Journal Homepage: - www.journalijar.com
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)
Article DOI: 10.21474/IJAR01/7028
DOI URL: http://dx.doi.org/10.21474/IJAR01/7028

RESEARCH ARTICLE

EFFECT OF INTER-MANUAL TRAINING OF HAND ON SKILL TRANSFER IN CHILDHOOD STROKE.

[*]Raj Kumar Sharma[1], Jyoti Sharma[1] and Shubham Singh[2].
1. Assistant Professor, Noida International University, Greater Noida.
2. Trident College of Education, Meerut.

Manuscript Info

Manuscript History

Received: 04 March 2018
Final Accepted: 06 April 2018
Published: May 2018

Keywords:-
Cerebro-vascular disorder; Inter-manual Training; Stroke; Spoon task; Pegboard.

Abstract

Cerebro-vascular disorders are among the top 10 causes of death in children, with rates highest in the first year of life. Childhood stroke is the weakness of one side of the body due to stroke during 3 months to 12 years of age. Learning or re-learning tasks are significant elements of the rehabilitation process for a child with a neurological or orthopedic impairment. Although many studies have been conducted to see the effects of ipsilateral hand training on the contralateral hand using inter-manual transfer in normal population but there is a dearth of studies to see the effect on inter-manual training of hand on skill transfer in childhood stroke patients. Hence, present research was carried out to study the effect of inter-manual transfer training of hand on skill transfer in childhood stroke in terms of motor learning.

Introduction:-

Cerebro-vascular disorders are among the top 10 causes of death in children, with rates highest in the first year of life. The mortality rate in 1998 attributable to stroke was 7.8 / 100,000 in children of O to 1 year of age, and is higher in males than females. Stroke mortality in children has remained the same over the last 40 years.

Childhood stroke is the weakness of one side of the body due to stroke during 3 months to 12 years of age. Occlusive vascular disease is slightly more common (55%) than intra cranial hemorrhage (45%) for causing stroke in children. Childhood stroke may result in an incomplete active functional inability to perform skillful activities with hand. As a result, childhood stroke patients are dependent on others for their ADL (Bock and Schneider, 2002).

Among physical impairments due to stroke, loss of hand function has a profound effect on individual's life. One of the major purposes of the rehabilitative process is to help patients achieve as high a level of functional independence as possible within the limits of their particular impairments. Consequently, one of the desired outcomes of many physical therapy intervention strategies is either to restore or to improve a patient's hand function.

Learning or re-learning tasks are significant elements of the rehabilitation process for a child with a neurological or orthopedic impairment. Physical therapists continue to search for a better understanding and application to rehabilitation of the phenomenon of motor teaming. It has long been documented that an un-practiced hand can be helped to acquire a motor task if that motor task has been practiced and acquired previously by the other hand. This is called Inter-manual transfer or cross transfer. Research has shown that the effects of inter-manual transfer can be seen in both the improvement of strength and the acquisition of motor skills of the contra-lateral extremity and may

Corresponding Author:- Raj Kumar Sharma.
Address:- Assistant Professor, Noida International University, Greater Noida.

provide insight into more efficient treatment strategies for population with unilateral impairments or immobilization (Camus et al., 2009).

Although many studies have been conducted to see the effects of ipsilateral hand training on the contralateral hand using inter-manual transfer in normal population but there is a dearth of studies to see the effect on inter-manual training of hand on skill transfer in childhood stroke patients. Hence, present research was carried out to study the effect of inter-manual transfer training of hand on skill transfer in childhood stroke in terms of motor learning.

Material And Methods:-

It is a Quasi experimental study carried out on 30 patients in the Department of Physiotherapy, Trident College of Education, Meerut (U.P). Patients were enrolled based on the following inclusion criteria:

1. Childhood stroke patients with left side hemiparesis.
2. Age group 6-12 years.
3. Strongly right handed.
4. Spasticity 1^+ or $<1^+$ grade modified Ashworth scale.
5. Oriented, able to comprehend.
6. Able to perform and complete the task.
7. Normal I.Q.

Exclusion criteria:-

1. Hemiplegia due to cerebral palsy.
2. Spasticity grade modified Ashworth scale.
3. Contracture and deformity of upper and lower limb.
4. Mentally retarded children.
5. Associated orthopedic and neurological disorder, which may interfere with the performance of the task.

Procedure:-

Participants were explained about the purpose and the nature of the study and informed consent was obtained from those willing to participate. Demographic details and the history like name, age, gender, side of paresis, etiology, sensory examination, able to comprehend and able to complete the task, were obtained.

Protocol for inter-manual training:-

A total of 30 subjects were selected and they were equally divided into two groups:
I. Group 1- experimental group (15 subjects); inter-manual training was given in this group.
2. Group 2 - control group (15 subjects); **NO** inter-manual training was given in this group.
The following activities were taken for inter-manual training in experimental group.

1. Spoon activity (picking up cheese chunks from the food tray with spoon and placing them in a plate one by one).
2. Square pegboard (picking up and placing pegs in holes of pegboard one by one).

Inter-manual training to right hand was given to all subjects in experimental group for 4 weeks daily for 30 minutes duration (15 minutes for each activity). 10 minutes rest period was incorporated between the activities. Therefore, a total of 40 minutes session was taken for giving inter-manual training in experimental group.

Outcome measures:-

1. Time taken to complete the task.
2. Number of errors during task performance.
3. Number of pegs placed in purdue pegboard within 30 seconds.

Data collection:-

Task related instructions were given to the subject that is to perform the task smoothly and ad fast as possible. Then, time taken to complete the task with left hand was recorded by using digital stopwatch and number of errors during the task performance with left hand was counted that is how many cheese chunks dropped outside from the plate and how many pegs fell outside from the square pegboard. Pre-test and post-test readings of left hand were taken both in experimental and control groups.

Left hand subtest of purdue pegboard was used to check dexterity in the left hand in both groups. In this, subjects were asked to place as many pegs as possible in purdue pegboard within 30 seconds. Pre-test and post-test readings of left hand were taken both in control and experimental groups.

Statistical Analysis:-
Statistics were performed using the STATA 7.0 and SPSS 14.0 software's. Paired sample t-test within group was used to compare the mean difference of all dependent variables. Significant level was defined at $p<0.05$ and 95% confidence interval. Unpaired t-test with equal variances was performed to analyze the pre-test and post-test data between groups.

Results:-

The study consisted of two groups. Each group consisted of 15 subjects. Parametric test was used to compare the left hand performance, in terms of time taken, maximum number of errors and number of pegs placed in purdue pegboard during spoon and square pegboard activity before and after the inter-manual training to right hand. Pre and post data of left hand performance were analyzed with paired t - test within groups and unpaired t - test was used to compare pre and post data between groups. The significant level of the test was set at p<O.05.

1. Comparison of average time taken to complete the tasks with left hand before and after training to right hand in experimental group as shown in table below.

Time (Seconds)	Mean	Standard Deviation	t value	p value
Pre test spoon activity	232.07	5.431	56.073	0.001
Post test spoon activity	155.07	2.963		
Pre test square pegboard activity	233.53	4.794	46.936	0.001
Post test square pegboard activity	148.87	4.824		

The result showed statistically significant difference ***p<O.05.***

2. Comparison of maximum number of errors during performance of the tasks with left hand before and after training to right hand
   Spoon task:
   Pre-test mean = 8.47, standard deviation = 0.834
   Post-test mean = 2.80, standard deviation = 0.862
   Square pegboard task:
   Pre-test mean = 16.47. standard deviation = 0.990
   Post-test mean = 5.40. standard deviation= 1. 242
   Both the above results showed statistically significant difference ***p<0. 05***
3. Comparison of maximum number of pegs place in Purdue pegboard within 30 seconds with left hand
   Pre-test mean = 5.67. standard deviation = 1. 175
   Post-test mean = 15.03, standard deviation = 2. 282
   The result showed statistically significant difference ***p<0.05***
4. Comparison of average time taken to complete the tasks with left hand before and after training to right hand in control group as shown in table.

Time (Seconds)	Mean	Standard Deviation	t value	p value
Pre test spoon activity	233.40	5.501	-0.823	0.424
Post test spoon activity	233.60	5.514		
Pre test square pegboard activity	233.80	4.507	0.000	1.000
Post test square pegboard activity	233.80	4.799		

The results were statistically not significant.

5. Comparison of pre-test and post-test data of maximum number of errors done during performance of the tasks with left hand.

Spoon task:
Pre-test mean = 8,27, standard deviation = 1.710
Post-test mean = 8.27, standard deviation = 1.580
The result show no statistically significant difference p>O.05

Square pegboard task:
Pre-test mean = 16.47, standard deviation = 0.990
Post-test mean = 16.47, standard deviation = 0.990
The result show no statistically significant difference p>O.05

6. Comparison of pre-test and post-test data of maximum number of pegs placed in Purdue pegboard within 30 seconds with left hand.

Pre-test mean = 5.67, standard deviation = 1.291
Post-test mean = 5.60, standard deviation = 1.352
The result showed no statistically significant difference p>O.05

Discussion:-

This study examined the effect of inter-manual training of hand skill transfer in childhood stroke patients. Data from this study shows that the control and training groups performed at about the same levels for the pre-test portion of the experiment, but the training group took significantly less time, did significantly less errors and placed significantly more pegs in 30 seconds, in Purdue pegboard than the control group for the post portion of the experiment. These results suggest that the changes in the training group were due to the unilateral training regime and not extraneous variables.

Within the experimental group, performance of left hand improved in terms of less time taken to complete the task, less number of errors during task performance and more number of pegs placed in 30 seconds in Purdue pegboard after inter-manual training of right hand.

Our findings, is similar to the past studies which demonstrated that unilateral training can improve the performance in the un-trained, contra-lateral limb. The data indicates that just by practicing with the right hand, participants were able to decrease the time taken and number of errors to complete the spoon task and square pegboard task with the untrained hand. Thus cross transfer occurred in the left hand as evidenced by the decreased time taken and less number of errors. This increase performance of left hand after inter-manual training to right hand is mainly due to the transfer of skill from trained hand to the untrained hand (Christou et al., 2007).

In the present study, Purdue pegboard was used to confirm the inter-manual transfer of skills. The observation of mean values of pre and post test shows an increase in the number of pegs placed, acknowledging the transfer of underying gross and fine motor skills from trained to untrained hand.

Following Dolcos and co-workers in 2002 sugesstions for the cause of skill transfer, they investigated two popular models of lateral transfer of learning. According to the colossal access model, a unilateral engram is formed within one cerebral hemisphere, which IS subsequently accessed, presumably across the corpus callosum. The location of this engram is controversial. Although it might logically be performed within the left or the right hemisphere, whichever is contralateral to the trained hand, some have argued that motor engrams are always stored within the left hemisphere. Later on the study have argued that multiple mechanisms must be involved in lateral transfer of learning. They proposed 'cross activation' model of inter-hemispheric communication. They suggested that coactivation of the ipsi-lateral hemisphere by a specialized hemisphere may result in the formation of dual engrams during training, facilitating the transfer of skill between hands when co-activation does not occur, a single engram would be formed in the hemisphere contra-lateral to the trained hand. This must subsequently be accessed across the corpus callosum by the opposite hemisphere as required.

In the present study, training was given with normal right hand and engram formed in the contra-lateral left hemisphere which was accessed, across the corpus callosum, by the opposite hemisphere according to colossal access model. This engram in right hemisphere may be responsible for improvement in the affected untrained hand.

Researchers also suggested that the skill acquisition occurs in terms of motor learning. Fitts defines three sequetial stages involved in motor learning process. In the cognitive stage, the learner tries to understand the requirements of the motor task. In the associative stage, learners begin to refine their skills. Through continuous practice and repetition, the learner's movements become more consistent and errors will decrease (Francis et al., 2012).

Learning and re-learning motor skills and improving the performance of motor skills are two main effects of practice of particular interest to physical therapists. Learning occurs through an interaction of external and internal factors

that influence the ability to process information. Motor learning refers to the increasing spatial and temporal accuracy of movements with practice (Gooderham and Bryden, 2013).

The process underlying skill acquisition depends on the nature of the task and the stage of the learner. In addition, feedback and practice are two potent learning variables when used appropriately in the instruction of motor task.

Based on the results of the spoon and square task, a therapeutic principle is proposed in the case of inter-manual motor learning transfer. As suggested by Griffin et al., 2009 when selecting a task to transfer, it is important to pay attention to the temporal and spatial properties of the task, because the transfer of learning depends on the task characteristics. Researchers have proved that selection of occupational embedded task i.e. spoon task and square pegboard which are commonly used in occupational therapy practice.

In the present study, the results of spoon and square pegboard activities lend support to premise that it would be easier for the weaker upper extremity to learn a known task already acquired by the contra-lateral upper extremity to get the maximum effect of inter-manual transfer or cross transfer of learning.

Majority of reviewed studies examined the effect and nature of inter-manual transfer especially in normal population. This study has additionally demonstrated positively on skill transfer through inter-manual training in childhood stroke patients which further be affected in other unilateral impairment conditions (Harabst et al., 2000).

Clinical Relevance:-

The results of the study have important implications for physical therapy practice. The transfer of skill from one hand to the other may influence the recovery of functions on the affected side and also the increase of functioning on the un-affected side. This will lead to a meaningful lifestyle in unilateral impairment patients. Inter-manual training of hand may be helpful in improving the activities of daily living and thus helpful in functional independence of childhood stroke patients and other unilateral impairment conditions.

The performance on various levels of transfer tasks can be used as outcome measure to assess the extent of generalization of the performance component being trained. It may guide the therapist in selecting appropriate occupationally embedded tasks to elicit better performance in the expected activities of daily living.

Conclusion:-

The findings from this study suggest that in a sample of childhood stroke patients, inter-manual transfer effects occur in terms of performance duration and number of errors during occupationally embedded tasks. The transfer of skills from one hand to the other may influence the recovery of function on the affected side and also the increase of functioning on the unaffected side, as in hemiplegia or amputation.

This study also confirmed the inter-manual transfer of the underlying dexterity skill. The therapist may need to assess the underlying skills of a task in addition to evaluation of the task performance. This study also suggests that, when selecting a task to transfer, it is important to pay attention to the temporal and spatial properties of the task, because the transfer of learning depends on the task characteristics.

Limitations Of The Study:-

1. Kinematical analysis of movement, a more accurate measure of motor performance was not feasible to do in this study.
2. Sample size was small.
3. Because of the limitation of time, only skill transfer was examined, not its generalization.
4. The effect of mental practice on spoon and square pegboard activities could not be controlled.

References:-

1. Bock, O. and Schneider, S. (2002): Sensorimotor adaptation in young and elderly humans. Neurosci. Biobehav. Rev., 7: 761-767.
2. Camus, M., Ragert, P., Vandermeeren, Y. and Cohen, L.G. (2009): Mechanisms controlling motor output to a transfer hand after learning a sequential pinch force skill with the opposite hand. Clin. Neurophysiol., 10: 1859-1865.
3. Christou, E.A., Poston, B., Enoka, J.A. and Enoka, R.M. (2007): Different neural adjustments improve endpoint accuracy with practice in young and old adults. J. Neurophysiol., 5: 3340-3350.
4. Dolcos, F., Rice, H.J. and Cabeza, R. (2002): Hemispheric asymmetry and aging: right hemisphere decline or asymmetry reduction. Neurosci. Biobehav. Rev., 7: 819-825.
5. Francis, K.L., Macrae, P.G., Spirduso, W.W. and Eakin, T. (2012): The effects of age on precision pinch force control across five days of practice. Curr. Aging Sci., 1: 2-12.
6. Gooderham, S.E. and Bryden, P.J. (2013): Does your dominant hand become less dominant with time? The effects of aging and task complexity on hand selection. Dev. Psychobiol., 3: 537-546.
7. Griffin, L., Painter, P.E., Wadhwa, A. and Spirduso, W.W. (2009): Motor unit firing variability and synchronization during short-term light-load training in older adults. Exp. Brain Res., 4: 337-345.
8. Harabst, K.B., Lazarus, J.A. and Whitall, J. (2000): Accuracy of dynamic isometric force production: the influence of age and bimanual activation patters. Motor Control, 2: 232-256.