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[REVIEW ARTICLE]

Effect of Motor Relearning Program on the Upper Limb Function in Stroke Survivors: A Systematic Review

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ABSTRACT :

Background: Problems with upper limb impairments are very common after a stroke. Improving arm function is a core element of rehabilitation. Many physiotherapy interventions have been developed some of which has have found to be beneficial.

Objective: To analyze the effect of motor relearning program (MRP) on the upper limb function in stroke survivors.

Data source: This systematic review included Randomized Controlled Trials (RCTs) and quasi-experimental studies for patients suffering from stroke. The articles were retrieved from Google Scholar, Cochrane and Pub Med. Articles were also accessed from Journals.

Study selection: Data belonging from 2012 to 2021 were included. RCTs and quasi experimental studies that focused on motor relearning program for upper limb/hand for stroke patients were included in this review.

Results: Total 10 studies were included in this review with 339 patients. Among them, 217 had received MRP whereas, 122 had received other physiotherapy treatment technique for stroke rehabilitation.

Conclusion: MRP given alone or in conjunction with other physiotherapeutic treatment is likely to yield beneficial results for improving the upper limb /hand function in stroke patients.

Key Words: Motor relearning Program, upper limb function , stroke.

Introduction:

The burden of stroke is increasing in India; stroke is now the fourth leading cause of death and the fifth leading cause of disability. Previous research suggests that the incidence of stroke in India ranges between 105 and 152/100,000 people per year.[1]

Motor impairment, typically affecting movement of the face, arm and leg of one side of the body, affects about 80% of stroke survivor. Upper limb motor impairments are often persistent and disabling; only half of all stroke survivors with an initial paralyzed upper limb regain some useful upper limb function after six months and, of those with initial arm impairment, 50% have problems with arm function four years post stroke .[2]

Persistent upper limb (UL) dysfunction after a stroke is one of the most challenging issues in rehabilitation[3] The effects of stroke on the upper limb are a common and significant source of long-term disability. Problems such as paresis, loss of sensation, pain and spasticity in the hand, arm and shoulder can have manifold consequences in the daily lives of that affected.[4]

The motor relearning program was developed based on motor learning theory. Carr and Shepherd proposed that training in motor control requires anticipatory actions and ongoing practice. To further enhance relearning, the motor tasks involved are practiced within a context that can be task or environment specific.[5]

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Previous studies and randomized control trials have targeted on upper limb function using the MRP approach subjects with stroke. However, to the best of our knowledge there is no data on systematic review for the same.

Therefore, the objective of this review is to systematically analyze the efficacy of MRP for improving upper limb function in patients with stroke patients.

Methods :

Search strategy

In this systematic review, we searched published literature that provided evidence of MRP intervention on upper limb function in stroke patients .A comprehensive search utilizing the PICO format on electronic databases like PubMed, Cochrane ,Google scholar from July 2021 till December 2021was done. RCTs and quasi experimental studies belonging from 2012 to 2021 were included. The searches were done using appropriate keywords and Medical Subject Heading (MESH) .Terms such as stroke and MRP, physiotherapy for upper limb and stroke , MRP and upper limb were used to identify relevant publications.

Study design

Quantitative study designs such as randomized controlled trials (RCT) and quasi-experimental studies were included in the present study .

Population

Studies with adult (>18 years) stroke patients of both gender in either acute, sub acute or chronic phase were included in the study .

Intervention

Studies were included if the physiotherapy intervention in the form MRP was prescribed to the affected upper limb /hand .

Comparator

The comparator in the present study were control or any other physiotherapeutic intervention like mirror therapy ,bobath approach , constraint induced movement therapy (CIMT) etc with or without MRP was prescribed targeting the upper limb/ hand function.

Outcome

The search was not limited to any specific outcomes measure. Commonly used outcome measures or evaluate upper limb / hand function like Fugl meyer performance (FMA),motor assessment scale (MAS) and Functional Independence measure (FIM) Scale were.

Data extraction

A customized data extraction was developed in microsoft word format including information related to author name and year of publication ,objective of study , study design , no of participants , stage of stroke ,intervention given, outcome ,scale/ instruments used to measure the outcome .

Table 1: Basic summary of included studies

Study	Objective	Study design	Participant	Stage of stroke	Intervention	Outcome Addressed	Scale/ instruments
Shafqatullah Jan et al [6] (2019)	To compare the effectiveness of motor relearning programme with mirror therapy in upper limb motor functions of stroke patients.	RCT	66	NA	EG: Motor relearning Programme, while the CG: Mirror therapy.	Upper limb function	Upper limb sub-scales of the motor assessment scale
P.R. Lerma Castano et al [7] (2020)	To determine the effects of Kinesio Taping combined	A quasi-experimental study	10	NA	EG: Kinesio Taping combined with the	Upper limb motor function	Instrument for evaluating selective movement patterns for

	with the motor relearning method on upper limb motor function in adult patients with post stroke hemiparesis.				motor relearning method and CG: motor relearning method.		adult patients with upper motor neuron lesions
M.N.EL-Bahrawy et al [8] (2012)	To investigate the effectiveness of motor relearning program on improving hand functions in chronic stroke patients.	RCT	40	Chronic stroke	EG: MRP in form of drinking task through grasping a cup, moving the cup toward the mouth, reaching down toward the table then releasing the cup on the table. CG: Bobath therapy in form of Recruitment of arm activity in functional situations with various positions	Purdue Pegboard test score, hand grip strength, resting angle of ulnar deviation and wrist flexor spasticity	Jamar Hand dynamometer, Purdue Pegboard test.
M.V.Shah et al [9] (2016)	To determine the effect of CIMT and MRP on upper limb function and to compare the effect of both in sub-acute hemiperatic patients.	RCT	45	Sub-acute stroke	G1: CIMT In form of task oriented approach For unaffected UL G2: MRP training for upper extremity functions involving all the joint and different body positions.	Function of upper limb	Nine Hole Peg Test, Motor Activity Log and FMA scale.
Sana Batool et al [10] (2015)	To compare the effectiveness of constraint induced movement therapy versus motor	RCT	42	NA	G1 :CIMT in form of tasks with the hemiplegic upper extremity with the unaffected	Upper limb Function and self care	Motor Assessment scale (MAS) and Functional Independence measure (FIM) Scale

	relearning programme to improve motor function of hemiplegic upper extremity after stroke.				hand restraint in a mitt. G2:MRP in form of task oriented exercises like reaching and pointing activities, weight bearing of hemiplegic upper extremity & practice of different bimanual tasks.		
Ikram Ullah et al[11] (2020)	To determine the effectiveness of motor relearning program along with electrical stimulation for improving upper limb function in patients with sub-acute stroke.	A quasi experime ntal study	44	sub-acute	Electrical stimulations for the effected arm for 15 minutes along with motor relearning programme	Upper arm function, hand movement and advance hand activities scores	Motor assessment scale
S. Pandian et al[12] (2019)	To compare the hand therapy protocols based on Brunnstrom approach and motor relearning program in rehabilitation of the hand of chronic stroke patients.	RCT	30	Chronic	G1:Brunnstrom hand manipulation (BHM). BHM is the hand treatment protocol of the Brunnstrom movement therapy, which uses synergies and reflexes to develop voluntary motor control. G2: MRP based hand protocol.	Hand function	Brunnstrom recovery stages of hand (BRS-H), Fugl Meyer assessment: wrist and hand (FMA-WH).
Rehani P et al[13] (2015)	To see effectiveness of mirror therapy and Motor relearning Programme for improving hand functions in stroke.	RCT	12	Sub- acute	G 1:conventional physiotherapy and MRP for the affected hand andG2: conventional physiotherapy for the affected hand and mirror therapy for the unaffected hand.	Hand function	Chedoke arm and hand inventory (CAHAI)

| Paul J et al [14] (2014) | To investigate and compare the effect of motor relearning program and thermal effect to improve upper limb motor function among stroke subjects. | RCT | 20 | Sub - acute | Group 1: MRP Group 2:Thermal stimulation | Upper limb function | Modified motor assessment scale (MMAS), Stroke Rehabilitation Assessment of Movements (STREAM) Scale. |
| Rabia R et al [15] (2021) | To compare the effectiveness of mirror therapy and motor relearning program for improving the upper limb motor function in stroke patients. | RCT | 30 | NA | G1: Motor Relearning Program while the treatment of G2: Mirror Therapy. | Upper limb motor function | Motor part of FMA was used as an outcome measure |

G1: group 1, G2:group 2 , EG: experimental group , CG : control group, NA: not applicable

Results:

After rigorous data search 10 studies fulfilling the inclusion criteria successfully were included in the present study .Of the 10 studies 8 studies were RCT and 2 studies were quasi experimental design . Table 1 provides a summary of the study characteristics. There were a combined total of 339 participants aged between 35 and 84 years .Of the total participants, there were more males (62%) participants than female (38%). Post stroke duration was mentioned in nine out of 10. Four studies included sub acute stroke patients, 2 studies included chronic stroke patients while the remaining 4 studies did not mention post stroke duration in their study.

In the present systematic review, all the studies applied MRP intervention with other physiotherapeutic interventions for upper limb / hand in stroke patients ,7 studies applied MRP as treatment in experimental group . Two studies mentioned MRP as treatment for control group. An individual study conducted by Ikram Ullah et al, a single group study applied electrical stimulations along with MRP. The intervention of the control group of this systematic, included any one from bobath technique, mirror therapy or conventional therapy.

The outcome used in all the 10 studies was related to upper limb/ hand function. Outcome measures varied between studies with almost all the studies utilizing objective type of outcome measures. The outcome measures applied in the selected studies were Nine Hole Peg Test, Motor Assessment scale and Functional Independence measure Scale, Brunnstrom recovery stages of hand , Fugl Meyer assessment, Cherokee arm and hand inventory, Stroke Rehabilitation Assessment of Movements.

Individual study results:

Shafqatullah J et al found significantly improved scores in MRP group as compared to the mirror therapy group. P.R .Lerma et al showed statistically significant result with kinesiotaping combined with

the MRP. Ikram U et al found significant differences between pre and post treatment scores suggesting MRP along with electrical stimulation beneficial.

El-Bahrawy MN et al found significant difference in favour of MRP group for hand grip strength and ulnar deviation after treatment but not the fine hand functions or wrist flexor spasticity as compared to Bobath treatment. Pandian S. et al showed that brunnstorm technique was better than MRP. M.V.Shah et al found CIMT was more effective than MRP. Batool S et al found CIMT statistically significant than MRP. Rehani P et al found statistically insignificant results, but found improvement in patients of both groups. Paul J et al found MRP showed better improvement than electrical stimulation .Rabia R et al found that Both MRP and mirror therapy improved the motor function however, statistically the results were non-significant

Discussion:

The aim of this systematic review was to summarize the evidence regarding effectiveness of MRP interventions for improving upper limb/hand function in stroke survivors. The findings from this review indicate that MRP is likely to have a positive impact on the upper limb/hand function in stroke patients .

Out of total 10 studies included in the present study 7 studies showed that MRP is better or equally effective in improving the upper limb/hand function while the remaining 3 studies proved that other physiotherapeutic treatments were better over MRP.

Upper limb function:

Out of 10 studies 7 studies targeted on the upper limb function . Five studies done by Shafqatullah Jan et al , P.R. Lerma Castano et al, Rabia R et al , Ikram Ullah et al, Paul J et al showed improvement in the upper limb function .Shafqatullah Jan et al showed that MRP had beneficial affect over MT in the rehabilitation of upper limb motor functions of stroke patients (p<0.001) whereas Rabia R et al showed statistically significant improvement in motor function of stroke patients from base-line to post assessment in MRP as well as MT group (p<0.005).Another study done by P.R. Lerma Castano et al found that the results obtained show statistically significant differences (p < 0.05) when comparing the means of the upper limb movement patterns of the experimental group.

Paul J et al showed significant (P<0.001) improvement in motor function of upper limb following MRP sessions as compared with electrical stimulation. MRP group had higher mean value for modified motor assessment scale and STREAM scale when compared with mean value electrical stimulation group .Similar results were seen in another study conducted by Ikram Ullah et al which stated that MRP along with electrical stimulation significantly improves upper limb function in stroke patients (P<0.05). There was a significant difference between the pre and post treatment mean scores of upper arm function, hand movement and advance hand activities.

On the contrary Sana Batool et al showed that the mean value in CIMT group was greater than in MRP group, showing better improvement in CIMT group .According to the author learned inhibition of movement after stroke is overcome by behavior technique called shaping in CIMT and also the use dependent neural plasticity leads to better functional results.

M.V.Shah et al proved that upper the CIMT is more effective as compared to MRP for upper extremity functions in stroke patients. The author attributed improvement in CIMT group to two reasons i.e., repetitive practice of functional task leading to cortical reorganization and repeated use of compensatory strategies rather than promoting appropriate movement control during functional use of the impaired limb.

Hand function:

A study conducted by S. Pandian et al. found statistically significant results in motor recovery of the hand in favor of the Brunnstrom movement therapy. Both BHM and MRP were effective in enhancing the motor recovery of hand in chronic stroke patients. However, the BHM was better than MRP for the wrist and hand recovery, particularly the mass finger flexion, extension and grasp. BHM directly focuses on the hand, wrist and finger movements unlike MRP and emphasizes on sequential development thereby enhancing the motor recovery post-stroke . Rehani P et al while comparing effect of MRP and mirror therapy on hand function found no significant difference between pre intervention scores and post intervention scores with in groups (p>0.05).Although statistically results were non significant but clinically improvement in the hand function was seen in both the groups

separately.

M.N. Bahrawy et al revealed that MRP group had more beneficial effect over BT group in terms of improvements in hand grip power and correction of the wrist posture. The mean values of hand grip strength, purdue pegboard test, the resting angle of ulnar deviation and the modified ashworth scale significantly differed after treatment for MRP (P <0.0001) when compared with BT group. The author claimed that repetition of task specific training in MRP plays a major role in inducing and maintaining brain changes.

Conclusion:

From the above studies it can be concluded that MRP given alone or in conjunction with other physiotherapeutic treatment is likely to yield beneficial results for improving the upper limb /hand function in stroke patients

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