



Physiotherapy

EFFECTIVENESS OF INCLINED TREADMILL WALKING ON CADENCE AND WALKING SPEED IN SUB-ACUTE HEMI PARETIC STROKE PATIENTS: AN EXPERIMENTAL STUDY.

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ABSTRACT

BACKGROUND: Patients with history of stroke experience residual limitations like walking speed, and walking-related self-efficacy. Many physiotherapeutic interventions are used for gait rehabilitation. Treadmill training like inclined treadmill training is also used for gait training and it helps to restore normal gait pattern in hemi paretic stroke patients.

AIM: To see the effectiveness of inclined treadmill walking on gait parameters like cadence and walking speed in sub-acute hemi-paretic patients.

METHODOLOGY: 24 subjects (sub-acute hemi- paretic stroke) with age group 40-65 years (M: 14, F: 10) were selected in study. All subjects were given inclined treadmill walking at level of 10% in 10 minutes for 5 days/week for 4 weeks. On first day pre-treatment outcomes were measured by using 10MWT for walking speed and cadence. Post treatment outcomes were measured after 4 weeks of treatment. Pre and post treatment outcomes were compared.

RESULTS: Data were analyzed by using SPSS 23 version for windows software. The statistics for cadence and walking speed showed significant results with “P” value < 0.05 (Confidence interval 95%).

CONCLUSION: The result at the end of 4 weeks treatment suggests that inclined treadmill walking improves cadence and walking speed in sub-acute hemi paretic patients.

KEYWORDS : Stroke, Hemi paretic gait, Gait Parameters, Inclined treadmill training.

INTRODUCTION

Stroke is defined as rapidly developing clinical symptoms and/or signs of focal and at times global loss of cerebral function, with symptoms lasting more than 24 hours with no apparent cause other than that of vascular origin. Clinically, a variety of focal deficit includes change in the level of consciousness and impairment of sensory, motor, cognitive, perceptual and language function. Motor deficits are characterized by paralysis (hemiplegic) or weakness (hemi paresis).^{1,2}

Due to stroke, patients have weakness (paresis) of upper limb and lower limb unilaterally, that affects their walking ability. The motor impairment caused by stroke is related to spasticity, abnormal muscle activation, alterations in sensation, reduced strength, and abnormal muscle extensibility. These factors generate a series of modifications in the spatial-temporal characteristics of gait, such as reduced velocity, stride length, cadence, stance phase of the paretic leg, and cycle length symmetry, so impaired motor control and balance that seriously affect their walking ability, leading to dependence and increasing burden to caregivers and society.^{3,4}

A various task-related training protocol, includes over ground walking, treadmill walking, and walking-related tasks (e.g. heel raises, step-ups, narrow base standing, stand up and walk, walking along a balance beam, walking backwards, walking while carrying, walking with speed, stairs step-ups, kicking a ball) are used for gait rehabilitation.⁵

Now a days, treadmill and locomat has become more readily and frequently available in various physical therapy hospitals. A novel approach introduced for early gait rehabilitation of stroke survivors involves the use of body weight support during gait training on a motorized treadmill.⁶ Gait training on a treadmill with body weight support (BWS) is a technique of treating walking impairment that is becoming popular. Treadmills with a body-weight support system may enable lower functioning individuals who cannot be safely supervised using traditional therapy methods to undertake early walking practice.⁷ the treadmill stimulates repetitive and rhythmic stepping with the patient supported in an upright position and bearing weight on the lower limbs. Moreover, providing BWS by symmetrically unloading both lower extremities creates an environment that discourages the development of compensatory strategies compared with gait training with walking aids, which favors an asymmetrical gait pattern.

Few studies also compared the effect of treadmill training without the use of partial weight support with the effect of conventional training.

While some of these studies included treadmill training as part of an intense task-oriented gait-training program, many subjects with hemi paresis are able to train on a treadmill without the use of partial weight support early on in the rehabilitation process, provided initial speed of the treadmill is as low as 0.2–0.4 km/hr.^{8,9}

Importance of better understanding control strategies for walking on inclined surfaces, inclined treadmills have been widely used in clinical practice to promote the rehabilitation of subjects with hemiparesis.^{4,10-14} There is an evidence that stroke patients do not recover the ability to increase paretic limb activity in response to increasing incline up to 5 degrees.¹¹ Treadmill inclination means of walked on the treadmill at inclinations of 5% and 10%, promoted angular alterations such as an increase in hip, knee, and ankle angle during initial contact and the swing phase and an increase in the amplitude of movement of the hip and knee, as well as an increase in stance time of the paretic lower limb.^{4,12}

The research suggests that an inclination up to at least 8% can be accommodated for treadmill training by ambulatory stroke patients and shows stride length increased and cadence decreased, whereas swing symmetry improved due to shortening of the relative swing phase of the affected side at the 6% and 8% inclination levels. For a given belt speed, heart rate increased without exceeding critical levels and patients walked with a more symmetric pattern. This protocol seemed to be safe in stroke patients. No change in the activation pattern of the leg muscles was found.^{13,14}

The 10-Meter Walk Test is a commonly used measure for assessing walking speed..10MWT has an excellent test-retest reliability (ICC = 0.95 to 0.99) and inter-rater reliability (ICC = 0.998).¹⁵

Aim of the study: Stroke is a leading cause of long-term disability. Impairments resulting from stroke leads to persistent difficulties with walking. Improved walking ability is one of the highest priorities for people living with a stroke. Previous researches were done for various inclined treadmill training at 0%, 2.5% and 5% on gait parameters in hemiplegic patients, in current study inclined treadmill training at 10% was examined and how it affects cadence and walking speed

METHODOLOGY

Study type: An experimental study

Sampling technique: Convenient sampling.

Study setting: Physiotherapy department, Veraval Civil Hospital.

Sample size: 24 sub-acute stroke patients

Study duration: The total duration of study was 4 weeks.

Inclusion Criteria:

- Age group: 40 to 70 years.
- Sex: both male and females were included.
- Had a single stroke with stroke duration >1 month <6 months.
- Functional use of affected upper extremity.
- Stable medical condition.
- Ability to walk 10 minutes independently without assistance.

Exclusion Criteria:

- Subjects were excluded if they had neurological diseases other than stroke.
- Subjects who required assistance to ambulate before the stroke were also excluded.
- Any traumatic or pathological orthopaedic condition affecting lower limbs.
- Un-cooperative patient.

Measurement procedure

- Total number of 24 subjects who were diagnosed as hemiparesis were selected for the study by giving consideration to inclusion and exclusion criteria. Written consent was taken from subjects who fulfilled the inclusion and exclusion criteria. Subjects were oriented to the study and explained the whole procedure prior to the testing.

Inclined treadmill walking (ITW):

- Prior to study, cadence and walking speed of all subjects were measured.
- The subjects were made to walk at treadmill **inclination of 10 degree** for a period of 10 minutes; the speed of the treadmill was determined by the fastest over-ground walking speed obtained from the subject's 10-m walk (10MW) test before training session. The subjects were made to walk at same speed throughout the training sessions for 4 weeks.
- Throughout the training sessions, an assistant was kept to supervise the subject for safety purpose.
- The subjects were trained for 5 days/week for 4 weeks, after 4 weeks cadence and walking speed were recorded.

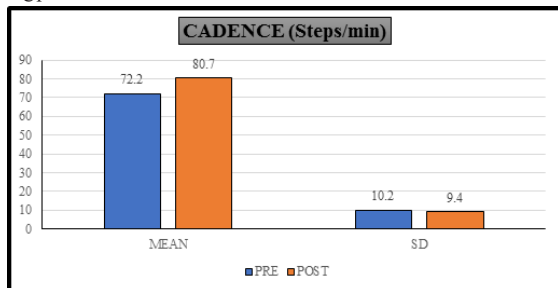
Outcome Measures:

1) Cadence: Cadence is the number of steps taken by a person per unit of time. Cadence may be measured as the number of steps per second or per minute.

2) Walking Speed: Walking speed is the rate of linear forward motion of the body, which can be measured in meters or centimeters per second, meters per minute, or miles per hour.

Statistical Analysis

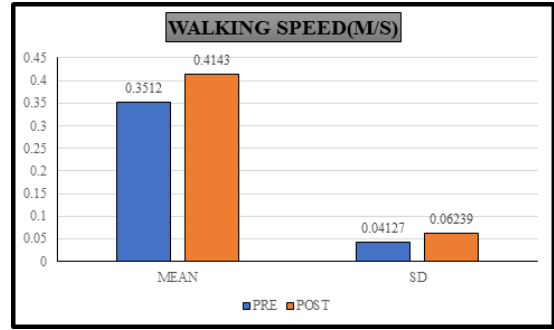
All the statistical analysis was done by using SPSS 23 version for windows software. Mean and standard deviation were calculated as measure of central tendency and measure of dispersion respectively. Analysis of pre and post intervention of cadence and walking speed difference was done using paired t test. The Confidence interval is set at 95%.



GRAPH-1: Pre and post intervention mean of cadence

Table-2: Paired T Test For Analysis Of Cadence

MEAN		't' VALUE	'p' VALUE	Result
PRE(Steps/min)	POST(Steps/min)			
72.20	80.70	4.652	0.001	S



GRAPH-2: Pre and post intervention mean of walking speed

Table-2: Paired T Test For Analysis Of Walking Speed

MEAN		't' VALUE	'p' VALUE	Result
PRE(SEC.)	POST(SEC.)			
0.3512	0.4143	5.636	0.0001	S

DISCUSSION

The result of the study suggests that there is significant difference found in improving cadence and walking speed when patients made to walk on 10% inclination in sub-acute hemi-paretic subjects.

Treadmill training could have beneficial effects on various gait parameters and that supported by previous research like **Kelvin W. K. Lau et al**, conducted a study to compare the effects of treadmill training on gait and balance performance in patients with sub-acute stroke. And It was concluded that treadmill training in patients with sub-acute stroke resulted in larger gains in gait speed and stride length compared with steady speed, The positive effect could stem from the activation of the central gait pattern generator. When patients with stroke walk on the treadmill, the rapid extension of the paretic hip may facilitate a reflex hip flexion. Walking with greater hip flexion could lead to a larger swing, longer stride length, and a more symmetrical and efficient gait pattern. Treadmill walking is task-specific and repetitive, and these characteristics are shown to be more effective than strengthening exercises to enhance motor learning in patients with stroke. These factors could account for the improvement in gait performance.³

Another possible mechanism that improve cadences and walking speed by treadmill training supported by **Pohl et al**, as they examined the effect of speed-dependent treadmill training (SDT) on gait in patients with stroke. The training mode draws on the principles of sports physiology, which have demonstrated that training at subjects' sub-maximal level does not provide optimal improvement in gait speed. In contrast, sprint training at maximum speed, while not intended to over-exert patients, results in optimal performance. After 2 weeks of training, subjects in the SDT group had significantly more improvement in gait performance than those with conventional treadmill trainings in both the SDT and the control group.⁶

The benefits from treadmill training may have neurophysiological underpinnings; spinalized peoples demonstrate coordinated activation of spinal neural circuits from the alternating limb movements facilitated from a treadmill. Treadmill practice could also be considered "forced use" which maximizes the use of the paretic limb through a large number of steps, and consequently a greater amount of load-bearing and activation of the paretic muscles, particularly at faster speeds.

In present study inclined treadmill walking on 10% inclination shows improvement in cadence and walking speed this result supported by **Phadke et al**, conducted a study to find out immediate effects of a single inclined treadmill walking session on level ground walking in 18 subjects, nine with stroke and remaining nine healthy individuals. The participants walked at treadmill inclines of 0, 2.5, and 5 degrees for 5 minutes at each level, for a total walking period of 15minutes. They concluded that the inclined treadmill walking would augments, muscle group activity, which would promote higher activation during over-ground walking, thus over ground propulsive forces after inclined treadmill walking in the stroke group were marginally higher in the non-paretic side, but were slightly lower in the paretic side.¹¹

Carda S et al, assessed whether a downhill walking training program is more effective than the same amount of training applied

uphill in chronic stroke survivors. Thirty-eight adults with hemiplegia were randomly allocated to one of the two groups: 'UP' - 45 minutes of physical therapy + 30 minutes of treadmill with 5% ascending slope; and 'DOWN' - 45 minutes of physical therapy + 30 minutes of treadmill with 5% descending slope. Both groups were treated 5 times a week for six weeks. . At the end of treatment, compared to UP group, more patients in the DOWN group showed clinically significant improvements in 10MWT.¹²

Perhaps the most significant finding of this research is supported by previous study of **Cinthia C. Moreno et al** as they analysed the effects of electric treadmill inclination on the gait of 18 individuals with chronic hemiparesis. All the individuals walked on the treadmill with inclinations of 0%, 5%, and 10%. And point out that even though there was a reduction in extension, hip joint amplitude and walking speed increased between 0% and 10% and between 5% and 10%. The increase in these parameters, which occurred at inclinations of 5% and 10%, may be a positive factor in promoting and stimulating a near-normative amplitude. These outcome increases their ability to move body mass forward, thereby enhancing gait quality and gait parameters.⁴

CONCLUSION AND CLINICAL IMPLICATION

The result of the experimental study concluded that inclined treadmill walking improves cadence and walking speed in sub-acute hemiparetic patients. The result of the study suggests inclined treadmill walking at level of 10% is effective in improving cadence and walking speed in sub-acute hemiparetic patients. It can be added as gait rehabilitation protocol for sub-acute hemiparetic patients.

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