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ORIGINAL ARTICLE

A STUDY TO KNOW THE EFFECTIVENESS OF TASK ORIENTED PROGRESSIVE RESISTANCE STRENGTH TRAINING ON LOWER EXTREMITY STRENGTH AND FUNCTIONAL PERFORMANCE IN PATIENTS WITH CHRONIC STROKE

Rahul shaik[1], Sameeha Shabnam[2]

[1]MPT Neurosciences, Assistant Professor, SIMS College of Physiotherapy, Mangaldas Nagar, Guntur.

[2]Sameeha Shabnam, Post Graduate Student, Neurosciences, Sims College Of Physiotherapy, Mangaldas Nagar, Guntur.

ABSTRACT

Background and Purpose: *The early stroke rehabilitation literature raised concerns that resistance training might adversely affect movement performance by increasing spasticity. But no empirical evidence supports these claims. Moreover, there is mounting evidence that progressive resistance strength training is effective in improving muscle strength following stroke. The purpose of the present study was to examine the effectiveness of task-oriented progressive resistance strength training on lower extremity strength and functional performance in chronic stroke subjects.*

Methodology: *Total of 30 patients was divided in to two groups and one group is given strength training and another is given task oriented strength training. The improvement in step length, staid length, cadence and lower limb muscle strengths were compared between both groups.*

Results: *The results of this study have revealed that there is no significant change noticed in both the groups with regards to parameters such as quadriceps (p=0.0657), dorsiflexors strength (p=0.0657), step length (p=0.2413), stride length (p=0.6798), and cadence (p=0.1403).The results indicated no significant difference in gait parameters between groups and the strength improvement is more in task oriented strength training group.*

Conclusion: *Both strength training and task oriented strength training are similar in getting effects in functional recovery and strength gain. This means strength training also as effective as task oriented strength training if the technique of application and specific set of exercises are not incorporated in task oriented strength training protocols.*

Keywords: *Stroke Rehabilitation, Task Oriented Strength Training, Strength Training, Lower Limb Recovery*

INTRODUCTION

Stroke, as defined by World Health Organization is a clinical syndrome consisting of rapidly developing clinical signs of focal disturbance of cerebral function lasting more than 24 hours or leading to death with no apparent cause other than vascular origin interrupted.1 It is reported that 1.2% of total deaths occur in India due to stroke. It is the third leading cause of death and second leading cause of disability .2In India the overall age adjusted prevalence rate for stroke is estimated to lie between 84- 262/ 100,000 in rural and between 334-424/ 100,000 in urban areas.3Global Burden of Disease study estimated the prevalence of India is projected to increase to 91/ 100,000 in 2015 and to 98/100,000 in 2030.3

Stroke is the most common cause of chronic disability of survivors, an estimated one-third will be functionally dependent after one year experiencing difficulty with activities of daily living (ADL), ambulation, speech, mostly involving functional limitations (limitations in performing functional tasks at the whole-body level).4 Approximately 22% are unable to walk without assistance, 26% are dependent in activities of daily living, 26 % seek institutionalized care. A stroke usually results in some degree of muscle weakness. The observed muscle weakness in the post stroke population has been attributed to reduced muscle fiber size, decreased firing rate, atrophy of type II muscle fibers, increased fatigue, decreased motor unit numbers and altered motor unit recruitment5. This results in marked deficits in balance and gait. Decreases in gait velocity, cadence, and step length are hallmark features of gait in patients with stroke .Gait deviations such as hip-hiking, hip circumduction, or drop foot are commonly noted6. Approximately two- thirds of acute hospitalized stroke patients cannot walk independently. Of those who recover their ability to walk, many are still disabled by slow walking speed and limited endurance7.Lower functioning hemi paretic stroke subjects would fail to effectively recruit both the hip flexors and ankle plantar flexor muscles of the paretic side. This failure in the lower functioning hemi paretic subjects would not only limit the potential to increase walking speed but would also introduce compensations on the non- paretic side.

Progressive resistance strength training refers to progressive increases in resistance to a muscle as training induces greater ability to produce and sustain force.8 The key elements of progressive resistance strength training are to provide sufficient resistance, to progressively increase the amount of resistance as strength increases, and to continue the training program for a sufficient duration (a minimum of four weeks) for benefits to achieve. Progressive resistance strength training has been used successfully to restore function in older adults with chronic disease and frailty.9

Literature has revealed that only a few clinically controlled trial studies have conducted motor relearning approach on stroke patients. The results of these studies suggested that patients tend to have a short hospital stay and high functional independence. Patients also showed a significant increase in gait velocity. However, these studies did not provide detailed information on how task-oriented strategies were developed and used. This study sought to investigate the effect of using a sequential function-based task strategy in a six-week motor relearning program

for improving the balance function and functional performance of a group of post stroke patients.

The ability to walk independently with efficient velocity and endurance is one of the major goals for rehabilitation after stroke. The discrepancy between strength gain and gait changes may be related to the fact that the strengthening protocols did not match the recruitments of functional task in terms of range of motion, velocity etc. Practice of content specific task has the advantage of directly practicing a problematic functional activity. According to Marie-Helene the strengthening protocols did not match the requirements of functional tasks and as the forward propulsion of body centre of mass is a central task of walking, task specific exercises are given to improve their gait performance10.

METHODOLOGY

Subjects were recruited from SIMS hospital. The age, sex, paretic side, and onset time of hemiparesis were obtained from patient interviews, and confirmed via medical records review. The subjects with one year of stroke who can able to walk 10mts independently without any assistive device and who are able to follow instructions and commands were included in the study. The subjects who are having neurological disease affecting balance other than stroke,vestibular lesions, Musculo-skeletal disorders,-cardio-vascular disorders were excluded from the study.A total of 40 stroke patients were taken, out of that a sample of 30 subjects were recruited who are willing to participate in the study after obtaining the consent form and the patients who met the inclusion criteria.

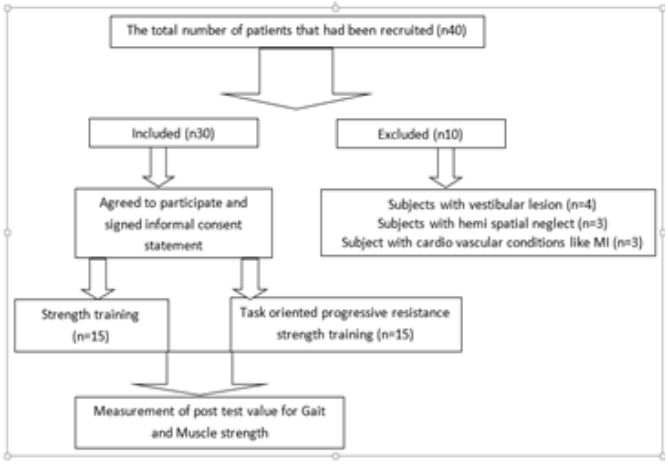


CHART 1: CONSORT FLOW CHART OF RANDOMIZATION AND INTERVENTION

These 30 subjects were randomized into two groups 15 Strength training Group (control group) i.e. Group - A and 15 task oriented strength training Group (experimental group) i.e. Group- B. All subjects were evaluated before commencement of training and at the end of the four-week training period with the outcome measures of gait parameters such as stride length,step length,cadence and also quadriceps and dorsiflexors muscle strength.

Each subject in strength training group was assessed for muscle strength by using 10 RM and the progressive resisted exercises are given according to oxford technique. Muscles of lower limb were strengthened in sitting position by using thera bands and weight cuffs. Quadriceps table was also used. Subjects in the experimental group participated in 30 min of task-oriented progressive resistance strength training to bilateral lower limbs in a functionally relevant way three times a week for four weeks. The six workstations were incorporated into the circuit of training (1) standing and reaching in different directions for objects located beyond arm's length to promote loading of the lower limbs and activation of lower limb muscles; (2) sit-to-stand from various chair heights to strengthen the lower limb extensor muscles; (3) stepping forward and backward onto blocks of various heights to strengthen the lower limb muscles; (4) stepping sideways onto blocks of various heights to strengthen the lower limb muscles; (5) forward step-up onto blocks of various heights to strengthen the lower limb muscles; (6) heel(s) raise and lower while maintaining in a standing posture to strengthen the plantar flexor muscles. Each workstation was 5 min in duration for each exercise class. Each subject participated in a one-to-one therapy. Subjects were encouraged to work as hard as possible at each workstation and were also given verbal feedback and instructions aimed at improving performance. Progressions included increasing the number of repetitions completed within 5 min at a workstation and increasing complexity of the exercise performed at each workstation, such as the distance reached in standing, reducing the height of the chair during sit-to-stand, and the height of the blocks.

Fig 01: Strength training

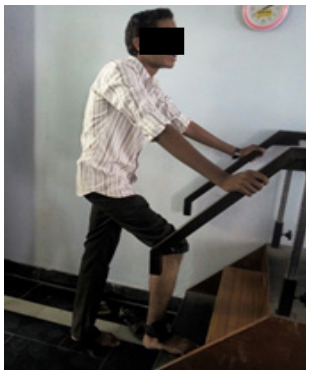


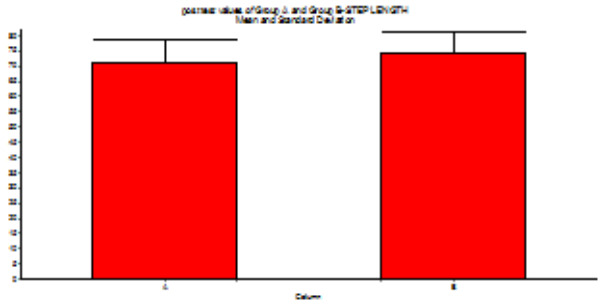
Fig 02: Task oriented strength training

DATA REPRESENTATION AND ANALYSIS

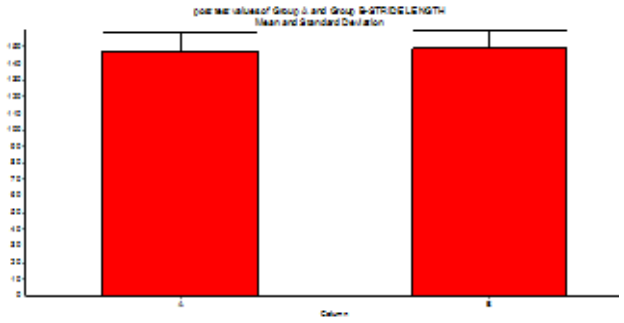
Statistical results		Step length		Stride length		cadence		Q'seps strength		Dorsiflexors strength	
		Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B
Mean	Pre	57.733	61.533	131.06	128.87	57.133	57.800	2.600	2.666	2.400	2.533
	Post	71.200	74.330	147.40	149.40	75.000	80.933	3.660	3.933	3.660	3.933
S.D.	Pre	9.896	8.175	9.787	10.990	5.655	4.648	0.5071	0.4880	0.5071	0.5164
	Post	7.213	7.108	10.776	10.225	10.941	10.464	0.4880	0.2582	0.4880	0.4648
S.E.	Pre	2.555	2.111	2.527	2.838	1.460	1.200	0.1309	0.1260	0.1309	0.1333
	Post	1.862	1.835	2.782	2.640	2.825	2.702	0.1260	.06667	0.1260	.06667
P Value		0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Table 1: Statistical Analysis of All Parameters

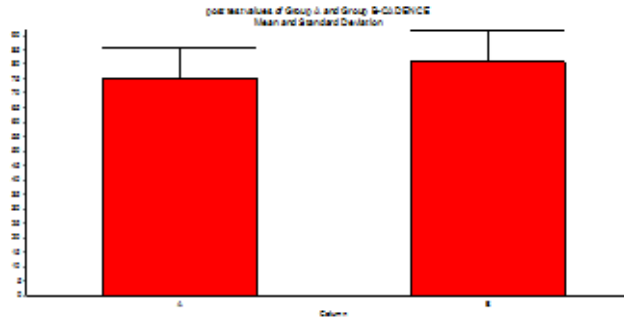
DIFFERENCES IN ALL OUTCOMES BETWEEN GROUP –A AND GROUP –B AFTER TREATMENT



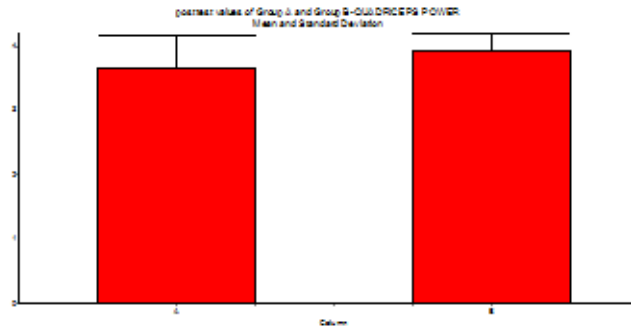
Graph: 1 comparison of step length between groups after treatment.



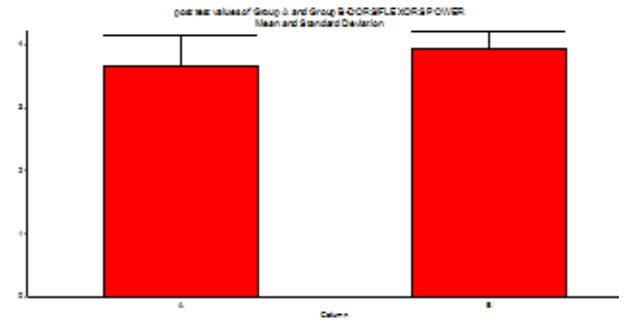
Graph: 2 comparison of stride length between groups after treatment.



Graph: 3 comparison of cadence between groups after treatment



Graph: 4 comparison of quadriceps strength between groups after treatment



Graph: 5 comparison of dorsiflexors strength between groups after treatment

RESULTS

Comparison of step length between Group A and Group B after treatment is considered not significant with P value is 0.2413, t = 1.197. Comparison of stride length between Group A and Group B after treatment is considered not significant with P value is 0.6798, t = 0.4171. Comparison of cadence between Group A and Group B after treatment is considered not significant with P value is 0.1403, t = 1.518. Comparison of quadriceps strength between Group A and Group B after treatment is considered not significant with P value is 0.0657, t = 1.915. Comparison of dorsiflexors strength between Group A and Group B after treatment is considered not significant with P value is 0.0657, t = 1.915.

DISCUSSION

Impairment in muscle strength is thought to be an important limiting factor in determining walking speed after stroke. So, the purpose of this study is to compare the effectiveness of task-oriented progressive resistance strength training and strength training in improving affected lower limb function in chronic stroke patients.

The results of this study have revealed that there is no significant change noticed in both the groups with regards to parameters such as quadriceps (p=0.0657), dorsiflexors strength (p=0.0657), step length (p=0.2413),stride length (p=0.6798), and cadence (p=0.1403).The results indicated no significant difference in gait parameters between groups and the strength improvement is more in task oriented strength training group. But the strength of statistical significance is very less. For both quadriceps and dorsiflexors strength the p value is 0.0657 which indicates the difference is not quite significance. Strength training group received oxford technique of training. In this the progression like inverted pyramid, which begins from 100% of 10 RM, 75% of 10 RM, 50% of 10 RM, and finally 25% of 10 RM. The selected protocol is to target the fatigue which occurs during resisted training. Even though there is no difference in De'lorm technique and oxford technique in improving muscle strength and tissue changes 11 this study opted oxford technique because the Counter group is receiving task oriented training where the development of fatigue is obvious when performing a task, to get same effects there is a need of other group to be treated same. It is possible that improved motor unit recruitment and motor learning (the development of neuro-motor patterns of co-ordination between agonist and antagonist muscles through practice of a skill) may have contributed to some degree in both the groups.

Both strength training and task oriented resisted training are showing similar effects in this study, where as literature is supporting task oriented training. This may be due to the gross improvement of strength may improve the functional activities irrespective of the technique applied12. Improving gait parameters is due to improved ability to stand and walk. This is not possible without strength in lower limb muscles. For individuals after stroke, walking is a highly practiced functional task where the learner has to reacquire the motor abilities associated with gait function13. But in this study all of the exercises that are incorporated in task oriented strength training program concentrated on promoting loading of lower limbs. This additional body weight loading over lower limbs in task oriented strength training group explains the mean increment in strength of lower limb muscles14. Both trainings will improve the strength in anti gravity muscles so that helps in maintaining the stability. Task oriented trainings were effectively conducted in upper limb to evaluate functional recovery after stroke. Lower limb trainings are limited in the literature. And the methodological variations also exist. Increase in hip extension in late stance phase may be functionally important because these changes are associated with moving the trunk forward over the stance foot, thus providing the hip flexors with better mechanical advantage to generate power to pull-off the limb, resulting in a larger contra lateral step length and an increase in speed.

So in final the improvement in lower limb strength is the key factor to get improvement in lower limb functional recovery 15, 16. This study is not showing significant difference between strength

training and task oriented strength training. This may be because of same level of strength gain in both groups or low specificity of task oriented strength training protocol.

CONCLUSION

Both strength training and task oriented strength training are similar in getting effects in functional recovery and strength gain. This means strength training also as effective as task oriented strength training if the technique of application and specific set of exercises are not incorporated in task oriented strength training protocols.

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