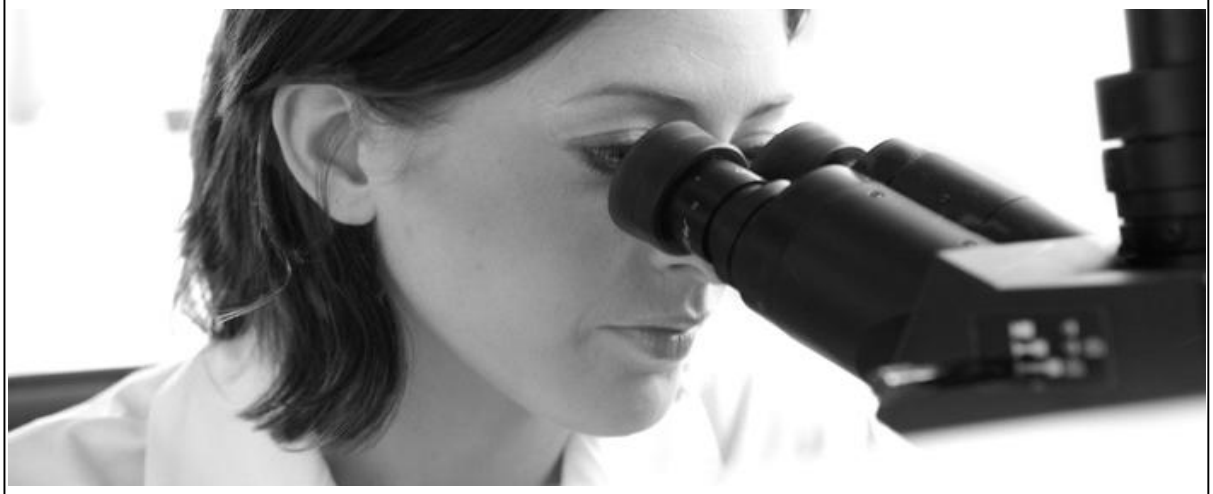
ISSN: 0976-3031

International Journal of Recent Scientific Research

Impact factor: 5.114

IMPACT OF TASK ORIENTED PHYSICAL ACTIVITY TO IMPROVE HAND MOTOR CONTROL IN STROKE PATIENTS: AN INTERVENTIONAL COMPARATIVE MOTOR LEARNING STRATEGY



Giuseppe Annino., Shashi Bhushan Savalla., Jagadish Babu Dasari and Matteo Vinciguerra

Volume: 6 Issue: 10

THE PUBLICATION OF
INTERNATIONAL JOURNAL OF RECENT SCIENTIFIC RESEARCH
http://www.recentscientific.com
E-mail: recentscientific@gmail.com

Available Online at http://www.recentscientific.com

ISSN: 0976-3031

International Journal of Recent Scientific Research
Vol. 6, Issue, 10, pp. 6623-6627, October, 2015

International Journal of Recent Scientific Research

RESEARCH ARTICLE

IMPACT OF TASK ORIENTED PHYSICAL ACTIVITY TO IMPROVE HAND MOTOR CONTROL IN STROKE PATIENTS: AN INTERVENTIONAL COMPARATIVE MOTOR LEARNING STRATEGY

Giuseppe Annino[1]., Shashi Bhushan Savalla*[1]., Jagadish Babu Dasari[1] and Matteo Vinciguerra[2]

[1]Faculty of Medicine and Surgery Torvergata, University of Rome Torvergata Rome Italy
[2]Villa Di Alba Physio Clinic, Rome, Italy

ARTICLE INFO

Article History:

Received 06th July, 2015
Received in revised form 14th August, 2015
Accepted 23rd September, 2015
Published online 16st October, 2015

Key words:

Physical activity, occupational therapy, inter-locking block therapy.

ABSTRACT

Background: The objective of this study was to compare the impact of task oriented physical activity to improve hand motor control in stroke patients by comparing with motor learning and motor strategy. **Methods**: A total of 20 patients who are post-stroke patients suffered a left brain hemisphere were recruited for the study. The patients were divided into 2 groups: the experimental group consisted of 10 patients who underwent occupational therapy 5 times per week along with occupational therapy based on differential training 5 times per week and control group consisted of 10 patients without any occupational therapy. **Results**: In the experimental group the mean performance time of all tasks for wrist, hand and lift of toys improved significantly ($p<5$) and no decline in quality of arm function was observed. In control group, the mean performance time of five patients is not improved significantly ($p<5$) and the lift of toys and the quality of arm function was not significantly improved. **Conclusions**: In the both groups, the experimental group with interventional and occupational therapy sessions improved arm function and differential training based occupational therapy and counseling on joint movements exercise,inter-locking blocks therapy, using extension and flexion along with enhancing fingers dexterity. this approach is inexpensive and more effectively.

INTRODUCTION

The World Health Organisation (WHO) estimates that stroke events in EU countries are likely to increase by 30% between 2000 and 2025[1]. And Stroke is the second leading cause of disability in Europe after ischemic heart disease[2].

Persons who suffer from functional impairment after stroke often have not reached their full potential for recovery when they are discharged from hospital, where they receive initial rehabilitation. This is especially the case for the recovery of arm-hand function, which lags behind recovery of other functions. A major obstacle for rehabilitation after hospital discharge is geographical distance between patients and therapists as well as limited availability of personnel[3,4,5,6,7]. The prevalence of stroke events is expected to increase across the global population aged over 65 increases. The number of stroke events in Europe is projected to rise from 1.1 million in 2000 to 1.5 million per year by 2025, largely due to the ageing population[8,9,10].

Many stroke patients suffer from persistent hand impairment results in diminished vocational and self care abilities and there by affecting the quality of life. And hand impairment stems not only from muscle trophy and altered supraspinal input to the muscles, but also from somatosensory deficits and it is well know that somatosensory feedback is a prerequisite for maintaining and regaining optimal motor control[11].

Much attention in rehabilitation research has been focusing on restoring the motor function after stroke and major issue is to restore the lost function. And the intervention emphasizes intensive, active repetitive movements are of high value in this regard. Therefore the strenghth, accuracy and functional use when applied to subject's paresis due to stroke[12].

Therefore, post stroke impairments in motor control cause functional limitations in the activities of daily living like grasping and object manipulation as compared with the normal persons. Our major concern with upper extremity motor function to regain motor function and get back normal ADL performance through rehabilitation[13,14].

*Corresponding author: **Shashi Bhushan Savalla**
Faculty of Medicine and Surgery Torvergata, University of Rome Torvergata Rome Italy

The motor deficits are often evaluated using scales such as the action research arm test and Fugl-meyer assessment (FMA)[15,16,17] Motor skill learning can be divided in two stages: a fast on-line learning process leading to large performance improvement over a single training session (i.e., early stages of motor skill learning as described in the present study), and a slower process involving smaller performance gains obtained through repeated training sessions[18].

And after stroke in 30% of the patients, spasicity occurs with first few days or weeks[19]. However, on set of spasticity is highly variable and can occur in the short, medium and long term post-stroke period. In upper limbs, the arm spasticity is internal rotation, adduction of the shoulder coupled with flexion at the elbow, the wrist and fingers. In this study the prevalence of spasticity does occurs in lower limb and determine by the Modified Ashworth Scale. The basic treatment for spasticity is to improve the viscoelastic properties of the muscle tendon and to increase its extensibility[20].

In this study, we aimed to demonstrate the effect of BT, consisting of a variety of tasks, on the recovery of arm function and the functional use of affected arm of stroke patients by the following Barthel Index (activity of daily living scale), Modified Ashworth scale (spasticity scale), Fugl Meyer Scale (motor function scale).Therefore the aim of this study to assess the safety and tolerability and impact of the physical activity supervision exercise training program for the post stroke patients. And also helps in improve performance and social participation, serves as an effective means of secondary prevention.

METHODOLOGY

This was a prospective, interventional, single center study from January 2015 to July 2014 for 6 months. Approval from the institutional ethics committee was obtained prior to the study. Twenty patients underwent treatment for CVA (cerebral vascular accident)-induced hemiplegias at a Villa Di Alba hospital located in Rome, Italy were enrolled. The patients were selected regardless of use of assisting devices like canes. However, the following eligibility criteria were considered: minimum score of 55 on the Barthel Index (Activity of Daily Living Scale) do not have any problem in musculoskeletal model, absence of a cardiac disorder, complete understanding of this research, and ability to communicate. The patients' characteristics, objective medical information, and medical records were analyzed.

The participants were divided into two groups: a control group of 10 patients who underwent standard physiotherapy for stroke patients and an experiment group of 10 patients who participated simultaneously in an Experimental therapy enhancing program and standard physiotherapy (Table 1).

Inclusion criteria included a minor ischemic stroke (mRS ≤ 2) within 6 months after the stroke, and independence in the activities of daily living prior to the stroke. Exclusion criteria included sensory or global aphasia, dementia with a mini-mental state examination score ≤ 21, major depression, systolic blood pressure ≥ 200 mmHg, diastolic blood pressure ≥ 110 mmHg, unstable angina pectoris, severe valvular stenosis, arrhythmia, congestive heart failure, ST depression ≥ 2 mm on electrocardiogram at rest, third-degree atrio-ventricular block with no pacemaker, severe peripheral vascular disease, severe lung disease, and orthopedic or neurological disability incompatible with a cardiovascular rehabilitation program.

Intervention program: Patients were educated on vascular risk factors and the importance of physical exercise and a healthy lifestyle. After the baseline evaluation, the patients in the exercise group were enrolled in a supervised exercise-training program performed daily for 6 months. Compliance was monitored, and the exercise prescription was adjusted if maximal exercise capacity improved.

Informed consent: Prior to the study, the general study process and the responsibilities of both participants and researchers will be explained to potential participants. They will be told that their entry into the trial is entirely voluntary and that they can withdraw at any time. In the event of their withdrawal, the data collected cannot be erased and will be used in the final analyses. Written informed consent should be obtained from each participant before any interventions related to the study are started.

Assessment Procedure: The following assessment scales are used to evaluate the improvement in subjects hand motor function according to the international classification of functioning (ICF), disability and health guidelines, pre-and post-intervention.

Fugl Meyer scale to evaluate motor function,
Modified Ashworth scale to evaluate muscle spasticity,
Barthel index to find improvement of the Activities of Daily Living (ADL's),

Participants were assessed on clinical outcomes at baseline ,pre-intervention (week 0),post-intervention (2,4,6,8 weeks),and a follow-up every 4thweeks (12,16,20,24 weeks) respectively. The joint specific required movements are facilitated from this kind of interventional therapy where the whole shoulder girdle exercise ,facilitated with systems has clear benefits, repetitive targeted therapy of specific muscle groups, especially in the hand and wrist ,is essential in all stages of a rehabilitation program.

The dose of intervention, we turned to play as a motivator. Accordingly ,we designed a task specific interventional inter-locking blocks therapy design and play controller that requires specific joint movements to trigger play events .In its present configuration ,the controller enables play with both affected and unaffected hand using wrist extension and flexion along with enhancing fingers dexterity. This approach could provide inexpensive home-based therapy to supplement institutional PT thus maximizing the dose of therapy received to promote hand function.

RESULTS

The ratio of male/female was 6/4 and 5/5 in experimental and control group. The mean and standard deviation of age in experimental and controls in male/female were 54.33±07.81 / 6 0.50±02.08 and 54. 20±7.79/59.00±02.23. Also, the distributions of sex, age, involved side were statistically similar in both the groups. These observations were shown in Table 1.

Table1 Demographic details

S.no.	Subjects details	Experimental Group	Control Group
1	Study population	10 (50%)	10 (50%)
	Age		
2	Males(Mean±SD)	54.33±07.81	54.20±7.79
	Females(Mean±SD)	60.50±02.08	59.00±02.23
	Gender		
3	Males	6 (60%)	5 (50%)
	Females	4 (40%)	5 (50%)
4	Involvement of hemiplegic area	Cerebral infarction in left brain hemisphere	
6	Onset of stroke	Between 1.5-3 months	Between1.5-3months

Exp 1-effect of FMA for wrist

Stimulation of intensity and rest motor threshold for left hemiplegic at baseline to 24th week (Table 2).At the baseline there were no much difference between in both groups. After, there was a significant effect in female and male patient shows 04.44±03.35 and 03.00±01.60 in experimental and control group. The mean and standard deviation of the both groups of FMA scale for wrist seen in table 2.

Table2 FMA wrist

Experimental Group			Control Group		
Age	Gender	Baseline to 24thweek	Age	Gender	Baseline to 24thweek
40	Male	04.33±01.98	44	Male	03.50±01.19
52	Male	05.55±01.66	56	Female	03.12±01.12
58	Male	04.00±01.22	60	Female	04.75±01.28
62	Female	03.33±01.65	64	Male	06.00±00.92
60	Female	04.44±03.35	57	Male	05.25±01.83
55	Male	04.55±02.40	57	Male	03.00±01.60
58	Female	04.00±01.58	59	Female	04.37±00.74
61	Male	03.00±02.12	62	Female	03.62±01.40
59	Male	04.77±01.39	58	Female	03.37±00.74
63	Female	04.55±01.81	49	Male	02.87±00.83

95% confidence interval, t-test 5.64

Exp-2 effect of FMA for hands

In analysis of FMA for hands, there statistically significant at the 95% confidence level with t-test 4.34.And we can see statistically differences among these mean and standard deviation scores were observed in table 3.

Table3 FMA hands

Experimental Group			Control Group		
Age	Gender	Baseline to 24thweek	Age	Gender	Baseline to 24thweek
40	Male	05.55±02.78	44	Male	03.50±01.19
52	Male	06.77±02.22	56	Female	04.75±01.28
58	Male	05.11±02.02	60	Female	03.87±00.83
62	Female	06.00±02.64	64	Male	07.75±01.83
60	Female	05.88±03.98	57	Male	06.25±03.19
55	Male	05.66±02.95	57	Male	02.37±01.06
58	Female	04.22±02.43	59	Female	04.12±00.83
61	Female	06.44±02.40	62	Female	03.75±01.48
59	Male	06.44±02.40	58	Female	02.62±01.06
63	Female	05.88±02.02	49	Male	03.50±01.19

*95% confidence interval, t-test 4.34

To investigate potential correlation with MAS, patients were evaluated and divided into two groups based on their scores which could be 1,1^{+},2 or 3.All tests were performed, equal patients were distributed 10 patients in both the groups respectively. In MAS review it should treated as a nominal scale for spasticity. All tests were performed in both the groups. The mean and standard deviation is shown in table 4 and 5.

Exp-3 wrist

Statistically significant differences for mean upper extremity coordination and reflex assessment were observed. In this one female patient shows 03.22±01.39 improvement as compared to control group male patient 03.87±00.83.The t-test was used and statistical significance was set at level 95% confidence level.

Exp-4 Fingers

In this phase, the patients in experimental group encouraged to use playing blocks to observe the range of motion of wrist to improve sensory motor and feedback in the distal parts of the body. During this phase, change in tension of extensor digitorium communis tendon which causes the interphalaneal extension and improves propioception feedback. A sixty year old female attained the normal post tone 02.55±01.66 as compared to control group which is not impressive results seen in table 5.

Table-4 MAS wrist

Experimental Group			Control Group		
Age	Gender	Baseline to 24thweek	Age	Gender	Baseline to 24thweek
40	Male	02.11±01.05	44	Male	01.87±00.83
52	Male	01.44±00.52	56	Female	02.62±00.51
58	Male	01.33±01.22	60	Female	02.87±00.83
62	Female	02.66±00.86	64	Male	01.12±00.83
60	Female	02.44±01.66	57	Male	02.50±01.19
55	Male	02.44±01.33	57	Male	03.87±00.83
58	Female	01.66±01.22	59	Female	02.50±00.53
61	Female	03.22±01.39	62	Female	02.75±00.88
59	Male	01.77±00.83	58	Female	01.87±00.83
63	Female	02.22±01.09	49	Male	02.50±00.53

*95% confidence interval, t-test-2.88

Table5 MAS finger

Experimental Group			Control Group		
Age	Gender	Baseline to 24thweek	Age	Gender	Baseline to 24thweek
40	Male	02.44±01.33	44	Male	03.37±00.74
52	Male	02.00±00.86	56	Female	03.37±00.51
58	Male	02.55±00.88	60	Female	03.25±00.88
62	Female	02..88±00.92	64	Male	02.00±00.74
60	Female	02.55±01.66	57	Male	02.37±01.40
55	Male	03.22±01.39	57	Male	02.87±00.83
58	Female	02.66±01.22	59	Female	02.12±00.83
61	Female	03.11±00.92	62	Female	03.25±00.70
59	Male	02.00±00.86	58	Female	01.50±00.53
63	Female	02.00±00.86	49	Male	02.00±00.75

*95% confidence interval, t-test-3.54

Exp-5 thumb

Though the results in both the groups are satisfactory, the experimental group showed its significance difference in improvement from 6th week which is continued throughout the duration of the study. In experimental group, patient's shows significant improvement as compared to control group with a t-test of -0.46, and the mean and standard deviation scores were seen in table 6.

Table 6 MAS thumb

Experimental Group			Control Group		
Age	Gender	Baseline to 24th week	Age	Gender	Baseline to 24th week
40	Male	01.66±01.22	44	Male	03.00±00.92
52	Male	01.11±00.92	56	Female	01.87±00.83
58	Male	02.22±00.86	60	Female	01.50±00.53
62	Female	01.88±01.26	64	Male	02.50±00.53
60	Female	02.66±01.22	57	Male	02.37±01.40
55	Male	02.00±00.86	57	Male	03.00±00.92
58	Female	02.11±00.92	59	Female	02.12±00.83
61	Female	02.00±01.73	62	Female	01.25±00.88
59	Male	01.22±00.83	58	Female	02.62±00.51
63	Female	01.22±00.83	49	Male	01.37±00.51

*95% confidence interval, t-test-0.46

In barthel index, in both the groups show statistically significant difference. And one attained complete recovery 80.00±17.32 bathrel index score as compared to control group 85.00±08.94 and 80.00±10.68 shown in table 7.

Table7 Barthel group

Experimental Group			Control Group		
Age	Gender	Baseline,4th to 24th week	Age	Gender	Baseline,4th to 24th week
40	Male	76.42±18.41	44	Male	70.83±10.20
52	Male	70.71±12.72	56	Female	75.00±09.48
58	Male	74.28±14.55	60	Female	79.16±08.01
62	Female	71.42±10.69	64	Male	75.83±06.64
60	Female	80.00±17.32	57	Male	85.00±08.94
55	Male	75.00±16.46	57	Male	80.00±10.68
58	Female	73.57±15.46	59	Female	76.66±05.16
61	Female	72.85±12.19	62	Female	75.00±10.00
59	Male	77.85±14.09	58	Female	77.50±10.36
63	Female	74.28±13.36	49	Male	70.00±08.94

*95% confidence interval, t-test 0.63

In this short period of time, the assessment scales in a comparative analysis between experimental and control group shows preliminary results and maximal recovery attained in experimental group as compared to control group, this kind of motor learning strategies would definitely benefit the post-stroke patients.

DISCUSSION

The mean value of the hand grip strength of adult male and female subjects were right hand than in left hand in different postures and in different body joints. *incel et al* shows that the hand grip strength is to be higher in dominant hand with right handed subjects, but no such differences between sides could be documentated for left handed people[21]. But according to *Rabergs and Roberts* explains that the use of more muscle and muscular hypertrophy in the dominant hand which leads to increased strength[22].

In this study, 50% of the patients were holding objects in experimental group as compared to control they were not holding objects but where in *Hsu HY et al*, 42% of the patients were holding the objects. The force parameters acquired during the pinch task indicate that the subject's sound hands perform with greater force control precession in functional tasks and produce better results in the hand function test that the affected hands do, and previous studies produced similar results[23,24,25].

It may be argued that 24 weeks is too short an intervention period to detect an effect of supervision however,24 weeks was chosen because it was believed that participants randomized to exercise would motivated for a longer intervention on their own and most improvement was expected within few weeks. Engebretsen K *et al*, studied the effect of supervised exercise in people with shoulder impingement and found that the largest improvement was within 6 weeks. The baseline symptom level for the present participants was similar to this study. In this present study the experimental group with intervention alone showed improvement in 24 weeks as compared to control group home alone[26].

In agreement with previous studies *Sale P et al*, our data suggests that observation of action, with the intention to imitate movements, can increase the excitability of the brain motor areas and, in doing so, can stimulate the recovery of motor control. Moreover, in addition to what has been already described by others, we hypothesized and observed that action observation, coupled with action execution, induce a higher improvement in right hemispheric compared to left hemispheric strokes[27].

Study limitations: The interpretation of group differences is only based on clinical measures and this methodological choice represents the main limitations of this research. Future studies and continuation of this study combining electrophysiological recording or functional neuroimaging with data acquired using experimental psychology will hopefully provide a more comprehensive understanding of how action observation modulates the brain activity and recovery of motor performances. The choice of applying effective exercise and intervention observed improvements as maximum percentage are achievable gains as compared to control group and was aimed at adjusting motor recovery by score severity at entry, thus controlling for inter-individual differences in the functional state before treatment .This kind of data processing may have helped to compensate the effects of the unavoidable differences in the amount and type of motor training undertaken by subjects showing different degree of motor impairment at enrollment.

CONCLUSION

In this present study, we examined and compared the responsiveness and validity of the interventional study. In this research endorse the use of the Interventional therapy in addition to SSR in first-ever stroke survivors with left hemisphere following right damage. The positive findings obtained in experimental subjects with moderate to severe upper limb, the simplicity of the treatment and lack of adverse events strongly recommended extending of the use of interventional studies. In association with medications and physiotherapy involving stroke rehabilitation designing of the feed forward-feedback mechanism to the early stage of stroke care can be more beneficial factor in future studies and future study can enhance the improvement in stroke patients.

References

1. Truelsen T, Piechowski-Jozwiak B, Bonita R, Mathers C, Bogousslavsky J, Boysen G: Stroke incidence and

prevalence in Europe: a review of available data. Eur J Neurol 2006, 13(6):581-598.
2. Timmermans A, Seelen H A M, Richard D Willmann R D and Kingma H. Technology assisted training of arm-hand skills in stroke: concepts on reacquisition of motor control and therapist guidelines for rehabilitation technology design. *Journal of Neuro Engineering and Rehabilitation* 2009; 6:1:1-18.
3. Duncan P, Studenski S, Richards L, Gollub S, Lai SM, Reker D, Perera S, Yates J, Koch V, Rigler S, *et al*.: Randomized clinical trial of therapeutic exercise in subacute stroke. Stroke 2003, 34(9):2173-2180.
4. Malouin FRC: Assessment and training of locomotion after stroke:evolving concepts. In Science-based rehabilitation Theories into practice Edited by: Refshauge Kathryn. Edinburgh: Butterworth Heinemann; 2005:185-222.
5. Broeks JG, Lankhorst GJ, Rumping K, Prevo AJ: The long-term outcome of arm function after stroke: results of a follow-up study. Disabil Rehabil 1999, 21(8):357-364.
6. Feys HM, De Weerdt WJ, Selz BE, Cox Steck GA, Spichiger R, Vereeck LE, Putman KD, Van Hoydonck GA: Effect of a therapeutic intervention for the hemiplegic upper limb in the acute phase after stroke: a single-blind, randomized, controlled multicenter trial. Stroke 1998, 29(4):785-792.
7. Hoenig H, Sanford JA, Butterfield T, Griffiths PC, Richardson P, Hargraves K: Development of a teletechnology protocol for inhome rehabilitation. J Rehabil Res Dev 2006, 43(2):287-298.
8. Rothwell PM *et al*. Change in stroke incidence, mortality, case-fatality, severity, and risk factors in Oxfordshire, UK from 1981 to 2004 (Oxford Vascular Study). Lancet, 2004, 363:1925-33.
9. Mukherjee D and Chirag PG. Epidemiology and the Global Burden of Stroke World Neurosurg, 2011, 76, 6S:S85-S90.
10. Truelsen T, Piechowski-Jozwiak B, Bonita R *et al*. Stroke incidence and prevalence in Europe: a review of available data. European Journal of Neurology, 2006, 13: 581–598.
11. Se N J, Kosmopoulos M L. Enders L Rand Hur P.Effect of remote sensory noise on hand function post stroke Effect of remote sensory noise on hand function post stroke. Front. Hum. Neurosci. 2014; 8:934.
12. Ausenda C D and Carnovali M.Transfer of motor skill learning from the healthy hand to the paretic hand in stroke patients:a randomized controlled trail. Eur J Phys Rehabil Med 2011; 47: 417-25.
13. Smania N, Paolucci S, Tinazzi M, Borghero A, Manganotti P, Fiaschi A, Moretto G, Bovi P, Gambarin M: Active finger extension: a simple movement predicting recovery of arm function in patients with acute stroke. Stroke 2007, 38:1088–1090.
14. Lum P, Reinkensmeyer D, Mahoney R, Rymer WZ, Burgar C: Robotic devices for movement therapy after stroke: current status and challenges to clinical acceptance. Top Stroke Rehabil 2002, 8(4):40–53.
15. Bohannon RW, Smith MB: Interrater reliability of a modified Ashworth scale of muscle spasticity. Phys Ther 1987, 67:206–207.
16. Ashworth B: Preliminary trial of carisoprodol in multiple sclerosis. Practitioner 1964, 192:540–542.
17. Fugl-Meyer AR, Jaasko I, Leyman I, Olsson S, Steglind S: The post-stroke hemiplegic patient: 1. a method for evaluation of physical performance. Scand J Rehabil Med 1975, 7:13–31.
18. Dayan, E., and Cohen, L. G. (2011). Neuroplasticity subserving motor skill learning. Neuron 72, 443–454. doi: 10.1016/j. neuron .2011.10.008.
19. Mayer NH, Esquenazi A. Muscle over activity and movement dysfunction in the upper motoneuron syndrome. Physical Medicine & Rehabilitation Clinics of North America 2003; 14:855–883,vii–viii.
20. Aurore T, Camille C, Erik Z, Marie-Aure´lie B, Steven L, and Olivia G. Spasticity after stroke: Physiology, assessment and treatment. Brain Inj, Early Online: 1–13.
21. Incel, N.A., Ceceli, E., Durukan, P.B., Erdem,H.R., Yorgancioglu, Z.R. 2002. Grip strength: Effect of hand dominance. *Singap.Med. J.* , 43(5): 234-237.
22. Rabergs, G., Roberts, L. 1997. Effect of handedness on grip strength. *Archv. Phys.Med. Rehab.*, 76: 410-414.
23. Hunter SM, Crome P: Hand function and stroke. Rev Clin Gerontol 2002, 12:68–81.
24. Hermsdorfer J, Hagl E, Nowak DA, Marquardt C: Grip force control during object manipulation in cerebral stroke. Clin Neurophysiol 2003, 114:915–929.
25. Nowak DA, Grefkes C, Dafotakis M, Kust J, Karbe H, Fink GR: Dexterity is impaired at both hands following unilateral subcortical middle cerebral artery stroke. Eur J Neurosci 2007, 25:3173–3184.
26. Engebretsen K, Grotle M, Bautz-Holter E, Sandvik L, Juel NG, Ekeberg OM, *et al*. Radial extracorporeal shockwave treatment compared with supervised exercises in patients with subacromial pain syndrome: single blind randomised study. BMJ. 2009; 339:b3360.
27. Sale P, Ceravolo M G, Franceschini M Action Observation Therapy in the Subacute Phase Promotes Dexterity Recovery in Right-Hemisphere Stroke Patients. BioMed Research International, Vol.2014.

****

How to cite this article:

Giuseppe Annino *et al*.2015, Impact of Task Oriented Physical Activity To Improve Hand Motor Control In Stroke Patients: An Interventional Comparative Motor Learning Strategy. *Int J Recent Sci Res.* 6(10), pp. 6623-6627.

International Journal of Recent Scientific Research

ISSN 0976-3031