12-4-2015

A Task Oriented Approach For A Patient With Chronic Effects Of Stroke: A Case Report

Sarah Richardson
University of New England

A Task Oriented Approach for a Patient with Chronic Effects of Stroke: A Case Report

Sarah Richardson

S Richardson, BS, ATC, LAT, is a DPT student at the

University of New England, 716 Stevens Ave. Portland, ME 04103

Address all correspondence to Sarah Richardson at: srichardson3@une.edu

The patient signed an informed consent allowing the use of medical information and video footage for this report and received information on the institution's policies regarding the Health Insurance Portability and Accountability Act.

The author acknowledges Amy Litterini, PT, DPT, for assistance with case report conceptualization; Marcene Germani, PT, MS, for supervision and assistance with patient care; and a sincere thank you to the patient in this report for her determined participation.

Abstract

Background and Purpose: Stroke is the leading cause of serious long-term disability for American adults. Most stroke survivors receive physical therapy (PT), and task-oriented rehabilitation is one novel approach known to benefit stroke survivors. The purpose of this case report is to illustrate the outcomes of a task-oriented approach to PT interventions on a patient >12 months post stroke. The unique aims were to 1) outline possible benefits in function from repetitive task-oriented training techniques and 2) document outcomes of a patient who had received PT services >12 months post stroke.

Case Description: The patient was an 82 year-old female who was suffering from late effects of two separate stroke events. She was seen for outpatient PT for one hour, two times weekly for a total of 12 weeks during this episode of care. The following outcome measures were used: Function in Sitting Test (FIST), Tinetti, and a modified Gait Speed Test.

Outcomes: Improvements in balance and functional mobility on the Tinetti (4/28 to 16/28) and Function in Sitting Test (43/56 to 56/56) were noted. Improved strength was noted based on manual muscle testing of the quadriceps and hamstrings. This patient was able to achieve independent bed mobility, increase her walking distance, and decrease the level of gait assistance needed (from max to contact guard) with improved quality of gait. No significant changes were noted in gait speed. Modified Ashworth Scale indicated no change in spasticity.

Discussion: The findings suggest that a task-oriented approach to physical therapy intervention may have been a feasible method for this individual with chronic effects of stroke. Further research is needed to validate these results for similar patients.

Manuscript word count: 3,499

Background and Purpose

Stroke is the leading cause of serious long-term disability for American adults.[1] Every year, more than 795,000 people in the United States experience a new or recurrent stroke, only 13% of which are hemorrhagic strokes.[2] Stroke places an expensive demand to the healthcare system and costs the United States an estimated $34 billion each year.[1] Many stroke survivors receive physical therapy (PT) services at some point in time during their recovery. While there are many treatment approaches, the gold standard has yet to be established. Task-oriented rehabilitation is one novel approach; it shifts from training at the impairment level to training at the activity level.[3] Training needs to be repetitive and the tasks chosen are intended to be meaningful and functionally specific for the individual. This approach is known to be beneficial for stroke survivors, [3] however the benefits for long-term survivors of stroke are not yet well established. According to O'Sullivan, [4] stroke survivors can continue to make measurable functional gains at a reduced rate for months or years after insult. PT professionals would benefit from learning about innovative interventions to improve functional mobility for long-term stroke survivors.

This case report provides insight into a patient who is receiving PT over a year and a half post stroke and highlights her ability to regain functional skills. This case will help to identify how the skills of a physical therapist can affect the functional mobility of an individual who had not achieved functional gait in more than 18 months. Further research is needed to explore the outcomes and benefit of physical rehabilitation for stroke survivors beyond 12 months.

The purpose of this case report is to illustrate the outcomes of a task-oriented approach to PT interventions on a patient more than 12 months post stroke. This was identified by: functional independence in transfers and bed mobility, quality of lower extremity (LE) movement during functional tasks, level of assistance needed at home, performance of gait with least restrictive assistive device (LRAD), and patient reported outcomes. The unique aims were to 1) outline possible benefits in function from repetitive task-oriented training techniques and 2) assess progress of a patient who had received continued PT services more than 12 months post stroke.

Case Description: Patient History and Systems Review

The patient signed an informed consent allowing the use of medical information for this report. The patient was an 82-year-old female, diagnosed with late effects of right (R) thalamic hemorrhagic cerebrovascular accident (CVA) and R cerebellar hemorrhage. She was referred for outpatient PT services to increase functional independence in activities of daily living (ADL), improve functional mobility with transfers, and accomplish functional gait to decrease dependence on family and caregivers. Upon most recent discharge from the skilled nursing facility she moved in with her daughter to be closer to family and needed to adapt to a new living environment; she required extensive assist with her mobility and received 24-hour care. Her primary means of mobility was a power wheelchair with joystick; however, it did not fit into her bathroom and the patient's main goal was to be able to take a few steps with an assistive device in order to access the toilet with modified independence. Her family wanted her to increase her independence in bed mobility and transfers in order to decrease dependence on the caregivers.

She had good general health status, medical conditions were well managed and she no longer needed to follow up with her neurologist. However, she was receiving continued management for hypertension (HTN). She had a medical history of: hyperlipidemia, HTN, atrial fibrillation, Diabetes Mellitus, glaucoma, cataracts, back pain, arthritis, and clipping of posterior communicating artery resulting in left LE weakness and use of a cane. A list of her medications addressing these conditions can be seen in Table 1. She required moderate assistance for bed mobility and minimal assistance for transfers into and out of bed using a transfer pole. She used a left rigid ankle foot orthosis for all mobility. She needed maximum assistance for dressing and completing ADLs.

Clinical Impression #1

Based on the location of her brain lesions it was expected that she would have left hemiplegic motor and sensory deficits resulting in impaired strength, coordination, balance, and sensation of the left upper and lower extremities. These impairments led to the patient's functional limitations in gait, maneuvering stairs, transfers, bed mobility, self-care, and ADLs. These limitations restricted her participation in family

outings, she was unable to cook and perform household chores, and she was no longer able to drive or access the community without assistance. There were confounding factors that were important to consider, such as hand dominance and history of weakness or impairments that were present prior to this current diagnoses that may have affected the prognosis. The patient was right side dominant with a history of left lower extremity (LLE) weakness following a posterior communicating artery clipping and bilateral knee osteoarthritis. The patient had received other episodes of PT since the onset of her most recent CVA. This examination was to obtain objective information in all areas of functional mobility including gait, transfers, bed mobility, and balance. Impairment level tests were selected to identify any structural deficits affecting the LEs.

The patient was selected for this report due to her motivation and willingness to participate in therapy, both in our skilled sessions and at home. She presented us with a rare opportunity, in a sub acute rehabilitation facility, to continue outpatient therapy and address the late effects of CVA. She was originally seen at the facility for rehabilitation immediately following onset of her two CVAs. She is appropriate for this report because she is medically stable, has a very supportive family, was showing significant progress towards her goals in prior PT episodes, and was very motivated to participate in therapy. She was good at following instruction and commands. Although her first language was Japanese and she had oromotor apraxia, it did not affect her ability to participate in therapy.

Examination:

Observational gait analysis revealed that she was able to ambulate 10 feet in parallel bars with moderate assistance. She was able to clear both feet and had decreased step length bilaterally. Due to impaired proprioception, she showed inaccurate and varying foot placement on the LLE. She compensated with a hiked hip on the left side and needed assistance to shift weight to the right side and advance the LLE. Decreased knee and hip flexion on the LLE during gait may have been due to abnormal extensor synergy pattern (See Table 2). During stance phase she had a left hip Trendelenburg and pelvic obliquity, which caused the left hip to be shifted posteriorly. During swing phase of the LLE, she was unable to achieve a step through pattern due to the posterior position of the left hip.

Once the patient was able to safely ambulate with an assistive device and physical assist, a modified Gait Speed Test was performed to monitor and assess the progress she made with gait speed and level of assistance needed. She used a hemiwalker during each trial and walked a measured distance of 10 feet. She had an acceleration distance of four feet from her sitting position to the start point before the timer was started.

Gross manual muscle testing (MMT) of the quadriceps and hamstrings was performed with the patient sitting in her wheelchair as described by Hislop et al.[5] Using this position provided an easy quantifiable reference for strength of the LEs. No reports of reliability and validity could be found for MMT for patients who have suffered a stroke. The Function in Sitting Test (FIST) was chosen to test sitting balance because the patient was unable to perform standing balance tasks at the time of initial examination. The FIST has excellent test-retest reliability [Interclass correlation (ICC)=0.97; 95% Confidence Interval (CI) 0.847-0.995].[6] In a study done by Gorman et al[7] the FIST demonstrated good to excellent concurrent validity with the Berg Balance Scale and the Functional Independence Measure at admission and discharge (Spearman ρ= .71-.85). The Tinetti Performance Oriented Mobility Assessment (POMA) was used as an initial test of standing balance and gait analysis four visits after the initial examination. The Tinetti has excellent test-retest reliability for POMA gait section (ICC=0.91).[8] It showed excellent correlation with the motor domain of the FIM (r= 0.646) and gait speed of the FIM (r= 0.638).[8] The Modified Ashworth Scale (MAS) was a reliable measurement for lower limb assessments made by a single rater and had excellent convergent validity with Fugl-Meyer (r = -0.94) and electromyography (r = -0.79).[9] A muscle tone assessment was done to quantify the presence of an abnormal synergy pattern affecting her movement pattern and coordination; results were graded and documented using the Brunnstrom Synergies of Motor Recovery (BSMR). There were no reports of validity and reliability found by this author for the BSMR.[10] All reported outcome measures can be found in Table 3.

Clinical Impression #2

The patient's PT diagnosis was ICD-9 code 781.2: abnormality of gait. Her diagnosis is classified in the Adapted Practice Patterns as practice pattern 5D. [11] The examination findings supported the initial

clinical impression of left sided weakness, sensory deficits, impaired coordination, and impaired balance, as the selected test and measures revealed decreased function in these areas. She had impairments in multiple body systems that were contributing to her functional limitations and need for extensive assistance. She was most limited in functional mobility due to decreased LE strength, lack of coordination, impaired standing balance, and abnormal muscle tone. MMT indicated decreased strength in the LEs, which could contribute to instability and decreased functional mobility. The FIST was used to document her balance impairments at a sitting level. Her score of 43/56 on the FIST indicated that she had some deficits in her sitting balance and decreased function from the seated level based on the criteria of this test. The student physical therapist anticipated that a baseline measure in standing balance and gait was necessary to document for future comparison; a Tinetti POMA was used in developing her goals and expected outcomes. Therefore, based on her score of 4/28 on the Tinetti POMA she was at a high risk for falls and not functionally able to complete a number of the test items. Her rating of a 1+ on the MAS for the gastroc/soleus complex and knee extensors indicated that she still had an increase in muscle tone, which negatively affected her motor control. She demonstrated a Brunnstrom Stage V extensor movement synergy pattern, as evidenced by abnormal hip extension, knee extension and plantarflexion of the LLE during functional movements. The movement synergy was not dominating her movement and she was able to achieve complex movement combinations.

Based on the results of the examination, a plan of care was developed that included a home exercise program (HEP) and interventions to improve functional mobility. She was scheduled to attend outpatient PT services two times a week for 60-minute sessions for 12 weeks. She also scheduled to receive occupational therapy services in the same facility with the same frequency directly following PT sessions. Strategies were coordinated with the occupational therapist to incorporate upper extremity involvement into PT sessions in order to promote continuity.

The patient continued to be appropriate for report as she demonstrated good prognosis for improvement. During the examination she was able to demonstrate a learned response to cueing during

transfers and bed mobility. The caregiver and daughter were present at the examination and were very involved in her care.

She was unlikely to return to her prior level of function; given the status of her condition at the initial examination, and the fact that she had not achieved functional gait in over a year and a half, it was unlikely that she would achieve independent gait. She had a history of glaucoma and cataracts that could have contributed to all functional limitations. The patient has a history of back pain, which could have limited her activity tolerance and resulted in more frequent rest breaks, ultimately limiting the volume and intensity of treatment interventions. Based on her impressive motivation, hard work ethic, compliance with her HEP, stable health status, and strong family support, she was likely to reach a level of ambulation with an assistive device that would allow her to access the toilet in her bathroom with contact guard assistance. With continued therapy and a regular HEP, she had good potential to make functional gains and prevent the onset of secondary complications; she was likely to develop more efficient compensatory strategies. The severity of her strokes, the length of time since onset, and chronicity of impairments may have limited her progress along with her pre-existing impairments. Based on the amount of time since onset, she was unlikely to experience restoration of function at the physiological level. Based on a study done by Lee et al[12] that investigated the effects of hemorrhagic stroke lesions on motor recovery, progress was noted for up to six months and then plateau.

PT interventions were selected to increase endurance and functional strength in the LEs, improve coordination, standing balance and postural control, motor control and gait biomechanics, and functional independence with bed mobility and transfers. Interventions were incorporated into task specific training in order to improve all aspects of functional mobility and decrease level of assistance needed from caregivers. The patient stated that her primary goal was gait training and therefore, it would be incorporated into each therapy session. Other goals for this episode of care can be found in Table 4.

Interventions:

The patient was also attending occupational therapy (OT) sessions that focused on improving function of her left upper extremity. Coordination with OT was helpful to maintain consistency in goals and

interventions. Communication with family members and caregivers was a high priority at each session to teach home exercises and discuss progress. Encounters were documented at each session; progress notes were performed every fifth visit (2.5 weeks).

Since the patient was only receiving therapy twice weekly for 60 minutes, she was encouraged to walk with family and caregivers at home and to perform functional mobility tasks with as much independence as possible. She was continually educated on the pathology of her condition and associated risk factors, along with proper techniques to protect the left upper and lower extremities during mobility tasks.

Procedural interventions were chosen in an attempt to improve lower extremity coordination, strength, motor control, and balance in order to improve all aspects of functional mobility and decrease level of assistance needed from caregivers (Table 5). Functional interventions were developed based on the task-oriented approach; normal movement emerges from interaction of individual, task, and environment. Therapeutic exercises consisted of: endurance training on the SCIFIT[*] (Appendix 1) and Omnicycle[†] (Appendix 1), balance and coordination training, body mechanics and postural stabilization, and implementation of the Axial Mobility Exercise Program (AMEP) [12]. Caregiver training was implemented immediately in order to achieve as much carryover as possible at home. Patient/client related instruction, education, and training consisted of: gait with hemiwalker[‡] (Appendix 1) and front-wheeled walker[§] (Appendix 1), transfer training with hemiwalker, and use of the AMEP as a home exercise program.

The patient was given an 8-15 minute warm up at the beginning of each session. It was either performed on the SCIFIT or Omnicycle with functional electrical stimulation to the quadriceps, using the Omnistim FX^2 Pro[**] (Appendix 1). Electrical stimulation facilitated quadriceps activation while pedaling the Omnicycle to improve motor planning and movement pattern generation. The Accelerated Care Plus (ACP) protocol was followed for functional stimulation of the quadriceps muscle. Electrodes were placed

[*] SCIFIT Systems Inc., Tulsa, OK 74146
[†] Accelerated Care Plus Corp., Reno, NV 89502
[‡] Drive Medical Design and Manufacturing, Port Washington, NY 11050
[§] Invacare, Elyria, OH 44035
[**] Accelerated Care Plus Corp., Reno, NV 89502

on the left quadriceps muscle; the negative lead was placed distally and the positive lead was placed proximally. The setting for lower extremity slow cycle was chosen and the intensity was set to 80mA.

The most limiting impairments affecting her function were noted to be limb coordination, postural control, and balance; therefore, interventions were selected that directly addressed these impairments. Balance and coordination exercises were performed with a mirror to improve posture and kinesthetic awareness during movements, as well as without a mirror to challenge motor learning. Due to the patient's limitations in bed mobility, interventions were selected that addressed different positions on the mat table to promote rolling and scooting. The patient had some residual tone in the left upper and lower extremities and demonstrated significant hip asymmetry that affected all aspects of her mobility. Based on these impairments the AMEP was an appropriate progression of rotational exercises to help improve bed mobility, reduce tone, and improve muscle performance and strength. This program offered an appropriate timeline and progression of exercises that could be utilized in the clinic and carried over at home. From the second progress report to the fourth progress report, the mat table was unavailable due to construction; therefore, interventions were performed in standing.

Gait training was assisted with either a hemiwalker or a front wheeled walker. Based on the patient's goal to walk 5ft with a hemiwalker to access the toilet in her bathroom, the hemiwalker was used at each session. However, the patient demonstrated better balance and an improved gait pattern with the front wheeled walker; therefore, each device was used for gait training. The phases of gait were broken into stance phase and swing phase for the left lower extremity (LLE). Neuromuscular reeducation exercises were performed in each phase to improve gait biomechanics and motor control. Postural control exercises included core stabilization exercises in standing and supine. Proprioceptive Neuromuscular Facilitation (PNF) was performed on the LLE in diagonal (D) D1 and D2 flexion and extension patterns with manual resistance through range and a quick stretch of the muscles at end range of motion. PNF pattern facilitation in this case was used to create overflow of muscle activation through massed movement patterns of the LLE, by stimulating the proprioceptors in a sequence of muscle activation that promotes irradiation from the stronger to weaker muscles in the chain. Active assistive left hip abduction was

facilitated against gravity while the patient was lying on her right side. Manually resisted left hip flexion was also performed in right side lying with a quick stretch to initiate movement; this was done to facilitate hip flexion prior to gait.

Deep tissue massage to the left hip abductors was performed to decrease muscle inhibition and improve biomechanics of the pelvis during gait. Manual stretching of LE muscles was done to improve range of motion and flexibility of the hip. Coordination exercises helped to improve step accuracy of the left leg during gait training and prevent a scissoring pattern. The patient received a total of 24 physical therapy sessions during this episode of care.

Outcomes

As rehabilitation progressed the patient demonstrated improvements in function and underlying impairments. Outcome measures were updated for progress reports two and four, and the day of discharge (Table 3). Improvements were noted in balance and functional mobility on the Tinetti (4/28 to 16/28), Function in Sitting Test (43/56 to 56/56), and reduced level of assistance for mobility were noted from initial evaluation to discharge. Marginal improvements were noted in lower extremity strength of the quadriceps and hamstring muscles. Most of the short and long-term goals were achieved (Table 4) and the family reported significant improvement in her ADLs.

Despite the chronicity of her impairments, this patient was able to achieve independent bed mobility, improve sitting and standing balance, increase her walking distance and decrease the level of gait assistance needed (from max to contact guard) with improved quality of gait. No significant changes were noted in gait speed and there was no change in spasticity based on the Modified Ashworth Scale.

Discussion

Although this patient was chronically affected by lasting impairments from cerebrovascular disease, there were outcomes to suggest that positive neuroplastic change may have still been possible. Emerging evidence suggests that new models of task-oriented exercise have the potential to improve motor function even years after stroke.[14] According to Indurkar and Iyer, [15] study findings support that a task-orientated intervention enhances walking distance, balance and speed in patients post stroke. In addition to a task-

oriented approach, Proprioceptive Neuromuscular Facilitation (PNF) was performed to facilitate normal movement patterns and inhibit abnormal movement patterns; theoretically this method could help to transfer motor control into functional movements. Based on a study by Akosile et al,[16] PNF techniques led to improvement in the functional ambulation of individuals following stroke. They recommended PNF as an effective treatment for functional ambulatory gains in stroke rehabilitation.[16] When applied to patients with hemiplegic gait, PNF has been shown to improve gait pattern and can lead to more functional independence.[17] This case challenges the idea that significant benefits in chronic stroke related deficits are not possible. The outcomes of this case substantially highlight the results of a task-oriented approach to PT interventions for a patient who demonstrated functional improvements more than 12 months post stroke. Research is needed on the outcomes of PT on the chronic effects of stroke in randomized, controlled trials.

References

1. Prevalence of Stroke - United States, 2006-2010. *MMWR*. Centers for Disease Control and Prevention Web Site. http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6120a5.htm?s_cid=mm6120a5_w. Updated May 25, 2012. Accessed September 16, 2015.
2. Mozaffarian D, Benjamin EJ, Go AS, et al. Heart disease and stroke statistics - 2015 update: a report from the American Heart Association. *Circulation*. 2015 ;179-205.
3. Rensink M, Schuurmans M, Lindeman E, and Hafsteinsdóttir T. Task-oriented training in rehabilitation after stroke: systematic review. *Journal of Advanced Nursing*. 2009; 65: 737–754. doi: 10.1111/j.1365-2648.2008.04925.x
4. O'Sullivan SB. Chapter 15: Stroke. In: O'Sullivan SB, Schmitz TJ, Fulk GD. *Physical Rehabilitation.* 6th ed. Philadelphia, PA: F.A. Davis Company; 2014:703-704.
5. Hislop HJ, Avers D, Brown M. *Daniels and Worthingham's Muscle Testing: Techniques of Manual Examination and Performance Testing*. 9th ed. Philadelphia: Saunders; 2013.
6. Gorman SL, Rivera M, McCarthy L. Reliability of the Function in Sitting Test (FIST). *Rehabilitation Research and Practice*. 2014;2014:593280. doi:10.1155/2014/593280.
7. Gorman SL, Harro CC, Platko C, Greenwald C. Examining the Function In Sitting Test for Validity, Responsiveness, and Minimal Clinically Important Difference in Inpatient Rehabilitation. *Archives of Physical Medicine and Rehabilitation*. 2014; 95(12): 2304-2311. doi: 10.1016/j.apmr.2014.07.415.
8. Tinetti Performance Oriented Mobility Assessment. Rehabilitation Measures Database. http://www.rehabmeasures.org/Lists/RehabMeasures/PrintView.aspx?ID=1039. Updated January 31, 2014. Accessed June 28, 2015.
9. Ashworth Scale/ Modified Ashworth Scale. Rehabilitation Measures Database. http://www.rehabmeasures.org/Lists/RehabMeasures/PrintView.aspx?ID=902. Updated April 26, 2013. Accessed June 28, 2015.

10. Sawner K, LaVigne J. *Brunnstrom's Movement Therapy in Hemiplegia: A Neurophysiological Approach*. 2nd Ed. Philadelphia: Lippincott; 1970.

11. Adapted Practice Patterns. American Physical Therapy Association Website. http://www.apta.org/Guide/PracticePatterns/. Updated October 11, 2015. Accessed December 3, 2015.

12. Schenkman M, Keysor J, Chandler J, Laub KC, MacAller H. *Axial Mobility Exercise Program: An Exercise Program to Improve Functional Mobility.* Claude D. Pepper Older American's Independence Center, Duke University, 1993.

13. Lee KB, Kim JS, Hong BY, Kim YD, Hwang BY, Lim SH. The Motor Recovery Related with Brain Lesion in Patients with Intracranial Hemorrhage. *Behavioural Neurology*. 2015;2015:258161. doi:10.1155/2015/258161.

14. Macko RF, Ivey FM, Forrester LW. Task-Oriented Aerobic Exercise in Chronic Hemiparetic Stroke: Training Protocols and Treatment Effects. *Topics in Stroke Rehabilitation.* 2005;12(1), 45-57. doi: 10.1310/PJQN-KAN9-TTVY-HYQH

15. Indurkar I, Iyer S. To study the effect of task oriented intervention on walking distance, speed and balance efficiency in post stroke patients. *Indian Journal of Physiotherapy and Occupational Therapy*. 2013;7(4):67-72.

16. Akosile CO, Adegoke BOA, Johnson OE, Maruf FA. Effects of proprioceptive neuromuscular facilitation technique on the functional ambulation of stroke survivors. *Journal of the Nigeria Society of Physiotherapy*. 2011;18/19:22-27.

17. Mann DK, Raja NAR, Bhardwaj N, Singh J. Effect of proprioceptive neuromuscular facilitation in hemiplegic gait a randomized trial of 4 weeks and a follow up after 2 weeks. *Indian Journal of Physiotherapy and Occupational Therapy*. 2013;7(3):59-64.

Table 1: Medications at Admission

Medication	Indication
Diltiazem	Hypertension
Candesartan	Hypertension
Hydrochlorothiazide	Edema
Travatan Ophthalmic	Glaucoma
Omeprazole	Ulcer
Docusate	Constipation
Miralax	Constipation
Glucosamine	Joint Pain
Calcium	
Vit D	
Potassium	
Magnesium	

Table 2: Systems Review

Cardiovascular/Pulmonary	**Not impaired**
Musculoskeletal	Impaired RLE ROM: WFL; LLE PROM: WFL (AROM 50% impaired); BLE strength impaired.
Neuromuscular	Impaired Brunnstrom stage 5 LLE extensor synergy pattern, clonus of L ankle, and 1+ MAS of quadriceps and gastroc/soleus complex. Impaired LE coordination and motor control. Impaired static sitting balance and standing balance. Impaired gait. Impaired transfers. Impaired bed mobility.
Integumentary	**Unimpaired**
Communication	Impaired Language barrier and oromotor apraxia
Affect, Cognition, Language, Learning Style	Unimpaired: A&Ox4. Good cognition, English is not her first language. Learns well with demonstration and concurrent tactile feedback.

RLE: right lower extremity, ROM: range of motion, WFL: within functional limits, AROM: active range of motion, BLE: bilateral lower extremity, L: left, MAS: Modified Ashworth Scale, A&O: alert and oriented.

Table 3: Objective Measures

Tests & Measures	Initial	PR #2 week 5	PR#4 week 10	Final
Right Hamstring Strength	4/5	Not Tested	Not Tested	4+/5
Right Quadriceps Strength	4/5	Not Tested	Not Tested	5/5
Left Hamstring Strength	3+/5	Not Tested	Not Tested	3+/5
Left Quadriceps Strength	3+/5	Not Tested	Not Tested	4/5

FIST	43/56	44/56	50/56	56/56
modified Gait Speed with hemiwalker (assistance provided)	.12 ft/s mod A	.15 ft/s min A	.22 ft/s CGA	.16 ft/s CGA
Tinetti	4/28	6/28	14/28	16/28
MAS	1+ quadriceps, gastroc/soleus	Not Tested	Not Tested	1+ quadriceps, gastroc/soleus
Brunnstrom	Stage V LLE extensor synergy pattern	Stage V LLE extensor synergy pattern	Stage V LLE extensor synergy pattern	Stage V LLE extensor synergy pattern

PR: Progress Report, RLE: right lower extremity, LLE: left lower extremity, FIST: Function in Sitting Test, MAS: Modified Ashworth Scale, Mod A: moderate assistance, Min A: minimum assistance, CGA: contact guard assistance

Table 4: Patient Goals

Short Term Goals (4 weeks)	**Long Term Goals (8 weeks)**
The patient will demonstrate the ability to roll side to side in bed with modified independence for pressure relief and to decrease dependence on family and caregiver.	The patient will be able to ambulate 10 ft. with hemiwalker and moderate assistance using step-to gait pattern.
The patient will perform supine to/from sit with minimal assistance 100% of the time to decrease caregiver burden.	The patient will demonstrate the ability to approach sitting surface and turn 180 degrees with hemiwalker to set up for stand to sit transfer in order to access the toilet in her bathroom at home.
The patient will be able to safely perform sit to stand pivot transfers with contact guard assistance in order to decrease caregiver burden.	The patient will demonstrate the ability to perform sit to/from stand transfers from various surfaces with modified independence using least restrictive assistive device to allow her to safely transfer between her bed and wheelchair.
The patient will be able to maintain unsupported standing balance for 30 sec. without assistance to increase safety and prepare for independent transfers.	

Table 5: Outline of Intervention Progression during Episode of Care

	Sets & Reps; time and level of assistance performed at each session				
Intervention	SOC- 1st PR	1st PR- 2nd PR	2nd PR- 3rd PR	3rd PR- 4th PR	4th PR- DC
Warm up					
Omnicycle with functional e-stim	15 min UE and LE	15 min UE and LE			
SCIFIT			6 min. at	6 min. at	6 min. at

			level 1.5	level 1.8	level 1.8
Gait training					
Gait training with hemiwalker	10ft. mod A	15ft x2 mod-min A	35ft x2 min A	50ft x2 CGA	50ft x2 CGA
Gait training with FWW			15ft min A	30ft min A	45ft min A
Stance phase of gait left LE		3x8	3x10	3x10	
Swing phase of gait left LE		3x8	3x10	3x10	
Transfer training					
Sit to and from stand with hemiwalker	3x mod A	5x-10x min A	5x CGA-min A	5x CGA	5x SBA
Stand pivot training with hemiwalker	2x mod A	4x min A	2x min A	2x CGA	2x CGA
Squat pivot toward right side	2x min A				
Bed mobility					
Sit to supine	2x mod A	2x min A			2x CGA
Supine to sit	2x mod A	2x mod A			2x min A
Rolling	4x min A	4x CGA			2x SBA
Axial Mobility Exercise Program[12]	Stage I,II	Stage I, II,III			Stage V, VI
Coordination					
Seated rapid alternating toe tapping			3x 30 sec.	3x30 sec with 6 inch box	
Seated alternating knee extension			3x30 sec	3x30 sec with alternating UE swing	
Standing Marching	3x30 sec.	3x30 sec	3x45 sec.		
Balance					
Unsupported standing	3x10 sec	3x30 sec	3x45 sec	3x60 sec with mirror	
Unsupported weight shifts		3x30 sec	3x45 sec	3x60 sec with mirror	
Semi tandem stance with one hand on bar			3x20 sec	3x30 sec forward and backward	

				weight shifts	
Motor Control					
PNF left lower extremity D1 and D2 flexion and extension	3x20 with min A through range with quick stretch at end range	3x20 with minimal resistance through range and quick stretch at end range			3x20 with moderate manual resistance through range and quick stretch at end range
AAROM: Left hip straight plane abduction lying on right side					3x15
Clam shell with left side					2x10
Manual Therapy					
Deep tissue massage to left hip abductors					3x 60 sec between sets of AAROM left hip abduction
Bilateral hip IR and ER stretch in supine with knee and hip at 90 degrees					3x30 sec
Left hip flexor stretch					3x30 sec with left leg off edge of table
Left hip flexion with manual resistance and quick stretch in right side lying position	3x15	3x15			
Supine hamstring stretch		3x30 sec			3x30 sec
Postural stabilization					
Pelvic bridge	2x6	2x8			3x12

Posterior pelvic tilt					Supine 2x10 Standing 1x15
Manual resisted rotational rhythmic stabilization of pelvis in standing			3x30 sec	3x30 sec	
Stability ball seated balance			3 min with ball wedged in corner	5 min with ball against one wall	

SOC: start of care, PR: progress report, DC: discharge, UE: upper extremity, LE: lower extremity, Min A: minimal assistance, Mod A: moderate assistance, Mod I: modified independence, CGA: contact guard assistance, SBA: stand by assistance, IR: internal rotation, ER: external rotation, AAROM: active assistive range of motion, PNF: proprioceptive neuromuscular rehabilitation, FWW: front wheeled walker

389 Appendix 1: Equipment
390

SCIFIT

Omnicycle

Hemiwalker

Front Wheeled Walker

Omnistim FX2 Pro