NeurologySection

Online Journal Club-Article Review Template

Background/Overview	
Article Citation	Reisman D, Kesar T, Perumal R, et al. Time course of functional and biomechanical improvements during a gait training intervention in persons with chronic stroke. *J Neurol Phys Ther* 2013;37: 159-165.
Study Objective/Purpose (hypothesis)	To identify the amount of time it takes to see changes in gait biomechanics and walking function in individuals with chronic stroke (6 months post stroke).
Brief Background (why issue is important; summary of previous literature)	Recovery of walking function is one of the primary goals reported by a majority of patients post-stroke. Previous studies have separately examined the time course for improved gait speed and endurance in patients with chronic stroke. However, this study was designed to simultaneously examine changes in walking speed, endurance and gait biomechanics, to determine the time course and minimum number of training sessions required for clinically significant improvements.
Methods	
Study Design (type of trial, randomization, blinding, controls, study groups, length of study, follow-up)	-convenience sample from local physical therapy clinics, stroke support groups and advertisements -Single-subject design completed over the course of 12 weeks -All subjects completed testing pre-intervention, at 4 weeks, 8 weeks and 12 weeks. -Assessors were blinded to all previous assessment data -Clinical evaluation and training was performed by same tester; gait analysis testing was performed by a different tester
Target Population (dx, acuity, inclusion/exclusion critieria)	**Inclusion criteria:** >6 months after stroke, Able to walk continuously for 5 minutes at self-selected pace without assistance, At least 5 degrees from neutral dorsiflexion with knee flexed (PROM) on paretic side, <5 degree PF contracture **Exclusion criteria:** Congestive heart failure, Peripheral artery disease with claudication, Uncontrolled diabetes, Shortness of breath without exertion, Unstable angina, Resting HR outside of 40-100 bpm, Resting BP outside of 90/60 to 170/90 mmHg, Inability to communicate with investigators, Pain in LE or spine, TKR, Cerebellar involvement, Neglect (star cancellation test)
Interventions (if applicable): (specificity of interventions, ability to replicate, frequency, duration)	Intervention included fast treadmill training combined with plantarflexor and dorsiflexor muscle functional electrical stimulation (FastFES) locomotor training implemented by a physical therapist 3x/week for 12 weeks. Training speed determined by the fastest speed the participant could walk

	continuously for 4 minutes. Training speed was re-evaluated and increased, as indicated, every 4 weeks. **Parameters of Intervention:** <u>Overground & treadmill walking each session</u> Treadmill: 4 bouts x 6 min with ~5 minutes rest between bouts FES applied to paretic DF/PF muscles during 1st, 3rd, 5th minutes with goal of maximizing motor learning and decreasing muscle fatigue FES was off during 2nd, 4th and 6th minutes and pt was encouraged to walk the same way During final bout – 3 minutes of walking with FES on treadmill immediately followed by 3 minutes of walking with FES overground <u>Functional Electrical Stimulation</u> 2"x2" electrodes placed over DF and PF muscles Amplitude – 300 ms; Frequency – 30Hz; Pulse Duration – 300 µs Amplitude was gradually increased until the foot reached a neutral ankle joint position or maximum dorsiflexion range was achieved o DF – patient seated o PF – patient standing and amplitude increased until heel off of the ground Two compression closing foot switches were used to control timing of FES during gait cycle o Forefoot switch: Placed under the 5th met head o Hindfoot switch: Placed under the lateral portion of the heel
Outcome Measures (relevant to purpose of the study; reliable, valid, clinical utility)	-Timed Up & Go was used as a measure of functional mobility: MCID = 3.7 seconds -10-meter walk test was used as a measure of gait speed: MCID = 0.16 m/s -6 minute walk test was used as a measure of endurance: MCID = 52m -Gait analysis was used as a measure of gait biomechanics. Retroreflective markers were placed over pelvis, thigh, shank, medial malleoli and lateral malleolli, bilaterally. Kinematic data was collected using an 8 camera Vicon Motion Capture System (2x 20 second trials). A harness was used without body-weight support and the individual could hold onto the rail during walking. Variables evaluated included: o *Peak paretic propulsion,* defined as, "peak value of the anterior GRF normalized to body weight" o *Paretic propulsive intergral*, defined as, "intergral of the anterior GRF from the onset of propulsion through the end of stance phase for the paretic leg" o *Peak knee flexion during swing phase*

	○ *Peak trailing limb angle*, defined as, "peak angle between the laboratory's vertical axis and a vector joining markers located on the lateral malleolus and the greater trochanter of the paretic lower extremity".
Statistical Analysis (statistics used, appropriate application)	The Kolmogorov-Smirnov test was used to ensure normal distribution of data. Nonparametric statistics were used to analyze variables which were not normally distributed. The Wilcoxon signed-rank test was used for a comparison between pre-training and 4-week outcomes and between 4-week and 12-week outcomes Softward used for statistical analyiss was SPSS 19.0 (SPSS Inc, Chicago, IL).
Results	
Enrollment/Subject Characteristics (sample size, gender, age, functional level; were groups similar on important variables prior to application of the intervention)	-13 subjects (age 61; +/- 8.3 years; 7 males) participated in study; 12 participants completed the study. One person dropped out due to unrelated knee pain -Average pre-intervention walking speed was 0.5 +/- 0.17 m/s. -Pre-intervention LE Fugl-Meyer scores varied from 13 to 24.
Summary of Primary and Secondary Outcomes (include aggregate and sub-group findings if reported); note results that were statistically significant; How many reached a level of clinical significance (exceed MCID if known); Was there retention of changes following intervention (if studied)	**Kinematic & Kinetics** <u>4 weeks</u>: peak paretic propulsion, paretic propulsive integral, peak knee flexion and peak trailing. limb significantly improved <u>12 weeks</u>: no significant difference in any variables from 4 weeks. **Clinical Measures of Walking Function** <u>4 weeks</u>: 10-meter walk test and 6MWT significantly improved. <u>12 weeks</u>: 10-meter walk test, 6MWT and TUG were all significantly improved.
Authors' Discussion and Conclusions	
Brief Summary of Authors' Main Discussion Points; Authors' Conclusion	-Improvements were observed in both functional, kinematic and kinetic gait patterns. -Changes in kinematics and kinetics were noted within the first 4 weeks. -Functional improvements continued throughout the study. -Improvements in biomechanics will plateau before improvements in function; therefore, goals should be written accordingly. -At least 36 sessions (12 weeks) were needed to see changes in walking speed and TUG beyond MCID. Changes beyond MCID were seen by 8-weeks, or 24 sessions, for 6MWT.
Reviewer's Discussion and Conclusion	
Study Strengths	The protocol is possible to reproduce in a clinical setting because it only requires about 30 minutes of the clinicians time. The outcome measures were appropriately chosen based on intervention
Study Limitations and Potential for Bias	**Limitations:** Small sample (N=13); sample of convenience; No measurement of long term outcomes or level of carryover after cessation of the intervention; No information about shorter intervals of change (i.e.: 2 weeks)

Applicability: • Types of patients (dx) and setting that results apply to • Can interventions be reproduced? Can results be applied to other pt populations?	-The results apply most directly to patients which chronic stroke (>6 months) but can likely be applied to other population with paresis. -The study design applies most directly to an outpatient setting, though this type of intervention could potentially be utilized in an acute rehabilitation setting. Time constraints and other challenges inherent to an inpatient setting may make this intervention more difficult to implement. -The interventions can be reproduced if your clinic has access to a split belt treadmill and FES equipment.
How will study results impact PT management of this patient population?; List suggestions for how to implement changes in your clinic/department to integrate study findings into patient care	This study demonstrates that split-belt treadmill training combined with FES to DF/PF muscles is an effective intervention for improving gait speed, endurance and gait biomechanics in patient post-stroke; however, this intervention requires a large number of treatment sessions in order to see desired outcomes beyond MCID. Therefore, patients post-stroke required high volume and high repetition of task-specific practice to improve functional walking. These findings can assist clinicians with focusing treatment planning and goal writing.