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## CHANGES OF THIGH MUSCLE ARCHITECTURE AFTER BODY WEIGHT SUPPORT TREADMILL TRAINING ON PERSONS AFTER SUBACUTE STROKE

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### SUMMARY

Body weight Support treadmill training (BWSTT) can improve motor function of lower limb in stroke patients, but it is not clear which biomechanical parameters of muscle architecture are changed, and which most associated with motor function recovery. The purpose of this study was to evaluate changes of muscle architecture parameters after stroke and compare the effect of BWST and traditional walking training at muscle fascicle level by using ultrasonography. Twelve subacute stroke patients within three months of first stroke admitted to clinic rehabilitation were recruited for BWST(n=7) training and conventional therapy(CT Group, n=5). Seven age-matched healthy subjects were also recruited. BWST group received training for 30 minutes per day, 5 days a week of three weeks. The conventional group received walking training according to the Neurodevelopment therapy (NDT) on the ground for 30 minutes for 5 days, three weeks. Motor function of the impaired lower limb was tested using the Fugl-Meyer and spasticity was evaluated by Modified Ashworth scale (MAS). The rectus femoris (RF) and biceps femoris long head (BF<sub>lh</sub>) muscle architectural parameters, including pennation angle, muscle fascicle length and muscle thickness at the rest condition and during maximal isometric voluntary contraction (MIVC) were measured with ultrasonography. All the assessments were performed at the beginning and the end of training. Muscles' strength of maximum voluntary contraction was measured by hand-held dynamometer at different knee joint angles. The results showed enhanced muscle strength after BWSTT ( $P<0.05$ ), but this was only found in BF<sub>lh</sub> after CGT ( $P<0.05$ ). After the gait training, FMA scores improved ( $P<0.05$ ) and the MAS scores reduced ( $P<0.05$ ) in BWSTT group. However, there is no significant difference of the scale scores after the training in control group ( $P>0.05$ ). Ultrasonography is a feasible method to evaluate muscle architectural changes in lower limb poststroke and these biomechanical parameters are associated with motor function improvement for persons with subacute stroke after BWST training.

### INTRODUCTION

Stroke is the main cause of death worldwide and one of the leading death in China. Those who survive stroke often exhibit functional disabilities and locomotion problems. About 3/4 loss motor function and 40% is serve disability. The ability to walk is one of the most important goals of Physical therapy for stroke patients. Recovery of walking ability occurs in 95% of patients within the first 11 weeks after stroke. The time and the degree of recovery are related both to the degree of the initial loss of walking disability and to the severity of lower extremity paresis[1].

Body weight supported treadmill training (BWSTT) is a task-specific nature of step training on treadmill with partial body weight of the subjects been hold[2]. Clinically, BWSTT is proved to be a promising technique for the restoration of gait in stroke and paralytic subjects. It enables the harness-secured patients to practice numerous steps assisted by therapists at an early stage after neurological. However, there are still reported in literature that BWSTT was not superior to conventional gait training[3]. This discrepancy might relate to the limitation of evaluation methods and less understanding of the recovery mechanism of treadmill training. The motor recovery of limb function is related to alternating flexor, and extensor lower limb muscles, which are highly responsive to phasic segmental sensory inputs and show evidence of learning during step training. Previous results proved BWSTT could reduce the level of loading on the lower limbs[4]. Ultrasound would be used to evaluate muscle architectural parameters in stroke survivors including pennation angle, muscle thickness and muscle fascicle length [5-7]. We hypothesis that these parameters are related to the muscle strength and motor functional recovery.

The purpose of this study was to measure the muscle architectural parameters of rectus femoris (RF) and biceps femoris long head (BF<sub>lh</sub>) in persons with subacute stroke by ultrasound and to investigate their changes after training together with other clinical scores to assess the effectiveness of the intervention and help to understand the biomechanical mechanism of the training.

### METHODS

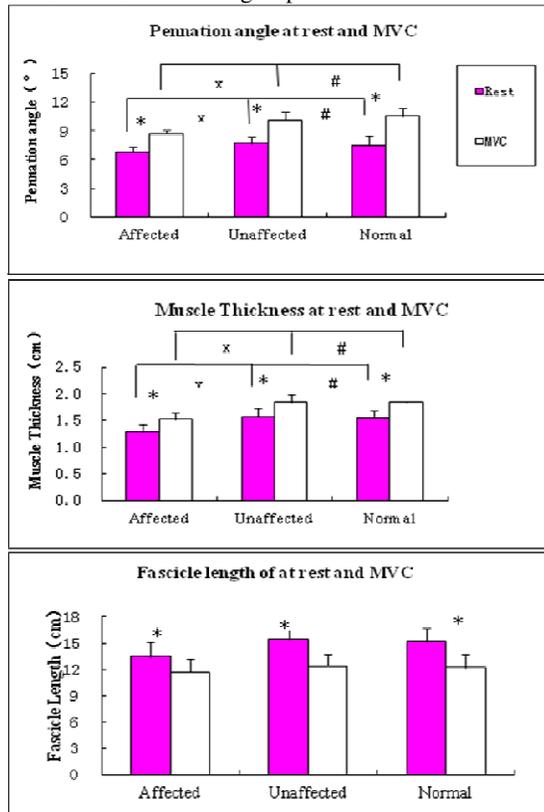
12 adults with subacute poststroke (8 men, 4 women; mean, 60.1y; age range, 41-76y) were recruited in this study. The selection criteria for the hemiparetic subjects included having (1) hemiparesis for no more than 3 months resulting from first stroke insult; (2) presence of clinically detectable spasticity in the ankle dorsiflexor, with a MAS score larger than 1 (maximal value, 4); (3) adequate mental capacity to attempt the tasks as instructed; and (4) an absence of other significant medical complications. This study was approved by the Human Subjects Ethics Subcommittee of the First Affiliated Hospital, Sun Yat-sen University. All the participants gave informed consent following the ethical procedures.

A paired t test was used to compare muscle architectural parameters, muscle strength and FMA scores before and after the training. Rank-sum test was used to compare MAS scores before and after the training.

### RESULTS AND DISCUSSION

It was found that the affected side of stroke survivors showed reduced muscle pennation angle, thickness and fascicle length than those of the unaffected side and healthy subjects (Figure 1). The muscle parameters were joint-angle-dependent in all the three groups at the rest condition. Muscles' strength of the affected side was reduced than the unaffected side and healthy subjects ( $P < 0.05$ ). Clinical scores were summarized in Table.

**Figure 1:** Comparison of muscle architecture parameters at Rector Femoris in three groups.



## CONCLUSIONS

This study showed that there are considerable changes in rectus femoris and biceps femoris fascicle architecture of subacute stroke survivors, which may contribute directly to the impaired lower limb motor functions. BWSTT can improve the motor function of subacute patients with stroke by enlarging muscle strength of rectus femoris and biceps femoris long head and our results demonstrate it is feasible and effective gait training method.

## ACKNOWLEDGEMENTS

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**Table 1:** Comparison of FMA, MAS scores before and after training (Mean  $\pm$  SD).

		Before	After	P
FMA	BWSTT	23.14 $\pm$ 4.63	25.57 $\pm$ 4.69	0.002*
	CGT	21.8 $\pm$ 4.49	24.2 $\pm$ 2.95	0.051
MAS	BWSTT	1.64 $\pm$ 0.24	1.48 $\pm$ 0.59	0.038*
	CGT	1.21 $\pm$ 0.24	1.14 $\pm$ 0.59	0.095

\* $P < 0.05$

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