Intensive Task-oriented Training for Mobility and Balance in a Patient with Multiple Strokes: a Case Report

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ABSTRACT

Patients with multiple strokes are often excluded from studies due to poor outcomes. This case report described change in mobility and balance in a 54-year-old male with four strokes following intensive physical therapy (PT) based on the Task-oriented Approach. Outcome assessment demonstrated clinically meaningful change in balance and mobility, and no adverse events. Intensive task-oriented PT is safe and feasible, and may contribute toward positive outcomes in severe disability related to multiple strokes.

Key Words: case report, neurological rehabilitation, task-oriented training

Introduction

Stroke is an injury to the brain that results in multiple body function and structure impairments, activity limitations, and participation restriction.[1] Impaired balance and restricted mobility are common serious consequences of stroke that significantly increase one's risk of falling and adversely affect independent and safe movement in one's milieu.[2] Stroke is a leading cause of disability worldwide and its incidence has been increasing alarmingly in those aged <45 and <55 years within the last 10 years.[3]

High-level evidence from systematic reviews of clinical trials supports the effectiveness of intense and task- and context-specific physical therapy (PT) for patients with stroke in different stages of recovery.[1,4] However, evidence is often limited to patients with mild to moderate motor impairments, and relatively good prognoses for functional recovery. Patients with severe motor impairments may demonstrate limited motor learning[5] and this limitation may translate into poorer functional prognoses that cause exclusion from most clinical trials.

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Neuroplasticity principles indicate that the brain has the capacity to learn and relearn how to control movement necessary to perform activities of daily living.[6] Studies in different populations such as stroke and spinal cord injury support structural changes in the brain given task-specific training and practice in enriched environments.[7-10] Therefore, motor intervention programs based on principles of experience-dependent plasticity may positively influence neural adaptation even in the presence of severe motor disability.

Shumway-Cook and Woollacott proposed the Task-oriented Approach (TOA) in 1990 as a physical rehabilitation approach for motor control problems caused by central nervous system injury.[11] This approach focuses on assessing task and environmental demands of functional activities, and structures training accordingly in congruence with neuroplasticity principles. The TOA aligns well with the World Health Organization's International Classification of Functioning, Disability and Health (ICF),[12] with its assessment and treatment of the patient at different levels, and consideration of contextual factors. This case report described the safety, feasibility, and outcomes of a carefully planned intensive TOA-based PT program with inpatient and outpatient components for a patient with severe disability from multiple strokes. The patient and legal guardian provided written consent to disseminate the anonymized case in scientific meetings and publications.

Case Description

History

A 54-year-old Filipino male was diagnosed with a fourth stroke and referred to the Philippine General Hospital for inpatient rehabilitation in December 2013. His first stroke in 2004 was an intracranial hemorrhage in the left thalamic area with extension into the left parietal area. He underwent two weeks inpatient PT in Catanauan, Quezon Province. His second stroke in 2005 was diagnosed as a hematoma secondary to arteriovenous malformation. From both strokes, he recovered with no significant functional deficits and returned to work as a driver and linesman in a telecommunications company. In 2010, he had an intracranial hemorrhage in the right basal ganglia that resulted in left-sided muscle weakness in the extremities and balance deficits in standing. Following physical rehabilitation for one month, he regained independent home-level ambulation aided by a walker. However, community ambulation was limited, as he required contact guarding for safety when negotiating uneven terrain and environmental traffic. The patient was managed medically for the first three strokes. In 2013, he experienced new-onset left-sided weakness and slurring of speech. Computed tomography scan (October 2013) revealed an acute infarct in the right corona radiata and bilateral cerebellar hemispheres. His medical history also included hypertension, dyslipidemia and cardiomegaly. Medications prescribed were simvastatin, losartan, clopidogrel, hydrochlorothiazide, omeprazole, and lactulose.

Assessment Using Task-oriented Approach

Around the time of baseline assessment in January 2014, the patient could consistently follow verbal instructions and showed intact visual function, but verbal output was limited to “yes” and “no”. He was dependent in self-care and needed physical assistance in changing positions from supine to sitting or standing, and in bed-to-chair transfers. He tolerated only two minutes of unsupported short sitting and maintained trunk alignment only when given verbal cues. He tolerated only five minutes of standing given physical assistance at the pelvis and constant verbal, visual, or tactile cues to maintain trunk alignment.

Applying the TOA, examinations were conducted at the functional activity and participation level, strategy level, and impairment level. As no single test or measure could provide information on all examination levels, an assessment battery was administered (Appendix 1). The Mini Balance Evaluation Systems Test (Mini-BESTest), Functional Reach Test (FRT), Performance Oriented Mobility Assessment – Gait subscale (POMA-G), 10 Meter Walk Test (10MWT), 2 Minute Walk Test (2MWT), and Falls Efficacy Scale (FES) directly corresponded to the patient’s therapy goal and were therefore considered primary outcome measures. Available data for interpreting clinical change (i.e., minimal detectable change [MCD] and minimal clinically important difference [MCID]) and for estimating risk of falling (i.e., cut-off scores) for these primary outcome measures, and the patient’s baseline scores are integrated in Appendix 1.[13] The Mini-BESTest evaluates various functional strategies that are important for balance and mobility. The FRT assesses postural stability on a fixed base of support given a self-generated perturbation from a reaching task. The POMA-G assesses various gait strategies such as step length, width, and symmetry, and trunk control. The 10MWT assesses walking speed that is a good indicator of efficiency of mobility, while the 2MWT assesses walking endurance that is a good indicator of walking distance covered during mobility. The FES is used to estimate confidence in performing during daily activities without falling. Examinations were conducted by the physical therapist at baseline, after four weeks of inpatient PT, and after four weeks of outpatient PT.

Diagnosis and Goal Setting

Physical therapy diagnosis and goal setting were completed following baseline assessment. Severe impairments in standing balance and functional mobility underpinned the patient’s severe participation restrictions in the home and community. Improved home-level ambulation using a walker was therefore the logical goal in PT, since it corresponded with the patient’s previous functional level and was the consensual goal of the patient, his wife, and the physical therapist.

Intervention Using Task-oriented Approach

The therapy intervention was designed based on the TOA, with the principal goal of improving a participation-level outcome (i.e., improved ambulation inside the home aided by a walker). As with the assessment, the intervention was structured to target the functional, strategy, and impairment levels. Inpatient PT was administered by the physical therapist five times a week for four weeks at the Department of Rehabilitation Medicine of the Philippine General Hospital. Outpatient PT for four weeks immediately followed the inpatient phase, with thrice-weekly sessions carried out by the physical therapist at the rehabilitation clinic and twice-weekly sessions conducted as a caregiver-supervised home program. Each therapy session lasted for 2 hours and was divided into: 40 minutes of flexibility, strength, and coordination training; 40 minutes of postural control training; and 40 minutes of functional mobility training. The caregiver observed all of the patient’s PT sessions to be familiar with the intervention procedures. On the last week of the inpatient phase, the physical therapist trained the caregiver over two sessions on implementing the written home program, with emphasis on correct execution of therapy procedures, proper physical guarding and support, monitoring of exercise tolerance, and documenting session outcomes using an exercise diary. Activity and exercise prescription was guided by literature on intensive PT for adults with chronic or complex neurological conditions.[4,14,15] Details of the TOA-based intervention are presented in Appendix 2.

Results

Overall, no adverse events occurred throughout the duration of the program. Outcome assessments were conducted after both the inpatient and outpatient training phases. Baseline assessment comprised three 60-minute sessions, which incorporated ample rest periods to prevent rapid onset of fatigue. The patient completed all therapy sessions in the inpatient and outpatient phases. As the PT sessions progressed, the patient showed a gradual and consistent increase in the number of correct repetitions of strength and coordination exercises, and assisted functional activities such as sit-to-stand, bed-to-chair transfers, reaching in standing, and ambulation with a walker. Perceived exertion rated on the Modified Borg Scale also gradually and consistently decreased from 5-7/10 at baseline to 1-3/10 at the end of the outpatient phase, with a similar decrease in pre- and post-exercise heart rate from 95-105 to 80-85 beats per minute.

The patient demonstrated an overall positive change in scores on the primary outcome measures from baseline through the end of the eight-week intervention. Scores on both the Mini-BESTest and FRT increased from 3/28 to 6/28 points and 10.5 to 22.5 cm, respectively. However, only change on the FRT was clinically significant, decreasing the patient's falls risk from high to low. Score on the POMA-G improved from 0/12 to 5/12. The patient changed in mobility status based on the 10MWT and 2MWT, from being non-ambulatory with a score of 0 on both tests to walking with assistance with scores of 0.18 cm/s and 5.57 m, respectively. Fear of falling decreased with an improvement in FES score from 74 to 61 points.

Discussion

This case report provides information on the outcomes of a carefully planned TOA-based assessment and intervention program for a patient with severe functional disability from multiple strokes. The program was safe and feasible, as no adverse events transpired during program implementation and the patient tolerated all the procedures well. Assessment and intervention involved practical equipment and materials that were easy to access in the clinical and home settings. The patient's complete attendance in all PT-supervised sessions was a good indicator of positive motivation and program adherence. The caregiver was successfully trained in observing correctness and promoting safety in implementing the home-based program component. Social or family support is a good predictor of exercise continuation at home as patients believe that they would readily exercise if accompanied by someone else during their activity.[16] Provision of a written home program and exercise diary, and use of functional movements and instruments which were already available to the patient might have augmented patient and caregiver adherence to the PT intervention program.[17]

The patient showed positive change related to the outcome measures for balance and mobility. Score on the FRT increased by 114%, exceeding the MDC of 6.79 cm and cut-off for increased falls risk of 15 cm, and suggesting a decreased risk for falls.[13] The Mini-BESTest required a 4-point MCID,[13] which was not reached given the 3-point change in the patient's score. On closer examination of Mini-BESTest performance, the patient improved on the sensory integration items (i.e., longer duration when standing on foam surface and on a wedge), although the ordinal scale could not detect such change. Although walking speed was still very slow at 0.18 cm/s and walking distance was very short at 5.57 m by the end of the program, these changes were meaningful to the patient since he was unable to perform any form of walking at baseline. Improvements in balance and mobility were accompanied by higher confidence in performing standing and ambulation activities (i.e., decrease of 13 points on the FES). These findings suggest the value of TOA-based PT assessment, with primary outcome measures being able to detect meaningful change in the performance of a patient with severe motor disability.

The change in balance and mobility measures suggests improvements in anticipatory balance control, integration of motor and sensory strategies, and balance confidence, as well as translation of such improvements into increased functional mobility. Principles of neuroplasticity, such as learned use, sufficient practice specificity, intensity and repetition, and transference of training experience[6] that were applied in designing the intensive TOA-based PT intervention may have contributed to the positive results. The two-hour sessions provided opportunity for increased intensity and repetition, compared with the conventional one-hour PT session. Compensatory strategies using the visual system may have also aided the organization of sensory information for balance and mobility. By the end of the program, the patient was using his vision to guide movement of the extremities during functional activities. However, the eight-week training duration might not have been sufficiently long in relation to the severity of the patient's motor disability. Nevertheless, the positive findings provide support for the hypothesis that intensive TOA-based PT interventions may be effective for patients with severe functional disability. This hypothesis requires testing using an appropriate research design and adequate intervention duration.

The patient and his caregiver's consensual goal for PT was indoor ambulation using a walker. By the final outcome assessment, the patient could ambulate with a walker at home for about 6 meters without resting, given contact guarding and verbal cues. The patient's performance in balance and mobility exceeded the family's modest rehabilitation expectations following the patient's four episodes of strokes. The patient's wife was optimistic that with continuous practice, the patient could achieve further improvement in indoor mobility using a walker.

Conclusion

This case report described the application of the Task-oriented Approach in the physical therapy management of a patient with multiple strokes. The intensive TOA-based PT program was safe and feasible to implement, and demonstrated clinically important outcomes related to functional balance and mobility. Findings support the need for further research using an appropriate design to validate the effectiveness of the TOA in patients with severe functional disability related to multiple strokes.

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Statement of Authorship

All authors have approved the final version submitted.

Author Disclosure

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References

1. Veerbeek JM, van Wegen EEH, van Peppen RPS, et al. Royal Dutch Society for Physical Therapy. Clinical Practice Guideline for Physical Therapy in Patients with Stroke [Online]. 2014 [cited 2017 Oct]. Available from http://neurorehab.nl/wp-content/uploads/2012/03/stroke_practice_guidelines_2014.pdf
2. Leroux A, Pinet H, Nadeau S. Task-oriented intervention in chronic stroke: changes in clinical and laboratory measures of balance and mobility. Am J Phys Med Rehabil 2006; 85(10):820–30.
3. Cabral NL, Freire AT, Conforto AB, et al. Increase of stroke incidence in young adults in a middle-income country: a 10-year population-based study. Stroke. 2017; 48(11):2925-30.
4. English C, Hillier SL, Lynch EA. Circuit class therapy for improving mobility after stroke. Cochrane Database Syst Rev. 2017; 6:CD007513.
5. Hardwick RM, Rajan VA, Bastian AJ, Krakauer JW, Celnik PA. Motor learning in stroke: trained patients are not equal to untrained patients with less impairment. Neurorehabil Neural Repair. 2017; 31(2):178-89.
6. Kleim JA, Jones TA. Principles of experience-dependent neural plasticity: implications for rehabilitation after brain damage. J Speech Lang Hear Res. 2008; 51(1):S225-39.
7. Chen H, Epstein J, Stern E. Neural plasticity after acquired brain injury: evidence from functional neuroimaging. PM R. 2010;2(12 Suppl 2):S306-12.
8. Dancause N, Nudo RJ. Shaping plasticity to enhance recovery after injury. Prog Brain Res. 2011; 192:273-95.
9. Hosp JA, Luft AR. Cortical plasticity during motor learning and recovery after ischemic stroke. Neural Plast. 2011;2011:871296.
10. Takeuchi N, Izumi S. Maladaptive plasticity for motor recovery after stroke: mechanisms and approaches. Neural Plast. 2012;2012:359728.
11. Shumway-Cook A, Woollacott M. Motor control: translating research into practice,4th ed. Philadelphia: Lippincott Williams and Wilkins; 2012.
12. World Health Organization. International Classification of Functioning, Disability, and Health: ICF. Geneva: World Health Organization; 2001.
13. Rehabilitation Measures Database [Online]. [cited 2017 Nov]. Available from https://www.sralab.org/rehabilitation-measures
14. Fritz S, Merlo-Rains A, Rivers E, et al. Feasibility of intensive mobility training to improve gait, balance, and mobility in persons with chronic neurological conditions: a case series. J Neurol Phys Ther. 2011; 35(3):141-7.
15. Casey AF, Mackay-Lyons M, Connolly EM, Jennings C, Rasmussen R. A comprehensive exercise program for a young adult male with Down syndrome who experienced a stroke. Disabil Rehabil. 2014; 36(17):1402-8.
16. Jack K, McLean SM, Moffett JK, Gardiner E. Barriers to treatment adherence in physiotherapy outpatient clinics: a systematic review. Man Ther. 2010; 15(3-2):220-8.
17. Sheetal K, Mokgobadibe VN. The effect of a written and pictorial home exercise prescription on adherence for people with stroke. Hong Kong Occupat Ther Ass. 2015; 26:33-41.

Appendices

Appendix 1. Assessment based on task-oriented approach

Outcome	Impairment Level (Body Structures and Body Functions) Assessment	Strategy Level Assessment	Functional Activities and Participation Level Assessment
Balance	Modified Ashworth Scale (tone): R knee flexors and ankle plantarflexors = 1+ L knee flexors and ankle plantarflexors = 1+ Motricity Index (strength): R LE = 75.5 L LE = 75.5 Test for dysmetria: R UE and LE = 2 L UE and LE = 2 Test for dysdiadochokinesia: R UE and LE = 2 L UE and LE = 2 Goniometry (range of motion): R ankle dorsiflexion = 0-3 degrees L ankle dorsiflexion = 0-5 degrees	Sitting and standing alignment (motor strategies): Trunk laterally leaning to R; knees slightly flexed; wide base of support; out toeing Performance Oriented Mobility Assessment – Nudged item (motor strategies): R = 1 L = 1 Mini Balance Evaluation Systems Test (motor and sensory strategies; cut-off < 18 points; MCID = 4 points):* 3/28 points	Mini Balance Evaluation Systems Test (postural control; cut-off < 18 points, MCID = 4 points):* 3/28 points Functional Reach Test (balance and falls risk; cut-off < 15 cm, MDC = 6.79 cm):* 10.5 cm Falls Efficacy Scale (fear of falling, cut-off > 80 points):* 74 points
Mobility	Modified Ashworth Scale (tone): As above Motricity Index (strength): As above Tests for dysmetria and dysdiadochokinesia: As above Goniometry (range of motion): As above	Performance Oriented Mobility Assessment – Gait subscale:* 0 / 12 points Mini Balance Evaluation Systems Test (sensory strategies; cut-off < 18 points; MCID = 4 points):* As above	10 Meter Walk Test (walking speed; MCID = 14 cm/s):* 0 m/s 2 Minute Walk Test (walking endurance; MDC = 16.4 m):* 0 m Falls Efficacy Scale (fear of falling; cut-off > 80 points):* As above

Note: L, left; LE, lower extremity; R, right; UE, upper extremity.
*Primary outcome measures directly corresponding with patient and caregiver's goal. Values for interpretation available online via Rehabilitation Measures Database [https://www.sralab.org/rehabilitation-measures]. Cut-off, cut-off score for increased risk of falling; MDC, minimal detectable change; MCID, minimal clinically important difference.

Appendix 2. Intervention based on task-oriented approach

	Impairment (Body Structures and Body Functions) Level Intervention	Strategy Level Intervention	Functional Activities and Participation Level Intervention
Balance	*To improve flexibility* Static stretching of ankle plantarflexors (60 seconds hold x 3 repetitions) *To improve lower extremity muscle strength* Heel raises, toe raises, half squats, standing hamstrings curls, marching in place (6 repetitions x 2 sets, each exercise) *To improve non-equilibrium coordination* Heel-to-shin in supine; finger-to-nose and alternating forearm pronation-supination in sitting (10 repetitions x 3 sets, each exercise)	*To improve steady standing alignment* Maintaining steady stance with sufficient alignment, with visual, verbal, or tactile cues as needed (5 minutes) *To improve anticipatory balance control* Standing weight shifting in anterior-posterior and medial-lateral directions, with visual, verbal, or tactile cues (5 minutes) Sit-to-stand (5 repetitions) *To improve motor and sensory organization strategies* Maintaining steady stance on firm surface, with eyes open then eyes closed; with feet together; with arms close to body; and with head movements (5 minutes) Maintaining steady stance on foam surface, with usual base of support and eyes closed intermittently (5 minutes) Marching in place on firm then foam surfaces, with pauses during unilateral stance (5 minutes) Stepping forward, backward, and sideways, with visual targets on floor (6 repetitions x 2 sets, each exercise)	*To improve functional balance* Reaching in different directions and height levels, and for various weights beyond arm's length (6 repetitions x 2 sets)
Mobility	Same intervention as with balance	*To improve mobility strategies for postural transitions and walking* Practicing sit-to-stand components using force control strategy, with physical assistance and cues: weight shifting or hip flexion for momentum phase; horizontal and vertical motion for critical transition phase; and hip-knee extension for lift phase (5 repetitions) Practicing postural control of the head-arms-trunk segment and stepping forward, backward, and sideways, with visual, verbal, or tactile cues (5 minutes)	*To improve functional mobility* Practicing sit-to-stand (5 repetitions) Walking inside parallel bars with manual assistance, and verbal and visual cues (as tolerated) Walking along hallway using walker with manual assistance, and verbal and visual cues (as tolerated)