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Effects of Cognitive Training on Gait Parameter while Talking During Walking among Stroke Survivors

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ABSTRACT

Introduction: Gait recovery is a major objective in the rehabilitation of patients who experience stroke. A wide range of walking ability is present in patients after stroke that is dependent upon the severity of impairment. After stroke, 50% of the patients initially are unable to walk, 12% can walk with assistance, and 37% can walk independently. Stroke patients have functional ambulation exhibit gait pattern that differ from the observed in the healthy persons and are associated with an increased risk of falling. The kinematic, kinetic and etc deviations from normal gait that commonly occur after stroke. Cognitive training is a newer approaches to clinical intervention based on task oriented approach, a new theories of motor control.

Objective: To know the changes of Balance, Cadence, Double Support Phase, Step Length, Stride Length, and Velocity of stroke survivors during walking while talking.

Purpose: Purposes of this study include;

- Analyse differences between patients performance and the parameter of normal gait
- Determination of need for adaptive, assistive, orthotic, prosthetic, protective, or supportive devices or equipment.

Design: Pretest-posttest experimental study design.

Setting: Occupational Therapy department, Swami Vivekananda National Institute of Rehabilitation Training and Research (SVNIRTAR), Olatpur, Odisha-754010

Participants: All participants who fulfill the inclusion criteria selected for study and all the subjects granted informed consent before testing. Participants were tested routinely during their initial assessment.

Intervention: All participants continued to receive conventional occupational therapy intervention (control group) throughout the entire duration of the study. Participants received an specific intervention (cognitive dual task training) with conventional (experimental group) . Subjects of both the group were provided occupational therapy session 45 minute per session 5 days in a week for 6 months.

Outcome Measure: 3D Gait Analysis, Berg Balance Scale

Methods: Forty (40) participants were selected (Conventional Intervention group-20) and (Experimental Intervention group-20) for the study with the convenient sample. Their mean age was 44.40 for control group and 49.40 for experimental group. Their age ranges from 35-65 years. Berg Balance Scale (BBS) was used before and after the training and Gait Parameter study was done at Gait Laboratory also before and after training respectively. Intermediate and Post-test measures of balance and gait parameter (Cadence, Double Support Phase, Step Length, Stride Length, and Velocity) were assessed in both without talk and with talk condition. Design-Two group Pre and Post experimental.

Result: Within group comparison of pre-test and post-test BBS and Gait cycle measure shows a significant difference in Control and Experimental groups, in both without talk and with talk condition. Between groups comparison of control group and experimental group also shows significant difference in Cadence, Double Support Phase, Step Length, Stride Length, and Velocity. The pre-test and post-test measure of balance shows a statistically significant in both groups($p=0.00$). The pre-test and post-test measure of gait parameter shows a statistically significant difference in both groups respectively.

Conclusion: In this study, it is concluded that there is positive effects of Cognitive training to improve gait parameter and balance which was generally impaired after stroke among stroke survivors.

KEYWORDS: *Cognitive training, Gait parameter, Stroke, walking and talking*

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INTRODUCTION:

Stroke is defined as a clinical syndrome, of presumed vascular origin, typified by rapidly developing signs of focal or global disturbance of cerebral functions lasting more than 24hrs or leading to death (National Clinical Guideline for stroke, World Health Organization 1978). It may occur at all ages, even in very young children, or at the age of 65years and can have many causes (Warlow CP; et al 2001).

Sensory impairments are affect more than 60% of people during the early phase of stroke recovery (Clinton J. et al 2013**)**. The presence of sensory deficits in people with post stroke may contribute to the commonly observed reductions in gait speed and increase in interlimb asymmetry. Inappropriate integration of sensory feedback may result in abnormal motor responses and altered movement patterns, which may further alter the afferent feedback to the CNS, propagating a vicious cycle and resulting in deficits gait and balance.

Sensory changes occur in the lower extremity as a result of stroke determining the influence of impaired lower extremity sensation on gait adaptation in people with post stroke (Clinton J. et al 2013).In the absence of elementary sensory deficit of the central integration of sensory inputs (somatosensory, visual and vestibular) in patient with stroke is important cause of balance impairment (Nicola Smania et al 2008).In normal adult subject, the somatosensory system involved in balance control and make up the system of coordinates on body's postural control (N. Smania, Alessandro P. et al 2008). Somatosensory information is comprised of cutaneous and pressure receptors on the soles of the feet and of muscle and joint receptors. This information helps determine characteristics of and the relationship of the individual to the support surface (Karen Halliday P. et al 2016).

In static standing position, somatosensory information which comes from the lower limb (feet pressure receptor, ankle joint receptor muscle proprioceptor) in order to build the main reference coordinates for balance. This process can be disturbed in patient with stroke. So, the stroke patient presents major difficulties during task that requires integration of somatosensory information from lower extremities (maintenance of equilibrium under a compliant surface support condition) (N. Smania, Alessandro P. et al 2008).

Stroke can affect a number of aspects of vision from our oculomotor function and our visual fields to the higher levels of the visual hierarchy such as visual memory and visual perception (Judi Edmans et al 2010).Visual impairments include visual field deficits, loss of ocular alignment or control, diplopia and changes in visual acquity and complex impairments like visual agnosia. To use vision to support participation in daily activities, visual information must correctly received and recognized (Glen Gillen et al 2014).

Vestibular lesions in stroke patients have complaints of vertigo are common. Vestibular dysfunction is recognized as one of the intrinsic factors leading to falls. The cardinal symptom of vestibular disorder is vertigo (a false sensation of movement of patient or their environment). Many patients present with dizziness, a sense of imbalance, being light headed, swimmy, giddy and feeling unsteady (V. B. Pothula, F. Chew et al 2004).

Cognitive deficits are common after stroke and have been linked to poor recovery of ADL abilities and rehabilitation outcomes (D. Hyndman & A. Ashburn et al 2009). Approximately 30%-40% of stroke survivors have been experience cognitive deficits (Tadhg Stapleton, Ann A. et al 2001).Cognition incorporates multiple domains, including attention (focusing, shifting, dividing or sustaining attention on a particular stimulus or task), executive function (planning, organizing thoughts, inhibition, control), memory (recall and verbal information) and language (expressive and receptive) (Toby B. Cumming et al 2012).

Attention is one aspect of cognitive functioning that has been reported as the basis for other components of cognition. Attention deficits are common among acute post stroke and reported association between distractibility, auditory selective attention, balance and functional impairment (D. Hyndman et al 2009).Attention deficits and postural instability have been linked to falls among people with stroke (Haggard, Bowen A, Cockburn J et al 2003). In post stroke has shown a link between attention deficits and the ability to perform functional task (D. Hyndman* et al 2009).

People utilize increased attention to maintain balance for performance of dual task (Joel stein, et al 2009).Walking while talking also a dual task performance. Cognitive performance under dual task condition in people with stroke have gait decrement occur when walking and cognitive task are performed simultaneously. Walking performance declines during simultaneous performance of a cognitive task-Dual task walking. Dual task walking also result in decreased performance on the concurrent cognitive task compared with performance on the cognitive task itself.

Audrey B. et al (2001) also stated that the effects of Dual task walking in individuals with stroke has been observed as decreases in Gait velocity, stride length, stride duration, double support phase and cadence. Previous study, (A. Bowen, Rachel W. et al 2001) investigate that, "talking while walking" adversely affected the stroke patients' velocity and balance.

Therefore, the intent was to investigate the effects of cognitive training to change gait parameter while talking during walking among stroke survivors

AIMS AND OBJECTIVES

To know the changes of: Balance and Cognition level, Velocity, Cadence, Double Support Phase, Stride length and Step length, of stroke survivors during walking while talking.

HYPOTHESIS

EXPERIMENTAL HYPOTHESIS

There is a positive effect of cognitive training to change the gait parameter while talking during walking among stroke survivors.

NULL HYPOTHESIS

There is a negative effect of cognitive training to change the gait parameter while talking during walking among stroke survivors.

METHODLOGY

STUDY DESIGN:

It is a pretest-posttest experimental study design.

SUBJECTS:

A total number of 40 stroke subjects were selected for the study with the convenient sample. Their mean age was 44.40 for control group and 49.40 for experimental group. Their age ranges from 35-65 years. All the subjects were recruited from Rehabilitation Unit, Department of Occupational Therapy, S.V. NIRTAR, Cuttack over a period of six (6) months and the year of 2017. All subjects were tested routinely during their initial assessment. All the subjects granted informed consent before testing.

INCLUSION CRITERIA:

- Subject diagnosed as stroke.
- Age range from 35 to 65 years
- Only male subjects
- Both right and left hemiplegics were taken
- Both hemorrhagic and ischemic stroke within 10 months
- Between Brunnstrom stage of 2 to 3 of hemiplegia
- At least functional use of one side upper limb

EXCLUSION CRITERIA:

- Stroke with associated problem like aphasia, and dysphagia.
- Significant vision and hearing impairment
- Unstable medical condition like uncontrolled blood pressure, seizure
- Apraxia

INSTRUMENTATION:

- Berg Balance Scale (BBS):
- 3-D Gait Analysis:

PROCEDURE:

The subjects were first screened according to inclusion and exclusion criterion and the ones fulfilling the criterion of the study were selected, the parents or care-taker of the adults with stroke were approached with the proposal of the study and the aims and the methods of the study were explained. Those who were willing to participate were invited to join the study and were asked to sign the consent form.

Subjects were 40 adults with a diagnosis of stroke who were classified by using Brunnstrom stages of recovery according to duration of the onset.

Berg Balance Scale (BBS) were used to assess the balance status of all subjects followed by Gait-mat in gait laboratory for assessing the gait parameter. standardized written guidelines was used for testing the BBS, & Gait-mat.

(Patient walking on gait-mat in 3D motion gait laboratory at SVNIRTAR)

(Patient wearing infrared body marker with sensor EMG device in his body during laboratory session)

DATA ANALYSIS

40 subjects (20 for control group & 20 for experimental group) were randomly selected for the study with the mean age group of 46.90 (control group 44.40 & experimental group 49.40) were taken into analysis. The SPSS 23 Chicago Inc was used for analysis. The Test parameters were compared before and after therapy in two phases (with & without talking) in each subject. Two instruments or tools were used namely “BTS MOTION ANALYSIS LAB” for Gait parameter and “BBS” for balance test. Wilcoxon Sign Ranks Test was done to show the score changes occurred within the control group and experimental group on BBS. One-sample T test was done to show the‘t’ test score changes occurred within the control group and experimental group. Repeated Measure ANOVA was done to show the changes of gait parameters in with talk& without talk condition of within and between both groups (Control & Experimental).

Table 1: Shows the Demographic statistics which include the range, min age, max age, mean age, standard error and standard deviation.

SL NO.	BASELINE CHARACTERISTICS	CONTROL GROUP	EXPERIMENTAL GROUP
1	No of subjects 'N'	20	20
2	Age (Range)	30-60	26-60
3	Minimum Age	30	34
4	Maximum Age	60	60
5	Mean age (SD)	44.40±1.883	49.40±1.950
6	Gender (Male)	20	20
7	Side Affected (Rt./Lt.)	13:7	8:12
8	Standard Error	1.883	1.950
9	Standard Deviation	8.419	8.720

Table 2: Comparison of Pre & Post Test score of BBS within Control and Experimental Group.

BBS	Z (2-tailed)	P (2-tailed)
CONTROL	-3.929	0.000*
EXPERIMENTAL	-3.923	0.000*

(Table 2: Shows the Comparison within BBS scores, Z denotes the Wilcoxon Signed Ranks Test, P denotes the Significant Difference, * Sig at p< .05).

Table 3: Between Group Comparison of BBS

OUTCOME MEASURE	Z (2-tailed)	P (2-tailed)
BBS	-3.908	0.000*

(Table 3: Shows the Comparison between BBS Scores using Mann Whitney U test. Z denotes the Wilcoxon Signed Ranks Test, P Denotes the Significant Difference, * Sig at p< .05)

RESULT AND DISCUSSION

Gait and Balance disorders are common in older adults or neurological disorder like stroke. They are associated with increased morbidity and mortality, as well as reduced level of function. It can lead to avoidance of physical activities and psychological & social participation. Evidence on the effectiveness of interventions for gait and balance disorder is limited. Hence intervention that can improve balance and gait is important part of rehabilitation.

So, the purpose of this study was to investigate the effectiveness of Cognitive Dual-Task Training (Cog DTT) program to improve balance and gait parameter in stroke subjects. The finding of the study suggest that both control group and experimental group shows statistically significant improvement in balance and gait parameter and there is statistically significant difference between the group as shown by scores.

There is significant result of BBS within the control group and experimental group with significant score of p≤.000.Whereas there is significant result of BBS in between both group score of p≤.000. At the initial assessment, none of the subject scored 56/56 points on the BBS, indicating that all the subjects had balance deficits. From the result it was found that patients in the experimental group improved significantly in BBS score compared to control group.

Similarly in Gait parameter, results indicate that, in all parameter both the control group and experimental group in both condition (without talking & with talking) exhibited improvement. There is significant result of BBS within the control group and experimental group with significant score of p≤ 0.000. Whereas there is significant result between the groups of BBS with significant score of p≤ 0.000.

There is significant result of Cadence within the control group and experimental group with significant score of p≤.000 & .000 for both without talking and with talking condition. Whereas there is significant difference between the group of cadence in between without talking and with talking condition score of p≤ .003 & .004 respectively.

There is significant difference of Double Support Phase (DSP) within the control group and experimental group with significant score of p≤ .002 & .000 for both without and with talking condition. Whereas there is significant difference between the group of DSP in between without and with talking condition score of p≤ .003 & .000 respectively.

There is significant result of Step Length within the control group and experimental group with significant score of p≤.000&.000 for both without and with talking condition. Whereas there is significant difference between the group of Step Length in between without and with condition score of p≤ .001 & .004 respectively. Nora E. et al., (2015) also concluded that dual-task training can improve spatiotemporal measure (step length) and have a modest impact on balance.

There is significant difference of Stride Length within the control group and experimental group with significant score of p≤ .001 & .000 for both without and with talking condition. Whereas there is significant difference between the group of stride length in between without and with talking condition score of p≤ .004&.005 respectively. Yan-Ci Liu, et al., (2017) found on his study that significant improvement in speed and in stride length during cognitive-motor dual-task training.

There is significant result of Velocity within the control group and experimental group with significant score of p≤

.000 & .000 for both without and with talking condition. Whereas there is significant difference between the group of velocity in between without and with talking condition score of p≤ .004 & .000 respectively. Nora E. et al., (2015) also concluded that dual-task training can improve spatiotemporal measure (gait velocity) and have a modest impact on balance.

In this study it has been found that there is an improvement in balance and gait parameter (cadence, double support phase, step length, stride length, and velocity). You, Anand Shetty, et al. (2009) dealt with effects of dual-task cognitive-gait intervention on memory and gait dynamics in older adults with a history of falls.

The reason for improvement in gait and balance may be due to cognitive dual-task training. Because cognitive plays an important role in gait (Al-Yahya et al., 2011). This relationship shows that higher order cognitive functions such as executive function and attention are working while walking (Alexander & Hausdorff et al., 2008). Stroke survivors also have impaired divided attention relative to controls (Marshall S, et al., 1997). Divided attention is necessary to successfully perform 2 tasks concurrently (ie, dual tasks), such as a cognitive and a motor task (eg, walking and talking) and patients with low performance in executive functioning experienced a greater slowing in their gait velocity (Housedorff JM, et al., 2005 & Ble A, et al., 2005).
Deficits in divided attention and dual-task ability seem linked to impairments in functional mobility in stroke, traumatic brain injury (TBI), and other neurological disorder (Yang YR et al., 2007). The dual-task protocol consists of a primary motor task (eg, walking or balancing task) and secondary attention demanding task (e.g. a motor or cognitive task) (Ying He et al., 2018).

Wan XQ, et al., (2015) shows on his study that dual-task training was more effective in improving pace (gait speed), rhythm (cadence), and postural control (stride length) in individual with stroke. In terms of balance function, he shows that dual-task training also improving balance. So in this study, the cognitive dual-task training was used as intervention protocol.

CONCLUSION

From this study it is concluded that there is positive effect of cognitive training to improve gait parameter and balance which was generally impaired after stroke among stroke survivors. Hence these findings should be used in caution when treating the patient with stroke with gait and balance impairment.

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