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Utilization Of Postural Control Training To Improve Gait Symmetry And Walking Ability In A Patient Following A Lacunar Stroke: A Case Report

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The patient gave consent to participate in this case report and signed informed consent paperwork allowing the use of any photo or video footage obtained for this case report. The patient was also given information on the Health Insurance Portability and Accountability Act.

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ABSTRACT

Background and Purpose

Stroke affects approximately 800,000 people annually and alterations in gait is one of the most noted impairments following stroke. The purpose of this case report is to outline physical therapy (PT) rehabilitation that utilized postural control training, task-oriented training, and visual feedback to address walking ability and functional capacity in a patient following a stroke.

Case Description

The patient was a 67-year-old male apple orchard owner three months post a lacunar ischemic stroke affecting the posterior limb of the internal capsule, the basal ganglia, and part of the cerebellum. His initial examination revealed impaired strength, sensation, range of motion, balance, endurance, and mobility. This case report describes his initial ten outpatient PT visits primarily focused on improving the patient's functional mobility, ambulation in particular, through postural control training and task-oriented training.

Outcomes

After ten outpatient visits, the patient demonstrated improvements in gait and postural symmetry on observation. Improvements were shown in both gait speed (from 0.24 m/s to 0.30 m/s) and gait endurance (from feet to 130 feet) and although the improvements did not meet established minimally important clinical difference values, he did demonstrate trends toward improvement.

Discussion

Postural control training and task oriented training are common PT interventions utilized in patients following stroke. Utilizing postural control training and task-oriented training, the patient showed initial improvements in postural symmetry and gait mechanics, which translated to improved access to his environment. Despite initial improvements, the patient’s various comorbidities likely contributed to his plateau in progress. Future research on lacunar stroke should address how comorbidities affect the acquisition of PT goals and improvements in gait speed.

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BACKGROUND AND PURPOSE

Stroke affects approximately 800,000 people annually in the United States, and survivors of stroke report persistent difficulties with daily tasks as a direct consequence of stroke.[1] Furthermore, alterations in gait is one of the most noted impairments following stroke, and improving walking ability is one of the most common goals amongst patients with stroke undergoing rehabilitation.[2] Of the common gait deviations observed following stroke, decreased gait speed is a significant limitation as a result of stroke.[3]

A case report by Lewek[3] addressed the effectiveness of visual and proprioceptive feedback to improve gait speed in two patients with chronic stroke. Improving mobility was the goal for the intervention, so intensive gait training was performed by either overground or treadmill training. During gait training, visual and proprioceptive feedback was given throughout. Following six weeks of intervention, both patients had improved gait speed as well as spatiotemporal symmetry with gait mechanics.

A systematic review by Eng and Tang[2] examined 39 randomized controlled trials (RCTs) assessing different rehabilitation strategies for improving walking ability in people following stroke. The interventions analyzed included neurodevelopmental training, strength training, treadmill training, and task-specific training. Among these interventions, task-oriented training showed highly compelling evidence of effectiveness in improving walking ability. These task-oriented training programs focused not only on walking, but also on a broad array of other functional mobility tasks. They were shown to be effective in improving walking ability following stroke, as well as including further benefits of functional strengthening, balance improvements, and cardiorespiratory benefits.

Salbach[4] used a RCT to further evaluate the effectiveness of task-oriented training on improving walking speed and distance in patients following stroke. In the experimental group (n=44), ten functional tasks were utilized that were hypothesized to improve lower extremity (LE) strength and subjects' walking speed, distance, and balance. The control group (n=47) performed only upper extremity activities. Following intervention, significant differences were shown between the experimental and control groups in both walking speed ($p < 0.05$) and distance ($p < 0.05$) in favor of task-oriented training.

Andersson and Franzen[5] evaluated weight-shift training and its ability to improve walking ability in patients with chronic stroke (n=10). They hypothesized that gait abnormalities were largely a result of asymmetry due to hemiparesis following stroke. By training patients to shift weight toward their involved sides, they believed patients would have greater postural control, more symmetrical gait mechanics, and improved walking ability. Following three weeks of weight-shift training, greater spatial and temporal symmetry of gait and increased gait speed (p=0.037) was noted.

Based on the findings in the literature, visual and proprioceptive feedback are effective in improving gait speed and mechanics following stroke.[3] Additionally, task-oriented training has been shown to be effective in improving walking ability, strength, and balance.[2,4] Finally, based on the positive results demonstrated with weight-shift training, postural control training may similarly improve walking ability following stroke. The purpose of this case report is to outline PT rehabilitation that utilized postural control training, task-oriented training, and visual feedback to address walking ability and functional capacity in a patient following a stroke.

CASE DESCRIPTION

Patient History and Systems Review

The patient (JT) gave written consent to participate in this case report. JT was a 67-year-old male referred to outpatient PT following a lacunar ischemic stroke affecting the posterior limb of the internal capsule, the basal ganglia, and part of the cerebellum approximately three months prior. This case report is based on the patient's first ten visits which comprise his initial phase of outpatient PT. JT was the owner of a hotel and apple orchard and was very involved in his community. He lived in a two story home with approximately four stairs to enter, but had not been able to access the second floor of his home following the stroke. He had a very supportive wife who was highly involved in his rehabilitation and was present for nearly every PT session. JT was unable to drive so his family drove him to therapy.

His stroke was a result of a blood clot that formed due to atrial fibrillation, which caused ischemia in the brain. Following his stroke, he had an acute stay in the hospital for one week, and was then transferred to a subacute rehabilitation facility where he stayed for 30 days. Following discharge, he returned home and received home PT services for five weeks prior to initiating outpatient PT.

As a result of his stroke, he had hemiparesis of his dominant left side upper and lower extremities. Upon his initial evaluation in outpatient therapy, his chief complaints included decreased endurance, and pain in the left shoulder and left lower extremity (LLE) with ambulation. JT's left shoulder pain was a result of chronic subluxation of the glenohumeral joint due to flaccid paralysis of his left upper extremity (LUE), and his LLE pain was a result of intermittent claudication. The patient used a manual wheelchair with left arm trough, and a wide base quad cane for ambulation. He also wore an ankle foot orthosis (AFO) on his LLE, and a sling on his left upper extremity (LUE) for ambulation. In addition to his stroke, the patient also had a history of high cholesterol, hypertension, peripheral artery disease, and atrial fibrillation. Please see Table 1 for results of his systems review and Appendix 1 for his medication list. In addition to outpatient PT, the patient was also receiving outpatient occupational therapy (OT), which focused primarily on his LUE function.

JT's primary goal for PT was to improve his mobility and endurance to be more independent and less reliant on his wheelchair.

Clinical Impression 1

Following a review of JT's history, his primary problems included impairments in strength, sensation, range of motion (ROM), balance, endurance, and mobility as a result of an ischemic stroke. Abnormal reflexes, clonus, and spasticity were also suspected. There were no differential diagnoses to be addressed upon initial evaluation. Planned tests and measures were: the Fugl-Meyer assessment for the LE, the Activities Specific Balance Confidence (ABC) scale, the Stroke Impact Scale (SIS-16), the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire (performed by OT), the Six Minute Walk Test (6MWT), the Ten Meter Walk Test (10MWT), and the Five Times Sit to Stand Test (FTSST or 5XSST). The patient remained an appropriate candidate for a case report because he was highly motivated to improve his walking ability to return to work and enhance his function.

Examination – Tests and Measures

Tests and measures performed during the PT initial evaluation focused primarily on gait, balance, and LE function. Tone, balance, sensation, and ROM were grossly assessed through observation and patient report. Since the patient was also receiving OT, the majority of his UE tests and measures were performed by the occupational therapist. While in the waiting area prior to the start of the PT evaluation, JT was given the ABC, the SIS-16, and the DASH. The ABC is a self-reported measure of balance confidence.[6] The SIS-16 is a shortened version of the Stroke Impact Scale and is used as a subjective measure to assess stroke-related physical disability.[7] The DASH is a self-reported questionnaire of disability related to UE function.[8]

From the waiting area to the treatment room, the patient self-propelled in his manual wheelchair using his right upper and lower extremities. While in his wheelchair, a gross postural assessment was performed in sitting. The patient performed a stand pivot transfer from the wheelchair to a chair with supervision to assess his functional mobility and independence. Following the patient history, further tests and measures were done to obtain objective measures of neuromuscular, cardiopulmonary, and musculoskeletal system functions (see Table 1).

The 5XSST was performed to assess JT's LE strength and function. It was used as a clinical assessment tool representing the body function domain of the International Classification of Functioning, Disability, and Health (ICF) model.[9] The Fugl-Meyer Assessment of Motor Recovery after Stroke has both upper and LE scales to assess the motor recovery in patients who have had strokes with hemiplegia and hemiparesis.[9] The LE scale of the Fugl-Meyer was completed with JT to assess his motor function, reflex integrity, coordination, and his ability to perform movements out of synergy. The Fugl-Meyer also represents the body function domain of the ICF model.

The 10MWT and 6MWT were used to assess walking ability and can be associated with both the activity and participation domains of the ICF model.[9,10] The 10MWT was specifically used to measure gait speed. Moreover, there is predictability in a patient's ability to be a home vs. community ambulator based on his self-paced gait speed as determined by the 10MWT.[10] The 6MWT was used to measure gait endurance. Cardiovascular deconditioning can occur following stroke due to increased energy demands from an inefficient gait pattern, making performing activities of daily living (ADLs) increasingly taxing.[11] Additionally, one of the patient's major complaints following his stroke was his limited endurance with ambulation, and it has been shown that gait endurance is one of the most challenging areas for patients following stroke.[12] Psychometric properties for tests and measures can be seen in Table 3.

Clinical Impression 2

The initial clinical impression was both confirmed, and rejected based on the examination data. It was originally hypothesized that JT would present with impaired sensation as a result of his stroke; however, sensation was grossly intact. He did, however, present with weakness, limited ROM, impaired balance and endurance, abnormal reflexes, clonus, and spasticity which were all consistent with the initial clinical impression.

Based on the patient's performance with his affected LLE on the Fugl-Meyer, it was determined that despite the extensor synergy pattern, he was able to coordinate movements of the left leg out of synergy, such as performing hip extension with knee flexion. It was also determined with the Fugl-Meyer, that JT's impairments were predominantly found in the distal joints compared to the proximal joints, affecting coordination and terminal accuracy of movements.

With the 10MWT, it was determined that the patient's gait speed was 0.24 meters per second (m/s). Eng and Tang[2] report that patients with stroke who can ambulate with a speed of 0.4 m/s are more likely to be able to be community ambulators. Based on this data, it was reinforced that improving JT's gait speed would be a major focus of PT in order to improve his function and increase his participation in the community. With JT's performance on the 6MWT, it was also reinforced that his endurance was impaired as a result of his stroke. He ambulated 85 feet (25.91 meters) in six minutes, which is below healthy age-matched norms (see Table 2). The patient continued to be appropriate for PT and this case study to further develop the body of literature on postural control training for patients with lacunar strokes, so the decision was made to continue with therapy.

Based on JT's medical history and the results of tests and measures, two rehabilitation ICD-10 codes were chosen. The primary ICD-10 code was I69.952, *hemiplegia and hemiparesis following unspecified cerebrovascular disease affecting left dominant side*, and the secondary code chosen was R26.9, *unspecified abnormalities of gait and mobility*.

There were several factors noted during the initial evaluation that were predicted to positively affect the patient's prognosis. Prior to his stroke, JT was very active and performed jobs that required high levels of mobility. He was also highly motivated and committed to the process of his recovery through PT, and his family was very supportive. Based on his performance on the Fugl-Meyer, it was concluded that the patient had the ability to move out of patterns of synergy, which indicated a greater ability to make functional improvements. It has been shown that improvements in scoring on the Fugl-Meyer are moderately correlated with improvements in gait speed in patients with stroke.[2] Additionally, his stroke had occurred approximately three months prior to the initial outpatient PT evaluation, placing him in the three to six-month window where the greatest recovery following stroke has been shown to occur.[14]

In addition to these positive prognostic indicators, there were also some negative indicators that needed to be considered in regards to JT's prognosis. His history of atrial fibrillation placed him at risk for a second stroke, as well as other cardiovascular and pulmonary complications. He also had complaints of pain in his left shoulder and LLE, which had the potential to limit his tolerance for activity. Based on these prognostic indicators, JT's prognosis was determined to be fair.

No additional referrals were needed, but coordination and consultation with the patient's OT were planned to take place as needed. It was also decided that additional testing would be performed as deemed necessary, and reassessments of outcome measures would take place monthly, or at every tenth visit to meet Medicare guidelines.

An intervention plan was developed following the patient's initial PT evaluation with the primary focus on improving postural control in order to increase functional mobility. It was also determined that there should be an emphasis on motor control training, and gait training to improve endurance. Eng and Tang[2] recognize that walking endurance is an important factor that can help to predict the ability for community reintegration in patients with stroke. Since decreasing dependence on his wheelchair and returning to work were JT's primary goals for PT, these were important factors that helped to drive decision-making for JT's therapeutic interventions. Additional PT goals were established and can be seen in Appendix 2.

Intervention

Coordination and communication of the patient's care occurred on a weekly basis with his occupational therapist (OT). Progress notes were sent to JT's primary care physician every eighth to tenth visit to give updates on any changes in his care and progress he had made. Sixty-minute PT sessions occurred three times weekly for ten weeks. The initial four weeks, or ten visits of outpatient PT interventions, are further described. Notes were documented in the electronic medical record system for the patient's treatment sessions as well as progress notes when necessary.

Patient-related instruction included patient education on the PT plan of care (POC), the importance of proper use of his manual wheelchair and arm trough, the typical disease process of stroke and the recovery timeline, and current evidence for improvements in gait following stroke. The patient and his wife were also updated on his improvements and the clinical significance of gains achieved. JT attended all scheduled PT sessions and was very compliant with his home program. At the start of every PT session he and his wife gave updates on his improved ability to perform ADL's.

PT interventions primarily focused on improving JT's functional mobility, ambulation in particular, through postural control training and task-oriented training. Andersson and Franzen[5] found that subjects with chronic stroke who underwent training to shift weight toward their hemiparetic side, had improved gait and ambulation. JT's therapists hypothesized that by increasing weight bearing on his hemiparetic L side in various positions, including sitting, standing, kneeling, and half kneeling, he would be able to perform a more efficient gait pattern. Additionally, it has been shown that visual feedback with postural control training can improve gait speed in individuals with stroke.[3] Therefore, postural control training with JT also involved visual feedback with a mirror, in addition to verbal and tactile feedback provided by therapists. Task-oriented training involved functional tasks, such as sit-to-stand, quadruped to half-kneeling, and stair climbing. Task-oriented training has been shown to have many benefits in improving walking ability and functional task performance following stroke.[2,4]

In addition to postural control training, and task-oriented training, other PT interventions were implemented to improve walking ability and functional capacity, including therapeutic exercise (ther ex) and neuromuscular re-education (NMR). See Table 4 for interventions. Ther ex interventions involved posterior shoulder and parascapular muscle strengthening to combat shoulder subluxation in the patient's LUE, and to prevent overuse injury of his RUE. Ther ex and NMR interventions were both geared toward inhibiting JT's LLE tone through positioning and activation of antagonist muscles, including the hip extensors, hip abductors, knee flexors, and ankle dorsiflexors.[15] With improved activation and strengthening of these muscles, it was hypothesized that JT would have a greater ability to coordinate and achieve L foot clearance during the swing phase of gait. NMR also included interventions aimed at improving JT's balance to enhance walking ability and decrease risk for falls.

Gait training interventions progressed over time throughout JT's POC (see Table 4). As he progressed, the ambulation distance increased, and the amount of rest time decreased. Additionally, the amount of support from the therapist and assistive device (AD) decreased. Early gait training utilized a hemi walker in the hopes JT's gait speed would increase using a more supportive AD. Gait training was then progressed to a less supportive wide base quad cane (WBQC), and TheraBand (TheraBand, Akron, OH) wrap to the ankle, knee, and hip for assistance with LLE mechanics and foot clearance (see Figure 1). As the patient's gait continued to progress, AD use was discontinued in order to train proper unsupported gait mechanics. O'Sullivan[15] notes that although AD's can improve stability during gait early on, they should be discontinued in patients who may be able to walk without them as they can inhibit balance reactions and proper gait mechanics.

Interventions continued both with and without AD use depending on the desired therapeutic response to the intervention. When the intervention was geared toward increasing gait speed and endurance, an AD was utilized; when the purpose was improving gait mechanics, the patient ambulated with therapist assistance only. It was planned as JT progressed in his ability to ambulate, use of external supports would be discontinued. It was also planned that gait and neuromuscular reeducation interventions would be progressed according to Gentile's Taxonomy of Tasks (see Appendix 4).[16] This allowed progression of therapeutic interventions as JT's motor learning and motor control improved by manipulating either the environmental conditions, or the desired outcomes of the task to increase complexity and demand.[16]

OUTCOME

PT interventions primarily focused on improving the patient's functional mobility, ambulation in particular, through postural control training and task-oriented training. After ten outpatient visits, JT demonstrated improvements in gait and postural symmetry on therapist observation. He showed improved ability to function out of synergistic movement patterns and isolate single-joint movements in the hemiparetic LLE. This resulted in improved step clearance which allowed the patient greater access to his yard, apple orchard, and to operate his tractor. Improvements were shown in both gait speed and gait endurance as measured by the 10 meter walk test and six minute walk test respectively. Although the improvements were not deemed clinically meaningful based on established minimally important clinical difference values, he did demonstrate trends toward improvement.[12,13] However, with PT intervention, the patient's improvements in gait allowed him to safely access his yard and orchards at home, advancing him from a limited household ambulator to an unlimited household ambulator.[17] Results of outcome measures taken during week four can be seen in Table 2, and status of short and long-term goals following four weeks of PT can be seen in Appendix 2.

DISCUSSION

Following ten visits of outpatient PT, the patient demonstrated improvements in mobility and function in tasks that were important to him. Based on his self-reports, he perceived a greater ability to negotiate stairs and access his tractor to mow his apple orchard. However, this did not correlate with achievement of predetermined PT established goals. Although the patient's gait speed improved, and he achieved his personal goal of being able to ride his tractor again, the patient's various comorbidities likely contributed to his plateau in progress. With complex patient cases such as this, it is important to recognize functional achievements, as they are meaningful.

This POC may be beneficial when applied to other patients with a similar presentation; however, further investigation is warranted. A limitation to this case report is the short time frame of ten visits, and although initial progress was seen, it is unclear what the patient's potential for further progress may have been. JT showed initial improvements in postural symmetry and gait mechanics, however, it is unknown whether these improvements remained over time. A long-term follow-up study would provide further information on maintenance of these achievements in this patient population and this type of POC's overall effectiveness through measurement of gait speed, endurance, and functional benchmarks over time on a larger scale.

A clear evaluation of the plan's effectiveness was also limited due to the patient's various comorbidities throughout PT intervention. Pain, for instance, was a confounding variable to patient progress. The patient had pain in his LUE due to chronic shoulder subluxation, pain in his RUE due to impingement as a result of overuse, and pain in his LLE due to claudication. Limitations in PT visits, and the need to show progress for insurance purposes, made striking a balance between PT interventions for functional mobility and pain management challenging. Further research on lacunar stroke should address how comorbidities such as shoulder subluxation, impingement syndrome, and claudication, may affect the achievement of PT goals as well as opportunities to improve gait speed. Co-morbidities such as these also affect a patient's ability to appropriately use an AD, further limiting potential gait speed improvements. Additionally, greater frequency of visits would allow targeted therapy to address both pain modulation and functional mobility goals in order to reveal the patient's true potential for recovery.

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TABLES and FIGURES

Table 1. Systems Review upon initial evaluation

Systems Review	
Cardiovascular/Pulmonary	**Impaired:** diagnosed with atrial fibrillation, history of peripheral artery disease (PAD) and hypertension
Musculoskeletal	**Impaired:** left shoulder separation, impaired range of motion of left hip and ankle
Neuromuscular	**Impaired:** Tone: increased tone in left upper and lower extremities, flexor spastic pattern of left upper extremity Posture: weight shifted to the right in sitting and standing Sensation: grossly intact Balance: decreased due to right weight shift
Integumentary	**Unimpaired:** rigid AFO on left lower extremity, sling on left upper extremity
Communication	**Unimpaired**
Affect, Cognition, Language, Learning Style	**Unimpaired:** preferred explanations and demonstrations for learning

Table 2. Tests and Measures

Tests & Measures	Age-Matched Norms	Initial Evaluation Results	Results at Week 4
Fugl-Meyer Assessment- Lower Extremity Scale	Not established	**Affected:** 20/34 **Unaffected:** 34/34	Not tested
Activities-Specific Balance Confidence (ABC) Scale	79.89/100[13]	32.5/100	Not tested
Stroke Impact Scale-16 (SIS-16)	Not established	54/100	Not tested
Disabilities of the Arm, Shoulder, and Hand (DASH)	Not established	70.7/100	Not tested
Six Minute Walk Test (6MWT)	527 m[13] (1,729 ft)	85 ft in 4:52 with WBQC too fatigued to continue	130 ft with hemi walker
Ten Meter Walk Test (10MWT)	1.36 m/s[13]	0.24 m/s	0.30 m/s
Five Times Sit to Stand (5xSTS)	8.1 ± 3.1 seconds[13]	15.3 seconds with use of right upper extremity	Not tested

m=meters, ft=feet, WBQC=wide base quad cane, m/s=meters per second

Table 3. Psychometric Properties of Tests and Measures

Tests & Measures	Psychometric Properties
Fugl-Meyer Assessment	Excellent test-retest and inter-tester reliability.[9]
Activities-Specific Balance Confidence (ABC) Scale	High internal consistency and test-retest reliability in individuals with stroke.[6]
Stroke Impact Scale-16 (SIS-16)	Good instrument reliability and concurrent validity.[7]
Disabilities of the Arm, Shoulder, and Hand (DASH)	Evidence in the stroke population is limited, but it has been shown to be reliable and responsive for impairments of the entire upper extremity in adults with UE musculoskeletal impairments.[8]
Six Minute Walk Test (6MWT)	Tested in stroke populations and has a strong predictability for community-based outcomes.[10]
Ten Meter Walk Test (10MWT)	High predictive validity and excellent correlation with level of dependence in instrumental activities of daily living (IADLs) in patients with stroke.[10]
Five Times Sit to Stand (5xSTS)	Excellent validity in measuring affected and unaffected lower extremity strength in patients with stroke.[9]

Table 4. Interventions

	Week 1 Interventions Treatments 1-2	**Week 2 Interventions Treatments 3-4**	**Week 3 Interventions Treatments 5-7**	**Week 4 Interventions Treatments 8-10**
Gait training	Step ups on 4" step B/L, 5x3	Ambulation with hemi walker (on R) to increase speed and step length, 3x25 ft, min assist x1 Stepping in parallel bars tapping Airex* mat behind and stepping to a piece of tape in front to increase stride length on left Ambulation with hemi walker and WBQC (on R) with LLE blue band wrap Step facilitation in parallel bars with LLE blue band wrap, CGA x1, mod assist x1 for improved knee	Step facilitation in parallel bars from Bosu ball+ posteriorly to piece of tape anteriorly, mod assist x1 for knee flexion with swing Ambulation with no AD, min assist x2, 2x25 ft Ambulation with no AD, min assist x2, 2x60 ft Stepping over WBQC with LLE for foot clearance, min assist x2 Ambulation with no AD, CG assist x1,	Stepping in parallel bars with LLE over Dynadisc^ to increase foot clearance and step length Reassessment of 10MWT and 6MWT

		flexion with swing (see Figure 1)	min assist x1, 150 ft	
Therapeutic exercise	Wheelchair pulls with LLE to facilitate hamstring strengthening, 12 ft	RUE rows in sitting with blue TheraBand°	Supine on table, single leg bridges with LLE on 8” stool for hip extension on L, use of gait belt to bring R hip into flexion to reduce compensation Supine on table with LLE over edge to bring L hip into extension, use of gait belt to bring R hip into flexion, hamstring curls on L with yellow Theraband° (see Figure 2) LUE shoulder extensions in sitting with yellow Theraband°	Side stepping in parallel bars, x5 L hip abduction in parallel bars, 5x3
Neuro-muscular Reeducation	Sitting and standing postural corrections in mirror Seated isometric hamstring activation with LLE on Dynadisc^ Seated L knee flexion with foot on towel to decrease friction Standing L hip extension and abduction with L foot on towel to decrease friction	Sit to stand from chair without use of arms, min assist x1 L trunk rotations in sitting with L scapular stabilization	Weight bearing through LUE on parallel bar Half kneeling on Airex* mat with RLE forward to bring L hip into extension and reduce tone Half kneeling Airex* mat with L foot forward with concentric lifting with verbal and tactile cues for L hamstring activation L hip extension with knee flexion onto 6” step in parallel bars (see Appendix 2)	Lunging on Airex* with R foot forward to stretch L hip flexor and reduce tone Trunk rotations in half kneeling Lunging with L foot forward, concentric lifting hamstring activation
Manual Therapy	Soft tissue mobilization to L lateral leg			
Modalities				Iontophoresis with

				Dexamethasone to R biceps tendon for pain management
Patient/Family Education	Instruction on importance of home activities that facilitate dorsiflexion, knee flexion, and hip extension Correction of L AFO height and recommendation of R heel lift for increase L foot clearance with gait	Clinical importance of increasing step length and gait speed and how his gait speed compares to age-matched norms Importance of using LUE trough on wheelchair Pushing from chair for transfers instead of pulling grab bar		Correct postural alignment with scapular activation

B/L=bilaterally, LLE=left lower extremity, RLE=right lower extremity, L=left, R=right, AFO=ankle foot orthosis, WBQC=wide bade quad cane, CGA=contact guard assist, min=minimum, mod=moderate, RUE=right upper extremity, LUE=left upper extremity, AD=assistive device, ft=feet

[*] Airex, Chattanooga, TN
[+]Bosu, Ashland, OH
°TheraBand, Akron, OH
[^]SPRI, Libertyville, IL

A. B.

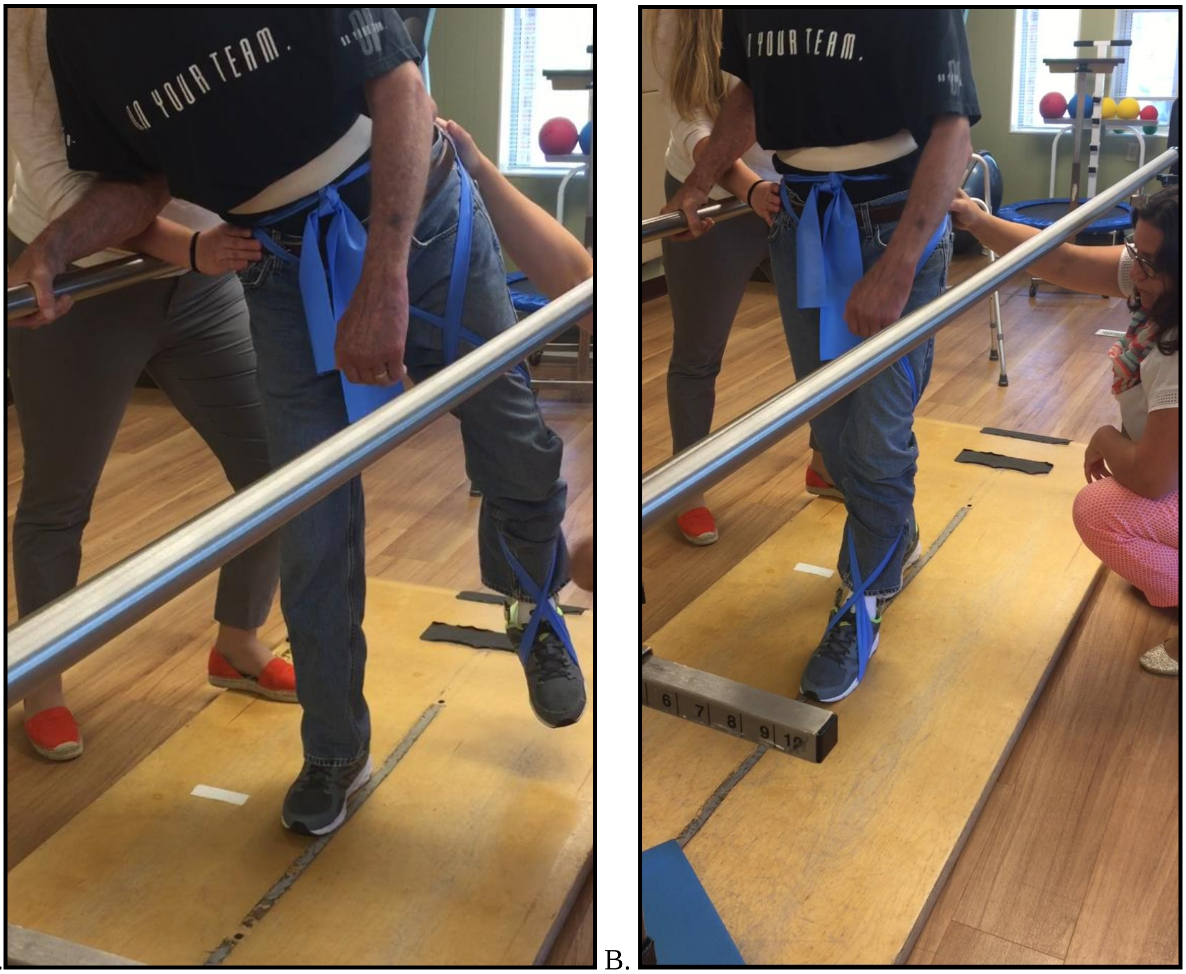


Figure 1: Use of Theraband as a walking and stepping aid to assist with control at the left ankle, knee, and hip joints. **A**: Active hip extension to initiate LLE swing phase of gait. **B**: Utilization of tape for visual cue of step width.

Figure 2: Left lower extremity (LLE) hamstring curls in L hip extension with right lower extremity (RLE) inhibition.

APPENDICES

Appendix 1. Medications at Initial Evaluation

Medications	Dosage	Purpose
Ropinerole	0.5 mg daily	For restless leg syndrome
Terazosin	10 mg daily	For hypertension
Ambien	5 mg as needed	For sleep
Amlodipine	5 mg daily	For hypertension
Eliquis	10 mg daily	For peripheral artery disease
Aspirin	Low dose	For preventing blood clots
Atenolol	100 mg daily	For hypertension
Atorvastatin-	40 mg daily	For high cholesterol

Appendix 2. Physical Therapy Short and Long Term Goals

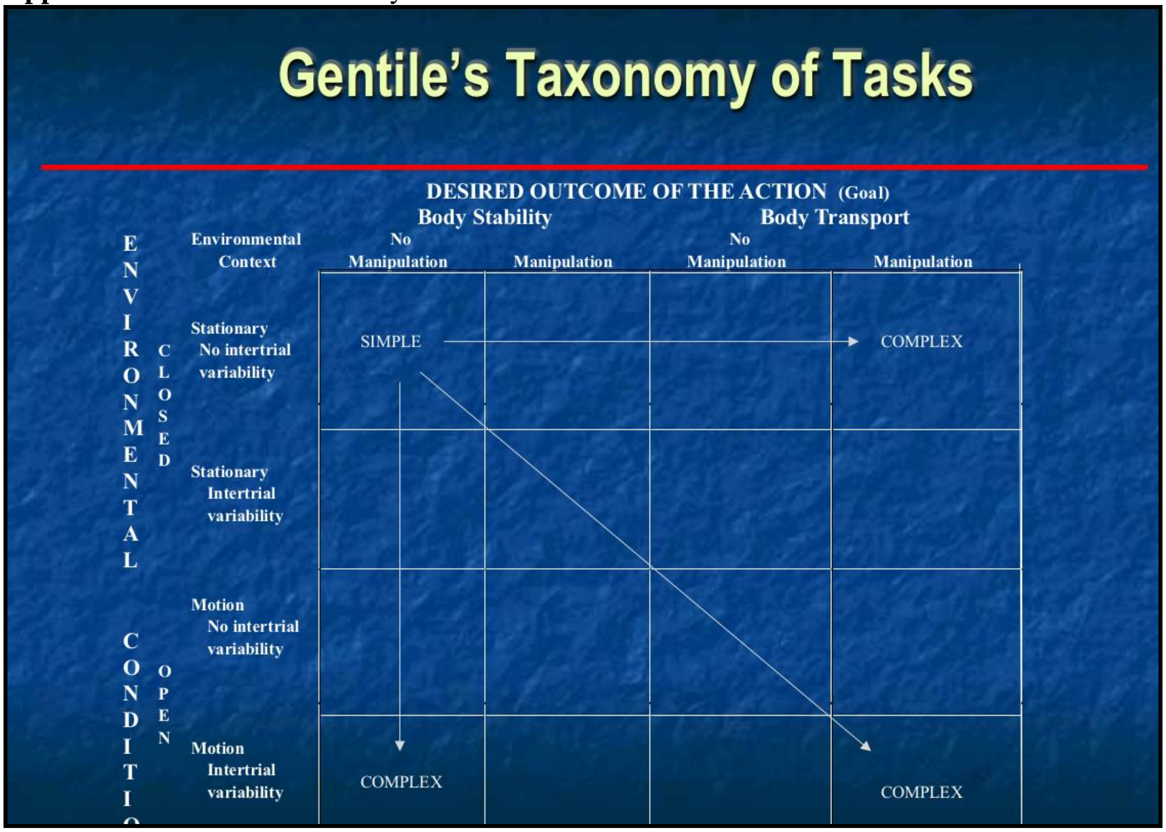
Time frame	Goal	At discharge
Short term: 4 weeks	Patient will demonstrate 60 ft improvement on the 6MWT as a result of improved endurance	Not achieved
	Patient will report improved functional capacity based on the SIS-16 with improvements between 4.7-7.1 points	Not tested/ deferred
	Patient will demonstrate improved static and dynamic awareness of his center of gravity with increased weight bearing symmetry through his lower extremities	Achieved
Long term: 8 weeks	Patient will demonstrate 120 ft improvement on the 6MWT as evidence of clinically meaningful detectable improvement for chronic stroke patients	Not achieved
	Patient will demonstrate meaningful improvement on the 5xSTS test scoring between 11-12 seconds	Not tested/deferred
	Patient will report improved functional capacity based on the SIS-16 with improvement between 9.4-14.1 points	Not tested/deferred
	Patient will be able to get on and off the floor with use of right UE and minimal assistance	Deferred
	Patient will increase gait speed by 0.17 m/s as measured by the 10MWT in order to have a minimally clinically important improvement	Not achieved
	Patient will report 75% reduced right lower leg pain during ambulation	Not achieved

ft=feet, 6MWT=six minute walk test, SIS-16=stroke impact scale 16, 5xSTS=five time sit to stand, UE=upper extremity, m/s=meters per second, 10MWT= ten meter walk test

Appendix 3. Example of neuromuscular re-education

Posterior stepping, L hip extension with knee flexion onto 6" step

Appendix 4. Gentile's Taxonomy of Tasks[12]



A tool for classification of tasks based on the goal of the action, and the environment in which it is performed. The complexity of a task is based on where it fits into the taxonomy.