ORIGINAL ARTICLE

Effectiveness of the Circuit Class Training versus Individual Task Specific Training for Improving Upper Limb Functions in Post-Acute Stroke Patients

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ABSTRACT

Objective: To determine the effectiveness of circuit class versus individual task specific training to improve upper limb functions in post stroke pateints.

Study Design: Double blinded randomized controlled trial.

Place and Duration of Study: This study was carried out from January 1st 2016 to December 31st 2016 at physiotherapy department Fauji Foundation Hospital Peshawar.

Materials and Methods: A total of 60 subjects with post-acute phase of stroke and upper limb impairments were enrolled in this study. The subjects were randomly allocated into two groups, experimental (n=30) treated with circuit based task specific training and control (n=30) treated with individual task specific training. The pateints in both groups were assessed using motor assessment scale at the beginning of treatment and 6 weeks after training program.

Results: The Mean age of pateints was 58 and 59 years in control and experimental group respectively. There were more left hemiplegics as compared to right hemiplegics in both groups. The patients in circuit training group showed better results as compared to the patients in individual task specific training group with respect to upper limb functions, advanced hand activities and hand functions six weeks after treatment.

Conclusion: Post-acute stroke survivors show better results in upper limb functions, advanced hand activities and hand functions with by task specific trainings in circuit groups as compared to individual task specific trainings.

Key Words: *Circuit Class Training, Motor Assessment Scale, Rehabilitation Stroke, Task Specific Training.*

Introductions

According to W.H.O about 85% of deaths due to stroke occur in middle and low income countries.[1] There is no well designed population based survey on stroke prevalence in Pakistan but estimated average incidence rates is 250/100,000, which is higher than incidence rates in western nations.[2] About 70-80% of individuals who sustain stroke have upper extremity impairments and many of them do not regain proper functional use of paretic arm which leads to difficulty in achieving activities of daily life (ADLs) and proper engagement in community.[3] At 6 months post stroke, about 25-53% of pateints remain dependent at least at one ADL task, which often involve use of bilateral or unilateral arm activities . It has been reported that 55% to 75% of patients suffering from stroke have difficulty in grasping, holding and manipulating objects .[2-3]

There are different approaches being proposed to improve upper extremity function after stroke such as functional training,[4] neuro-facilitation techniques[4-7] and strengthening[8-9] and reported with mixed results. Majority of these studies have small sample sizes with limited generalizable effects.[9] While increase in strength following strength training, especially in chronic stroke reported no indication for functional use of paretic arm.[8] There is now mounting evidence that both motor and functional change in the paretic extremities is associated with forced use of affected extremity.[10,11] Indeed cortical re-organization had been demonstrated following task specific training, intensive movement therapy,[12] constraint induced

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movement therapy CIMT,[10] rhythmic auditory cueing (BATRAC)[13] and robotic aided exercise training.[14,15]

Task specific training(TST) which is now evident for stroke rehabilitation[16,17] established that positive cortical reorganization occur in human cortex which is driven by activity and repetitive practice of new task, furthermore it had been concluded that recovery of motor function in patients with stroke is best facilitated by intensive and task specific treatment. Based on the motor relearning theory,[18] TST emphasizes on repetition of functional task not the isolated movement patterns.[16]

Observational studies showed that patients receiving treatment after stroke spend large parts of the day inactive and appear to have the presence of therapist to practice all new skills. Providing task specific treatment to a group of patients in post stroke in circuit class had been proposed as a new method of increasing amount of time patients spend actively participated in task specific practice[19] Circuit class therapy can be defined as the therapy provided to more than 2 pateints involving tailored interventions, with the focus on functional tasks received within the group settings, provided to pateints with similar or different degree of functional abilities and that involves a staff to pateints ratio no more than 1:3.[20] Practically this can involve the subjects physically moving among the stations or circuits according to the functional need within the group setting, optimally the stations are targeted at repetitions of e.g. range of motion exercises, electrotherapy sessions, strengthening exercises, balance and gait training etc.[7,8] Participants are continuously monitored and progressed accordingly.[21]

There are number of benefits associated with circuit training. It is beneficial for the patients and health system as it is cost effective and for therapist as well as time and energy saving treatment model. Studies therefore investigated the effects of circuit trainings with the aim to establish it as alternative approach for stoke rehabilitation. Interestingly most of studies favored circuit training program over individual training program in improving different functional parameters post stroke. However, most of the circuit based tasks from the published studies were focused on the leg strength, walking speed, distance and balance etc. Only few studied circuit class training effects on upper limb functional parameter[18] Also results of these studies cannot be generalized to all stroke population due to very small sample size[6] and due to baseline differences in subjects characteristics in as those studies as they enrolled pateints with wide range of neurological impairment other than stroke and other baseline differences in groups for evaluating effects of circuit training program.[19,22] The approaches should be utilized to implement circuit trainings as alternative treatment model in stroke setup of Peshawar as a evidence based practice.

A randomized controlled trail was therefore conducted to examine the effects of circuit based training programs versus individual training on recovery of upper limb functions in post stroke patients.

Materials and Methods

A double blinded randomized controlled trail was done in physiotherapy department at Fauji Foundation Hospital Peshawar. Sixty subjects with post-acute phase stroke and upper limb impairments were enrolled. Recruitment method included self-referred pateints, pateints referred by clinicians or physiotherapist from other hospitals. Previous medical charts of the patients were reviewed for duration of hospital stay, diagnosis, side of the brain injury, onset of stroke and patients were evaluated for the eligibility criteria i.e., Stroke with unilateral motor deficits, patients between 3-8 months of stroke, Age 45-65years, Able to participate in group and >1 grade on manual muscle testing (MMT) for upper limb including hand, <2 on Ashworth scale of spasticity at the affected upper extremity. The exclusion criteria included, poor cognition, patients previously received physiotherapy, medically non stable patients, patients with pain in upper limb ;>3 on visual analogue scale, history of significant psychiatric illness, patients having moderate to severe visual impairments. The ethical approval was taken from Fauji Foundation Hospital Peshawar. The informed consent was based on Helsinki ethical considerations.[22]

In this program evaluation, each therapy model, delivered for 1.5hour/day, 5week for 6 weeks. Both group received standard physiotherapy treatment, one group at individual level and another group in a circuit's class.

Individual Task Specific Training: Patients participated in a total 1.5hour/day for 6 weeks with the 1:1 patient to therapist ratio. Activities performed number of repetitions, time on task and progressions of those activities were determined individually by treating therapist.

Circuit Class Training: Patients participated in the 1.5hour/day of physiotherapy session with >1:1 patients to therapist ratio. The whole study consisted up-to 5:1 patients to therapist ratio. The circuits were divided up-to 3specific stations (figure 1), 15-20 minutes on each circuit as tailored to patients activity level. In station 3 electrical stimulation for wrist extensor provided to those patients reported wrist extension less than 20 degrees (frequency, 100Hz: 150micro-second with on time 10 seconds and off time 10 seconds ramp 1s and treatment time 10-15 minutes). Each exercise session had a brief warm up and cools down period for 5 minutes in which subjects performed upper extremity stretches and active and assisted range of motion exercises. These exercises were specific to pateints as directed by physiotherapist. Any adverse symptom e.g. pain, fatigue etc. were reported to therapist.

Class 1: Thera-band exercise. Movements: flexion, extension, adduction, abduction, internal and external rotations. Progressed by increasing the resistance of thera-band and increasing the repetition from 2 sets of 10 to 3 sets of 15.
Class 2: Range of motion, weight bearing exercises, elbow and wrist exercises.
1) Passive or self -assisted ROM for joints with no or minimal active movements
2) Upper limb weight bearing activities e.g. pushing therapy ball, pushing on the armrest of chair, or 4 point standing
3) Dumbbells or wrist cuff weight exercises. Movements; elbow/wrist flexion extension. Progressively increasing weight and increasing repetitions from2 sets of 10 to 3 sets of 15
Class 3: 1) Hand muscles strengthening: Exercises using putty, grippe rs (movements: pinch, grip finger extension), (progressed by increasing the resistance of putty and grippers and increasing the repetitions from 2 sets of 10 to 3 sets of 15.
2) Functional activities : playing cards, picking up of objects of various shap es and sizes, reaching task and fine motor task.
3) Hand to hand coordination activities.
4) Strengthening using traditional gymnasium equipment's. Electrical stimulations for wrist reported > 20 extension.

Fig 1:[19,23]

Progression: Each functional activity was progressed such that the level of difficulty, complexity and repetition numbers matched to each individual's ability. It was ensured that pateints were performing tasks with sufficient challenge. The overall rehabilitation goals were made independently to conduct of study.

Outcome measure: The outcome measures were three subscales of the motor assessment scale MAS (1 upper arm functions, 2) hand movements and 3) advanced hand activities). MAS developed by Carr et al. to evaluate functional ability skills after stroke. It uses a 9 point ordinal scale. This instrument has revealed high test re test consistency(r=0.98), inter-rater reliability(r=0.95) with high construct validity (0.88). This instrument can be used to document motor recovery at any stage of stroke.[24]

Non-parametrical test was used for the statistical analysis because it was convenience sampling, using SPSS version 19. Man-Whitney U test was used to examine between group differences for baseline and final treatment scores.

Results

The Means and standard deviations were calculated for descriptive parameters of study given in the Table I. There were no statistically significant differences between groups for age, stroke onset, gender, length of hospital stay and hemi-paretic side as $p< 0.05$. In both groups the number of left hemiplegics was more as compare to right hemiplegics. In both groups the attendance rate was 100% for 6 week training program and all subjects were able to perform the exercise plane as prescribed by experienced physiotherapist.

Table I: Subjects Characteristics at Baseline

Variables	Experimental Group n=30	Control G roup n=30
Mean Age of subjects± SD	58.01±3.69	59.83±2.76
Gender of the subjects	14=male,16=female	15=male, 15=females
Stroke onset (months)±SD	4.46±1.38	4.63±1.35
Side of the hemiparesis	18 LHP and 12RHP	20 LHP and 10 RHP
Mean LOHS (days)± SD	13.10+2.27	14.40+1.95

LHP= Left hemiparesis RHP= Right hemiparesis
LOHS=Length of hospital stay SD= standard deviation

Table II indicates that there was no statistical significant difference at baseline between groups for upper limb functions (ULF), hand movements (HM) and for advanced hand activities (AHA) as p value was >0.05. The association of post treatment scores showed that there was major variations in the experimental group for study parameters as p value was <0.05.

The group A indicates control group that received individual task specific training and group 2 indicates experimental group (circuit class training) in tables below. The Mean rank for upper arm function of individual task specific training ITST and circuit class training CCT group were 25 and 35, respectively (p=0.01), hand movement for ITST and CT were 20 and 40 (p=0.00). The statistical analysis shows that circuit group was 10% more effective to individual group on upper limb functions, 20 more effective on hand movements and 12% more effective on advanced hand activities.

Table II= Baseline and Post-Treatment Analysis between Groups

Variable	Groups	Mean rank	Sum of rank	1st Quartile	Median	3rd Quartile	Z-value	*p*-value
ULF	ITST CCT	28.30 32.70	849.00 981.00	3.0000	3.5000	4.0000	-0.94	0.2[b]
HM	ITST CCT	33.80 27.20	1014.00 816.0	1.0000	1.5000	2.0000	-0.83	0.1[b]
AHC	ITST CCT	31.10 29.90	933.00 897.00	1.0000	1.5000	2.0000	-0.01	0.7[b]
ULF	ITST CCT	25.60 35.40	768.0 1062.0	4.0000	2.0000	4.0000	-2.49	0.02[a]
HM	ITST CCT	20.20 40.60	612.0 1218.0	3.0000	4.0000	5.0000	-5.00	0.01[a]
AHC	ITST CCT	24.52 36.48	735.50 1094.5	4.0000	2.0000	4.0000	-3.59	0.01[a]

ULF=upper limb functions HM=hand movements
AHC= advanced hand activities CCT= circuit class training
ITST= individual task specific training
b= before treatment a=after treatment

Discussion

A number of systematic reviews have suggested that task based intense treatment should be the top priority for stroke patients functional recovery.[25] The recent studies emerged with an approach that task based training can be organized into circuit with series of work stations. Circuit class training stratifies at-least 3 key features of efficient and effective training. First by utilizing different work stations, circuit class training allows patients to extensively practice training in a meaningful and progressive way. Second circuit class training is efficient use of therapist time in which pateints actively engaged in practice when compared to individual training. The circuit class training is potentially cost effective to health care system by decreasing therapist to pateints ratios. Thirdly, circuit class training consists of peer support and social interactions that may enhance compliance to exercise programs.[18] The present study indicates that circuit class training for 4 week durations promoted a significant improvement in upper limb functions of stroke pateints. The more significant effects for functional improvement in circuit group can be due to many reasons including the maximum repetition of activity, social interactions of pateints and less inactive time duration in such circuits. If the circuit trainings are able to prevent the inactive time durations and associated secondary complications, it would presumably lead to health cost saving in long run. The health care system is therefore promoting the community based rehabilitation programs. The results of present study are consistent with studies done by Blennernshesset et al[26] and Pang et al. and they also concluded for better effectiveness of circuit class training on upper limb functions post stroke. The pilot study conducted by Dean et al[6] concluded the significant effects of circuit training on upper limb functional group. These studies examined and compared the improvement of upper limb with lower limb functional improvement that is the control group practiced the mobility task while the experimental group practiced the upper limb tasks. It is well known fact that recovery after stroke is immediate in lower limb as compare to upper limb which recovers slow comparatively due to nature of blood supply of brain[27] The baseline similarities of the groups cannot be excluded in phenomena called generalizability.

Study Limitations and Future Recommendations: Small sample size was one of the limitations of this trial. The trial was conducted on post-acute stroke patients and the result of this study cannot be implemented on chronic stroke subjects. Future studies therefore needed to have larger sample size with extensive assessment tools to consider diversity in functional abilities of upper limb. Also there is need to divide stroke subjects with subgroups with different impairment level so the results would be generalizable to stroke population.

Conclusion

This study suggests that circuit based task specific

training is more effective as compared to individual task specific training for improving functional parameters of upper limb among Post-acute stroke patients.

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