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Original Research Article

MOTOR RELEARNING PROGRAM VERSUS PROPRIOCEPTIVE NEURO-MUSCULAR FACILITATION TECHNIQUE FOR IMPROVING BASIC MOBILITY IN CHRONIC STROKE PATIENTS-A COMPARATIVE STUDY

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ABSTRACT

Background: Individuals who have had a stroke basic mobility such as sit to stand performance and walking speed is substantially decreased as compared to nondisabled. There are limited studies which compared various Physiotherapy treatment approaches for improving basic mobility in chronic stroke patients and also follow up to find there effectiveness(in home setting) .

Purpose: To investigate the effectiveness of Motor relearning program (MRP) for improving the basic mobility in chronic stroke patients when compared to conventional physiotherapy (PNF-Proprioceptive Neuromuscular Facilitation).

Methodology: 30 participants were allocated by a simple random sampling using lottery method into MRP (Experimental-Group A) and PNF (Control/Conventional Group B).Both groups received treatment for 30 minutes per day,3 times per week for 3 weeks. Outcome measures were recorded at pretest, post test and post 1 month follow up using Timed Up and Go Test (TUG) and Sit to stand (STS) item of Motor Assessment Scale (MAS). Study was done in respective participants home. ANOVA was used for data analysis.

Results: The MRP group showed significant improvement in Timed Up and Go(TUG) Test and Sit to stand item(STS) of Motor Assessment Scale(MAS) in post test and post 1 month follow up compared to PNF group.

Conclusion: MRP is more effective than PNF for improving basic mobility of sit to stand and walking in chronic stroke subjects and subjects were able to maintain their basic mobility at 1-month follow-up also.

KEY WORDS: Basic mobility, MRP, PNF, stroke, TUG, STS, MAS

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INTRODUCTION

Stroke is the third most common cause of death in the Western world, behind heart disease and cancer, and consists of over half of the neurologic admissions to communityhospitals [1]. The rehabilitation of stroke individuals is time consuming and is costly [2]. As most patients with stroke survive the initial injury, the biggest effect on patients and their families is usually through long-term impairment, limitation of activities (disability),and reduced participation (handicap) [3]. Stroke is defined by World Health Organization (WHO) as ¯a condition characterized by rapidly developing symptoms and signs of a focal brain lesion, with symptoms lasting for more than 24 hours or leading to death, with

no apparent cause other than that of vascular origin [4]. In individuals who have had a stroke, muscle strength is impaired and several authors have reported that subjects with stroke demonstrate an increase in Sit to Stand (STS) time when compared to older individuals without neurological impairment [5]. Lee et al have found that individuals with stroke who put less weight through their paretic leg during STS had lower mobility scores on the functional independence measure (FIM). Cheng et al have reported that individuals with stroke place less weight on their paretic lower limb during STS than those with stroke that did not fall [6]. Although functional ambulation is the primary goal for many individuals after stroke, many never regain this functional ambulation. For those stroke individuals who do walk after a stroke, their gait is often slow; they have poor endurance and balance, and have changes in their quality and adaptability of their walking pattern. As individuals having chronic stroke continue to walk with a degraded pattern of coordination, they are at greater risk of falling, developing a fear of falling, and losing independence and function [6].

There is evidence overall that physiotherapy in a general sense improves outcome in stroke rehabilitation. There is a growing body of evidence that the adult brain is capable of reorganizing after injury and that environmental factors, including the amount of activity (i.e., use), affect the extent of and actually drive neural reorganization. Although recent evidence of the effectiveness of task specific training and muscle strengthening is promising, it is doubtful that present physiotherapy approaches are providing optimal training at present time [7]. Pollock et al carried out a systematic review of 11 clinical trials about functional recovery of stroke patients. The results of these studies showed that stroke patients tended to have a short hospital stay and high functional independence. Stroke patients also showed a significant increase in gait velocity. The authors stressed that there is a need to further investigate the efficacy of this approach by conducting high-quality, randomized, controlled trials and refining the intervention techniques [8].

Dora et al conducted a randomized controlled trial study to find the effectiveness of the Motor Relearning Approach(MRP) in promoting physical function and task performance for stroke patients. The MRP was found to be effective for enhancing functional recovery of stroke patients [8].

Generally, research has suggested that task-specific exercises would be most beneficial for stroke individuals, because this approach is thought to drive neural plasticity [6]. The MRP for stroke developed by Janet Carr and Roberta Shephard is a good example of this approach. This approach includes many aspects of Motor learning theory and provides practical guidelines for retraining functional skills (e.g., balanced sitting, sitting and standing, transfer skills, gait, etc.). Their approach focuses on task specific learning and through effective use of feedback and practice development of active movement control. Facilitation techniques are deemphasized whereas verbal instruction, demonstration, and manual guidance are emphasized. The approach is based on four distinct steps: 1.Analysis of the task.2.Practice of the missing component.3.Practice of the task.4.Transference of training [9].

Various physiotherapy interventions have been used to improve basic mobility of sit to stand, stand to sit and gait in chronic stroke patients. This includes Bobath/(Neuro-developmental Therapy)NDT, PNF, Roods, Constraint-induced movement therapy (CIMT), Brunnstrom Approach, Treadmill Training, Weight Supported Locomotor Training. At present, there is a paucity of experimental evidence available to indicate what physical therapy techniques are effective for improving basic mobility such as sit to Stand, stand to sit and gait in an individual with chronic stroke in home setting/environment for long term (follow-up). So there is a need of study to investigate the effectiveness of MRP in improving basic mobility of sit to stand, stand to sit and gait in chronic stroke patients in home environment and its long term implication or effect. Studies with stroke populations have shown that Motor Relearning Program (MRP)/ task specific training /Task-related training (TRT) with specific strengthening exercises for paretic muscles leads to improvement in locomotion, lower limb weight bearing in sitting, and standing up. Recent studies using functional MRI and

optical imaging system have already shown that lower limb MRP induces use-dependent plastic changes of brains in patients with stroke [10].

Aims and objectives of the study: 1. To evaluate the effectiveness of 3-week Motor Relearning Program for improving basic mobility in chronic stroke patients in home setting. 2. To evaluate the effectiveness of 3-week conventional (PNF) physiotherapy for improving basic Mobility in chronic stroke patients in home setting. 3. To compare the effectiveness of motor relearning program and conventional (PNF) Physiotherapy for improving basic mobility in chronic stroke patients in home setting.

Hypothesis: Experimental Hypothesis -Motor relearning program will be more effective than conventional (PNF) Physiotherapy for improving basic mobility in chronic stroke patients in home setting.

Null Hypothesis: Motor Relearning Program will be equal or not more effective than conventional (PNF) Physiotherapy for improving basic mobility in chronic stroke patients in home setting.

METHODOLOGY

Sample: Total 34 participants meeting the inclusion criteria and who were previously diagnosed by Neurologist as having Stroke were recruited for the study (4 participants left the study in the middle due to various reasons). Participants were chronic stroke patient residing in Dehradun, Uttarakhand, India. The ethical committee of Dolphin PG Institute of Biomedical and Natural Sciences approved the study.

Inclusion criteria: 1. They were more than 6 month post stroke .2. No serious unstable medical complication. 3. They could follow directions (written, verbal or demonstration), minimum 24 or greater out of 30 in Mini mental state examination .4. Can ambulate 25 feet/10 meter (with or without assistive device).5. Age between 25-65 years. 6. Not receiving any other form of physiotherapy for lower limb.

Exclusion criteria: 1. History of neurologic disease other than the chronic stroke.2.Orthopedic disorder involving any joint of lower limbs that interfere with study.3. Gross visuospatial or visualfield deficits .4. Unhealed fracture of lower limb .5. Peripheral arterial occlusive disease. 6. Any cardiac problems diagnosed by physician. 7. Uncontrolled hypertension.

Study design -Experimental Study.

Instrumentation: 1. Inch/measure tape 2. Red tape 3. Chair with arm rest 4. Sphyghnomano meter 5.Pen 6. Paper 7. Watch with second hand

Outcome measures: 1. Timed up and go (TUG) test scale. 2 Sit to stand (STS) item of motor assessment scale (MAS).

DESCRIPTIONS OF SCALES

Timed-Up-And-Go (TUG) Test: The Timed Up and Go (TUG) test was modified from the Get-up and go test by Podsiadlo & Richardson in 1991 [11]. In this test the patient is timed while he or she rises from a chair, walks 3 m, turns, walks back and sits down again [12]. According to Anne Shumway-Cook, Sandy Brauer, and Marjorie Woollacott Older adults who take longer than 14 seconds to complete the TUG have a high risk for falls. This cutoff is different from Podsiadlo and Richardson, which is 30 seconds [13,14].

Sitting to standing (STS) item of motor assessment scale (MAS) -Motor Assessment Scale (MAS) comes from the intervention theory of Carr and Shepherd [15]. MAS is a seven-point ordinal scale, items are scored from 0 to 6 [7]. Patient is scored on his best performance of three times performance [16]. MAS appears to be useful measure of functional ability both in clinical data collection and for laboratory research [7].

Procedure

MRP -Group- A protocol [9]: This group received MRP of 30 minutes duration and it was given in a single session of 30 minutes.

MRP was divided into 10 minutes in which sit to stand and sitting down were practiced and 20 minutes in which walking was practiced.

MRP for sitting to standing: Physiotherapist standing in front of subject (sitting on the chair with armrest). Initially subject was taught backward foot placement which was followed by forward trunk bending. If subject was not able to perform or was performing in wrong way Physiotherapist guided the movement by holding the affected side shoulder and hand and then

subject was told to perform forward trunk bending more quickly. Subjects were told to push down through affected foot and stand up as quickly as possible and bring his hips forward. Physiotherapist gave the idea of pushing down through affected foot by pushing down through subject's knee along the shank while moving it forward.

MRP for stand to sit: Subject in standing position. The Physiotherapist helped the subject with the forward movement of the shoulders and knees at the beginning of the movement. Physiotherapist helped the subject to keep his weight on the affected leg while the subject sits down. Complexity is increased as subject practices standing up and sitting down with different chair heights, stopping in different parts of the range, and altering speed. The Physiotherapist directs these temporal and spatial variations. Transference of training was done by performance of sit to stand and sitting in various places and things in subject's home i.e.; practicing standing up and sitting down on stool, bench, bed etc and in garden, gallery, dining room, bedroom etc. The subjects were told to perform minimum of 15 minutes of sit to stand and stand to sit each day. The number of repetitions and intensity of each exercise was graded to subject's level of ability and progressed as they improved. Verbal feedback, e.g. about weight distribution and speed, as well as encouragement were provided.

MRP for walking

To train hip extension throughout stance phase: Subject standing with hip in correct alignment (Physiotherapist assistance if required), subject practices stepping forward then backward with intact leg, making sure he extends his affected hip as he steps forward. Physiotherapist stands on either in front or on affected side and encouraged the subject to take weight through affected leg.

To train knee control for stance phase: Subject sitting with knee held straight, Physiotherapist gives firm pressure through heel towards knee while subject 1.practises controlling eccentric and concentric of quadriceps through a 15 degree range, and 2.attempts to keep knee straight (isometric contraction). Physiotherapist give firm pressure through the heel so the quadriceps must contract and instruct subject to bend a knee little and straighten the knee and hold the knee straight. This is followed by subject stepping forward and backward with intact leg as above and standing with intact leg in front of affected leg. Subject practiced moving his weight forward over his intact foot and back while maintaining knee extension of the affected leg. Physiotherapist instruct subject to move his hips forward over his intact foot and to keep his knees straight and practices bending and straightening (affected) knee a few degrees and to keep hip forward while doing this. To add variety subject perform stepping on and off stepper with intact and affected leg. Physiotherapist guide and encourages subject to put weight on the affected leg while performing this stepping activity by lightly holding at affected knee.

To train lateral horizontal pelvic shift: Subject in standing, hips in front of ankles practices shifting his weight from one foot to other. Physiotherapist standing in front indicates with his finger how far subject's pelvis should shift (approximately 1 inch). Physiotherapist instructs subject to shift his weight on to his leg one by one.

To train flexion of knee at start of swing phase: Subject lies prone on bed. Physiotherapist flexes knee to just below a right-angle. Subject practices first controlling his knee flexors both concentrically and eccecentrically throughout the small range of movement and holding his knee in different parts of the range, sustaining muscle activity to counting. Physiotherapist instructs subject to bend knee, then hold bend knee for 5 to 10 seconds and gradually straighten the knee. This is followed by subject standing, Physiotherapist holding subject's knee in some flexion and subject practicing controlled concentric and eccentric contraction .This is followed by subject stepping forward with affected leg, Physiotherapist helps subject to control the initial knee flexion.

To train knee extension and foot dorsiflexion at heel strike: Subject standing on intact leg, Physiotherapist holds the subject's affected foot in dorsiflexion, with the knee in extension. Subject moves his weight forward onto heel. Physiotherapists instruct to shift his weight forward so to put his heel down.

Practice of walking: Practice of individual component of walking is followed by practice of walking itself. The Subject steps with his intact leg first. Physiotherapist steady subject at the upper arms, standing behind if necessary.

Transference of training into daily life: Subject performs walking during different hours of the day. Subject can set a goal of how far he walks on the first day and can extend distance and/or time taken on the next day. Subjects also practice on their own and under supervision by Physiotherapist and family members, with a checklist of those components to which they need to direct their attention. Subjects were told to walk in different places or rooms in their home environment few times everyday depending on subject's tolerance along with any family member to prevent fall. Subjects were asked to practice walking on their own each day for approximately 25-30 minutes with any family members.

PNF -Group-B protocol [14]: Conventional Physiotherapy in the form of Proprioceptive Neuromuscular Facilitation Treatments (PNF) for Group B was used in this study. PNF of 30 minutes duration was given in a single session. Patterns of movement used in this study were, Pelvic anterior elevation and posterior depression of the hemiplegic side. Participant position was side lying with affected lower extremity up. The sequence was rhythmic initiation first for 10 minutes, then slow reversal for an additional 10 minutes, and then agonistic reversals for an additional 10 minutes. An alarm clock was used to measure the time.

For Rhythmic initiation the command "relax and let me move you" was used first to move the pelvis through the available range of motion of anterior elevation and then to return the pelvis through the posterior depression pattern. When Physiotherapist could not feel resistance during the movements, the command "now help me move you" was used to have the subject assist the movement for three to four repetitions. Using the command "pull" as appropriate, the subject was asked to superimpose resistance upon the movement, with Physiotherapist gradually increasing the resistance with the increase in subject's response. This was repeated for three to four repetitions. The subject moved the pelvis actively through the anterior elevation pattern and returned to the starting position passively by relaxing. Both sequences were repeated for the remaining 10 minutes.

For Slow reversal the subject's body part was moved to the lengthened range of the anterior elevation. Using the manual contacts and verbal cues, Physiotherapist made the subject perform a contraction of the internal and external oblique abdominal muscles to anteriorly elevate the pelvis with maximal effort against resistance added by Physiotherapist. Physiotherapist switched manual contacts to the posterior depression pattern and had the subject perform a contraction of the contra lateral quadratus lumborum and iliocostalis lumborum muscles to posteriorly lower the pelvis against maximal resistance. Both sequences were repeated for the total 10 minutes.

For Agonistic reversal Physiotherapist moved the subject's body part to the point at which the muscle was lengthened in the desired pattern (anterior elevation).Using manual contact and verbal cues, Physiotherapist made the subject perform a concentric contraction of the target muscles to the point at which the muscles are shortened. Using the command "make it hard for me to move you," Physiotherapist made the subject perform an eccentric contraction of the target muscles, returning to the point at which the muscles are lengthened. Both sequences were repeated to fulfill the 10-minute period.

Outcome measures:

The pretest, post test and follow up parameters were recorded by using Timed Up and Go Test (TUG) and Sit to stand (STS) item of Motor Assessment Scale (MAS) as an outcome measure to assess the change in basic mobility in chronic stroke patients.

Visual demonstration by physiotherapist was done of both Timed Up and Go Test and Sit to stand item of Motor Assessment Scale as trial session to make the participants get an idea about the tests. The participants were made to perform test 3 times before the actual testing session. The data were collected in the respective participant's home. For TUG, time in

seconds to complete the TUG performance was collected whereas for sitting to standing item of MAS, which was performed 3 times, best performance score was used for data analysis.

Data Analysis: Statistics are performed by using SPSS 13 and SIGMASTATE. Results were calculated using 0.05 level of significance. Differences in scores of all outcome measures, obtained by subtracting pre treatment scores from post treatment scores, and were analyzed with repeated measures of analysis of variance (ANOVA) using SPSS followed by Tukey Post hoc tests.

RESULTS

Table 1: Distribution of age, and onset of stroke.

Demographic	Group A		Group B	
	Mean	SD	Mean	SD
Age(In Years)	50.876	6.28	51	5.23
Onset(In Years)	1.76	0.68	1.98	0.64

Table 1 shows that age and onset bias is eliminated and samples are matched between the two groups A and B respectively.

Table 2: Comparison of Mean and SD of TUG- pre, TUG- post and TUG- follow up for Group A and Group B.

TUG	Group A		Group B	
	Mean	SD	Mean	SD
TUG- pre	54.8	3.1	55.2	3.12
TUG- post	27.06	2.46	37.266	5.65
TUG- follow up	27.2	2.59	46.51	8.44

Table 2 shows comparison of mean and standard deviation of pre, post and follow up TUG score of Group A and comparison of mean and standard deviation of pre, post and follow up TUG scores of Group B.

Table 3: Comparison of mean values of TUG- pre, TUG- post and TUG- follow up within Group A and Group B.

	Group A		Group B	
	F - Value	P- value	F - value	P- value
TUG	608.23	0.000<0.05	73.07	0.000<0.05

Table 3 shows that f - values and p- values for TUG- Pre, TUG- Post and TUG-Follow up for Group A are 608.23 and 0.05 and the f- values and p- values for TUG-Pre, TUG- Post and TUG-Follow up for Group B are 73.07 and 0.05. It shows that the treatment given to both the groups were effective.

Table 4 shows comparison of mean and standard deviation of pre, post and follow up STS score of Group A and comparison of mean and standard deviation of pre, post and follow up STS scores of Group B.

Table 4: Comparison of Mean and SD of STS for Group A and Group B.

STS	Group A		Group B.	
	Mean	SD	Mean	SD
STS - Pre	3.26	0.67	3	0.703
STS - Post	5.46	0.51	4.06	0.7
STS - F	5.46	0.51	3.2	0.45

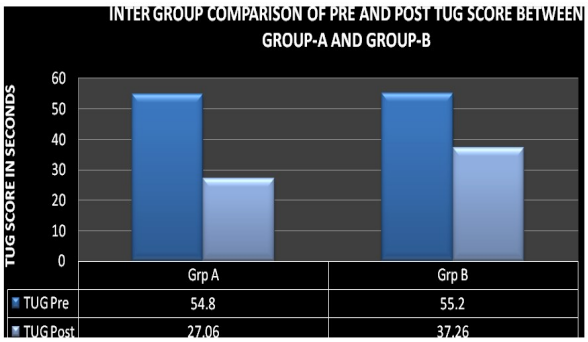
Table 5: Comparison of Mean values of STS- Pre, STS- Post and STS- Follow up within Group A and Group B.

	Group A		Group B	
	F - Value	P- value	F - Value	P- value
STS	77.8	0.000<.05	10.5	0.000<.05

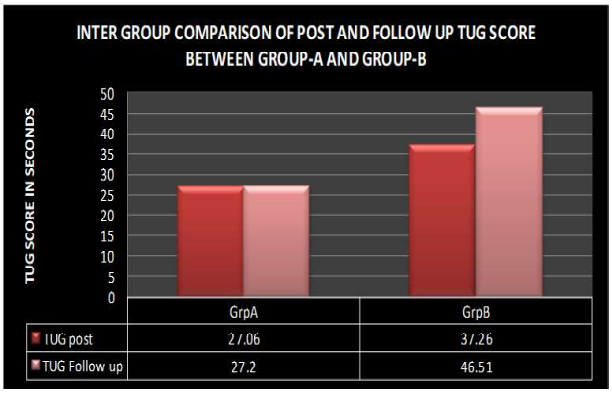
Table 5 shows the f- values and p- values for STS-Pre, STS-Post and STS-For Group A are 77.8 and 0.05 and for Group B are 10.5 and0.05. It shows that the treatment given to both the groups were effective.

INTER GROUP COMPARISONS OF PRE, POST AND FOLLOW UP TUG AND STS SCORES BETWEEN GROUP-A AND GROUP-B

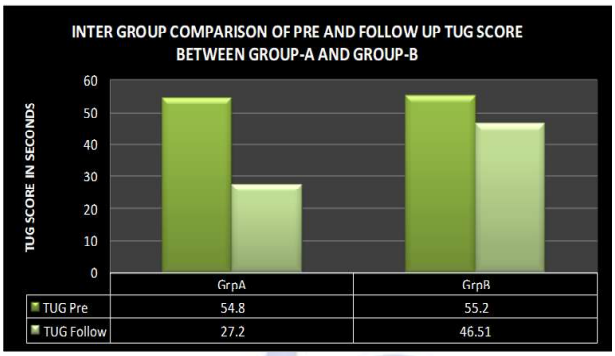
Graph 1: Depicts improvement in mean difference of pre TUG score of subjects of group A as compared to subjects of group B.



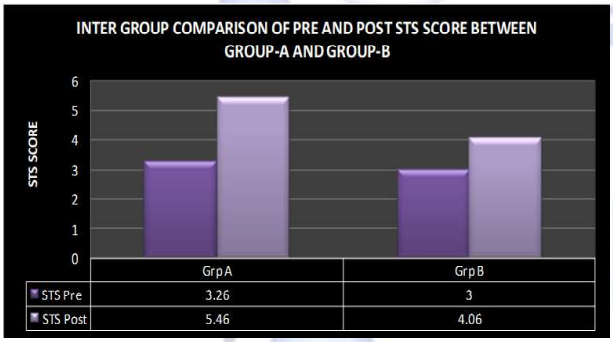
Graph 2: Depicts insignificant improvement in mean difference of post TUG score of subjects of group A as compared to subjects of group B.



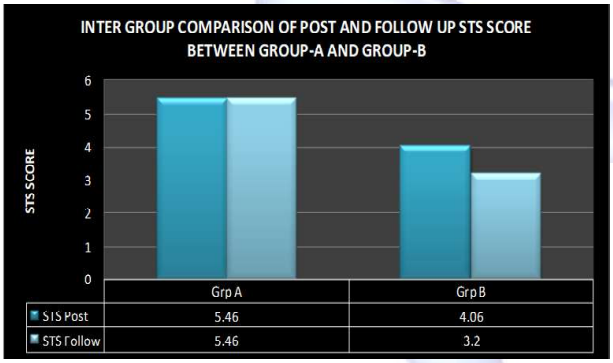
Graph 3: Depicts improvement in mean difference of follow up TUG score of subjects of group A as compared to subjects of group B.



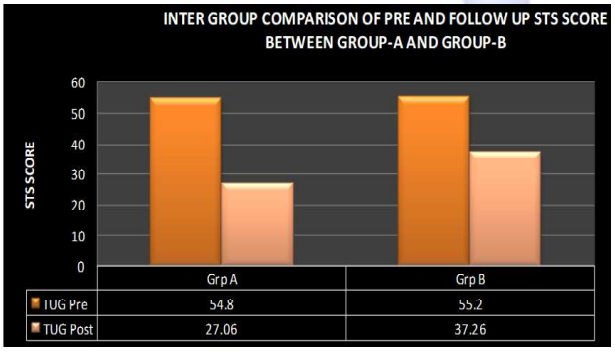
Graph 4: Depicts improvement in mean difference of pre STS score of subjects of group A as compared to subjects of group B.



Graph 5: Depicts no improvement in mean difference of post STS score of subjects of group A and group B.



Graph 6: Depicts improvement in mean difference of follow up STS score of subjects of group A as compared to subjects of group B.



From above graphs and tables we can say that treatment were effective for both group.

From above graphs and tables we can say that Group A showed significant improvement as compared to Group B in both TUG and STS item of MAS.

For TUG, Group A showed significant improvement at post intervention compared to Group B, and maintained their TUG score at 1 month follow up. Whereas Group B was not able to maintain their post TUG score at 1 month follow up.

For STS, Group A showed significant improvement at post intervention compared to Group B, and maintained their STS score at 1 month follows up. Whereas Group B was not able to maintain their post STS score at 1 month follow up.

From these Results we conclude that the Group A is better Than Group B.

DISCUSSION

Past studies have shown that both interventions of MRP and PNF are effective for improving gait and thus basic mobility in stroke patients.

Previous studies have shown that MRP/ Task Oriented training is effective in improving basic mobility such as gait [10,17-20].

The mechanisms underlying improvements in TUG score post intervention appear multifactorial and could be attributed to reduced agonist–antagonist co-contraction, enhancement of descending voluntary commands to the paretic muscles, and reorganization of synapses and cortical representation after repetitive practice of functional tasks as were observed and mentioned in previous study done by Shamay and colleague [10].

In this study, the MRP was structured in such a way that participants had ample opportunity to gain experience of different tasks.

Firstly in MRP, the participants were involved in identifying their own problems of performance. The selection of the remedial tasks used for training was meant to target those missing components. The incorporation of this strategy turned the program into a patient/client centered intervention. The second component of the MRP was the emphasis placed on the transfer of skills between the remedial and functional tasks. The third component of the motor relearning program

was the sequential organization of the function-based intervention [8,9].

In this program all practice, including most exercises, is task and context-related meaning that the actions to be learned are practiced in an appropriate environment with exercises directed specifically at the muscles (and muscle synergies) which were required for the performance of that action, working through the range, at which they must generate force.

Participants also practiced on their own and under supervision by Physiotherapist and family members, with a checklist of those components to which they need to direct their attention. At 1 month follow up post TUG score were nearly maintained by MRP group .As participants of MRP group continued to practice the exercise on their own even after treatment ended, they were able to maintain their post intervention TUG score.

For control group who received conventional Physiotherapy in the form of PNF also showed improvement in TUG score at post intervention. Previous study done by Ray-Yau Wang has shown that PNF is effective in improving gait [21]. The improvement at post treatment TUG score may be due to the improvement in gait speed after 9 PNF treatments, which was due to an increase in cadence accompanied by an increase in average stride length as was observed in one of the previous study. Various PNF techniques used in pelvic pattern not only lead to better control on pelvis by subject but also lead to facilitation of lower extremities as both pelvic and lower limb facilitate each others. Pelvic depression patterns work with and facilitate weight bearing motion of the legs. Pelvic elevation patterns work with and facilitate stepping and leg lifting motions [21,22].

The reasons for better score and thus better performance by experimental group as compared to control group could be multifactoral. There is increasing evidence in literature on the effectiveness of many newer methods of intervention, developed out of recent scientific investigations and focusing particularly on task-specific exercise and training. There is also evidence in literature as was done by Roberta B. Shepherd that training methods designed to stimulate motor learning can have positive effects on brain reorganization after a neural lesion. Task specific training (i.e., specific training of functional actions, such as walking, reaching, standing up) stimulates the regaining of motor control by training muscles to generate and time force at the necessary length and the appropriate relationship to each other for specific actions or task [23]. In present study biomechanics of sit to stand, stand to sit and walking were kept in mind along with their application which resulted in better score in MRP group than compared to PNF group.

Rosenbaum has pointed out that movement or task becomes more skilled with learning, and this is probably due to improvements in timing, tuning, and coordinating muscle activations. Training walking should, therefore, include exercises to strengthen weak extensor muscles, to preserve muscle length, plus the practice of walking. It is well known, that motor learning and developing skill require practice with concrete goals and objective feedback about effectiveness. The learner must have the opportunity to practice actively and to understand the importance of frequent repetitions of task. Exercise and training sessions are being carried out throughout the day, thereby increasing the time spent in practice of task. In this study, emphases were placed on physical training and exercise and on skill training, stressing cognitive engagement and practice, gaining strength, control, and fitness. There is increasing evidence in literature that such methods can be effective in improving functional performance in elderly individuals, including those with stroke. Since it is evident that task-specific training has the potential to drive brain reorganization toward more optimal functional performance, it is therefore important to utilize training methods most likely to have a positive impact on this process and shown to be effective [23]. In present study theses point were kept in consideration which resulted in better functional outcome post intervention and there maintenance at follow up in MRP group.

For the action of sit-to-stand (which has been part of MRP group in this study), there is now a rational biomechanical model that forms the basis for standardized guidelines for training this task. This model has also provided methods for

measuring performance and an increased focus on clinical research is enabling us to test the effectiveness of intervention. The principal research areas driving present work include motor control mechanisms, muscle biology, biomechanics, skill acquisition (motor learning) and exercise science. Earlier study done by Carr and Shepherd have found that over the past few decades few studies have focused on the client as learner and on the need for task-oriented exercise and training, together with strength and fitness training, as the means of improving the patient's capacity to learn motor skills and optimize functional motor performance. An increasing number of investigations of this theoretical perspective have found positive impact in individuals with brain lesions. Improvement in the functional performance suggests that learning has taken place. In addition to that, training that is sufficiently intensive can increase muscle endurance and produce a cardiovascular training effect. It seems that exercise needs to be specific to the task being learned and the context (as in this study), if performance of that task is to improve, since muscle strength and motor control are relative to the action being performed and its context [24].

Neurophysiological and neuroanatomical studies in animals, and neuroimaging and other non-invasive mapping studies in humans, are providing sufficient evidence that the adult cerebral cortex is capable of significant functional reorganization. These studies have shown plasticity in the functional topography and anatomy of intact cortical tissue adjacent to the injury and of more remote cortical areas. Of critical importance for rehabilitation is that experience, learning and active use of the affected limbs appear to modify the adaptive organization that inevitably occurs after cortical injury. Study by Daniel et al found that for rehabilitation to be effective in optimizing neural reorganization and functional recovery, increased emphasis should be placed on challenging, engaging and meaningful task training to promote learning. Motor learning concepts and applications applied in this study were kept in mind to produce favorable results in MRP group [24].

Motor learning theory describes the ways in which motor patterns can be acquired and modified through experiential learning, such as through observations and repeated practice of task or action. The motor relearning approach promotes the regaining of normal motor skills through task-oriented practice with appropriate feedback and the active participation of the individual [8]. In this study, the motor relearning program was structured in such a way that patients had ample opportunity to gain this experience. The training thus became more anticipatory for the patients and hence was more self-initiated, targeted and effective. Carr and Shepherd's motor relearning program provides the theoretical foundation for the present study. The findings of this clinical trial reveal that ' sequential' and 'function-based' training are equally important for enhancing patients' functional recovery after stroke.

Review article by Richard W. Bohannon have found that studies employing a regimen of repeated sit-to-stands as in this study have all demonstrated functional benefits. Studies that focused on such techniques have yielded favorable results. This may be related to the concept of specificity of training. Step-ups and Sit-to-stands, as well as other activities such as going from side-lying to sitting in bed, represent everyday activities that can be performed almost anywhere with a minimum of equipment. They have been shown to promote improvement in functional activity performance in older adults without a history of stroke as well. Activities such as knee flexion and extension on an isokinetic dynamometer or leg-presses with a weight stack for resistance are neither portable nor functional as described in earlier studies [25].

Note that patients'active participation could be a key reason for the group to maintain the improvement in muscle strength at follow-up, because most subjects in MRP group continued to practice the exercise on their own even after treatment ended. Whereas this trend was not present in control group who were receiving PNF which resulted in deterioration in their performance at follow up.

A recent meta-analysis done by Jean-Francois and colleague demonstrated significant homogeneous summary effect sizes in favour of MRP/

task-oriented circuit class training for gait speed, walking distance and a timed up-and-go [20]. Recent systemic review by Peter Langhorne have further supported the effectiveness of MRP as the Interventions program that they have identified to show promise, most could be argued to involve elements of intensive, repetitive task-specific practice (constraint induced movement therapy, robotics, mental practice, repetitive task training, increased intensity therapy, physical fitness training, electro mechanical-assisted gait training, mixed physiotherapy treatment approaches, rhythmic gait cueing, and training with a moving platform). This observation lends support to the belief that high-intensity repetitive task-specific practice might be the most effective principle when trying to promote motor recovery after stroke [3].

As compared to MRP, PNF approach has been used extensively in orthopedic and neuromuscular problems, and the research on this method has been studied more in lower motor neuron and musculoskeletal problems than in upper motor neuron lesions(stroke) [15]. Also there are no studies we come across in literature which states that PNF drives neural plasticity as MRP does. Also we have not come across any experimental study with PNF, in chronic stroke population which had done follow up.

Thus the above mentioned reasons has explained why MRP has lead to better outcome in basic mobility in experimental group than PNF group in chronic stroke subjects.

CONCLUSION

Three weeks Motor relearning program done for half an hour, 3 times per week is effective for improving basic mobility of sit to stand ,stand to sit and walking in chronic stroke subjects in their home setting and subjects can maintain their basic mobility at 1-month follow-up also. Therefore, MRP should be recommended for improving basic mobility in chronic stroke subjects.

Limitations of study: Small numbers of subjects were recruited for the study. Subjects were between 40-60 years only. Chronic stroke subjects were less than or equal to 3 years only

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ABBREVIATIONS:

ANOVA- analysis of variance

SPSS - statistical package for social studies

Conflicts of interest: None

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