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Influence of Number of Repetition and Variety of Task in Upper Limb Motor Recovery in Hemiplegia

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ABSTRACT

Knowledge of rehabilitation of stroke seeks to be important source of promoting recovery and independence of activity of daily living in stroke survivor. This study has the purpose to utilize the motor relearning program by means of task oriented approach. It is a novel approach towards the cortical reorganization in the sensorimotor cortex, where the sensation of normal movement pattern is achieved through variety of task practice. The major relearning of functional activity can be enhanced by increasing the intensity of task oriented practice. Subjects with cerebro vascular accident referred by their primary care physician to a physical therapist were recruited from the inpatient and outpatient department of Saveetha Medical Hospital based on the inclusion and exclusion criteria and informed consent obtained and was screened for the eligibility. The collected data was tabulated and analyzed using descriptive and inferential statistics. The results of pre-test and post-test within group analysis showed extremely statistically significant with p-test values (P=0.0001 and P <0.0001). It is concluded from this study that both the variety of tasks and number of repetition improves upper limb function following hemiplegia. Further intervention with more number of repetition resulted in a better recovery than intervention with more number of tasks.

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Introduction

Knowledge of rehabilitation of stroke seeks to be important source of promoting recovery and independence of activity of daily living in stroke survivor. Stroke is interchangeable from cerebro vascular accident where the condition pertains to damage in brain. Stroke is the 2nd leading disease which is caused mainly by two types, namely ischaemic and hemorrhage. Among this, ischaemic is the leading cause of stroke of about 80% to 87% of people affected. The epidemiology of stroke reveals about the prevalence rate of about 84-334 per one lakh population where the urban area people are more affected than the rural population according to the stroke fact sheet in India. Stroke is the major cause of death. Asians have high mortality rate in the world wide population where the Indian statistical analysis shows 1.12 of total death. Mortality of stroke had been declined since 1950's due to the attribution of better management and improved diagnosis.

As per the research, age is the major important factor that cause stroke where women are more affected than men earlier because the lifetime risk in women is higher than men. Later, in these centuries, the males are being affected more than the females due to the modifiable risk factors that lead to cause the disease. About one fourth of the strokes occur in people under the age of 65 years, whereas the young stroke increases at the age of 40 years.

The cause of stroke leads to the sign and symptom of major impairment or permanent disability. Major impairment following stroke includes the motor deficit. Motor deficit represents the paralysis (hemiplegia) or weakness (hemiparesis) of body on the contralateral side of lesion. Stroke often impairs the ability of functional independence of upper limb. The recovery of upper limb is slow in progress when compared to lower limb. The impairment of upper limb function reduces the reaching and grasping activity that has an integral part in performance of daily activity. As patient mostly develops flexor synergy pattern, there will be a limitation in the upper limb active range of motion which makes them to use compensatory strategies to fulfill their functional outcome.

Thus to bring out the normal strategies, therapist make their intervention passively which do not have an impact on the recovery by means of limited practice by patients. Limited practice in stroke rehabilitation creates a negative scenario among inpatient hospitalization. So that the motor learning process which comes under the mechanism of neuroplasticity loses its adapting skill that leads to slow recovery. When there is disruption to the central nervous system through unexpected factors, error results. Patients with neurological deficits con be examined with the combination of errors (perception of sensory information, selection and execution of motor program).

Thus errors in motor programming are extremely important in rehabilitation for learning which could be revealed between an intended and actual motor behavior. As attention is one of the major factor during intervention which will enhance neuroplastic changes. This will make the brain's ability to learn the task into a functional, and a meaningful, skilled practice. The utilization of motor learning has an effective part on neuronal cortical reorganization which has the capacity to adjust and adapt to the skilled strategies. Traditional therapeutic interventions such as range of motion exercise, strengthening exercise, positioning, and mobilization to improve motor, balance emphasized the need of specific movements to control and execute and to develop the basic movement's strategies.

This study has the purpose to utilize the motor relearning program by means of task oriented approach.it is a novel approach towards the cortical reorganization in the sensorimotor cortex, where the sensation of normal movement pattern is achieved through variety of task practice. The major relearning of functional activity can be enhanced by increasing the intensity of task oriented practice. Repletion of task can reveal a positive progress in learning adaptation towards the skill. Thus the present study focus on task oriented rehabilitation with an increase in intensity of intervention, utilizes the ability to detect and correct the error in an efficient way through a goal directed practice as a key role for recovery after an insult [1-10].

Background and Purpose

Stroke is a clinical syndrome, a form of cerebro vascular disease that affect the blood supply to the brain [11].This is becoming an important cause of motor deficit with a major symptoms of numbness or weakness of arm, leg, face on one side of the body. With 70% to 80% of people who sustain upper limb impairment [12,13].

Task specific training is a therapy which will facilitate the development of motor programs by reducing the signs of deficits thereby improving functional performance, balance, muscle endurance, and gait [14,15].Task specific training is a matter of research interest, hence various factors that influence the outcome are being analysed by researches around the world.

Hence, the need for the study in the present scenario, variety of exercises is desirable in task specific training. Physiotherapists prefers, more variety of exercises at cost of repetition though it will emphasize a similar components of movement, the researcher believe that it may interfere with motor learning. Hence in this study an effort is taken with the aim to find and compare the influence of number of repetition and variety of task in motor recovery following stroke.

Review of Literature

Definition and prevalence of stroke

The WHO clinically defines the stroke as "the rapid development of clinical signs and symptoms of a focal neurological disturbance lasting more than 24 hours or leading to death with no apparent cause other than vascular origin. The Indian National Commission on macroeconomics and healthy estimated that the number of strokes will increase from 1,081,481 in 2000 to 1,667,372 in 2015. As stroke is becoming an important cause premature death and disability in low income and middle income countries like India that had been largely due to a demographic changes with an increase in prevalence rate of about 10% to 15% of strokes occur in people below the age of 40 years [16,17].

Motor disability of stroke

There will be an increase in compensatory movements that may potentially limit motor recovery and so in order to improve the motor functions by reducing the compensation of movements paradigms training had been described. Upper extremity complications are common following stroke which may be seriously debilitating where the mobility of upper limb will be difficult to regain than lower limb [18-20].

Overview of motor learning

The complex set of neural, physical, and behavioral process that control posture and movement are termed as motor control. The movements learned through interaction and exploration through environment by means of moor skills are acquired and modified by means of central nervous system through motor learning. It is an internal process associated with practice and experience leading to relatively permanent changes in capability. The cooperative actions of central nervous system depend on the motor control theories mainly dynamical system and hierarchical theories that allow accommodation of movement. This reveals the concept of organization of CNS from top to down around specific task demands. Damage to the central nervous system may affect the motor function that can produce recognizable deficits and differences between CNS plasticity, recovery and functional outcomes can be expected among individuals [21].

Evolution of task oriented approach

There is an increasing evidence of neural plastic changes which emphasize an intensive task specific practice to facilitate training –induced plasticity. Task specific training is a training with practice of context-specific motor tasks and receive some form of feedback to improve functional performance of daily activities. As the repetitive practice may facilitate the integration of remaining altered sense and motor system that reflects the concept of plasticity and motor learning in rehabilitation. Functional task training related to movement frequently used in daily life is considered to have more positive effects on the recovery of upper extremity motor functions in stroke patients than repetitive training using simple movement. The trends on research would implicate a potential outcome in rehabilitation that interprets the shorter length of the intervention. Some trials had concluded that additional practice of tasks could gain functional outcome of both upper limb and lower limb mobility in stroke subjects. The circuit training could provide a potential implication on task related practice in a structured way [22-26].

Exercise programmes in which movement related to functional activity is directly trained (referred to as task-related training) have shown better results than impairment-focused programmes. There is increasing evidence of neural plastic changes associated with TSE where these changes are associated with specific skill learning, consistent with a learning-dependent model of neural plasticity. A Cochrane review evaluated the effect of task-specific training, on both upper and lower-extremity function. Trials were included if one of the intervention arms included an active motor sequence

was performed repetitively within a single training session, and where the practice was aimed towards a clear functional goal [27-29].

Functional scales for upper limb outcome

The outcome measure of Motor Assessment Scale used to assess the mobility of arm where the test item hierarchy in the upper arm and hand movements to be valid .The motor assessment scale was developed to provide valid and reliable means of assessing everyday motor function following stroke. The MAS is based on a task oriented approach to evaluation that assesses the performance of functional tasks rather than the isolated pattern of movement [30-32].

The Action Research Arm Test is an observer rated performance based on the upper extremity function and dexterity. The ARAT is relatively a short and simple measure of upper limb function that provide an assessment of variety of tasks over a range of complexity, where the emphasis placed on functional task items as it may be predictive on improving the ADL and IADL. The Action Research Arm (ARA) test has frequently been used in clinical trials to measure improvement in the motor function of the affected arm itself. The ARA are reliable enough to detect clinically relevant changes, but the ARA test is substantially more responsive to improvement in upper extremity function in chronic stroke patients. Therefore, the ARA test is recommended to evaluate changes in arm motor function in chronic stroke patients. The Action Research Arm Test assesses mainly the ability to handle smaller and larger objects with a variety of qualitatively rated items and can therefore be considered as an arm specific measure of activity limitation [33-37].

The Nine Hole Peg Test has demonstrated a good validity and reliability in adult as well as in pediatric, as this is a timed, quantitative measure of fine manual dexterity [38].

Study Design: Experimental design

Methodology

Subjects with cerebro vascular accident referred by their primary care physician to a physical therapist were recruited from the inpatient and outpatient department of Saveetha Medical Hospital and were screened for the eligibility. This study was approved by the ethical committee. Inclusion criteria were as follows: Male and female hemiplegic subjects, Aged between 40 to 65 years of hemiplegic subjects, Hemiplegic subjects who are able to sit without support for more than 5 minutes. Exclusion criteria were as follows: Recurrent cerebro vascular disease, Cognitive deficits, Perceptual deficits which may interferes with the study, Other complications which interferes the study as perceived by the researcher. Prior to the study initiation, the objectives and requirements were explained to all participants, who signed a written informed consent form.

A total of thirty subjects were randomized using a lottery method by consecutive sampling technique created prior to the start of data collection by simple random sampling technique. The primary researcher was not involved in the selection and recruitment of the study. Following the baseline measurement, subjects were allocated into two groups (Group- A and Group-B). A therapist, who was blinded involved in the recruitment of subjects and group assignment. Two therapists along with the primary researcher gave the intervention and the outcome was evaluated by another therapist who was not involved in the study at the end of fourth week.

All subjects underwent an evaluation of upper extremity function at the start of the study. The following outcome measures were used for assessing the upper extremity performance. Motor assessment scale, Action research arm test, nine hole peg board test. The outcome measures were assessed before the intervention with the follow up of after 4 weeks of intervention as pre-test and post-test. Participants in both the group completed their training in 40 minutes session, 5 times per week for 4 weeks. In addition to this, both groups received conventional physical therapy for 20 minutes session, 5 times per week for 4 weeks. Group- A were trained with more variety of tasks with less repetition and Group-B were trained with less variety of tasks with more repetition.

Each participant was positioned according to their comfortable position and the tasks were performed. Assistance was also given for patients when needed. The tasks included: Keep boxes on shelf, Block placement, Push the given object placed on the table using wrist along with shoulder movement from one side to other side, Ask the patient to touch or get the given object in different directions as shown by the therapist, Take the given object from opposite side either by bending or turning the trunk , Take the given object by moving either forward or sideway and place it on a table, Drink from the glass, Key turning or cup inversion, Squeeze a ball or open a jar/bottle, Pull or take a pegs from the peg board.

Statistical Analysis

Statistical analysis was done for all the collected data with mean and standard deviation. For between group analysis of the pre-test and post-test values, unpaired t-test was used. For the analysis of within group, paired t-test was used.

Results

Thirty subjects were recruited into the study and fifteen subjects were allocated in each training group. All subjects completed the physical examination and the procedure to examine upper limb function were assessed using motor assessment scale, action research arm test and nine hole peg board test in the initial week and the fourth week of the study period.

The data analysis revealed that the results of this study were statistically significant in the upper limb function of stroke subjects. The results of the pretest and posttest values of within group analysis showed extremely statistically significant with the p test values (P=0.0001 and P<0.0001) of group A and group B in MAS and ARAT scales. But the nine hole peg board test did not showed any significant results in within group of analysis statistically in group A and group B (P=0.8341 and P=0.5581).

The between group analysis of pretest (P=0.7104, P=0.6140) and posttest (P=0.1271, P=0.5915) values in group A and group B of ARAT, and 9HPBT on upper limb function showed not statistically significant with the p value. The results of posttest values of between group analysis showed statistically significant in MAS outcome measure of upper limb function test in stroke subjects with the p value (P=0.0363 and P<0.0001) [40-41].

Motor Assessment Scale

Between group analysis of the pretest values of group A and group B for MAS

Group	Group A Pre	Group B Pre
Mean	4.67	5.13
SD	3.68	3.11

Between group analysis of the posttest values of group A and group B for MAS

Group	Group A Pre	Group B Pre
Mean	6.20	8.60
SD	3.84	1.76

Within group analysis of Group A for MAS

Group	Group A Pre	Group B Pre
Mean	4.67	6.20
SD	3.68	3.84

Within group analysis of Group B for MAS

Group	Group A Pre	Group B Pre
Mean	5.13	7.07
SD	3.11	2.87

Action Research Arm Test

Between group analysis of the pretest values of group A and group B for ARAT

Group	Group A Pre	Group B Pre
Mean	3.20	3.67
SD	2.24	2.74

Within group analysis of Group A for ARAT

Group	Group A Pre	Group B Pre
Mean	3.20	4.33
SD	2.24	2.41

Within group analysis of Group B for ARAT

Group	Group A Pre	Group B Pre
Mean	3.67	5.07
SD	2.74	2.43

Between group analysis of the posttest values of group A and group B for ARAT

Group	Group A Pre	Group B Pre
Mean	4.33	5.07
SD	2.41	2.43

Nine Hole Peg Board Test

Between group analysis of the pretest values of group A and group B for 9HPBT

Group	Group A Pre	Group B Pre
Mean	1.2433	1.5160
SD	1.1057	1.4319

Within group analysis of Group A for 9HPBT

Group	Group A Pre	Group B Pre
Mean	1.2433	1.1833
SD	1.1057	1.0017

Within group analysis of Group B for 9HPBT

Group	Group A Pre	Group B Pre
Mean	1.5160	1.3867
SD	1.4319	1.0494

Between group analysis of the posttest values of group A and group B for 9HPBT

Group	Group A Pre	Group B Pre
Mean	1.1833	1.3867
SD	1.0017	1.0494

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