Effect of Task-specific Training on Gait Parameters in Hemiparetic Stroke Patients

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Abstract

Functional mobility is viewed as essential to enabling an individual to engage in full range of life areas and is central to enabling the individual to participate in live situations. The walking after stroke is characterized by slow gait speed, poor endurance and in the quality and adaptability of walking patterns. The instantaneous adaptation to speed and load changes during over ground locomotion has major implication for mobility after stroke. Task specific training is a therapeutic approach based on System theory given by Berstein in 1967 to retrain the patients with movement disorders.

It is a one group pre test post test quasi experiment design with the objective of to find out the effectiveness of task specific training on gait parameters in right hemiparetic patients.

10 right hemiparetic patients (n=10) of either sex in the age group of 40-65 yrs (mean age 54.44 yrs) were selected by convenient sampling method and were assigned in one group. Different tasks in a prefixed pattern aiming at functional activities were introduced over a period of 40 min duration per day/session, 3 days a week and for total duration of 4 weeks. i.e. total 12 sessions.

Main outcome measures: Changes were measured in terms of Cadence, Step length, Stride length and Gait Velocity.

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Kaur J, Kumar A. Effect of Task-specific Training on Gait Parameters in Hemiparetic Stroke Patients. IJPMR 2009; 20 (1): 23-26.

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Significant statistical improvement was measured in terms of cadence (P= 0.038) step length and gait velocity (P= 0.033) whereas there is no significant statistical improvement in Step length (P= 0.140) and Stride length (P= 0.162).

Key Words: Hemiparetics, Gait Parameters, Task related Training, Cadence

Introduction

Stroke is rapidly developing clinical symptoms and / or signs of focal, and at times global (applied to patients in deep coma and to those with subarachnoid hemorrhage) loss of cerebral functions, with symptoms lasting more than 24 hours or leading to death, with no apparent cause other than that of vascular origin[1].

Ischemic stroke is the most common form of stroke, which accounts for 61% to 81% of all strokes. Hemorrhagic strokes account for 12% to 24% of strokes. Middle cerebral artery is the largest branch of cerebral artery which is most commonly affected in stroke. Clinical syndromes from middle cerebral artery infarction of either hemisphere results in contra lateral spastic hemiparesis and sensory loss of face, upper extremity and lower extremity, with face and upper extremity more involved than lower extremity[2].

The primary clinical manifestations following stroke are somatosensory deficits, motor deficits such as (alteration in muscle tone, abnormal synergy patterns, motor programming deficits and disturbances of postural control and balance), visual deficits, behavioral and intellectual deficits, perceptual dysfunction, cognitive dysfunction bowel and bladder dysfunction, impaired balance and coordination which all result in the impairment of locomotion and functional mobility[2].

The walking after stroke is characterized by slow gait speed, poor endurance and in the quality and adaptability of walking patterns. The instantaneous adaptation to speed and load changes during over ground locomotion have major implication for mobility after stroke[3].

In persons with hemiparesis, postural tone and co-ordinate reciprocal movements which are required for normal gait are usually impaired. Normal reciprocal movement is often replaced by a fixed pelvic retraction which makes it difficult for the patient to swing the affected lower

extremity forward. This result in a short step length and asymmetric steps often called 'Hemiplegic gait'. This slow gait can be observed in clinical setting as a decrease in gait speed and cadence[4].

Task specific training is a therapeutic approach to retrain the patients with movement disorders, based on system theory of motor control. This approach utilizes a training program that focuses on specific functional tasks to engage the Neuromuscular and Musculoskeletal systems. Patients are instructed to practice those tasks that present difficulties for them and to practice them[2].

Berstein, 1967 who gave the system theory recognized that it is impossible to understand the neural control of movement without understanding the characteristics of system that is moving and external and internal forces acting on the body and looked at the whole body as a mechanical system with mass, external forces such as gravity, and internal forces such as joint stiffness and inertia etc. He also suggested that control of integrated movement was probably distributed throughout many interacting systems working co-operatively to achieve movement[5].

Materials and Methods

Study Design: It is a quasi experimental design where the pre test values are compared with post test values within one group after treatment.

Study Setting: Tagore Hospital and Research Center, Jalandhar.

Population And Sampling: 10 Patients with right hemiparesis from Tagore hospital, Jalandhar were choosen as population for the study and were assigned in a single group.

Inclusion Criteria:

Ischemic stroke involving Left Middle Cerebral Artery Territory.
Right Hemiparesis with symptoms less than 6 months in the age group of 45-60 years.
Able to walk 10 meters independently with or without an assistive device.
Intact sensations.

Exclusion Criteria:

Stroke involving other arterial territories.
Hemorrhagic stroke.
Sensory impairments involving lower limbs.
Severe orthopedic or rheumatologic conditions interfering with gait.
Cognitive disorders.

During pre test, each subject was evaluated for Cadence, Step length, Stride length and Gait velocity. They received

Task-Specific training program as per protocol after obtaining informed consent from the patients.

Task-Specific program consisted of 8 activities. These activities were primarily intended to improve gait performance. 10 patients received task-specific program. The training session was of 40 min duration per day/ session (3 days a week) and total duration is 4 weeks (Total 12 sessions).

The post test scores were measured again after completion of 12th session for above selected gait parameters and results were compared for pre test and post test values to identify the amount of changes in the parameters selected.

The specified protocol was administered that included,

·   Sitting at a table and reaching in different direction for objects located beyond arm's length.

·   Stepping forwards, backward and sideways onto blocks of various heights.

·   Sit to stand from various stool heights Heel lift and standing (Figure 1)

·   Standing with base of support constrained with feet in parallel and random condition reaching for objects including down to the floor

·   Reciprocal leg flexion and extension.

·   Standing up from a chair.

·   Walking a short distance and returning to a chair.

·   Walking over slopes.

Material used: 3 Minute walk test, Stop watch, Finger paint, Paper roll, Calculator, Measuring Tape.

Cadence, Step length, Stride length and Gait velocity were used to measure the gait performance during pre test and post tests. Cadence measured the number of steps per minute. Step length measured linear distance from

Figure 1: Sitting to standing transition position

the point of heel strike of one extremity to the point of heel strike of opposite extremity.

Stride length measured the distance from the point of heel strike of one extremity to the point of heel strike of same extremity and Gait velocity measured the rate of linear forward motion of the body which can be measured in meters per minute.

Results and Discussion

The aim of the study was to investigate the effect of task-specific training program on gait parameters in patients with right hemiparesis.

10 patients (6 Males and 4 Females) participated in this study with mean age of 54.44 years (SD = 5.69). Paired 't' test was performed between pre test and post test values to analyze the significance of task-specific training program. Table value at degree of freedom 9 and at 0.05 significance level is 2.262.

For Cadence, the mean value before treatment was 59.90 steps/minute whereas the value at post interval, it was 61.60 steps/minutes. Calculated 'T' value (2.429) was greater than Table value and "p" value (0.036) was also too low. This indicates that there is a significant improvement in gait performance (Table 1).

	Cadence (Steps/minute)		Step Length (Meters)	
	Pre Value	Post Value	Pre Value	Post Value
Mean	59.90	61.60	0.26	0.25
SD	4.45	4.81	0.03	0.03
T value	-2.42		1.620	
P value	0.038		0.140	

Table 1: Cadence and Step length, pre and post interval.

	Stride Length (Meters)		Gait Velocity (meters/sec)	
	Pre Value	Post Value	Pre Value	Post Value
Mean	0.52	0.51	20.57	20.85
SD	0.06	0.07	1.21	1.16
T value	1.52		-2.50	
P value	0.162		0.033	

Table 2: Stride Length & Velocity, pre and post interval.

For Step Length, calculated value (1.620) was less than table value and 'P' value is also too high. This indicates that there is no statistical significant improvement in Step length.

For Stride Length, calculated value (1.522) was less than table value 'P' value is also too high. This indicates that there is no significant improvement in gait performance (Table 2).

For Gait Velocity calculated value (2.509) was greater than table value. This indicates that there is significant improvement in gait performance.

Slow walking after stroke may be a behavioral adaptation to poor endurance, poor balance and decreased stability. Improvement in cadence and gait velocity is attributed to more appropriate timing of lower limb muscles, improved balance and coordination as a result of improved ability to use the affected leg for support, increased load taken through the affected foot; coordinated muscle activity is stimulated more. Yang YR et al[6] examined the effectiveness of additional backward walking on gait outcomes including walking speed, cadence, gait cycle and symmetry in 25 stroke subjects and observed significant improvement in selected gait parameters. The results of this study also support improvement in cadence and gait velocity. Salbach NM[7] et al evaluated the efficacy of task-oriented intervention comprising of 10 activities in enhancing walking ability and found significant improvements.

As the cadence increases, gait velocity will also increase and this will result in shorter step length. With improved cadence and gait velocity, the duration of double support decreases, person walks fast resulting in shorter step length[8].

Appropriate timing of lower limb muscles might be due to increase in the strength of calf and tibialis anterior muscle. This may also be due to decreased in muscle tone in hypertonic muscles. Improved balance and coordination could be because of improved proprioception, repetitions and instructions to walk fast without compromising stability. Other factor could be successful accomplishment of one of the task trained and asked to complete it within the shortest period possible as home-based activity. Monger et al[9], also demonstrated that a home-based task-specific training program can improve gait performance.

Although many literatures suggested task-specific training program with other treatment techniques for improving gait performance in hemiparetic stroke patients, but task-specific training program alone has significant effect on gait performance.

All the subjects participated in this study showed significant improvement in Cadence and Gait velocity with no improvement in Step length and Stride length.

Conclusion

Based upon this clinical study, it was observed that the task related circuit training is a useful mean for improving cadence and gait velocity parameters whereas its having no significant effect on step length and stride length in right hemiparetic stroke patients.

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