomized pilot data for this study was also included in final analysis (n=35). Graded treadmill tests with kinematic assessments were performed at BSL and POST interventions including frontal and sagittal plane joint excursions, and spatiotemporal parameters at peak treadmill speeds and at matched speeds to peak BSL testing.

Results : Significant gains were observed in non-paretic plantar-flexion and knee extension range of motion in the experimental vs conventional training group. In addition, the average coefficient of correlation (ACC), which provides a metric for intra-limb (hip-knee) coordination was also significantly improved in the experimental vs conventional group. There was a significant increase in peak hip abduction during swing in the experimental group, with changes correlated to initial Fugl-Meyer scores. No significant differences between groups were found for all reported measures at matched treadmill speeds at POST testing.

Conclusions : High intensity, dynamic stepping training with allowance for errors and minimal focus on gait kinematics in subacute stroke led to improved walking ability compared to conventional therapies. Although no additional focus was given to gait kinematics during the intervention, similar or improved kinematic outcomes were observed between groups.

Clinical Relevance : Clinician's focus on normalizing kinematics and minimizing compensatory strategies during walking therapies in individuals with subacute stroke may not be beneficial. These findings challenge therapists to incorporate error based task specific walking therapies when retraining gait early after stroke.

TITLE: Kinematics and Muscle Activity During Over Ground Bionic Ambulation in Able-bodied Individuals

AUTHORS/INSTITUTIONS: A. Domingo, B. Swanson, C. Sanscartier, Doctor of Physical Therapy Program, San Diego State University, San Diego, California, UNITED STATES|

ABSTRACT BODY:

Purpose/Hypothesis : A class of lower limb bionic suits has recently been developed to enable over ground walking in persons with quadriplegia and paraplegia. Some of these devices can provide variable levels of assistance so that residual motor function can be used instead of the legs being passively moved through the motions of walking. Little is known about the effects of variable assistance during over ground bionic ambulation training on motor control of walking after incomplete spinal cord injury. The first step towards understanding its effects is to test able-bodied subjects walking in the bionic suit in order to observe how users adapt to variable assistance, independent of compromised motor and/or sensory function. The purpose of this study was to explore how using the Ekso, a wearable bionic suit, changes muscle activity and joint angles during walking in able-bodied individuals. We hypothesized that able-bodied subjects walking with adaptive swing assistance in the Ekso would have similar muscle activation and joint angles to that during normal over ground walking.

Number of Subjects : 3 able-bodied subjects

Materials/Methods : Subjects walked in 3 conditions: normal walking, walking with a front-wheeled walker, and walking in the Ekso with adaptive assistance and the walker. Each condition was performed three times, with speed kept constant between conditions. When walking in the Ekso, subjects were instructed to decrease the assistance of the Ekso by maintaining its prescribed trajectory during the swing phase of gait. We collected muscle activity data from 4 muscles (tibialis anterior (TA), medial gastrocnemius (MG), biceps femoris (BF) and vastus lateralis(VL)) using surface electromyography (EMG), as well as kinematic data from the hips, knees and ankles using electro-goniometers. EMG root-mean-square (RMS) was calculated to estimate muscle activation magnitudes, and sagittal plane ranges of motion during walking was calculated from joint angle data.

Results : Muscle activation amplitudes (EMG RMS) were significantly higher when walking in the Ekso in 2 of the muscles tested (MG and VL, all $P \leq .008$). Maximum range of motion during walking was significantly greater in the hip and knee when walking in the Ekso (all, $P \leq .008$), but not the ankle ($P = .264$).

Conclusions : Bionic ambulation causes greater muscle activation in some lower extremity muscles and larger ranges of motion at the hip and knee than in normal walking. More subjects should be tested to further elucidate differences in muscle activity and joint angles between normal walking and bionic ambulation.

Clinical Relevance : Therapeutic interventions that improve mobility after spinal cord injury can improve quality of life and lessen secondary complications from reduced physical activity. Over ground bionic ambulation may be one method to help increase walking function in those with neurological injury. Studies are needed to examine the effectiveness of currently available devices and to help inform best practices for their use.

TITLE: The Safety and Feasibility of Mobilization of patients in Active Vasospasm following Subarachnoid hemorrhage.

AUTHORS/INSTITUTIONS: E.M. Hallett, H. Bhide, R. Mustille, J. Abele, S. Tatebe, Department of Rehab Services, UCSF Medical Center, San Francisco, California, UNITED STATES|

ABSTRACT BODY:

Purpose : To demonstrate the safety and feasibility of mobilizing patients in vasospasm following subarachnoid hemorrhage; to facilitate clinical decision making with the use of a PT-created decision tree to mobilize this patient population.

Description : Decreased mobility in critically ill neurologic patients has long term negative effects on a patient's ability to return to their prior level of function. Multiple studies have demonstrated the benefits of early mobilization in patients in Medical ICUs, however evidence is limited on the benefits of early mobility in the Neurologic ICUs. In 2012, Titsworth et al. studied the effects of early mobility in patients in the Neuro ICU and found decreased length of stay and reduction in hospital acquired infections when early mobility was implemented. In 2011, Cumming et al. showed that early and intensive mobility was associated with good functional outcomes in patients who have had ischemic strokes. Survivors of aneurysmal subarachnoid hemorrhages (SAH) have a difficult medical course due to the high risk complications associated with this type of stroke. After a SAH, patients are hospitalized for a minimum of two weeks with at least a week of close monitoring for vasospasm in the ICU. With such a long prolonged hospitalization, these patients are at high risk for complications related to immobility. In 2015, Oklowski et al. showed that early mobility for patients status post SAH accelerates recovery and reduces hospital length of stay. However, patients in active vasospasm were excluded from mobilizing. In our literature search, we found no studies that address the mobilization of patients in active vasospasm. Two adult inpatients in the Neuro ICU at UCSF in vasospasm following SAH were mobilized using a PT-created decision tree to guide clinical reasoning and progression of mobility and therapeutic activities.

Summary of Use : As soon as physical therapy was ordered and the mobility parameters identified, the physical therapist (PT) completed an evaluation and set up a treatment plan. Throughout all sessions, the PT was in constant collaboration with the nurse regarding patient status and appropriate titration of medications. In the case of an acute drop in blood pressure or change in neurologic status, the patient was safely returned to supine in bed (see decision tree).

Importance to Members: In the neurological ICU at UCSF, we work as collaborative teams to mobilize patients as early and as often as possible. This decision tree was created to help facilitate decision making to ensure safe mobility with patients in active vasospasm. Both patients presented very differently but were able to safely mobilize when the decision tree was utilized as a framework. Though more research is needed, this case study suggests that the early mobilization of patients in active vasospasm is safe and feasible with the use of this decision tree.

TITLE: Go Baby Go Café': An Immersive Rehabilitation Environment to Improve Functional Outcomes, Quality of Life and Vocational Skills

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ABSTRACT BODY:

Background & Purpose : Treatment for survivors of traumatic brain injury (TBI) involves two general phases: physical, occupational and speech therapy within an inpatient or outpatient clinical setting followed by vocational training in a simulated then actual work environment as appropriate. Two issues addressed by this report are: 1) the potential advantage of co-treating within a complex, real world environment which in this case is functioning business, and 2) the use of technology to allow participants to be functionally mobile before they can walk independently within that environment. The purpose of this report is to determine the effectiveness of involving TBI survivors in a novel "immersive rehabilitation environment" in which physical, cognitive, social and speech impairments are simultaneously addressed during the performance of vocational training within a functioning business.

Case Description : Participant was a 34 year old with a history of a severe closed head injury 17 years ago due to a motor vehicle accident. She presents with right side hemiparesis, poor bilateral manual dexterity, non-fluent speech, poor gross and fine motor function, slow processing speed with poor recall and short term memory. Intervention was provided within the Go Baby Go Café at the University of Delaware. The Café is a functioning eatery serving breakfast, lunch and small snacks. Within the Café is a free-standing 10' x 10' mechanical structure equipped with an overhead body weight support system (BWSS) that allows the participant to freely move throughout the café while preventing falls. The participant performed various tasks during her two-hour shifts, three times a week for 2 months. Tasks were selected to address weekly goals and included serving ice cream and snacks, stacking supplies and making beverages.

Outcomes : Measures were gathered at baseline and after 1 and 2 months of intervention. Hand function was measured by Jenson Hand Taylor Function Test (JHTFT), Functional mobility was measured by the 10 M walk test and TUG test, Cognition by Trail Making Test - B (TMT B) and Quality of life with Neuro - QOL. The subject improved in performing the 7 tasks by 1.54 minutes with the left hand and 1 minute with the right of the JHFT. Self-selected walking speed improved by 42% at 1 month and 55% at 2 months of intervention. The TUG test showed an increase of 50% at 1 month and 33% after 2 months of intervention. Time taken to do the TMT B showed a decrease from 130.56 seconds to 60.2 seconds after two months of intervention. The Neuro QOL showed positive changes in various social activities, feeling of well being, gross motor function and cognitive domains.

Discussion : The results suggest that the Café' may be a feasible environment for comprehensive intervention. Moreover, our measures may be useful in tracking changes in future group studies. Most importantly, participation in the Café' was associated with wide spread gains in scores on a variety of physical, cognitive, quality of life outcomes.

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