

To Study the Effect of Jigsaw Puzzle versus Modified Constraint Induced Movement Therapy on Fine Motor Abilities of Upper Extremities in Individuals with Subacute Stroke - An Experimental Study

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Abstract: ***Introduction:** Stroke is one of the most serious disease affecting thousands of people worldwide. Clinically, a variety of focal deficits are possible, including changes in the level of consciousness and impairments of sensory, motor, cognitive, perceptual, and language functions. To be classified as stroke, neurological deficits persist for at least 24 hours. Motor deficits are characterized by paralysis (hemiplegia) or weakness (hemiparesis), typically on the side of the body opposite the side of the lesion. In the patients with stroke, the hemiplegic upper extremity can be a major cause that is responsible for activities of daily living. JIGSAW PUZZLE is a game puzzle that consists of gripping, holding and manipulating objects using concentration and coordination between eyes and hands. mCIMT is a technique used in physical rehabilitation to treat individuals with decreased upper extremity function. **Aims:** To study the effectiveness of Jigsaw Puzzle versus Modified Constraint Induced Movement Therapy on fine motor abilities of upper extremities in individuals with subacute stroke. **Method:** 30 subacute individuals were taken for the study those who fulfilled the inclusion criteria. They were randomly divided into two groups for the study, Group – A will be given Jigsaw Puzzle training and Group – B will be given mCIMT training. Participants received 1 hour individualized training session, for 4 weeks. An assessment was done prior to starting of intervention and after 4 weeks of intervention including FMA - UA and WMFT. **Result:** The result was analyzed within group and between group. For between group analysis for FMA and WMFT outcomes, result showed significant improvement, p value (<0.005). And within group, results showed significant improvement for Group – B (<0.005). **Conclusion:** This Jigsaw Puzzle and mCIMT training groups are effective in improving fine motor abilities in subacute stroke individuals. Those who were trained under mCIMT training group showed better improvement as compared to Jigsaw Puzzle group.*

Keywords: Stroke, mCIMT, Jigsaw puzzle, fine motor.

1. Introduction

In India, the prevalence of stroke is estimated to be 203 per 1, 00, 000 people and it is projected to rank as the fourth leading cause of disability by the year 2020¹. Even though acute stroke care and intensive rehabilitation have significantly improved, two - thirds of stroke survivors have to cope with persisting neurologic deficits and less than 20% of the patients are able to go back to their normal professional and private life. The most common impairments after stroke are motor deficits, such as hemiparesis of the contralateral limb, affecting more than 80% of stroke survivors and more than 40% of the patients in the chronic stage². Most stroke survivors have upper limb motor impairments, along with difficulties in performing activities of daily living³. Stroke patients experience physical, cognitive, and psychosocial malfunction that had influence on the patients' quality of life and disturb activities of daily living (ADL). Treatment of disability in upper extremity is more difficult than lower extremity. So, proper treatment is needed to prevent permanent disability especially during acute phase of stroke 48 hours post - stroke where the appropriate treatment can affect 33% of patient's recovery within 3 months⁴. Importantly, loss of arm function occurs in up to 85% of stroke survivors, with a significant long - term impact on Activities of Daily Living (ADL), leisure activities, and work.⁵Literature shows that only a small portion of stroke patients with upper limb motor impairment (12%) is able to regain full function, while the majority requires constant care from family or social services⁶. It is

estimated that 55–75% of post - stroke patients experience upper limb (UL) functional limitation. This UL functional impairment results in restrictions on functional tasks and daily activities, and therefore, leads to decreased health related quality of life. A reported 50–60% of patients experience variable degrees of motor function limitation following stroke, even when undergoing traditional rehabilitation programs⁵. Distal arm function is essential for the execution of activities of daily living (e. g. eating, dressing) and is often severely impaired after stroke, with low probability of regaining its full functional use. No motor function recovery of the hands six months after the onset of a stroke, indicates a poor prognosis for hand function. Thus, efforts to improve hand and finger strength should be emphasized in rehabilitation programs⁷. Although stroke survivors often regain most of the functional reach and grasp capabilities in their upper extremities, the recovery of the pinch skill remains incomplete in the majority of patient. Pinch movements represent an important upper - extremity motor skill, and impaired pinch substantially affects a persons' dexterity after a stroke⁸. A fine motor impairment that often occurs following stroke needs proper therapeutic intervention to minimize the patient's dependency in performing daily activities. Many studies have been conducted to see the effect of mCIMT, Jigsaw puzzle etc. on fine motor abilities in post stroke patients.

Also, there are fewer literature's available to study the effectiveness of Jigsaw puzzle versus mCIMT on fine motor abilities of upper extremities in individuals with subacute

Volume 13 Issue 2, February 2024

Fully Refereed | Open Access | Double Blind Peer Reviewed Journal

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stroke. So, this research intends to contribute in reaching a final conclusion about superiority of either intervention so that it can be used to treat fine motor abilities in subacute stroke patients.

Aim:

To study the effectiveness of Jigsaw Puzzle versus Modified Constraint Induced Movement Therapy on fine motor abilities of upper extremities in individuals with subacute stroke.

Objectives:

- To evaluate the effectiveness of Jigsaw Puzzle on fine motor abilities of upper extremities in individuals with subacute stroke.
- To evaluate the effectiveness of mCIMT on fine motor abilities of upper extremities in individuals with subacute stroke.
- To study the effect of Jigsaw Puzzle versus mCIMT on fine motor of upper extremities in individuals with subacute stroke.

2. Materials and Methodology**Ethical Approval**

The study was approved by Institutional Ethics Committee.

Study Design

An Experimental Study.

Sampling Technique

Simple Random Sampling.

Study Duration

Study was conducted for 6 months. Participants were treated for 4 weeks, 5 days per week and once a day.

Source of Data

Shree Swaminarayan Physiotherapy College OPD, Ranip, Ahmedabad.
Apang Manav Mandal, Ahmedabad.
Community in Ahmedabad.

Sample size

N=30.

Gender: Both males and females.

- 1) Group A: 15 patients (Jigsaw puzzle and conventional physiotherapy).
- 2) Group B: 15 patients (mCIMT and conventional physiotherapy).

Inclusion Criteria⁷:

Willing to participate.

Age: 34 - 60 years.

Sex: Both males and females.

Duration: 2 - 16 weeks after stroke.

First ever ischemic or hemorrhagic stroke.

Considerable nonuse of the affected upper extremity. (Amount of use <2.5 on the Motor Activity Log Scale).

Able to actively extend at least 10 degrees at the Metacarpophalangeal joint and Interphalangeal joint and 20 degrees of the wrist.

No excessive spasticity in any joint of the affected upper extremity (Modified Ashworth Scale <2 in any muscles).

Subject who can maintain a sitting position for more than 30 minutes.

Ability to stand for at least 2 minutes without arm support.

Exclusion Criteria⁷:

- Subject with cognitive deficit (MMSE score <24/30).
- Subject who has undergone treatment of upper limb spasticity and surgery (e. g. Botulinum toxin).
- Subject having preexisting neuromuscular diseases.
- Subject with fixed contractures in upper extremity (maximum passive movement less than 10 degree).
- Visual analog scale for pain >/4 at the affected arm.

Materials used for this study:

Consent form.

Assessment form.

Pen.

Paper.

Writing pad.

Motor activity log scale sheet.

Modified Ashworth scale sheet.

Mini mental scale examination sheet.

Visual analog scale sheet.

Fugl - Meyer assessment sheet.

Wolf motor function sheet.

Goniometer.

Jigsaw puzzle.

Mitt glove.

Chair.

Spoon.

Glass.

Hammer.

Piece of paper.

Pencil.

Small can.

Tennis ball.

Stopwatch.

Box - 10 inches in height.

Weight cuff.

Screening Tests**Motor Activity Log Scale⁹:**

Motor activity log was used to assess the level of motor arm function. Motor activity log with observation checklist consists of 15 items to examine the amount and how well patients have used their affected arm.

Interpretation:

Scale ranges from 0 (never used) to 5 (same as pre - stroke).

The total score is 150 points.

Mini - Mental State Examination (Mmse)⁹:

The Mini - Mental State Examination (MMSE) is the most commonly administered psychometric screening assessment of cognitive functioning. It includes test for orientation, attention, memory, language and visual - spatial skills.

The MMSE scale is scored on a scale of 0 - 30.

Interpretation:

Severe cognitive component - 0 - 17.

Mild cognitive component: 18 - 23.

No cognitive component: 24 - 30.

Goniometer¹⁰:

Goniometric measurements are to quantify baseline limitations of motion, decide on appropriate therapeutic interventions, and document the effectiveness of these interventions.

Modified Ashworth Scale¹¹:

The MAS is the most universally accepted clinical tool used to measure the increase of muscle tone. It is a velocity - dependent increase in muscle stretch reflexes associated with increased muscle tone as a component of upper motor neuron syndrome. Bohannon and Smith modified the Ashworth scale by adding 1+ to the scale to increase sensitivity.

Outcome Measures:

Fugl–Meyer Assessment of Upper Extremity. (FMA - UA)¹²:

The Fugl – Meyer assessment (FMA), which assesses the upper extremity to reveal and measure the improvement of motor function after stroke. It is considered as gold standard and is the only impairment level measure recommended for stroke trials. The Fugal - Meyer Assessment of upper extremity (FMA - UE) is a 66 - point UE section of the FMA - UE, which assesses several impairment dimensions by using a 3 - point ordinal scale (0: cannot perform; 1: can perform partially; 2: can perform fully). The FMA was used

to determine body function and structure changes of the arm and trunk, respectively. The FMAUE examines reflex activity, voluntary movements within, partially out and independent of synergies. The scale includes 33 items divided into 4 subscales: shoulder/elbow (A, 18 items), wrist (B, 5 items), hand (C, 7 items) and coordination/ speed (D, 3 items).

Interpretation:

- a) UPPER EXTREMITY - /36.
- b) WRIST - /10.
- c) HAND - /14.
- d) COORDINATION /SPEED - /6.

Wolf Motor Function Test¹³:

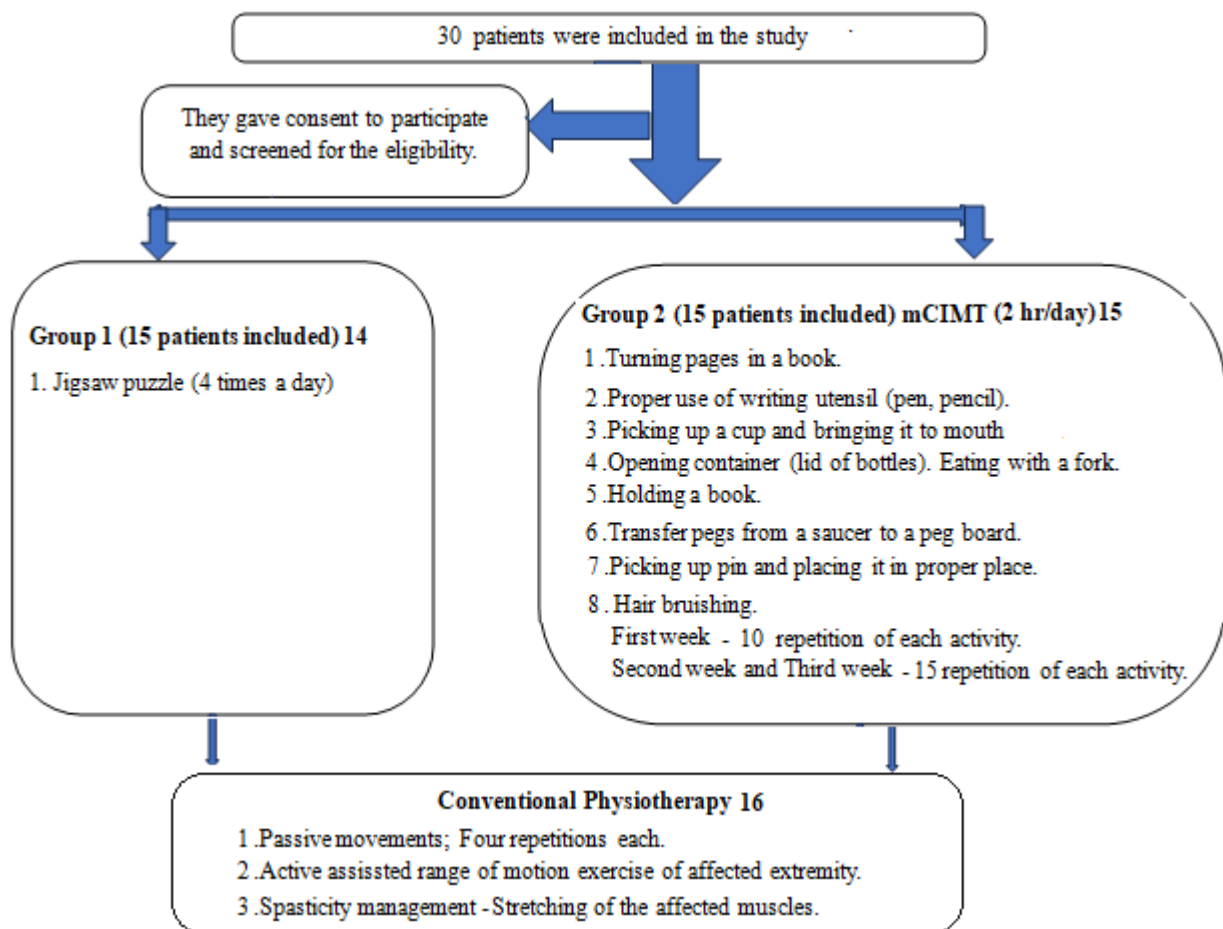
The WMFT is a 17 - item test of arm motor function. It consists of 15 movement tasks and 2 strength measures. Each movement task was filmed, and the time to complete a task was determined by analyzing it. The median time for all 15 tasks was used for analysis. In addition, the movement quality was rated using a 6 - point functional ability scale (0 = does not attempt; 5 = normal movement). The maximum time to complete a task was 120 s. If a trial was incomplete, the result was recorded as 121 s (WMFT).

Interpretation:

(WMFT - FA) is scored on a 6 - point functional ability scale.

0 = does not attempt, 5 = normal movement.

3. Procedure



4. Results

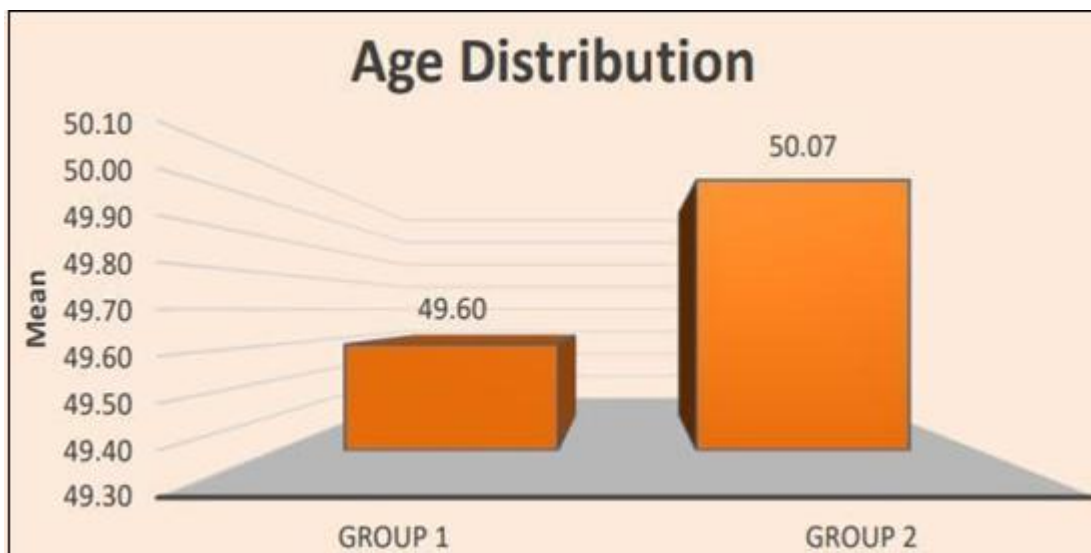
The present study was conducted to study the effect of Jigsaw puzzle versus mCIMT on fine motor abilities of upper extremities in individuals with sub - acute stroke. Total 30 sub - acute patients were included in the study out of which 15 patients were the part of Jigsaw Puzzle group who received jigsaw puzzle and conventional physiotherapy and other group included 15 patients were part of the mCIMT and conventional physiotherapy. Data of 30 patients were analyzed using statistical package for social science

version 28 (SPSS v.28) and Microsoft excel 2010. Before applying statistical tests, data was screened for normal distribution using Shapiro - Wilk test.

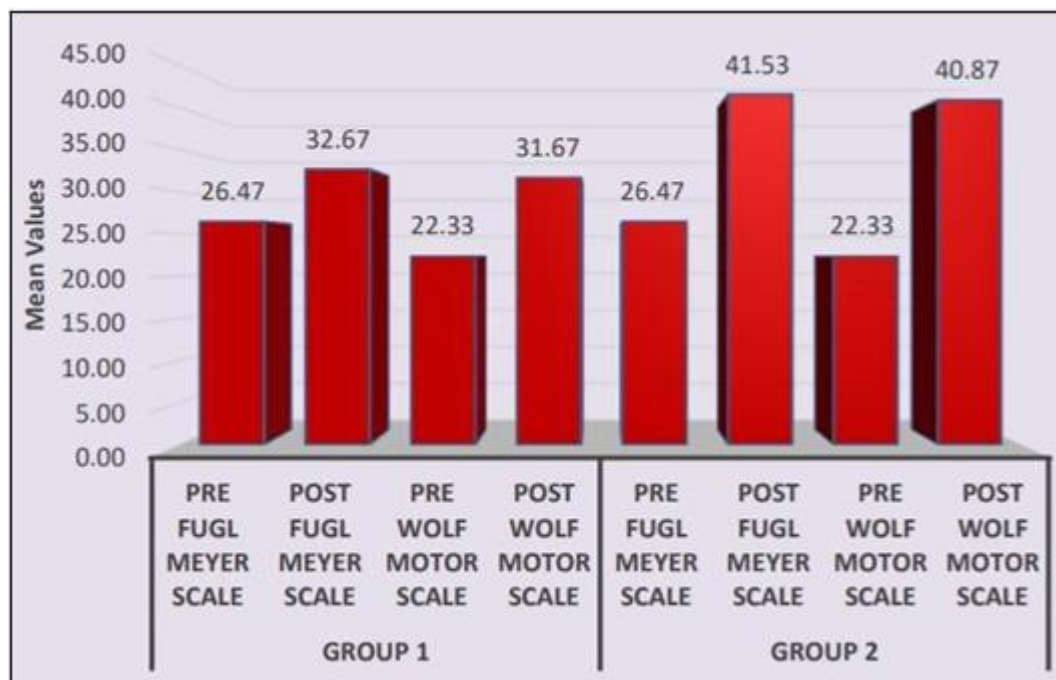
Age Distribution of the participants

Group	No.	Mean	SD
Group A	15	49.60	5.32
Group B	15	50.07	8.04

Age Distribution among both groups



Mean Score of Pre and Post Training in both groups



Graph show the difference in Fugl –Meyer assessment scale and Wolf motor function scale within the groups. To analyze the difference in within group after 4 weeks of intervention in both the groups paired t test was applied. Results showed that in Group A in Wolf –Motor function test $p < 0.001$ and in Group B in Fugl - Meyer assessment scale and Wolf – Motor function scale $p < 0.001$ showing significant difference in

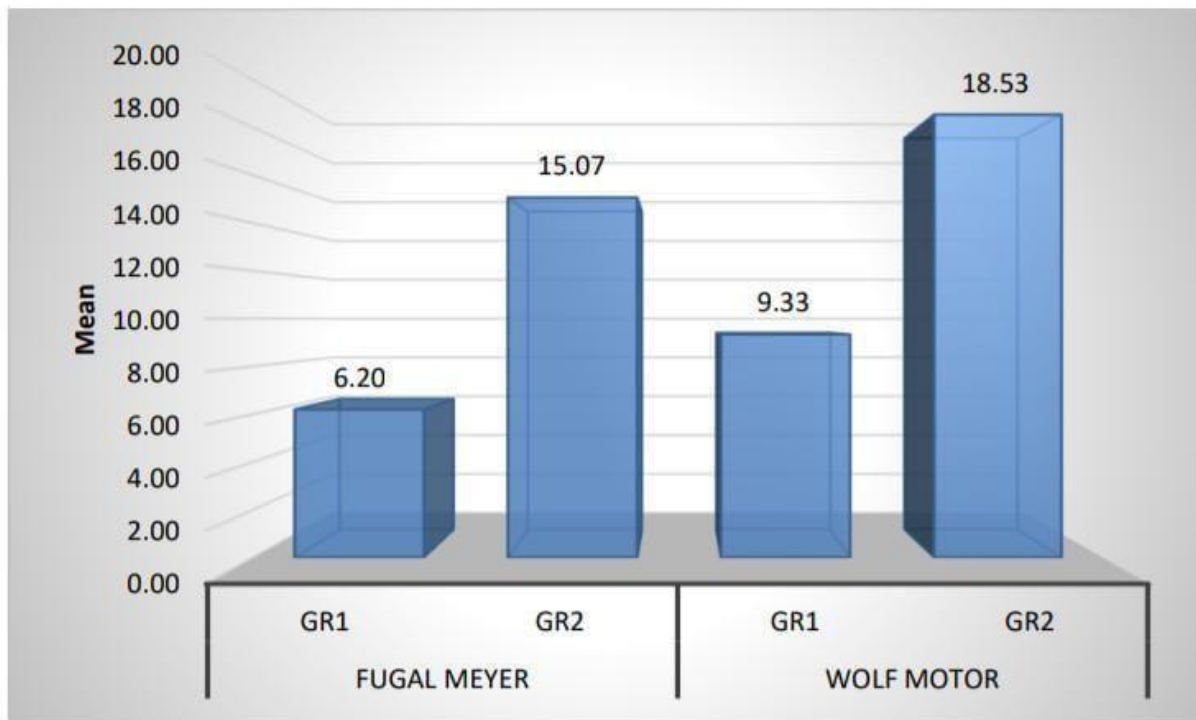
both outcomes as compared to baseline in both the groups. ($p < 0.005$).

In the present study the mean of pre intervention FMA - UA of individuals in Group – A is 26.47 and pre intervention of WMF scale is 22.33 and in Group – B the mean of pre intervention of FMA - UA is 26.47 and pre intervention of

WMF scale is 22.33. Whereas the mean of post intervention FMA - UA of individuals in Group - A is 32.67 and pre intervention of WMF scale is 31.67 and in Group- B the mean of pre intervention of FMA - UA is 41.53 and pre intervention of WMF scale is 40.87. The p value for FMA -

UA is 0.021, WMF SCALE is <0.001 in Group - 1. The p value for FMA - UA is, 0.001, WMFT scale is <0.001 in Group - 2.

Shows between Group Analysis



Graph shows between group analyses. To analyze the difference in between group values after 4 weeks if intervention Unpaired t test was applied. Results showed that in Fugl -Meyer Scale - Upper Extremity p value is 0.001 and in Wolf - Motor Function Scale $p < 0.001$ as compared to baseline in both the groups.

5. Discussion

This study showed that activities given to the participants in the mCIMT group were much more difficult than the tasks given to the participants in the Jigsaw Puzzle group. As a result, the fine motor abilities of the participants in the mCIMT group were continually challenged. Further research is necessary to understand this finding¹⁷. It is believed that stroke subjects express greater motor disability on their more affected sides than that which actually exists. Over time, this movement suppression or learned non - use becomes so habitual that subjects use the less affected side for most ADLs¹⁸. Before intervention, the individuals occasionally used their more affected arms for ADL tasks. The substantial improvements of FMA - UA and WMF scale after treatment showed that the patients were more willing to engage their affected upper extremities and produced enhanced movement. Immediately after the intervention subjects in both groups tried to use their more affected limbs in daily activities more than before. These discrepancies were greater and significant in mCIMT groups.

A study done by Kusnanto et al., concluded that Jigsaw puzzle game administration as additional rehabilitation in upper extremity fine motor to minimize the occurrence of

contractures and motor disorders in patients with ischemic stroke¹⁹. On contrary, in this study, Group A that is trained under Jigsaw puzzle group showed no statistical improvement in fine motor abilities.

A study done by Manting Cao et al., stated that mCIMT improved the function of damaged limbs by countering compensation strategies⁹. On contrary, in this study, Group B that is trained under mCIMT training shows statistical improvement in fine motor abilities.

6. Conclusion

It can be concluded that mCIMT training is more effective in improving fine motor in subacute individuals as compared to Jigsaw Puzzle training as indicated by significant difference in between group comparison of WMFT and FMA - UA.

7. Limitation of the Study

- 1) Although this study provided some interesting finding regarding the mCIMT training on fine motor functions, a number of unanswered questions remain.
- 2) First, the small sample size in the study may have limited the statistical power to detect the mCIMT effect on fine motor abilities.
- 3) Second, limitation is the fact that the subjects in this study were only subacute stroke affected.
- 4) Third, limitation is one of the important issues in training studies is whether the benefit of training is retained several months after training has ended.

8. Future Recommendations

- 1) Further study with larger population N.
- 2) Further studies are needed to examine long term effect of training.
- 3) Further studies can be using other scale to measure fine motor disabilities.
- 4) Further studies can be done on different type of population with having neurological condition in which they have fine motor disabilities.

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