International Journal of ChemTech Research
CODEN (USA): IJCRGG, ISSN: 0974-4290, ISSN(Online):2455-9555
Vol.10 No.2, pp 544-549, 2017

Effect of Task-Oriented Exercises on Improving Hand Function in Subacute Stroke Patients: A Randomized Controlled Trial

Wanees M. Badawy

Department of Physical Therapy for Neuromuscular Disorder and its Surgery, Faculty of Physical Therapy, Cairo University, Egypt.

Abstract : Background and Purpose: Hand function impairment is one of the main causes of functional disability in stroke patients. The study aimed to determine the effect of task-oriented exercises combined with a selected physical therapy program on improving hand function in subacute stroke patients. **Subjects:** Thirty patients (17 males and 13 females) diagnosed with stroke were included. The patients were randomly assigned into two equal groups a task-oriented group (n=15) or conventional group (n=15). **Patients and Methods:** The task-oriented group carried out task-oriented exercises directed for the affected hand for 30 min per day, 3 days a week for 6 consecutive weeks in addition to a selected physical therapy program. The conventional group carried out only the selected physical therapy program that was lasted for 30 minutes. The outcome measures were the hand grip, lateral pinch, and palmar pinch strength; the box and block test; and the Modified Barthel Index. The measured variables were accomplished before and after the training. **Results:** The task-oriented group showed a significant improvement in terms of hand grip, the box and block test and Modified Barthel Index scores. **Conclusion**: According to the results of this study, task-oriented exercises were found to add benefits in improvement of hand function if accompanied by conventional physical therapy program in treating subacute stroke patients.
Key words : Stroke, task-oriented exercise, hand functions, activities of daily living.

Introduction

Stroke is an acute, neurological incident that is caused by a reduction of blood supply to the brain. As defined by WHO stroke is "rapidly developing clinical signs of focal (or global) disturbance of cerebral function, with symptoms lasting 24 hours or longer or leading to death, with no apparent cause other than of vascular origin" [1].

Stroke patients experienced physical, cognitive, and psychosocial malfunction that had influence on the patients' quality of life and disturb activities of daily living (ADL) [2]. One of the major sources of impairment in neuromuscular disorders and dependence in daily life is the loss of hand function [3]. Several studies had shown that task-oriented exercises can aid in improving movement execution as a rehabilitative method in a natural environment [4,5].

Task-oriented exercise is directed to improve performance in a functional task via a goal-directed practice with repetition which is having an important effect for the patient [6]. Neural plasticity changes showed evidence to be maximized by specific skill learning [7,8].

Although hand function is one of the most difficult motor functions after stroke to return there are lack of researches investigating the rehabilitative intervention to improve it. Thus, the aim of this study was to investigate the effect of task-oriented exercise on hand function in subacute stroke patients.

Subjects and Methods:

Selection of the subjects:

The research was carried out in outpatient clinic of Faculty of Physical Therapy, Cairo University, Egypt. Patients were referred from a neurologist. The diagnosis was confirmed by CT and/or MRI scans. The patients were selected from the Out-Patient Clinic of Kasr El Aini, Teaching Hospital, Cairo University and from the Out-Patient Clinic of Faculty of Physical Therapy, Cairo University. It was applied in the period between 2014-2015.

Inclusion criteria for the study were: a) The age between 45 to 65 years; b) Both males and females were enrolled; c) Subjects with one episode of stroke only; d) Both ischemic and hemorrhagic stroke individuals were included; e) Duration of stroke between 1 to 6 months; f) Patients with Brunnstrom Stage 4 and 5 [9].

Exclusion criteria for the study were: a) Individuals having any musculoskeletal Disorders; b) patients with neurological disorder other than stroke as visual impairment or ataxia; c) Mini Mental Status Examination (MMSE) score < 23 [10]; d) Non co-operative patients or patients suffering from psychological problems.

With these criteria, a final sample of 30 patients was selected and randomly assigned to either the Group I (the study group) received task-oriented exercises plus a selected physical therapy program or Group II (the control group) who received the selected physical therapy program only. The randomization schedule was computer generated using a basic random number generator.

After the participants received an extensive explanation about the protocol, all patients were given an informed written consent to the study approved by the ethical committee of the Faculty of Physical Therapy, Cairo University.

For clinical evaluation:

The affected hand was tested using a Jamar® hydraulic hand dynamometer (Sammons Preston, Model #5030-J1, WisdomKing.com Inc., USA) to measure the hand grip and a Jamar® hydraulic pinch gauge (Sammons Preston, Model #7498-05, WisdomKing.com Inc., USA) to measure the lateral pinch, and palmar pinch. The average value of three measurements was calculated, and expressed in pounds (lb). And the manual dexterity of hand function was measured using the box and block test; this test depends on moving small blocks one by one from one partition to another within 60 seconds. The test-retest reliability of the box and block test has been reported to be between 0.93 and 1.00 [11]. The ability to perform activities of daily living was measured using the modified Barthel Index. The Modified Barthel Index had adequate reliability and validity [12]. All measurements were done before and after treatment.

For treatment:

Both groups (GI and GII) received the selected physical therapy program in form of weight bearing exercises as modified plantigrade, proprioceptive neuromuscular facilitation (PNF) (Contract-hold relax), reaching from different positions (sitting and standing) and to different directions. These exercises were given for 30 minutes, three days a week for six consecutive weeks.

In addition the study group (GI) took the task-oriented exercises included eating using a spoon and cup, wearing and taking off a shirt, using a belt and zipper, personal hygiene using a towel, combing, tooth brushing, and standing up and sitting down a chair [13]. Each exercise was repeated for five times for three sets and was carried out for 30 min per session. The level of difficulty was progressed by either by increasing the distance in between the hand and the object and/or by decreasing the object shape. The therapist gave oral explanations and guidance throughout the exercise.

Statistical Analysis:

The SPSS software (Version. 19.0) was utilized for statistical analyses. All values were expressed as a mean ± standard deviation (SD). Non-parametric independent variables (sex, affected side and type of stroke) were tested by chi-squared test. Paired t-test was used to assess changes within groups and un-paired t-test was used to assess the changes between both groups. The significance level was set at $p < 0.05$.

Results:

The sample size was 18 (60%) males and 12 (40%) females; their average age was 57.56 years. The numbers of cerebral hemorrhage and cerebral infarction patients were 5 (16.66%) and 25 (83.33%), respectively. All patients were right-hand dominant. Patients with right hemiparesis were 27 (90%) while patients with left hemiparesis were 3 (10%) as shown in table 1.

Group (I) showed a statistically significant increase in hand grip ($p=0.027$), box and block test ($p = 0.049$) and modified Barthel index scores ($p < 0.0001$) post treatment. In group (II) there was a statistically significant increase in modified Barthel index scores only ($p < 0.0001$). Comparison between posttreatment mean values of both groups showed that there was a statistically significant increase in the hand grip ($p = 0.049$) in favor of the task-oriented group while the remaining mean values showed no significant differences (Table 2).

Table 1. Demographic characteristics of the patients.

	Group I (n=15)	**Group II (n=15)**	**p-value**
	Mean±SD	**Mean±SD**	
Age (years)	56.74± 5.23	58.38± 6.31	0.444
Sex (M:F)	9:6	8:7	0.135
Weight (kg)	75.58±7.98	78.49±8.67	0.347
Height (cm)	169.29±5.94	171.36±6.37	0.365
Stroke (Hge:Inf)	3:12	2:13	0.24
Affected side (rt:lt)	13:2	14:1	0.37
Duration of illness (months)	4.9±2.18	4.87±2.71	0.92

SD: Standard deviation, Hge: Hemorrhage, Inf: Infarction, rt: Right, lt: Left, Significant level set at $p < 0.05$.

Table 2. Comparison between pre and posttreatment scores of hand functions and Modified Bathel Index in both groups (I and II).

Variables	Group I (n=15)	Group II (n=15)	Mean difference (95% CI)	p-value
	Mean±SD	Mean±SD		
Hand grip (lb) Pretreatment Posttreatment	 12.8± 5.47 17.1±4.6	 12.4± 4.97 13.2±5.72	 0.4 (-0.645, 1.445) 3.9 (2.86, 4.93)	 0.835 0.049*
Mean difference (95% CI)	-4.3 (3.29, 5.31)	-0.8 (-0.27, 1.87)		
p-value	0.027*	0.685		
Lateral pinch (lb) Pretreatment Posttreatment	 4.4± 2.1 5.1± 1.8	 4.3± 2.0 4.7± 3.4	 0.1 (-1.43, 1.63) 0.4 (-1.63, 2.43)	 0.894 0.69
Mean difference (95% CI)	-0.7 (-0.76, 2.16)	-0.4 (-2.48, 1.68)		
p-value	0.335	0.697		
Palmar pinch (lb) Pretreatment Posttreatment	 4.3± 2.5 4.9± 2.2	 4.2± 2.4 4.8± 1.8	 0.1 (-1.73, 1.93) 0.1 (-1.4, 1.6)	 0.911 0.892
Mean difference (95% CI)	-0.6 (-1.16, 2.36)	-0.6 (-2.18, 0.98)		
p-value	0.491	0.445		
BBT (score/60sec) Pretreatment Posttreatment	 10.5± 7.12 14.8± 3.9	 10.1± 8.2 13.3± 6.4	 0.4 (-5.34, 6.14) 1.5 (-2.46, 5.46)	 0.887 0.444
Mean difference (95% CI)	-4.3 (-8.59, -0.006)	-3.2 (-8.7, 2.3)		
p-value	0.049*	0.243		
Modified Barthel Index (total score) Pretreatment Posttreatment	 47.31± 11.15 74.54± 12.4	 46.23± 12.47 71.25± 11.46	 1.08 (-7.76, 9.92) 3.29 (-5.64, 12.22)	 0.804 0.456
Mean difference (95% CI)	-27.23 (-36.04, -18.41)	-25.02 (-33.97, -16.06)		
p-value	<0.0001*	<0.0001*		

SD: Standard deviation, lb: Bound, BBT: Box and block test, CI: Confidence interval, * Significant at $p < 0.05$.

Discussion

Stroke has critical interference with changes in the muscle tone as spasticity, motor control, production of isolated active movement, and functional abilities in the upper extremities more than the lower extremities [14]. The first three months poststroke plays an important role for the recovery in the upper extremity functions but could continue up to six months [15]. The recovery process that enhances the level of neurologic improvement poststroke does not depend on a classic therapy. Different approaches and techniques are believed to have part in motor recovery Bobath, Brunnstrom, and proprioception neuromuscular facilitation. These valuable rehabilitative approaches when added with functional task may benefit stroke patients if based on the patient's functional status and abilities[16].

The results of the current study revealed that patients in the task-oriented group demonstrated more functional improvement than those who were in the conventional therapy group in terms of hand skills, activities of daily living, and decrease the number of community services needed.

The six-week task-oriented programme emphasizing sequential and function based training appeared more effective for enhancing the functional recovery of poststroke patients than the sensorimotor integration techniques used in conventional rehabilitation alone.

Activities of daily living are highly dependent on the ability of the affected hand, especially if it was the dominant, to grip and release objects. Repeated active muscle stretch after weight bearing exercises resulted in increasing the rate of grasping and releasing objects for the paretic hand as in the study group there were emphasis on catch and release [17,18].

Limitations

Limitations of this study appeared in the patients' everyday life could not be controlled. The study was limited to 6 weeks intervention period and the long-term effect was not tested. Also the study evaluated the effect of unilateral practice training and the bilateral training was not been studied.

Conclusion

In accordance to the present findings, it is suggested that task-oriented exercises was beneficial in development of hand function if added to the conventional physical therapy program. Future researches on larger randomized controlled trials are recommended to generalize the benefits of task-oriented exercises in stroke rehabilitation.

References

1. Thorvaldsen P, Asplund K, Kuulasmaa K, Rajakangas AM, Schrollet M. Stroke incidence, case fatality, and mortality: the WHO MONICA Project. Stroke 1995; 26: 361-7.
2. Urton ML, Kohia M, Davis J, Neill MR. Systematic literature review of treatment interventions for upper extremity hemiparesis following stroke. Occup Ther Int 2007;14:11-27.
3. Deutsch JE, Merians AS, Adamovich S, Poizner H, Burdea GC. Development and application of virtual reality technology to improve hand use and gait of individuals post-stroke. Restor Neurol Neurosci. 2004;22(3-5):371–386.
4. Patten C, Dozono J, Schmidt SG, Jue ME, Lum PS. Combined Functional Task Practice and Dynamic High Intensity Resistance Training Promotes Recovery of Upper-extremity Motor Function in Post-stroke Hemiparesis. J Neurol Phys Ther. 2006;30(3):99-115.
5. French B, Thomas L, Leathley M, Sutton C, McAdam J, Forster A, Langhorne P, Price C, Walker A, Watkins C. Does repetitive task training improve functional activity after stroke? A cochrane systematic review and metaanalysis. J Rehabil Med 2010 ;42 ;9- 14.
6. Carr JH, Shepherd RB: Stroke rehabilitation; Guidelines for exercise and training to optimize motor skill, 1st ed. London: Butterworth Helenemann, 2003.
7. Richards LG, Stewart KC, Woodbury ML, Senesac C, Cauraugh JH. Movement-dependent stroke recovery: a systematic review and meta-analysis of TMS and fMRI evidence. Neuropsychologia 2008; 46(1):3.
8. Schaechter JD, Perdue KL. Enhanced cortical activation in the contralesional hemisphere of chronic stroke patients in response to motor skill challenge. Cerebral Cortex. 2008; 18: 638–47.
9. Safaz I, Yilmaz B, Yaşar E, Alaca R. Brunnstrom recovery stage and motricity index for the evaluation of upper extremity in stroke: analysis for correlation and responsiveness. Int J Rehabil Res. 2009 Sep;32(3):228-31.
10. Pangman VC, Sloan J, Guse L. An Examination of Psychometric Properties of the Mini-Mental State Examination and the Standardized Mini-Mental State Examination: Implications for Clinical Practice. Applied Nursing Research. 2000; 13(4): 209–213.
11. Siebers A, Oberg U, Skargren E. The effect of modified constraint-induced movement therapy on spasticity and motor function of the affected arm in patients with chronic stroke. Physiother Can 2010; 62(4): 388-396

12. Fricke J, Unsworth CA. Inter-rater reliability of the original and modified Barthel Index, and a comparison with the Functional Independence Measure. Australian Occupational Therapy journal 1997Mar; 44(1):22-29.
13. Timmermans AA, Spooren AI, Kingma H, et al.: Influence of task-oriented training content on skilled arm-hand performance in stroke: a systematic review. Neurorehabil Neural Repair 2010; 24: 858-870.
14. Kwakkel G, Kollen BJ, van der Grond J, Prevo AJ. Probability of regaining dexterity in the flaccid upper limb: impact of severity of paresis and time since onset in acute stroke. Stroke. 2003; 34: 2181-6.
15. Duncan P, Studenski S, Richards L, Gollub S, Lai SM, Reker D, et al. Randomized clinical trial of therapeutic exercise in subacute stroke. Stroke 2003;34:2173-80.
16. Chen JC, Shaw FZ. Progress in sensorimotor rehabilitative physical therapy programs for stroke patients, World J Clin Cases. 2014 Aug 13;2(8):316-26.
17. van der Lee JH, Wagenaar RC, Lankhorst GJ, Vogelaar TW, Devillé WL, Bouter LM. Forced use of the upper extremity in chronic stroke patients: results from a single-blind randomized clinical trial. Stroke, 1999; 30: 2369-2375.
18. Seo NJ, Rymer WZ, Kamoper DG. Delays in Grip Initiation and Termination in Persons With Stroke: Effects of Arm Support and Active Muscle Stretch Exercise. J Neurophysiol 2009 Jun; 101(6):3108-15.

*****