NEED BASED APPROACH: EFFECTIVENESS OF MOTOR RELEARNING PROGRAM ON FUNCTIONAL BALANCE, FUNCTIONAL MOBILITY AND QUALITY OF LIFE AMONG POST STROKE PATIENTS

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ABSTRACT

Background: Driven by increasing size and aging of populations, and escalating prevalence of risk factors such as smoking and tobacco use, unhealthy diet, physical inactivity and obesity, hypertension, stroke is becoming a major cause of premature death and disability in developing countries. Stroke is the leading cause of adult disability and second leading cause of mortality worldwide (WHO 2003). Balance impairment is important to consider after stroke since the number of falls are high and these falls can further lead to pathological events and additional declines in function and disability status. Based on the ICF model, neurological deficits from stroke are segregated into impairments of body function, activity limitations and participation restriction. Mobility is a critical part of maintaining independence and an essential attribute of quality of life. When mobility impairs, it restricts the ability of individuals to move about the residence or the community to perform necessary activities of daily life, disability results. Thus, impact leads to disability leading to emotional changes and quality of life. Different therapeutic approaches have been developed to enhance the functional recovery of patients after stroke. The Motor Relearning Programme (MRP) 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 practised within a context that can be task or environment specific.

Objectives: (1) To find out whether Motor Relearning Programme (MRP) is effective in improving functional balance and mobility by improving motor performance. (2) To find out effect of the functional improvement of motor performance on quality of life among post stroke patients.

Methodology: An interventional study was conducted at the OPD-16, Physiotherapy Department, S.S.G. Hospital, Vadodara, Gujarat. In this present study, total 34 patients included were both males and females with the age in between 40-65years who suffered first time from stroke, which was confirmed by CT SCAN/MRI and duration of stroke was at most 6 months, MAS at most 3 out of 6 and MMSE at least 23. Those patients who fulfilled the above criteria were referred to OPD were included and given training for functional balance and mobility skills through Motor Relearning Approach along with routine conventional exercises. To evaluate this, pre intervention and post intervention MAS, BI and SSQOL were taken as outcome measures.

Result: All the statistical tests and calculations were performed with the help of using MedCalc. Paired t-test was applied to evaluate the effectiveness of MRP on functional balance, functional mobility and quality of life among post stroke patients. Statistical analysis showed that p<0.0001 at 95% CI and hence the results were statistically highly significant. And the correlation analysis also showed that there is significant relationship between post intervention BI and SSQOL (r = 0.489), while correlation was less significant between post intervention MAS and SSQOL (r = 0.129).

Conclusion: Motor Relearning Program along with conventional therapy is effective in improvement of functional balance, functional mobility and quality of life among post stroke patients and it can be effectively used for post stroke patients in physiotherapy setups and community based rehabilitation to improve functioning in activities of daily living.

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patients will only improve if they practise a range of actions under the conditions occurring in daily life and if they are challenged to extend the limits of stability. [3]

Based on the ICF model, neurological deficits from stroke are segregated into impairments of body function, activity limitations and participation restriction. Impaired mobility function is one of the earliest and most characteristic symptoms of wide variety of neurological dysfunction. Mobility is a critical part of maintaining independence and an essential attribute of quality of life. [4] When impairment in mobility restricts the ability of individual to move about the residence or the community to perform necessary activities of daily life, disability results. Walking ability is emphasized for measuring rehabilitation outcomes because it significantly affects patient’s ability to return to the premorbid environment. [5] These functional impairment affects the quality of life style which leads to deterioration in self-confidence and self-esteem. And hence, their participation in the society is also restricted. Thus, impairment leads to disability leading to emotional changes and quality of life.

The Motor Relearning Programme (MRP) [3,6,7] 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 practised within a context that can be task or environment specific. [6] It utilizes a training programme that focus on specific functional task to engage neuromuscular and musculoskeletal systems. So this study aimed at evaluating the effectiveness of Motor Relearning Program on functional balance, functional mobility and quality of life among post stroke patients.

**METHODOLOGY**

An interventional study was conducted at the OPD-16, Physiotherapy Department, S.S.G. Hospital, Vadodara, Gujarat. Total duration of the study was one year. The duration of the intervention provided to the patients was 6 weeks. Total 34 post-stroke patients referred to OPD fulfilling the inclusion and exclusion criteria were included in the study after the ethical clearance. The inclusion criteria were 1) First-ever stroke with hemiparesis verified clinically and by CT SCAN/MRI. [8] 2) Patients have to be between 40 to 65 years of age group and both male and female patients. [9] 3) The stroke have must occurred within 6 months [10] (eligible patient for outpatient setting) 4) MMSE score of at least 23. 5) MAS at most 3 out of 6 and the exclusion criteria were history of other neurological diseases (i.e. chronic stroke, Parkinson’s disease, multiple sclerosis); musculoskeletal injuries, fixed contracture or deformity; other co-morbidities; subject was unable to give informed consent. A written and informed consent about enrolment in the study and maintaining adequate privacy and confidentiality was taken from all patients included in the study. Those patients who fulfilled the above criteria were included and given training for functional balance and mobility skills through Motor Relearning Approach that is MRP along with routine conventional exercises and to prevent accidents during exercise, a little assistance was permitted if required.

| Balanced sitting: Sitting on firm surface, hands in lap, feet and knees approximately 15 cm apart, feet on floor. | Head and trunk movements: Turning head and trunk to look over shoulder, returning to midposition and repeating to other side. Looking up at the ceiling and returning to upright. |
| Balanced standing: Standing on a firm surface, hands over side of body, feet apart, while therapist stabilizes affected side of knee. | Reaching actions: Reaching forward (flexing at the hips), sideways (both sides), backward, returning to midposition. Therapists’ assists in shoulder forward flexion over affected side, one hand on elbow and other hand on wrist. |
| Standing up and sitting down: Sitting on a firm flat surface, no arm rests, feet flat on floor, no flexion within upper body throughout action. | Standing up: Start with upper body vertical, feet placed backward. Patients swings upper body forward at the hips and stands up. A therapist stabilizes paretic foot and knee, one hand over trunk and other hand over knee, to prevent buckling. Sitting down: Patient flexes hip, knee and ankles to lower body mass toward the seat. While therapist assists the movement. |
| Walking: | Stance phase: a) Standing with hip in correct alignment, patient practices stepping forward then backwards with intact leg, making sure that patient extends his affected hip as he steps forward. b) Walking sideways. Swing phase: a) Patient lie prone on bed, therapist flexes knee to just below a right angle. Patient practices controlling his movement. b) Patient standing on intact leg, therapist holds the patient’s affected foot in dorsiflexion, with knee in extension. Patient moves his weight forward on to heel. |

To evaluate this, pre intervention and post intervention Motor Assessment Scale (MAS) in that only item 3 (balanced sitting), item 4 (sitting to standing) and item 5 (walking); Barthel Index (BI) and Stroke Specific Quality of Life (SSSQOL) were taken as outcome measures.

**RESULTS**

All the statistical tests and calculations were performed with the help of using MedCalc.

<table>
<thead>
<tr>
<th>Table 2 Patients characteristics</th>
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</thead>
<tbody>
<tr>
<td>Characteristics</td>
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<tr>
<td></td>
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<tr>
<td>53.617 ± 8.499</td>
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</tbody>
</table>

Paired t-test was used to compare the pre intervention and post intervention values of three outcomes MAS, BI and SSSQOL.
Thus, the p value obtained for all the three outcomes for 34 patients receiving MRP is <0.0001, which indicates that the results are statistically significant at 95% confidence interval before and after the given intervention.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Mean difference ± sd</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAS</td>
<td>9.294 ± 0.835</td>
<td>64.831</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>BI</td>
<td>57.941 ± 13.546</td>
<td>24.940</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>SSQOL</td>
<td>78.324 ± 16.747</td>
<td>27.270</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

This graph represents the correlation between BI and SSQOL after intervention and its value is correlation coefficient $r = 0.489$

**DISCUSSION**

As optimal functional recovery is the ultimate goal in stroke rehabilitation, in the present study the Motor Relearning Programme (MRP) was inculcated among patients of post stroke who were functionally dependent. The main focus of the present study is to train and relearn the functional activities especially balance and mobility skills to improve their quality of life. Although, Pollock A. et al. [2014] [11] conducted systemic review in which the findings summarized that physical rehabilitation, comprising a selection of components from different approaches is effective for recovery of function and mobility after stroke. Evidence indicates that physical rehabilitation should not be limited to named approaches, but rather should comprise clearly defined, well described, evidenced based physical therapies, regardless of historical or philosophical origin. Henceforth this study was conducted to evaluate the effectiveness of MRP on functional balance, mobility and quality of life among post stroke patients.

According to Motor learning theory [12], the ways in which motor patterns can be acquired and modified is through experiential learning, such as through observations and repeated practice. The people with a damaged brain have deficits in motor programmes, motor memory, and associated feedback and feed forward mechanisms, which largely impede their functional performance. Hence, the Motor Relearning Approach promotes the regaining of normal motor skills through task-oriented practice with appropriate feedback and the active participation of the patients. In this present study all the patients whose duration of stroke was at most 6 months received MRP (along with the routine conventional exercises) for improving functional balance and mobility for six days a week for total six weeks. The analysis of the results of before and after intervention were statistically highly significant (p<0.0001) which showed that the need based approach, that is MRP, is effective to improve functional balance, functional mobility and quality of life. Similarly, the study done in 2013 by Bhalerao also suggest that MRP is more effective in early enhancement of activities of daily living and ambulation starting at 2 weeks of treatment. Hence, improvement is because MRP in initial phase of rehabilitation helped in learning of the motor control and pattern of movement for specific activity and not just learning the non task specific movement and motor control of movement. This active participation and self reliance helped in motor learning of the pattern of movement, in a given context and task. [11]

Statistical analysis of the results of the present study showed that values of mean difference of MAS & BI pre and post intervention, which are 9.294 ± 0.835 & 57.941 ± 13.546 respectively, are highly significant as the p value is <0.0001 which indicates that the effect of MRP is robust for functional recovery among post stroke patients which was similar to the findings from the study of Langhammer and Stanghelle, 2000; Nammourah and Bar-Haim, 2008; Van Vliet et al., 2005; Chan et al., 2006; Paci, 2003; French et al., 2007 [13,14,9], the functional effects of task oriented exercises in the acute treatment of stroke seem to be robust.
As we go about our daily activities, the postural system must need three principal challenges: maintain a steady posture, generate postural adjustments that anticipate goal-directed movements and are adaptive as movement unfold, and react swiftly and appropriately when we predict a threat to balance. According to literature [7, 3], balanced sitting, sit-to-stand, balanced standing and walking are the demanding everyday tasks we perform regularly (Berger et al, 1988) and lack of independence in these tasks in stroke patients has been reported to be the likely factors associated with risk of institutionalization (Branch and Meyers 1987). Also, Nichols et al. (1996) revealed that sitting balance was necessary to perform most self-care activities, such as dressing, transferring and eating, whereas standing balance was necessary for coping with household and outdoor activities. [14,15] Postural adjustments in most of these activities requires to move the body mass forward from a large BOS (thighs, feet) to small BOS (feet) and to extend the lower limbs to raise the body mass over the feet. And so support, propulsion and balance are the major attributes. Postural adjustments are anticipatory and ongoing and changes occur in muscular organization of a person, occur simultaneously with the plan to move and prepare the person for performing the task. The anticipatory postural adjustment of muscular activity is impaired in stroke patients. [16] So in present study, the patients underwent motor strategies according to MRP which train postural adjustments to the shift in COG and these postural adjustments are brought about by muscle activation and movement of segments. Postural adjustments (and therefore muscle activity) are probably task specific (and posture specific).

By indulging patients in MRP, the possible mechanism emphasized may be movement strategies described by Horak & Nashner. [17], which include ankle, hip and stepping strategies as the deficits in motor components of balance control can be caused by musculoskeletal and/or neuro-muscular impairments. These strategies suggest that pre programmed muscle synergies comprise the fundamental movement unit used to restore balance which are activated during specific task. And the responses targeted include lower limb strengthening and vestibular stimulation too.

The activities imparted in the present study are such that they focused on the key point of control like head, neck, trunk and pelvis which according to Bobath & Bobath 1984 [18] change the patterns of spasticity so that a patient is prepared for movement and correct the posture.

The current concepts on Brain Plasticity suggest that neuronal cortical connections can be remodelled by our experience. [19] In this need based approach, MRP, there is analysis of abnormal pattern movement of the different task which focus on the relearning of daily activities, correction of these abnormal patterns and repetitive practice of a task which can facilitate the development of new motor programs or the refinement of existing programs in order to improve performance of the task in different environment and daily life situations (Carr et al., 1987, 1998). As the nervous system is dynamic, according to the theory of Neuroplasticity, the nervous system is adaptable and changing when there are demands from the environment, from new learning, developmental processes and from a variety of experiences. The following influence the changes in the structure and neurophysiology of a developing nervous system or damaged nervous systems in children, adolescents and adults (Kidd et al. 1992) [20,21] ; Practice and repetition, Task-related voluntary actions for learning, Movements in the context or under conditions in which they are to be used, Active and purposeful sensorimotor experiences which are part of a person’s daily life. Early treatment takes more advantage of neuroplasticity after brain damage in children, adolescents and adults. Similarly, the study done by Yin et. al. (2013) [22] in Rhesus Macaque following MRP for sixty days showed significant functional improvement as the study concluded that MRP promoted neuronal regeneration, repair and angiogenesis in surrounding of infracted hemisphere and hence improved neurological function. These widespread synaptic changes may be the underlying physiological mechanism for relearning or compensatory process which is actually responsible for recovery.

Degree of support is the factor by which the progress is judged and that defines the quality of life of an individual. Taking this into consideration, the secondary objective of this present study is to find the effectiveness of MRP on quality of life and the results from the correlation analysis suggest that there is significant relationship between post intervention BI and SSQOL (r = 0.489), while correlation was less significant between post intervention MAS and SSQOL (r = 0.129). The mean difference of pre and post intervention value of SSQOL is 78.324 ± 16.747(p=0.0001) which shows that there is significant effect of intervention on quality of life, as the better quality of life could be explained by a significant improvement in functional mobility. [23] Langhammer et al. has also seen that regular exercise have an effect on motor function, balance, mobility and independence in ADL which have effect on enhanced QOL. [24] Hence, the Motor Relearning Programme is significantly better on the activity level (World Health Organization, 2001).

So based on the results obtained we reject null hypothesis that ‘There will be no significant effect of Motor Relearning Program on functional balance, functional mobility and quality of life among post stroke patients and we accept the alternative hypothesis that ‘There will be significant effect of Motor Relearning Program on functional balance, functional mobility and quality of life among post stroke patients.’ And conclude that MRP along with conventional therapy is effective in improvement of functional balance, functional mobility and quality of life among post-stroke individuals and can be effectively used in physiotherapy setups and community based rehabilitation as early intervention to improve functioning in activities of daily living.

Carr and Shepher's motor relearning programme provides the foundation for the present study. The findings from this clinical trial suggest that 'sequential' and 'function-based' training are equally important for enhancing patients' functional recovery after stroke.

CONCLUSION

Motor Relearning Programme along with conventional therapy is effective in improvement of functional balance, functional mobility and quality of life among post stroke patients and it can be effectively used for post stroke patients in physiotherapy
setups and community based rehabilitation to improve functioning in activities of daily living.

Limitations
1. Results of males and females cannot be compared because of fewer female patients as compared to male patients.
2. Division of patients according to age group was not done in the study.
3. Follow up of patients was not done after completion of intervention duration; hence long term benefits of the intervention are unknown.
4. Sample size was small.

Suggestions
1. Same study can be done involving equal number of male and female patients comparing results among them.
2. A Comparative study including different age groups or different duration of stroke can be done.
3. A further study can be carried out to know the long-term benefits of the intervention.

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References

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