



ORIGINAL ARTICLE

**A COMPARATIVE STUDY TASK-ORIENTED ARM ABILITY
TRAINING VERSUS STRENGTH-BASED DEXTERITY EXERCISE
FOR HAND REHABILITATION IN STROKE SURVIVORS**

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ABSTRACT

Background: Stroke (CVA) is a rapidly developing loss of brain function due to disturbance caused by an interruption of the blood flow to the brain. The purpose of this study was to compare the effectiveness of Task-Oriented Arm Ability Training (TOAAT) and Strength-Based Dexterity Exercise (SBDE) in improving hand function among stroke survivors. **Methods:** A total of 30 male stroke patients aged 40 to 60 years, with mild to moderate upper limb impairment and Modified Ashworth Scale ≤ 2 , were selected and randomly divided into two groups (n=15). Group A received TOAAT, and Group B received SBDE. The interventions were conducted for a structured duration. Outcome measures used were the Nine-Hole Peg Test (NHPT) and the Jebsen-Taylor Hand Function Test (JTHFT), assessed before and after the intervention. Data were analyzed using paired and unpaired t-tests. **Results:** Both groups showed statistically significant improvements in hand function. However, participants in Group A (TOAAT) demonstrated greater gains in both fine motor coordination and functional task performance compared to Group B (SBDE). **Conclusion:** Task-Oriented Arm Ability Training was found to be more effective than Strength-Based Dexterity Exercise in enhancing hand function in stroke survivors.

Keywords: Task-Oriented Arm Ability Training, Strength-Based Dexterity Exercise, Nine Hole peg test, Jebsen Taylor Hand Function Test

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INTRODUCTION

A stroke is a common term used to refer to ischemic lesions of vascular origin, “a rapidly developed clinical sign of cerebral function lasting more than 24 hours leading to death with no apparent cause other than vascular origin¹. In South India, the incidence of stroke is 56.9 per 1000 population. Analysis of data from major urban university hospitals suggests that nearly 2% of all hospital cases, 4.5% of medical, and 20% of neurological admissions are due to stroke.

It is one of the leading causes of long-term disability, often resulting in significant motor impairments, especially in the upper limb. Hand dysfunction following a stroke severely affects activities of daily living (ADL), limiting independence and reducing the overall quality of life. Despite various rehabilitation strategies, regaining optimal hand function remains a major challenge in stroke rehabilitation².

Task-oriented arm ability training is a rehabilitation strategy designed to improve upper limb function by focusing on the practice of real-life, meaningful activities that the patient needs or wants to perform³. This approach is based on the principle that practicing specific tasks—such as reaching for objects, grasping, manipulating items, or using tools—helps to restore movement control and dexterity more effectively than general exercise alone. During each session, patients actively engage in repetitive, goal-directed tasks that are relevant to their daily lives, which help to promote motor learning and functional recover⁴.

The difficulty of these tasks is progressively increased as the patient’s abilities improve, ensuring ongoing challenge and adaptation. Therapists may use a variety of tools and technologies, including haptic feedback devices or specialized orthoses, to provide enhanced sensory input and support movement accuracy. This method is especially effective for individuals recovering from neurological conditions such as stroke, where it has been shown to be superior to traditional therapy in improving dexterity and overall arm function.

Strength-based dexterity exercises are designed to build both hand strength and fine motor control, making them essential for improving the ability to perform precise, coordinated tasks. These exercises often use tools such as therapy putty, stress balls, or resistance bands, which provide progressive resistance to challenge the muscles of the fingers, thumbs, and wrists⁵. For example, squeezing a therapy ball strengthens grip and finger muscles, while manipulating putty by pinching, rolling, or spreading it between the fingers enhances both strength and the ability to control movements with accuracy.

Wrist extension and flexion exercises performed with light weights or resistance further support the muscles that stabilize the hand for delicate tasks. By regularly practicing these activities, individuals can see improvements not only in their strength but also in their ability to perform complex hand movements required for daily activities such as buttoning shirts, writing, or manipulating small objects⁶.

METHODOLOGY

30 patients with Stroke survivors were selected based on the inclusion and exclusion criteria and they were divided into 2 groups, Group A and Group B. A pre test and post test were conducted for the Group A and Group B on Nine hole peg test and Jebsen Hand Function Test (JHFT) for stroke. First group (Group A) was treated Task-oriented Arm Ability Training for (Group A), Second group (Group B) was treated with Strength based dexterity Exercise.

Inclusion criteria: Only Male Patient is involved, Age group above 40 to 60 are taken, only affected side was considered, Modified Ashworth Scale score ≤ 2 , Mild to moderate upper limb Impairment.

Exclusion criteria: Chronic cases, Cognitive impairment, Other Neurological Disorders participate, Severe contracture, Uncontrolled hypertension patient, Uncontrolled Diabetic patient.

Procedure and Protocols

Group A-Task-Oriented Arm Ability Training (TOAAT)

Exercises Included:

- Reach-to-grasp tasks: Picking up varied-sized objects placed at different distances
- Object manipulation: Pegboard tasks, buttoning a shirt, inserting pegs

- ADL Simulations: Combing hair ,Brushing teeth, Drinking from a cup, Writing and page turning
- Translational movements: Transferring objects from one container to another
- Bilateral tasks: Using both arms in coordinated actions (e.g., folding towels)

Dosage and Duration: Frequency: 5 days per week, Intervention duration: 30 minutes, Total duration of the study is 3 Months

GROUP B – Strength-Based Dexterity Exercise (SBDE)

Exercises Included:

- **Grip Strengthening:** Squeezing smiley ball and sponge ball, Therapy putty for variable resistance pinching and rolling
- **Wrist & Forearm Training:** Flexion-extension with 0.5–1 kg weight cuffs, Supination- Pronation using weight cuff
- **Dexterity Drills:** Finger abduction using rubber bands, Thumb-finger opposition, Peg placement and coin stacking
- **Object-based Tasks:** Turning bolts and nuts, Opening and closing containers, Towel wring

Dosage and Duration: Frequency: 5 days per week, Intervention duration: 30 minutes, Total duration of the study is 3 Months.

RESULT

Descriptive statistics –Nine Hole Peg Test (Post Test Analysis) For GROUP A and B

| GROUP | NHPT | MEAN | STANDARD DEVIATION | PAIRED 't' VALUE |
|---------|-----------|-------|--------------------|------------------|
| Group A | Pre test | 38.87 | 2.70 | 24.3862 |
| | Post test | 30.13 | 2.88 | |
| Group B | Pre test | 39.67 | 2.29 | 20.1904 |
| | Post test | 33.93 | 1.91 | |

Table 1: Dependent t test within Group A and B on NHPT

Descriptive statistic for Nine hole peg test in Group A shows that paired 't' test value of pre vs post test values of group A was 24.3862 at 0.001% level which was greater than tabulated 't' value 2.5. Group B shows that paired 't' values of pre and post test values of group B was 20.1904 at 0.0001% level which was greater than tabulated t

values 2.5. this showed there is significant difference between pre vs post test results of Group A and Group B for nine hole peg test. This exposed that there was significant reduction in post test mean values in response to nine hole peg test in Group A and Group B.

Descriptive statistics for Nine Hole peg test Group A and Group B.

| GROUP | MEAN | STANDARD DEVIATION | PAIRED 'T' VALUE | MEAN DIFFERENCE |
|---------|------|--------------------|------------------|-----------------|
| GROUP A | 9 | 1.60 | 7.6391 | 3.40 |
| GROUP B | 5.60 | 0.63 | | |

Table 2: Mean difference between Group A and B

The unpaired 't' value of 7.6391 was greater than the tabulated unpaired 't' value of 2.14 which showed that there was a statistically significant difference at 0.0001 level between Group A and Group B.

The pre vs post test mean of Group A was 9 and the pre vs post test mean of Group B was 5.60 and the mean difference of Group A and Group B was 1.00 which showed that there was a significant reduction numerical pain rating scale for Group A and Group B.

| GROUP | NPRS | MEAN | STANDARD DEVIATION | PAIRED 'T' VALUE |
|---------|-----------|--------|--------------------|------------------|
| Group A | Pre test | 147.07 | 6.09 | 81.4837 |
| | Post test | 92.67 | 5.08 | |
| Group B | Pre test | 147.13 | 6.40 | 20.5930 |
| | Post test | 122.40 | 6.66 | |

Table 3: Dependent t test within Group A and B on NPRS

Descriptive statistic for Jebsen Hand Function Test in Group A shows that paired 't' test value of pre vs post test values of group A was 81.4837 at 0.0001% level which was greater than tabulated 't' value 2.5. Group B shows that paired 't' values of pre and post test values of group B was 20.5930 at 0.0001% level which was greater than

tabulated t values 2.5. this showed there is significant difference between pre vs post test results of Group A and Group B for NHPT severity score. This exposed that there was significant reduction in post test mean values in response to Jebsen Taylor Hand Function Test severity score in Group A and Group B.

| GROUP | MEAN | STANDARD DEVIATION | PAIRED 'T' VALUE | MEAN DIFFERENCE |
|---------|-------|--------------------|------------------|-----------------|
| GROUP A | 54.40 | 2.59 | 21.5893 | 29.67 |
| GROUP B | 24.73 | 4.65 | | |

Table 2: Mean difference between Group A and B

The paired 't' value of 21.5893 as greater than the tabulated unpaired 't' value of 2.14 which showed that there was a significant difference at 0.0001 level between Group A and Group B.

The pre vs post test mean of Group A was 54.40 and the pre vs post test mean of Group B was 2.07 and the mean difference of Group A and Group B was 24.73 which showed that there was significant reduction in Jebsen Hand Function Test severity score for Group A and Group B.

DISCUSSION

The purpose of the study were to compare treatment effectiveness of Task oriented Arm Ability Training And Strength based dexterity training for sub acute stroke survivors and the Nine hole peg test and Jebsen hand function test scores were taken as the parameter of quality the effectiveness of the treatment

Task oriented arm ability training and strength based dexterity training.

The study sample comprised of 30 patients of which 15 group A and B. The mean age of subjects was 40 to 60 years. Among 30 subjects, 15 were treatment with Task oriented arm ability training and 15 were treated with strength based dexterity training In both Group A and Group B.

The outcome evaluation was carried out using the Nine-Hole Peg Test (NHFT) and the Jebsen–Taylor Hand Function Test (JTHFT), with pre- and post-intervention scores recorded. The paired t-test values were found to be 24.38 and 20.19 for the NHPT, while for the JTHFT the values were 81.48 and 20.59, respectively. The unpaired t test values for NHFT7.639 and JTHFT is 21.5893 respectively.

By analyzing the values of paired and unpaired t test the result showed a statistically significant results comparing with the table value with 0.05 level of significance of both

groups between pretest vs post test results. The result obtained from statistical analysis indicates that there was a statistically significant difference between two groups in showing improvement in Sub acute stroke survivor.

The improving motor function and hand dexterity was seen in all subjects received irrespective of the technique Task oriented Arm Ability Training and strength based dexterity exercise.

By the result alternate hypothesis is accepted and also there is significant difference between-task oriented Arm Ability Training and strength based dexterity exercise for the improvement in motor function and hand dexterity.

By analyzing the mean and standard deviation values the result showed the subjects who received Task oriented Arm Ability Training is found to be more effective in improving motor function and hand dexterity then strength based dexterity exercise. While consideration of improving quality of life in stroke patients lifestyle this study shows there was effective and good improvement for the patient.

A study conducted by Glass J. et al., 2009 on response to strength based dexterity exercise for cerebro vascular patient to improve the strength and dexterity of patient. The result of the study is to supports the present study where the participants have improved in hand function and strength⁷.

This study's outcomes parallel those of the present investigation, showing clear enhancement in participants hand function performance on functional hand assessments..

A study conducted by Frontiers in Neurology, 2018 with 45 stroke patient which it show the task oriented arm ability training which show the measure improvement which the using the tools of nine hole peg test This randomized trial included 45 stroke patients with mild to moderate arm paresis to investigate the effectiveness of Task oriented Arm Ability Training (TOAAT) on manual dexterity⁸.

Upper-limb dexterity was primarily evaluated using the Nine-Hole Peg Test. Participants showed measurable improvement in NHPT scores after a 4-week training period. The study concluded that NHPT is a valid and sensitive test for evaluating improvements in manual dexterity and hand coordination in stroke rehabilitation.

A study conducted by Husted GR et al. (2010) carried out a study on 54 stroke patients to examine the reliability and validity of the Jebsen–Taylor Hand Function Test (JTHFT). The test was administered to evaluate functional hand performance⁹. The JTHFT was administered under controlled conditions to assess functional hand tasks such as writing, lifting small object. And it helps to assess the tracking of post stroke patient.

A study conducted by Mathiowetz V , 1985 with total of 291 healthy adults for normative values for the Nine-Hole Peg Test (NHPT). Each subject was assessed using NHPT to measure finger dexterity NHPT is a highly reliable and valid tool for assessing finger dexterity¹⁰. And it also used in the clinical and rehabilitation mainly for post stroke assessment.

Task oriented exercise produces significant physiological effect in functional task, real life

task & improve the hand independence and TOAAT enhanced neuro plastic changes through increased cortical activation and reorganization in motor-related brain areas. The intervention promoted sensory-motor integration, improved synaptic efficiency, and reduced manipulative patterns.

The study concluded that task-oriented training supports cortical re-mapping, enhances motor control, and improves functional independence through physiological adaptations. TOT reduced learned non-use and improved inter hemispheric balance, contributing to better somatosensory integration. The study concluded that task-oriented training fosters adaptive neuroplasticity, accelerates functional motor recovery, and restores purposeful movement patterns through targeted cortical stimulation.

Strength based dexterity exercise resulting in significant improvements in grip strength and moderate enhancement in upper-limb function. SBDT was shown to activate motor units, increase cortical excitability, and facilitate muscle hypertrophy. It enhanced neural drive to affected muscles, improved proprioceptive input, and promoted reorganization within the primary motor cortex.

Hence from this Task Oriented arm ability training has more functional independence and faster return to functional activity and real life task. Therefore, Task Oriented arm ability training has more effective in improving motor function and real life task.

CONCLUSION

Task-Oriented Arm Ability Training was found to be more effective than Strength-Based Dexterity Exercise in enhancing hand function in stroke survivors

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