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Effect of Motor Relearning Program with Obstacle Walking on Dynamic Gait Performance and Functional Mobility in Subacute Stroke Subjects

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Abstract

Background: Gait difficulties are common post-stroke due to muscle weakness and postural imbalance. Motor relearning program is known to improve motor skills through task oriented practice, appropriate feedback and active participation of subjects. Obstacle walking helps in improving gait parameters, stepping over objects, walking endurance and reduces fall risk.

Objectives: To determine effect of Motor Relearning Program with obstacle walking on dynamic gait performance and functional mobility in sub-acute stroke subjects.

Materials and Methods: 30 sub-acute stroke subjects were assigned to one of the two groups. Group-A received Motor Relearning Program and Group-B received Motor Relearning Program with obstacle walking for 30 minutes, 5 days a week for 4 weeks. Both groups received 15 minutes of conventional exercises for upper limb. Dynamic gait performance and functional mobility were assessed pre- and post-intervention at 4 weeks using Dynamic Gait Index and Motor Assessment Scale.

Results: Pre-test scores of DGI and MAS were 11.53±3.53 and 3.83±0.48 in Group-A, 12.43±4.12 and 3.67±0.81 in Group-B which improved to 15.80±3.82 and 4.07±0.59 in Group-A, 18.67±4.86 and 4.73±0.96 in Group-B, post-intervention. Within group comparison of pre to post-test scores of DGI and MAS was found to be statistically significant in both groups. When post-test scores of DGI and MAS were compared in between groups, Group-B was found to be statistically significant than Group-A ($p<0.05$).

Conclusion: Both interventions were individually effective but Motor Relearning Program with obstacle walking was better than Motor Relearning Program alone to improve dynamic gait performance and functional mobility in sub-acute stroke subjects.

Keywords: Stroke, Motor Relearning Program, Obstacle Walking, Dynamic gait performance, Functional Mobility, Dynamic Gait Index, Motor Assessment Scale.

Introduction

Stroke is an acute, irreversible cerebrovascular accident caused due to interruption of blood flow in the brain[1] leading to motor impairment,[2] loss of voluntary control and walking speed affecting balance and mobility.[3] Deficits in gait, posture and

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walking speed require more energy consumption during walking. Asymmetric body alignment leads to imbalance and increases fall risk.[4, 5] Living with these post-stroke deficits increase the burden on the individual's family and community.[6] The recovery of mobility, especially walking is an important goal in both neurologic and geriatric population and therefore is an essential part of rehabilitation.

Motor Relearning Program (MRP) can train muscle activity and function preventing compensatory activity. Learning and mastering a motor skill depends on correcting unwanted muscle activity, feedback, practicing individual components of movement, understanding the relationship between postural adjustment and movement, progression of the activity and skill transfer.[7, 1] MRP helps in regaining control over motor activity in post-stroke individuals. An obstacle training program helps in balance and walking endurance thereby improving gait parameters, paretic side foot clearance, spatial temporal symmetry and better stride length.[8,5,9] It places a high demand on both the limbs and requires well-coordinated joint movements, helping individuals to understand motor deficits while crossing over objects.[10] Post-stroke, patients and their families face challenges that greatly alter their life style as a result of the sudden loss of functional independence.[9] MRP helps in achieving motor skills with task oriented approach and appropriate feedback.[1] Literature evidence suggests the importance of MRP in gaining functional recovery in post-stroke subjects than those who were in the conventional therapy in terms of balance function, performance on self-care and activities of daily living and integration into the community.[6] There is a dearth of literature on the effect of MRP in the lower limb and a previous study suggested the use of MRP in improving dynamic gait performance and functional mobility.[11] Similarly, the combined effect of MRP and obstacle walking on gait was not studied extensively. So this study aims to determine the effect of MRP along with obstacle walking on dynamic gait performance and functional mobility in sub-acute stroke subjects.

Methods and Methodology

30 male and female subjects between 40-65 years of age with sub-acute stroke (4 weeks to 6 months post-stroke)[12] were recruited and randomly assigned to one of the two groups. Subjects who could walk independently or by using an assistive device, having good cognition with Mini Mental State Examination score of 23 or greater and a score of 4 or greater on the Brunnstrom voluntary control grade were included in the study. Individuals with unstable cardiovascular, musculoskeletal or medical conditions, visual disturbances or any other neurological co-morbidities were excluded. Ethical clearance was obtained from the Institutional Ethical Committee and informed consent was taken from all the subjects. Demographic variables such as age, gender, type and duration of stroke were documented. Pre and post-intervention, dynamic gait performance and functional mobility were assessed using Dynamic Gait Index (DGI) and the walking component of Motor Assessment Scale (MAS) respectively. DGI and MAS were widely studied for their reliability and validity to assess gait and functional mobility.[13, 14, 15, 16, 17, 18]

Intervention conducted on the subjects

Subjects in Group A received MRP training which varied for each subject based on the missing components and difficulty they experienced while walking. Analysis of function, practice of the missing components and the activity, its progression and transference of learning were considered while training. The essential gait components were trained for during the stance and swing phases.[19] Subjects in Group B received MRP along with obstacle walking training on a 10 meter way on which obstacles were placed and the participants were asked to step over the obstacles while walking.[5] All subjects were given training for 30 minutes per session, 5 times a week, for 4 weeks. The frequency of exercise was based on the individual's physical performance and subjects were given rest whenever required while training. Both groups received another 15 minutes of conventional exercises for upper limbs which included stretching, range of motion and strengthening exercises.[20, 21]

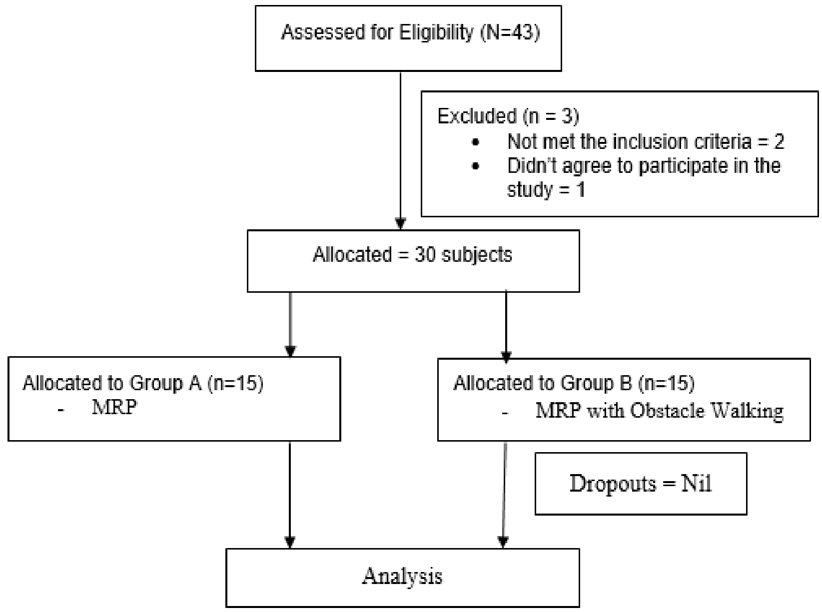

Fig 1: Consort Flow Diagram

Results

Table 1: Range, mean and SD of age and gender of subjects with subacute stroke in both the groups

S. No.	Variable	Group A	Group B
1	Age in Years	50.80±6.71	48.33±6.70
2	Male / Female	9(60%) / 6(40%)	10(66.7%) / 5(33.3%)

Table 2: Range, mean and SD of outcome measures of subjects with subacute stroke in Group A

S. No.	Outcome measures	Group-A				Wilcoxon test	p-value
		Pre test		Post test			
		Range	Mean ±SD	Range	Mean ±SD		
1	DGI	5-17	11.53±3.53	8-21	15.80± 3.82	z=4.800^S	p<0.001
2	MAS	3-4	3.83±0.48	3-5	4.07±0.59	z=4.833^S	p<0.001

Note; S-Significant(p<0.05)

Table-3: Range, mean and SD of outcome measures of subjects with subacute stroke in Group B

S.No.	Outcome measures	Group-B				Wilcoxon test	p-value
		Pre test		Post test			
		Range	Mean ±SD	Range	Mean ±SD		
1	DGI	3-17	12.43±4.12	7-24	18.67± 4.86	z=3.820^S	p<0.001
2	MAS	2-5	3.67±0.81	3-6	4.73±0.96	z=3.557^S	p<0.001

Note; S-Significant (p<0.05)

Table 4: Range, mean and SD of outcome measures of subjects with sub-acute stroke in between the groups

S. No.	Outcome measures	Pre test		Post test	
		Group-A	Group-B	Group-A	Group-B
		Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD
1	DGI	11.53±3.53	12.43±4.12	15.80± 3.82	18.67± 4.86
2	MAS	3.83±0.48	3.67±0.81	4.07±0.59	4.73±0.96
Between groupcomparisons: Mann-Whitney U test		• DGI: Z=0.814, p>0.05, NS • MAS: Z=1.821, p>0.05, NS		• DGI: Z=2.019: p<0.05, S • MAS: Z=2.029, p<0.05, S	

S- Significant (p<0.05); NS – Not Significant (p>0.05)

Discussion

The present study aimed to determine the effect of MRP with obstacle walking on dynamic gait performance and functional mobility in sub-acute stroke subjects. Subjects in both groups were homogenous in terms of their age and gender. 15 subjects in Group-A were treated with Motor Relearning Program and the pre- to post-intervention results showed improvement in both DGI and MAS scores (p<0.001). The results are in line with previous literature where the authors observed that motor relearning was effective for improving functional recovery post-stroke. Motor learning takes place through observation and practice. It helps regain normal motor skills using task-oriented practice, appropriate feedback, self-reliance and active participation of subjects.[6, 22] Introducing normal daily routine, early intervention and task specific training during the initial phase of rehabilitation must have helped in motor control.[23] MRP concentrates on training real life activities adding specificity and variability to the tasks practiced.[24] In the present study, it was observed that the missing components of gait were different in each individual. It was seen that if foot dorsiflexion was weak in some participants, a few other participants had difficulty doing knee flexion. In MRP, the whole task was broken down into discrete parts, and then, individual components were practiced separately. MRP can help improving attention and inhibitory control, flexibility and updating memory which could have a direct relation with improvements in functional skills and mobility.[11] In Group-B, subjects were treated with MRP and Obstacle walking and significant improvement was observed between the pre- to post-intervention scores (p<0.001). The results of the present study are in line with Tung-Wu Lu et al., who observed improvement in gait with obstacle training by a specific symmetric kinematic strategy which primarily consisted of increased posterior pelvic tilt, a kinematically efficient way to elevate swing toe. During obstacle walking, post-stroke individuals seemed to adopt a strategy involving swing hip and knee flexion to maintain constant toe clearance. Pelvic control was more efficient than the distal hip or knee control and posterior pelvic tilt offered a more efficient approach to elevate the swing toe.[10] In another study, authors observed that obstacle walking helped foot clearance of the paretic limb during swing phase, also increasing knee flexion and ankle dorsiflexion which improved gait in community dwelling stroke survivors.[8]

While comparing the pre-test scores of DGI and MAS among the subjects in between the groups, it was observed that the scores were not statistically significant (p>0.05) and the subjects in both the groups were homogenous. When the post-test scores of DGI and MAS were compared in between the groups, though both groups improved individually post-intervention, Group B showed more significant improvement than Group A (p<0.05). It could be because of the combined effect of MRP and obstacle walking training. MRP involved assessment and training of various activities of daily living. This practice could have led to relatively permanent changes in skilled behavior.[25] On other hand, Obstacle walking helped gait parameters by improving the ability to step over objects, balance and walking endurance and speed.[8, 9, 20] Due to time restrictions, long term follow up and changes in functional mobility could not be assessed. In the present study, subjects who were able to walk independently were included. It is recommended to apply MRP with obstacle walking in subjects who need assistance.

Conclusion

Based on the results of the study, it can be observed that though MRP and MRP with obstacle walking are individually effective, MRP with obstacle walking was more effective in improving the dynamic gait performance and functional mobility in sub-acute stroke subjects and it can be considered as an integral part of gait rehabilitation.

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Ethical Clearance: Obtained from the Institutional Ethical Committee of Padmashree Institute of Physiotherapy. Ref: PIP/EC/02-03/03-2020, Date: 02.03.2020.

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