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The effect of graded repetitive arm supplementary program (Grasp) on upper limb function in activities of daily living in acute stroke patients

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Abstract
Background and Objective: Stroke previously known medically as a cerebro vascular accident (CVA) is the rapidly developing loss of brain function due to disturbance in the blood supply to the brain. Upper limb dysfunction post stroke is prevalent with up to 70% individuals incurring paresis in the initial stage of recovery. This single group experimental study was carried out to know the effect of Graded Repetitive Arm Supplementary Program (GRASP) on arm function in Activities of Daily Living in acute stroke patients.
Method: Thirty patients fulfilling the inclusion criteria were selected and given GRASP protocol for thirty days. Chedoke arm and hand activity inventory for arm and hand function improvement (CAHAI-9), Action research arm test (ARAT) and Fugl Meyer score were used for assessment and analysis of the subjects.
Result: Significant improvement in upper limb function was observed using Graded Repetitive Arm Supplementary Program (GRASP) with a mean improvement of 4.067 in Fugl Meyer score, 5.400 in CAHAI-9 and 6.167 in ARAT.

Keywords: Stroke, cerebrovascular accidents, graded repetitive arm supplementary program

Introduction
Stroke is one of the most common neurological disorders leading to chronic disability. Like all the developing countries, Stroke is fast emerging as a major public health problem in India [1-3].
The term cerebrovascular disorders includes all disorders in which an area of the brain is temporarily or permanently affected by ischemia or haemorrhage which one or more of the cerebral blood vessels affected by disease [4].
Stroke is a generic term referring to a group of disorders that include cerebral infarction, cerebral haemorrhage and subarachnoid haemorrhage that describes the abrupt and sudden nature of onset [4, 5].
Stroke is major cause of long term disability and has potentially enormous emotional and socioeconomic consequences for patients, their families and health services [6].
Stroke is defined by World Health Organisation as a clinical syndrome consisting of rapidly developing clinical signs of focal (at times global) disturbance of cerebral function, lasting more than 24 hours or leading to death with no apparent cause other than that of vascular origin [7].
Stroke is an acute onset neurological dysfunction due to an abnormality in cerebral circulation with resultant signs and symptoms that correspond to involvement of focal areas of the brain [8].
The level and type of disability caused by stroke depends on the degree of brain injury and the region involved, but upper and lower extremity dysfunction and sensory, mood and cognitive impairments predominate and manifest as reduced capacity for active exercise and loss of mobility [9].
Paralysis of an arm after a stroke makes arm movements, such as reaching, grasping, and manipulating an object difficult. In turn, this causes many difficulties in activities of daily life, such as bathing, dressing, eating, and toileting [10].
More than 70% of individuals who have a stroke experience upper limb deficits that impact daily activities. Increased amount of upper limb therapy has positive effects. Participants in a

qualitative study of upper limb recovery after stroke, stated that use of the paretic upper limb is critical to carrying out Activities of Daily Living, but is neglected by health care professionals [11]. A strong relationship between upper limb function and ability to perform activities of daily living, social, and recreational activities has also been found [12, 13]. It has been established that early admission to stroke units and thus involvement in rehabilitation is strongly associated with improved functional recovery [14, 15]. It is evident in reviews of early rehabilitation treatment for the paretic upper limb, that increased treatment intensity using repetitive task oriented methods improves motor and functional recovery compared to facilitative approaches. Despite the knowledge that increased therapeutic activity leads to better outcomes poststroke, patient inactivity during inpatient rehabilitation is a concern [16-18].

Studies in acute and subacute settings have revealed that individuals were involved in therapy for 5.3% of the day (approximately 47 minutes/d) with upper limb treatment accounting for only 4 to 11 minutes [19, 20]. Graded Repetitive Arm Supplementary Program (GRASP) is an innovative program for upper limb recovery that increases the hours of repetitive goal oriented tasks without increasing costly therapy time or requiring expensive equipment. Graded Repetitive Arm Supplementary Program (GRASP) is an arm and hand exercise program which is supervised by a therapist, but done independent by the patient. It is studied that individuals with subacute stroke who received the supplemental Graded Repetitive Arm Supplementary Program (GRASP) protocol would attain greater upper limb function at the end of 4 weeks compared with those who received only usual inpatient care. [19, 20].

The level and type of disability caused by stroke depends on degree of brain injury and the region involved resulting in upper and lower extremity dysfunctions and sensory, mood and cognitive impairments which predominate and manifest as reduced capacity for active exercise and loss of mobility. Mini Mental State examination is used to assess the cognitive status of patients. It was developed by Folstein MF, Folstein SE and McHugh PR as a tool for the detection of dementia within a psychiatric setting. Its use, however has become widespread. The MMSE consists of 11 simple questions or tasks. Typically, these are grouped into 7 cognitive domains; orientation to time, orientation to place, registration of three words, attention and calculation, recall of 3 words, language, and visual construction. The test yields a total score of 30 and provides a picture of the subjects present cognitive performance based on direct observation of completion of test items/tasks [21].

Fugl Meyer is used to evaluate upper limb function of the patient for inclusion into the study (score 10-57). Fugl Meyer was developed as the quantitative evaluative instrument for measuring sensorimotor stroke recovery, based on Twitchell and Brunnstorm's concept of sequential stages of motor return in the hemiplegic stroke patient. Its primary value is the 100 point motor domain, which has received the most extensive evaluation. Limitations of the motor domain include a ceiling effect, omission of some potentially relevant items and weighing of the arm more than the leg [22].

Materials and methods

The purpose of the study was to evaluate the effect of graded repetitive arm supplementary program (grasp) on upper limb function in activities of daily living in acute stroke patients. To achieve this 30 subjects were selected by purposive sampling at Kempegowda Institute of Medical Science and Research Centre, Bangalore.

All the 30 subjects were given routine GRASP protocol for thirty days. Chedoke arm and hand activity inventory for arm and hand function improvement (CAHAI-9), Action research arm test (ARAT) and Fugl Meyer score were used for assessment and analysis of the subjects.

Intervention

The subject is assessed for inclusion using Fugl- Meyer scale, upon which the patients is assigned the level of exercise protocol to be followed and the patients are assessed with Mini Mental Scale for exclusion from the study if the score is below 20 and the intervention to be done is explained to the subject in the language understood by the subject / family members. A written informed consent is obtained.

A pre intervention assessment is done using Chedoke Hand and Arm Inventory, Action Research Arm Test. The patients are then administered the exercises according to the level assigned to them on the basis of their Fugl Meyer upper extremity scores.

Fugl-Meyer Score	Level of Grasp	Activities
10-25	Level 1	Stretching exercises - Total arm stretch - Shoulder shrugs - Trunk rotations - Hand and wrist stretch - Strengthening exercises - Weight bearing through affected hand - Weight bearing through both hands. - Shoulder flexion with weights - Shoulder abduction with weights - Elbow flexion with weights - Elbow extension with weights - Wrist flexion with weights - Wrist extension with weights - Grip power - Finger strengthening with theraputty - Hand activities using bean bag and cups using target board - Ball rolling (with and without partner) - Gross motor activities - Folding a towel
26-45	Level 2	Stretching exercises - Total arm stretch

		- Shoulder shrugs - Trunk rotations - Hand and wrist stretch - Strengthening exercises - Weight bearing through affected hand - Weight bearing through both hands - Chair ups - Shoulder flexion with weights - Shoulder abduction with weights - Elbow flexion with weights - Elbow extension with weights - Wrist flexion with weights - Wrist extension with weights - Grip power - Finger strengthening with theraputty - Twisting theraputty using fingers. - Hand activities using bean bag and cups using target board - Ball rolling (with and without partner) - Pouring using two cups - Drop and catch a ball - Fine and Gross motor activities - Folding and unfolding a towel - Buttoning and undoing buttons - Hanging up with large clothes pins - Stacking lego blocks - Arranging wooden blocks atop each other - Picking up candy sticks - Picking up paper clips and placing in a cup - Opening and closing a jar (stabilizing with affected and unaffected upper extremity) - Drying with a towel
46-58	Level 3	Stretching exercises - Total arm stretch - Shoulder shrugs - Trunk rotations - Hand and wrist stretch - Strengthening exercises - Weight bearing through affected hand - Weight bearing through both hands. - Chair ups - Shoulder flexion with weights - Shoulder abduction with weights - Elbow flexion with weights - Elbow extension with weights - Wrist flexion with weights - Wrist extension with weights - Grip power - Finger power with theraputty - Twisting theraputty using fingers. - Finger strengthening - Cutting theraputty with knife - Hand activities using bean bag and cups using target board - Advanced waiter cup with target board at ground level - Ball rolling (with and without partner) - Pouring using two cups - Drop and catch a ball - Bouncing ball with partner - Fine and Gross motor activities - Buttoning and undoing buttons - Hanging up with small clothes pins - Stacking lego blocks - Picking up candy sticks - Picking up paper clips and placing in a cup - Opening and closing a jar (stabilizing with affected and unaffected upper extremity) - Drying with a towel

GRASP protocol is an exercise program designed to improve paretic upper performance, and to encourage the use of the paretic upper limb in ADL. Each exercise in the GRASP protocol was graded by varying repetitions to meet each participant's need. Exercises included strengthening of the arm and hand (small wrist weight, putty, hand gripper), range of motion (stretching, active exercises), and gross and fine motor skills (eg, blocks, Lego, pegs). Repetitive goal and task oriented activities were designed to simulate partial or whole skill sets required in ADL (eg, folding, buttoning, pouring, and

lifting). Each level is administered for 10 days. The patients are then assessed and progressed to the next level. Post intervention scores are assessed at the end of the 10th, 20th and the 30th days.

Frequency: One hour per session
Five days per week
Thirty days.

Results & Discussion

This study was conducted to analyze the effect of Graded Repetitive Arm Supplementary Program (GRASP) in improving upper limb function in activities of daily living in acute stroke patients.

The subjects were analysed for improvement in upper limb function using Fugl meyer score, CAHAI and ARAT.

Fugl Meyer score was also used as an inclusion criteria tool. Based on Fugl Meyer score subjects were progressed to the next level of GRASP activity.

As shown in Table 1 and figure 1, Fugl Meyer score Compared to a 18.67±2.01 Mean ± SD at pre intervention, subjects showed significant improvement in upper limb functions at the end of 30th day with a Mean ± SD of 22.73±3.68 and a p value < 0.001. all 30 subjects started with level 1 on GRASP manual out of which 5 subjects progressed to level on GRASP manual based on their post intervention Fugl Meyer scores.

As shown in Table 2 and figure 2, CAHAI score Compared to a 22.20±2.33 Mean ± SD at pre intervention, subjects showed significant improvement in upper limb functions at the end of 30th day with a Mean ± SD of 27.60±3.79 and a p value < 0.001.

As shown in Table 3 and figure 3, ARAT score Compared to a 26.27±1.98 Mean ± SD at pre intervention, subjects showed significant improvement in upper limb functions at the end of 30th day with a Mean ± SD of 32.43±4.88 and a p value < 0.001.

GRASP program demonstrated significant improvement in subjects in two important areas of upper limb function: (1) the ability to use the paretic upper limb in Activities of daily living (CAHAI), (2) the ability to reach and grasp objects (ARAT). Our primary outcome measures that are CAHAI and ARAT are very applicable to real life situations, as it evaluates a wide variety of daily activities that incorporate the full range of upper limb movement, motor control, and coordination.

This study was conducted to analyze the effect of Graded Repetitive Arm Supplementary Program (GRASP) in improving upper limb function in activities of daily living in acute stroke patients.

For this intervention, 30 subjects with acute stroke were selected with age ranging from 30 to 70 years.

Table 1: An Evaluation of Fugl Meyer score

Fugl meyer score	Min-Max	Mean ± SD	difference	95% CI	t value	P value
Pre	15.00-23.00	18.67±2.01	-	-	-	-
Post 10th day	15.00-25.00	19.83±2.82	-1.167	-1.595 to -0.738	-5.570	<0.001**
Post 20th day	15.00-27.00	21.27±3.24	-2.600	-3.193 to -2.007	-8.963	<0.001**
Post 30th day	16.00-30.00	22.73±3.68	-4.067	-4.851 to -3.283	-10.608	<0.001**

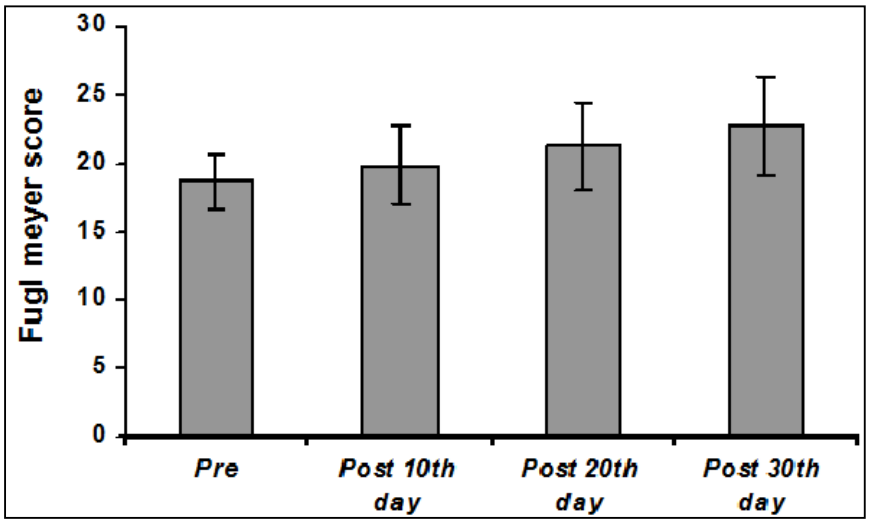

Fig 1: Comparison of fugl meyer score from baseline to post 30th day

Table 1 Shows evaluation of fugl meyer score on baseline, post 10th day, post 20th day and post 30th day. The fugl meyer score values on baseline is 18.67±2.01, post 10th day value is 19.83±2.82, post 20th day value is 21.27±3.24 and post 30th day value is 22.73±3.68. The P value obtained is <0.001**. The fugl meyer score before treatment was 18.67±2.01 and after treatment was 22.72±3.68 with a mean improvement of 4.067. 't' test shows that there is significant improvement in fugl meyer score after treatment.

Table 2: An Evaluation of CAHAI

CAHAI	Min-Max	Mean ± SD	difference	95% CI	t value	P value
Pre	17.00-28.00	22.20±2.33	-	-	-	-
Post 10th day	19.00-30.00	23.77±2.73	-1.567	-1.929 to -1.204	-8.833	<0.001**
Post 20th day	19.00-32.00	25.27±3.05	-3.067	-3.629 to -2.504	-11.145	<0.001**
Post 30th day	21.00-37.00	27.60±3.79	-5.400	-6.323 to -4.477	-11.965	<0.001**

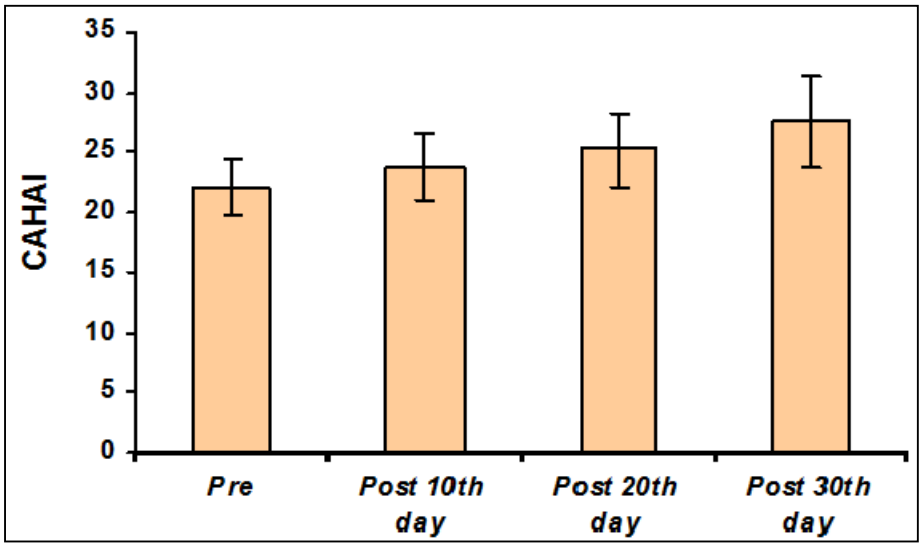

Fig 2: Comparison of CAHAI score from baseline to post 30th day

Table 2 Shows evaluation of CAHAI score on baseline, post 10th day, post 20th day and post 30th day. The CAHAI score values on baseline is 22.20±2.33, post 10th day value is 23.77±2.73, post 20th day value is 25.27±3.05 and post 30th day value is 27.60±3.79. The P value obtained is <0.001**. The CAHAI score before treatment was 22.20±2.33 and after treatment was 27.60±3.79 with a mean improvement of 5.400. 't' test shows that there is significant improvement in CAHAI score after treatment.

Table 3: An Evaluation of ARAT

ARAT	Min-Max	Mean ± SD	difference	95% CI	t value	P value
Pre	23.00-30.00	26.27±1.98	-	-	-	-
Post 10th day	23.00-33.00	27.63±3.01	-1.367	-1.998 to -0.735	-4.426	<0.001**
Post 20th day	23.00-37.00	29.90±3.92	-3.633	-4.640 to -2.626	-7.378	<0.001**
Post 30th day	25.00-42.00	32.43±4.88	-6.167	-7.543 to -4.790	-9.162	<0.001**

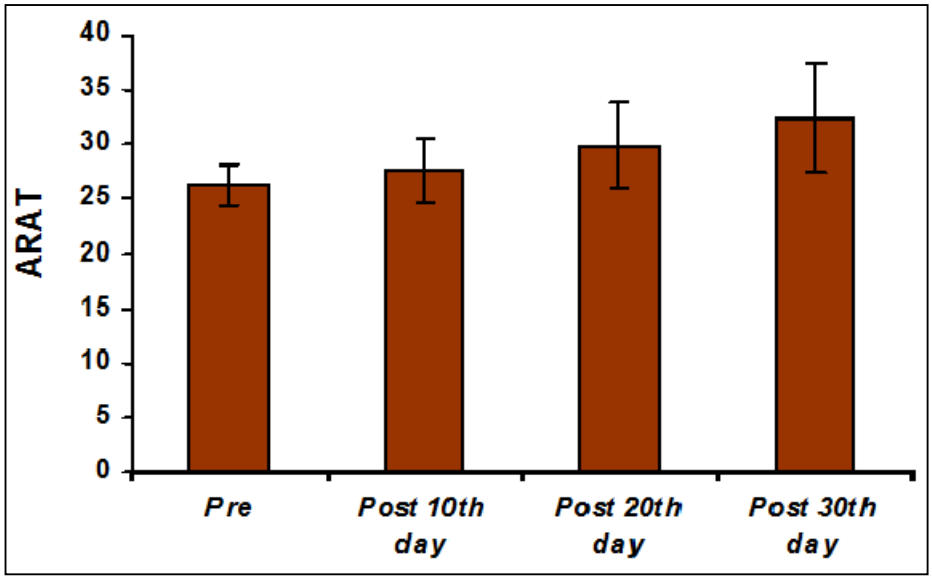

Fig 3: Comparison of ARAT score from baseline to post 30th day

Table 3 Shows evaluation of ARAT score on baseline, post 10th day, post 20th day and post 30th day. The ARAT score values on baseline is 26.27±1.98, post 10th day value is 27.63±3.01, post 20th day value is 29.90±3.92 and post 30th day value is 32.43±4.88. The P value obtained is <0.001**. The ARAT score before treatment was 26.27±1.98 and after treatment was 32.43±4.88 with a mean improvement of 6.167. 't' test shows that there is significant improvement in ARAT score after treatment.

Fig 4: Ball rolling with partner

Fig 5: Exercise using bean bag and target board

Conclusion

At the end of my study of Graded Repetitive Arm Supplementary Program (GRASP) intervention to improve upper limb function in Activities of daily living in Acute stroke patients, subjects showed a clinically and statistically significant improvement in upper limb function and in the performance of Activities of Daily living essential to carrying out day to day chores.

Therefore, a 30days intervention consisting of Graded Repetitive Arm Supplementary Program (GRASP) proved to be effective in improving upper limb function in Activities of daily living in Acute stroke patients as assessed using Fugl Meyer upper extremity motor impairment score in acute stroke patients and this in turn translated to a better performance in Activities of daily living as assessed using Chedoke Arm and Hand Activity Inventory (CAHAI-9) and Action Research Arm test (ARAT).

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