A Study to Compare The Effects of Unilateral Arm Training Versus Bilateral Arm Training in Post-Stroke Patients with Motor Impairment of Hand

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Abstract

Background of The Study: Motor function deficits are life changing and devastating consequences of stroke[9]. It affects the patient's mobility, daily life activities, participation in society. The most common manifestation of upper extremity motor impairment includes muscle weakness, changes in the tone and impaired motor control. Both unilateral and bilateral arm training found to be an effective strategy for the recovery of upper limb motor function after stroke.

Aim of The Study: The aim of the study is to compare the effects of unilateral arm training versus bilateral arm training in post-stroke patients with motor impairment of hand.

Objective Of The Study:

Ø To assess the effects of unilateral arm training in post-stroke patients with motor impairment of hand.

Ø To assess the effects of bilateral arm training in post-stroke patients with motor impairment of hand.

Ø To compare the effects of unilateral arm training versus bilateral arm training in poststroke patients with motor impairment of hand.

Method: 30 post stroke patients were recruited for the study based on the inclusion criteria and were divided into group A and group B consisting of 15 subjects each. Group A were treated with unilateral arm training and Group-B were treated with bilateral arm training. Pretest and posttest scores assessment was done.

Result: It showed significant improvement in functional ability of the upper limb as measured by ARAT and CAHAI-13. The p value of both the group is <0.05. This study showed that Group-B subjects who were treated with Bilateral arm training proved to be more effective than Group-A who were treated with unilateral arm training in post stroke patients with motor impairment of hand.

Conclusion: This study showed that bilateral arm training is more effective than unilateral arm training in improving the overall motor function of hand in post stroke individuals.

Key WordS*: Post-stroke, unilateral, bilateral arm training, chedoke arm and hand activity inventory.*

Introduction

Stroke represents a clinical syndrome rather than a specific disease. Stroke is a common, serious, and disabling global health-care problem, and rehabilitation is a major part of patient Care.[1] The World Health Organization (WHO) defined stroke as "rapidly developed clinical signs of focal (or global) disturbances of cerebral function, lasting, more than 24 hours or leading to death, with no apparent cause other than of a vascular origin[2]. About 1.2% of deaths in India are due to stroke, the incidence is 105 per 1 lakh population in

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urban community and 262 per lakh in rural community[3]. Stroke is the leading cause for long-term disability[4]. Approximately, 20% of stroke are due to cerebral haemorrhage. The remaining 80% are due to ischemic stroke which is sub divided into: large artery disease, cardio-embolism and small vessel diseases. Common problems after stroke are impaired motor functions including balance, trunk control and gait disturbances.[6] In stroke patients, it is known that the initiation of the trunk muscles is delayed, because the muscles involved in reach arm are activated earlier than the trunk muscles.[5] Impaired trunk balance and increased risk of falling toward the paretic side is found to be significantly correlated with locomotor function, functional abilities and length of stay inpatient rehabilitation facilities.[7]

Unilateral arm training is a common rehabilitative strategy used in patients with stroke which includes repetitive task-related training, which is focused on rehabilitating the affected arm. Bilateral arm training has shown efficacy, not only with stroke survivors with mild impairments, but also for individuals with moderate and severe motor impairments[8]. Bilateral arm training incorporates task oriented motor relearning strategies including intense practice, intrinsic feedback, bi-manual coordination and goal-focused movements that improve upper extremity function[15]. A basic assumption of bilateral arm training is that the symmetrical bilateral movements activate similar neural networks in both hemispheres when homologous muscles are simultaneously activated[11], which been established in stroke that even if one limb is activated with moderate force, it can produce motor overflow to the other limb such as both arms are engaged in the same or opposite muscle contractions, although at different levels of force [12,13]. Both unilateral arm training and bilateral though representing conceptually contracting approaches, serves an ultimate goal and is found to be and effective strategies for the recovery of upper limb motor function after stroke[10]. These arm training exercises were performed on trunk and specifically aimed at improving trunk performance and balance.[14]

Aim of The Study

The aim of the study is to compare the effects of unilateral arm training versus bilateral arm training in post-stroke patients with motor impairment of hand.

Objective of the Study

The objectives of the study are as follows:

Ø To assess the effects of unilateral arm training in post-stroke patients with motor impairment of hand.

Ø To assess the effects of bilateral arm training in post-stroke patients with motor impairment of hand.

Ø To compare the effects of unilateral arm training versus bilateral arm training in poststroke patients with motor impairment of hand.

Research Design and Methodology:

An experimental study design was conducted with 30 patients who fulfilled the inclusion criteria. The samples were divided into group A and Group B consisting of 15 samples each.

Inclusion Criteria:

Ø Hemi-paretic patients with 40-70 years of age

Ø Stroke at least six months to three years prior

Ø No significant range of motion limitations in hemi-paretic upper limb

Ø Mini-mental status examination score >24

Ø Voluntary movement control to perform the task

Exclusion Criteria:

Ø Perceptual disorders

Ø Recurrent stroke

Ø Symptomatic cardiac failure

Ø Patients who are not able to follow the commands

Outcome Measures:

CHEDOKE ARM AND HAND ACTIVITY INVENTORY (CAHAI-13)[7]

The CAHAI-13 is a performance test using 13 functional items which evaluates the functional ability of the paretic arm and hand to perform tasks

ACTION REACH ARM TEST[7]

The action research arm test is a 19 item measure divided into four sub-types (grasp, grip, pinch, gross arm movement). This test is used to assess the upper limb functioning using observational method.

Procedure:

In this experimental study, 30 post stroke patients who have met the inclusion criteria were selected for this study, and were grouped into two groups: Group-A and Group-B, consisting of 15 subjects each. Group-A patients were treated with unilateral arm training which includes six task-specific activities performed with the affected arm. Each activity was repeated for 30 times, progression is done once in two weeks as 30 repetitions in the first two weeks with 2 sets, 45 repetitions in the next two weeks with 3 sets, 2-5 minutes of rest time was provided between each task. Group-B patients were treated with Bilateral arm training which includes six task-specific activities which were performed with both the hands simultaneously. Each activity is repeated for 30 times, progression is done once in two weeks as 30 repetitions in the first two week, 45 repetitions in the next two weeks with 3 sets. 2-5 minutes of rest time was provided between each task. Duration of the treatment is 4 weeks. Pre and post-test assessment was done by means of CAHAI-13 and ARAT.

Intervention:

1.UNILATERAL ARM TRAINING:

Ø Wiping the table

Ø Reaching and placing objects

Ø Moving an object from table to shelf with affected arm

Ø Elbow extension during horizontal reach

Ø Grasp an empty glass, take it to mouth and return to starting position

Ø Cup stacking

2.BILATERAL ARM TRAINING:

Ø Wiping the table with both hands

Ø Reaching and placing objects with both hands

Ø Moving an object from table to shelf with both arms

Ø Bilateral Elbow extension during horizontal reach

Ø Grasp an empty glass, take it to mouth and return to starting position with both hands

Ø Cup stacking with both hands

DATA ANALYSIS:

The collected pre and post test data were analysed. For the descriptive statistics, the mean and standard deviation were calculated. The results were tabulated.

- Intra Group Analysis – Paired Samples t-test
- Inter Group Analysis – Independent Samples t-test

Intra-Group Analysis - Treatment A

Null Hypothesis, H_0: $\mu_d = 0$, Alternate Hypothesis, H_1: $\mu_d > 0$, (μ_d = mean difference between Pre and Post-test scores)

Level of significance, $\alpha = 0.05$, Test to be applied: Paired Sample t-test

Testing the effect of Treatment A in increasing CAHAI Score

H_0: There is no significant effect of Treatment A in increasing CAHAI score

H_1: There is significant effect of Treatment A in

increasing CAHAI score

The above hypothesis is tested by the use of Paired t-test:

Output of Paired t-test:

TABLE :1 OUTPUT OF PAIRED T-TEST – GROUP-A(CAHAI)

t-Test: Paired Two Sample for Means		Pre	Post
Mean		31.73	33.47
SD		6.57	6.09
Variance		43.21	37.12
Observations		15.00	15.00
Pearson Correlation		0.99	
Hypothesized mean difference		0.00	
df		14.00	
t Stat		6.98	
P(T<=t) one-tail		0.000	
t Critical one-tail		1.76	
P(T<=t) two-tail		0.000	
t Critical two-tail		2.14	

Result: Test Statistic: t = 6.98, p value = 0.000 < 0.05

Testing the effect of Treatment A in increasing ARAT Score

H_0: There is no significant effect of Treatment A in increasing ARAT score

H_1: There is significant effect of Treatment A in increasing ARAT score

The above hypothesis is tested by the use of Paired t-test

Output of Paired t-test:

TABLE 2: OUTPUT OF PAIRED T-TEST GROUP-A(ARAT)

t-Test: Paired Two Sample for Means		Pre	Post
Mean		39.87	41.47
SD		4.22	4.52
Variance		17.84	20.41
Observations		15.00	15.00
Pearson Correlation		0.99	
Hypothesized mean difference	e	0.00	
df		14.00	
t Stat		8.41	
P(T<=t) one-tail		0.000	
t Critical one-tail		1.76	
P(T<=t) two-tail		0.000	
t Critical two-tail		2.14	

Result

Test Statistic: t = 8.41, P-value = 0.000 < 0.05

Intra-Group Analysis – Treatment B

Testing the effect of Treatment B in increasing CAHAI Score

H_0: There is no significant effect of Treatment B in increasing CAHAI score

H_1: There is significant effect of Treatment B in increasing CAHAI score

The above hypothesis is tested by the use of Paired t-test

Output of Paired t-test:

TABLE 3: OUTPUT OF PAIRED T-TEST- GROUP-B (CAHAI)

t-Test: Paired Two Sample for Means	**Pre**	*Post*
Mean	35.67	42.00
SD	3.29	3.12
Variance	10.81	9.71
Observations	15.00	15.00
Pearson Correlation	0.91	
Hypothesized Mean Difference	0.00	
df	14.00	
t Stat	17.55	
P(T<=t) one-tail	0.000	
t Critical one-tail	1.76	
P(T<=t) two-tail	0.000	
t Critical two-tail	2.14	

Result

Test Statistic: t = 17.55, P-value = 0.000 < 0.05

Testing the effect of Treatment B in increasing ARAT Score

$\mathbf{H_0}$: There is no significant effect of Treatment B in increasing ARAT score

H_1: There is significant effect of Treatment B in increasing ARAT score

The above hypothesis is tested by the use of Paired t-test

Output of Paired t-test:

TABLE 4: OUTPUT OF PAIRED T-TEST- GROUP-B(ARAT)

t-Test: Paired Two Sample for Means	**Pre**	**Post**
Mean	37.93	42.13
SD	4.32	4.00
Variance	18.64	15.98

Cont... **TABLE 4: OUTPUT OF PAIRED T-TEST- GROUP-B(ARAT)**

Observations	15.00	15.00
Pearson Correlation	0.97	
Hypothesized mean difference	0.00	
df	14.00	
t Stat	16.04	
P(T<=t) one-tail	0.000	
t Critical one-tail	1.76	
P(T<=t) two-tail	0.000	
t Critical two-tail	2.14	

Result:Test Statistic: t = 16.04, P-value = 0.000 < 0.05

Inter-Group Analysis

Comparing the effect of Treatment A and B in terms of CAHAI

H_0: There is no significant difference between Treatments A and B in terms of improvement in CAHAI.

H_1: There is significant difference between Treatments A and B in terms of improvement in CAHAI.

The above hypothesis is tested by the use of **Independent Samples t-test.**

TABLE 5: OUTPUT OF INDEPENDENT SAMPLES T-TEST

t-Test: Two-Sample Assuming Equal Variances		**A**	**B**
Mean		1.73	6.33
SD		0.96	1.40
Variance		0.92	1.95
Observations		15.00	15.00
Pooled Variance		1.44	
Hypothesized mean difference		0.00	
df		28.00	
t Stat		10.50	
P(T<=t) one-tail		0.000	
t Critical one-tail		1.70	
P(T<=t) two-tail		0.000	

t Critical two-tail		2.05	

Result

Test Statistic: t = 10.50, P-value = 0.000 < 0.05

Comparing the effect of Treatment A and B in terms of change in ARAT

H_0: There is no significant difference between Treatments A and B in terms of improvement in ARAT

H_1: There is significant difference between Treatments A and B in terms of improvement in ARAT

The above hypothesis is tested by the use of **Independent Samples t-test.**

t-Test: Two-Sample Assuming Equal Variances		**A**	**B**
Mean		1.60	4.20
SD		0.74	1.01
Variance		0.54	1.03
Observations		15.00	15.00
Pooled Variance		0.79	
Hypothesized mean difference		0.00	
df		28.00	
t Stat		8.03	
P(T<=t) one-tail		0.000	
t Critical one-tail		1.70	
P(T<=t) two-tail		0.000	
t Critical two-tail		2.05	

Result

Test Statistic: t = 8.03, P-value = 0.000 < 0.05

Since the p-value (0.000) of the test statistic is less than 0.05, we reject the null hypothesis at 5% level of significance (t = 8.03, p < 0.05). In addition, the mean improvement in ARAT score by Treatment B (4.20) is more than that of Treatment A (1.60). Hence, it is concluded that Treatment B is effective than Treatment A in increasing ARAT score.

Discussion

The main aim of the study is to assess the effects of unilateral arm training and bilateral arm training in improving motor function of the hand in post stroke patients with motor impairment of hand. The study included 73% of male and 27% of women in Group-A, and 80% of male and 20% of women in Group-B who have satisfied the inclusion and exclusion criteria. The oldest patient in Group-A is patient-1 (male aged

70), and the youngest patient is patient-13 (male aged 48). The oldest patient in Group-B is patient-12 (male aged 70), and the youngest is patient-8 (male aged 49). There is not much significant difference between the improvement in the outcome values between these two groups to prove the influence of age on functional recovery, which lead to the hypothesis that age has insignificant or less significant impact on the functional recovery of the patients. The inability to perform the activities of daily living is the most common deficits that results due to hemiparesis[10], both the Groups who underwent the therapy have improved upper limb functioning ability as measured by ARAT and functional ability as measured by CAHAI and are able to perform the functional activities better. The usage of the affected arm during the activities has been improved in both treatment groups. However, the usage of the affected arm is higher in bilateral arm training group than the unilateral group in the amount of usage of the affected extremity in bilateral extremity training group. They believed that a strong coupling exits between the arms when they act together which could have resulted in better amount of use of affected arm in bilateral training group than the unilateral training group.

Conclusion

The analysis clearly showed that both the treatments (A and B) are effective in terms of improvement in CAHAI and ARAT. However, the inter-group analysis showed that Treatment B is more effective than Treatment A in terms of improvement in CAHAI and ARAT.

Conflict of Interest : Nil

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