Effectiveness of Gluteus Maximus Strengthening on Gait in Patients with Hemiparesis

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Abstract

Background: Seventy five per cent of patients who outlive stroke have inadequacies whilst walking and the hemiparetic gait is the most prevalent form of walking. The asymmetric pattern of walking is most commonly seen in hemiparetic gait.

Aim and Objectives: To find the effectiveness of gluteus maximus strengthening on gait in patients with hemiparesis.

Materials and Method: The hemiparetic patients were assessed for the MMT and gait, prior to the treatment. The muscle strength and gait was assessed by Manual Muscle Testing and objective method respectively. Subjects signed the consent form then total number of three exercises were given-i)Standing leg lifts with trunk supported, ii) Quadruped leg lifts, iii) Standing extension.Statistical analysis was done once the data was collected

Results: In this study the gluteus maximus strengthening had effect on the gait of the hemiparetic individuals. The gait parameters taken in this study step length, step width, stride length, cadence and speed significantly increase after the treatment.

Conclusion: On the basis of the result of this study, it was concluded that the strengthening of gluteus maximus muscle has effect on gait in patients with hemiparesis. The gait parameters taken in this study such as step length, step width, stride length, cadence and speed has increase in the averaged values before and after treatment.

Keywords: *Gluteus Maximus, Strengthening, hemiparesis, Stroke, Gait.*

Introduction

Weakness of muscle usually occurring after stoke is referred as paresis. Patients are generally unable to generate the force which is necessary to initiate and control the movement [(1)]. The word 'hemi' means 'one side' while 'paresis' means 'weakness' so hemiparesis denotes the weakness of the one side of the body.[(2)]

World Health Organization defines stroke as 'rapidly developed clinical sign of focal disturbance of cerebral function of presumed vascular origin and of more than 24 hours' duration'. Ischemic stroke, one of the types of stroke, is due to occlusion or atheroma or emboli in the artery. This type of stroke shows symptoms of headache, hemiparesis or dysphasia. The other type, Hemorrhagic stroke is usually due to hypertension which causes lipohyalinosis in the small penetrating arteries in the brain. The symptoms are severe headache, vomiting, and

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loss of consciousness.[3]

Gluteus Maximus is the largest muscle of the body situated superficially. It originates from outer slope of the dorsal segment of iliac crest and posterior gluteal line and dorsal surface of lower part of sacrum and it's deep fibers are inserted on the gluteal tuberosity and the greater part of the muscle is inserted into the iliotibial tract [4]. This important muscle is different in its characteristics with other primates as a result of progression in postural alteration from quadrupeds to bipeds. First and foremost it serves the hip extension and lateral rotation because of its attachment. Gluteus maximus has a major function in pelvis stability. This muscle carries out many daily activities like lifting, walking, running [5]. The studies has shown that more importance should be employed on contraction in the course of early phase of the lift to provide pelvic stability which will enable a secure and well-organized movement to occur .[5]

Seventy five per cent of patients who outlive stroke have inadequacies whilst walking and the hemiparetic gait is the most prevalent form of walking [6].

Gait

The period from heel strike of one extremity to heel strike of same extremity is described as gait cycle and includes a stance and swing phase[7].Gait includes Time and distance variable. Temporal variable include stance time, single-limb and double limb support time, swing time, stride and step time, cadence and speed. The distance variables include stride length, step length, width, and degree of toe out. [8]

Gluteus Maximus in Gait

A basic understanding of a role of gluteus maximus is mandatory as a complete discussion on muscles contributing throughout the gait cycle fall outside the scope of this topic. The flexor moment during the loading response is coordinated by the hip extensor muscles, and the hip extension is initiated by the gluteus maximus muscle. A posterior lurch of the trunk occurs at foot contact with loss of extensor function to shift the centre of the gravity of the trunk, posterior to the hip.[9]

Gait Alterations in Hemiparesis

The gait after stroke is mostlyconsidered asdeceleratedat speed of walking. [10]The symptoms such as contralateral motor weakness, motor control deficits, sensory and/or proprioceptive loss, and/or ataxia associated with the asymmetric pattern of walking are most commonly seen in hemiparetic gait[11].

SPATIOTEMPORAL PARAMETERS

The distance taken to complete one gait cycle is referred as stride length. The distance between heel strike of an ipsilateral limb to heel strike of the contralateral limb step length . The number of steps per unit time (minute) is defined as cadence. The distance per unit time is referred as walking speed and, is the most important interpreter of ambulation status after stroke. In hemiparetic individuals the walking velocity, stride length, step length, cadence, single-stance duration and stance duration is decreased while double-stance duration and swing duration is increased [11] .

So the paucity in the literature regarding this field denotes the need to study.

Methodology

Prior to the commencement of the study the ethical clearance was taken from the Institutional ethical committee. The purpose of this study is to find the effectiveness of gluteus maximus strengthening on gait in hemiparetic patients.

Individuals with hemiparesis were selected as per inclusion and exclusion. The informed consent was taken from the subjects. The sample size for this study was 40. Prior to the treatment the pre-treatment assessment of the muscle strength and gait was assessed by Manual Muscle Testing and objective method respectively. To assess the muscle strength of the gluteus maximus muscle the subjects were asked to do side lying position on plinth with testing limb superior to the other limb. Once the patient acquires suitable position, patient is asked to extend the hip. The gait assessment was executed by a 10m pathway which was covered with white cardboard for every subject .The participants were asked to put their foot in coloured talcum which as kept in a tray. Then subjects were instructed to walk in their normal way along the pathway. Then cardboard was preserved for foot print analysis.

Then detailed instructions were given to the participants about treatment protocol. Total number of three exercises were given out of which first was standing leg lifts with trunk supported in which the patients stands on the edge of the plinth with trunk supported on the table. Then patient is asked to extend both the hips one

by one. In the second exercise, Quadruped Leg Lifts, the patient acquires quadruped position. Then patient is asked to perform alternate hip extension while keeping the knee flexed. The third exercise is standing extension. In this the patient position is single leg stance and patient is directed to extend the opposite hip. Patient was instructed to perform these exercises two times per day for 6 weeks.

After treatment the post- treatment assessment of manual muscle testing and gait were done. Then derived values were entered in the master chart and the collected data was sent for the statistical analysis.

STATISTICAL ANALYSIS AND INETERPRITATION:

Table 1.MMT of Gluteus Maximus Muscle before and After Treatment

MMT OF Gluteus Maximus Muscle	Mean	SD	Paired t -value	p-value	95% CI
PRE	2.85	0.5799	27.92	<0.0001	-0.1072 to -0.9276
POST	3.85	0.5796			

Result

The above table revealed that the effectiveness on gluteus maximus muscle, in this study the strengthening protocol appeared to be on gluteus maximus muscle with paired t value of 27.92 when the p-value <0.0001.The 95% confidence interval was -0.1072 to -0.9276.Here we found the extreme statistical significance.

Table 2.Step Length Before and After Treatment

Step Length	Mean	SD	Paired t-value	p-value	95% CI
PRE	23.025	1.387	9.56	<0.0001	-1.636 to 1.064
POST	24.375	0.9789			

Result

The above table shows the effectiveness of strengthening protocol on Step Length. In this study the step length parameter had the paired t value of 9.56 while the 95% confidence interval ranging from -1.636 to 1.064 .we had found the extreme significance with p- value <0.0001.

Table 3. Stride Length Before and After Treatment

Stride Length	Mean	SD	Paired t -value	p-value	95%CI
PRE	52.775	1.510	13.79	<0.0001	-1.290 to -0.9601
POST	53.9	1.464			

Result

The above table indicates the effect of treatment on stride length parameter of gait. The paired t value and 95% confidence interval for this parameter was 13.79 and -1.290 to 0.09601 respectively. Here we obtained extreme statistical significance when the p-value was <0.0001.

Table 4. Step Width Before and After Treatment

Step Width	Mean	SD	Paired t-value	p-value	95% CI
PRE	8.95	1.280	8.832	<0.0001	-1.229 to -0.7710
POST	9.95	1.300			

Result:

The above table revealed the effect of treatment protocol on step width. For this parameter of gait the paired t value and 95% confidence interval was 8.832 and -1.229 to -0.7710 respectively with p-value <0.0001. It was found that there is extreme statistical significance.

Table 5. Cadence Before and After Treatment

Cadence	**Mean**	**SD**	**Paired t value**	**p- value**	**95% CI**
PRE	80.65	11.615	11.322	<0.10	-11.816 to -82.34
POST	90.675	11.674			

Result

The above table shows the effectiveness on cadence parameter of gait. In this study the cadence parameter had the paired t value <0.10 and 95% confidence interval ranging from -11.861 to -82.34. Hence it is found that there is extreme statistical significance when p value <0.10.

Table 6. Speed Before and After Treatment

Speed	**Mean**	**SD**	**Paired t value**	**p- value**	**95% CI**
PRE	3.675	1.047	13.964	<0.0001	-2.290 to -1.710
POST	5.675	1.207			

Result

The above table revealed effectiveness of strengthening program on speed of the gait. In this study the speed parameter had paired t value and 95% confidence interval ranging -2.290 to -1.710 respectively. Therefore it is proved that there is extreme significance with p value <0.0001.

Results

In this study the gluteus maximus strengthening had effect on the gait of the hemiparetic individuals. The gait parameters taken in this study step length, step width, stride length, cadence and speed significantly increase after the treatment.

Discussion

Seventy five per cent of patients who outlive stroke have inadequacies whilst walking and the hemiparetic gait is the most prevalent form of walking. The purpose of this study is to find the effectiveness of gluteus maximus strengthening on gait in hemiparetic patients.

Individuals with hemiparesis were selected as per inclusion and exclusion. The sample size for this study was 40. Demographic data including name, age, gender, address was collected .Prior to the treatment the pre-treatment assessment of the muscle strength and gait was assessed by Manual Muscle Testing and objective method respectively.

Then total number of three exercises were given -i) Standing leg lifts with trunk supported, ii) Quadruped Leg Lifts, iii) Standing extension. Patient was instructed to perform these exercises two times per day for 6 weeks.

After treatment the post- treatment assessment of manual muscle testing and gait were done. Then derived values were entered in the master chart and the collected data was sent for the statistical analysis.

In this study the statistical analysis of the recorded data was done by using the software SPSS version20. Arithmetic mean & standard deviation was calculated for each outcome measure.MS Excel was used for drawing various graphs with given frequencies and the various percentages that were calculated with the software.

Combined Task-Specific Training and Strengthening Effects On Locomotor Recovery Post-Stroke: A Case Study concluded that functional locomotor recovery was associated with increase in magnitude of the paretic leg gluteus maximus and gluteus medius activation during gait. Their study analysis confirmed an increase of hip and knee extension throughout stance and swing [(12)]. Hence Outcome measure used in this study , Manual Muscle Testing, had positive effect of strengthening protocol with paired t value of 27.92 when the p-value <0.0001.The 95% confidence interval was -0.1072 to -0.9276.

The effect of strengthening exercises on biomechanical parameters of gait in chronic hemiparesis following stroke ,supported that the muscle strength training has a positive effective in improving gait patterns as well as velocity and stride length in the chronic stage of rehabilitation following stroke[(13)]. In this study the paired t value and 95% confidence interval for this parameter was 13.79 and -1.290 to 0.09601 respectively. Here we obtained extreme statistical significance when the p-value was <0.0001.

The effect of step climbing exercise on balance and step length in chronic stroke patients, concluded that the step climbing exercise improved the muscle strength in the lower limbs of the stroke patients, as well as their timed Up and Go results and step lengths[(14)].The present study the step length parameter had the paired t value of 9.56 while the 95% confidence interval ranging from -1.636 to 1.064 .we had found the extreme significance with p- value <0.0001.

The effect of water exercise on gait characteristics in the elderly post- stroke patients" stated in the results of their study that there was significant increase in the gait velocity, step length & step width after the water exercises[(15)]. For this parameter of gait, step width, the paired t value and 95% confidence interval was 8.832 and -1.229 to -0.7710 respectively with p-value <0.0001. It was found that there is extreme statistical significance.

Effects Of Aerobic Treadmill Training On Gait Velocity, Cadence, And Gait Symmetry In Chronic Hemiparetic Stroke: A Preliminary Report" have stated in their results that the exercise training given to the patients produced a 9% increase 'straight-away-walk' cadence from a mean of 89 ± 9 to 97 ± 8 steps/min[(16)]. In this study the cadence parameter had the paired t value <0.10 and 95% confidence interval ranging from -11.861 to -82.34. Hence it is found that there is extreme statistical significance when p value <0.10.

Effects Of Muscle Strengthening And Physical Conditioning Training On Temporal, Kinematic And Kinetic Variables During Gait In Stroke Survivors" provided evidence in their study that gait speed at post-training was 0.76 ± 0.37 m/second, which was significantly faster than speed observed at baseline 37.2%. Associated with improved speed, increase in cadence and stride length was observed[(17)]. In this study the speed parameter had paired t value and 95% confidence interval ranging -2.290 to -1.710 respectively. Therefore it is proved that there is extreme significance with p value <0.0001.

Thus , the present study is postulating evidence that the strengthening of the gluteus maximus muscle has significant effect on gait in patients with hemiparesis. Hence the alternative hypothesis is accepted.

Conclusion

On the basis of the result of this study, it was concluded that the strengthening of gluteus maximus muscle has effect on gait in patients with hemiparesis. The gait parameters taken in this study such as step length , step width , stride length, cadence and speed has increase in the averaged values before and after treatment.

Conflicts of Interest: None

Ethical Clearance: Ethical clearance was taken from institutional committee of Krishna Institute of Medical Sciences Deemed To Be University, Karad.

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