

## Study on the Usefulness of Sit to Stand Training in Self-directed Treatment of Stroke Patients

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**Abstract.** [Purpose] This study sought to determine the usefulness of sit to stand training in self-directed treatment of stroke patients. It examined the effect that sit to stand training has on balance and functional movement depending on the form of support surfaces. [Subjects and Methods] Thirty stroke patients were randomly sampled and divided into an unstable support surface group (15) and stable support surface group (15). In order to identify the effect depending on the form of support surfaces, 15 minutes of support surface training plus + 15 minutes of free gait training was performed. [Results] The results of the unstable support surface training showed that the corresponding sample t-test results were significant for the 7-item 3-point Berg balance scale, timed Up and Go test, and 6-minute walking test. The independent samples t-test, showed that there were significant outcomes in step length on the affected side, and step length on the unaffected side. [Conclusion] In conclusion, the sit to stand training on stable support surfaces was not as effective as the training using unstable support surfaces, but it is a simple and stable exercise with less risk of falls during training. It can also be performed alone by the patient in order to increase endurance and dynamic balance ability. Therefore, it is considered a useful exercise that can be performed alone by the patient outside the treatment room.

**Key words:** Stroke, Self-directed treatment, Sit to stand

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### INTRODUCTION

In order to maximize the curative effect of therapy on stroke patients, the patient must have much interest and a strong will regarding the treatment, have positive belief regarding his/her own ability, and have a creative learning attitude to try to apply a new method when solving a problem.

Balance is very crucial functional movement of a human being, and control of movement is dependent on the somatic sensory input into the limbs resulting from contact with the support surface. Balance is maintained through changes in various postures from extra stimulation for effective movement<sup>1)</sup>. In carrying out normal activities in daily life, the sit to stand motion is the most frequently occurring movement. It is the precondition for engaging in independent gait

or movements, and refers to the process of shifting one's center of mass from the sitting position to the standing position<sup>2)</sup>. It requires control of the knee joint extensor, ankle joint dorsiflexion muscle, and plantar flexion muscles<sup>3)</sup>. As a result of sit to stand training, frequency or risk of falls is reduced<sup>4)</sup>, and dynamic balance and muscular strength are enhanced<sup>1)</sup>. Moreover, sit to stand training is a very useful method for constancy, symmetry, and dynamic stability as essential elements for the patient with hemi-paralysis due to stroke.

Balance ability is the results of integration and control of information from the somatic senses, sight, and vestibular system<sup>5)</sup>. However, because a stroke patient has a significantly deteriorated ability to maintain his/her center of gravity and postural stability within the basal plane, the patient is dependent on the somatosensory information input from the foot that comes in contact with the support surface. To help improve the deteriorated balance ability in these patients, a method of balance training on top of an unstable support surface has been suggested. This training can increase trunk stability and postural control ability by increasing external swing<sup>6,7)</sup>. It has also been found to im-

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pact postural control by reinforcing the integration of the compensative sensory system<sup>8</sup>).

This study aimed to examine the effect of sit to stand training on the functional moving ability, static balance ability, and dynamic balance ability of stroke patients based on precedent studies. This type of training has fewer risks of falls, and is a form of self-directed treatment that a patient can perform on his/her own under circumstances in which they cannot be controlled 24 hours in a treatment.

## SUBJECTS AND METHODS

### *Subjects*

The study was conducted on 30 patients who experienced the onset of stroke more than 6 months previously and underwent hospital treatment from January to March 2013. All patients included in the study understood the purpose of the study and provided written informed consent prior to their participation in accordance with the ethical standards of the Declaration of Helsinki. The subjects were patients who could perform independent gait for more than 20 m, and independently perform the sit to stand motion. Patients who had respiratory or cardiovascular diseases or orthopedic diseases were excluded from the study. All subjects were given a sufficient explanation of the experiment method and subsequently gave consent to the experiment. There were no significant differences in age, height, weight, and disease period between the two groups.

### *Methods*

In this study, the 10 m gait speed test (10mWT), Timed Up and Go test (TUG), 6-minute walking test (6MWT), and 7-item 3-point Berg balance scale (BBS-3P) were performed. Measurements were taken twice: before the experiment and 4 weeks after the experiment. Each evaluation used the average of 2 repeated measurements.

The subjects consisted of 15 patients who were randomly assigned to the unstable support surface (USS) group and 15 patients who were randomly assigned to the stable support surface (SSS) group. For the therapy intervention, the control group performed sit to stand for 15 minutes plus free gait for 15 minutes, while the test group performed 15 minutes of sit to stand training plus 15 minutes of free gait; each session was 30 minutes and was performed 3 times a week for 4 weeks.

For the sit to stand training, the subject was instructed to adjust the height of the height adjustable sickbed according to the height of the his/her knee joint, and was then asked to maintain both hands in a comfortable position and stand up without using them. Then, half of the subject's femoral region was made to come in contact with the height adjustable sickbed. Airex balance pads (50 × 41 × 6 cm) were used for the unstable support surface applied to the test group. For muscle fatigue due to repetition of the standing motion during the test process, a 30-second rest was randomly provided if the patient was unable to maintain the posture during the experiment or upon request for a break<sup>8</sup>.

To examine the gait width, speed, and left and right time on each foot, which are general components of gait, a gait

Trainer 2 treadmill (Biodex, Shirley, NY, USA) was used. Gait speed was measured using the 10 m gait test<sup>9</sup>, and static balance ability was measured using the 7-item BBS-3P<sup>10</sup>. For dynamic balancing ability, the TUG was performed, and for the level of functional performance ability of the stroke patient and gait endurance, the 6MWT was used. Regarding the 6MWT, the subjects were instructed to walk along a 20-m-long straight line on the floor<sup>11</sup>.

Statistical analysis was conducted using SPSS 18.0 for Windows, and a paired t-test was conducted as the effect test before and after the intervention in each group. An independent t-test was conducted to compare the variation between the two groups. Significance was accepted for values of  $\alpha < 0.05$ .

## RESULTS

Among the 30 subjects, 5 from the USS group and 6 from the SSS group dropped out midway through the study period for various reasons: discharge from the hospital, injury, and accumulation of fatigue. These subjects were excluded from the data analysis. With respect to the general characteristics of the subjects, there were no significant differences between the two groups in terms of age (USS group 56.6±13.9, SSS group 66.3±10.2), height (USS group 165.3±2.9, SSS group 167.3±2.6), and weight (USS group 67.8±3.1, SSS group 66.3±3.4).

The 7-item BBS-3P, TUG, 10mWT, and 6MWT were performed in order to examine the effect this experiment intervention had on the functional variables. Step length, time on each foot, velocity, and step cycle were measured to investigate the effect the experiment had on the gait components. As a result of conducting the unstable support surface training, the corresponding sample t-test results were found to be significant for the 7-item BBS-3P, TUG, and 6MWT. There were significant outcomes for step length on the affected side, and step length on the unaffected side according to the independent sample t-test. With the stable support surface training, the corresponding sample t-test results were significant for the TUG and 6MWT. We were unable to find anything notable for the remaining measurement variables (Table 1).

## DISCUSSION

The sit to stand movement accounts for a very important part of the functional movements of everyday life. In this study, the sit to stand movement was identified as one of the important goals in relation to rehabilitation treatment for stroke patients<sup>12</sup>. The study was conducted to examine the effect of sit to stand movement depending on changes in support surfaces on the functional movement ability of stroke patients. It was also aimed at providing the training as a self-directed treatment intervention for the patient and guardians.

The results of the study showed a statistically significant increase in the result of the 7-item BBS-3P, TUG, and 6MWT for the USS group and in those of the TUG and 6MWT for the SSS group. Regarding the movement ability of the stroke patients, significant outcomes were obtained

**Table 1.** Effect on functional movement variables and gait components

	USS Group (n=10)		SSS Group (n=9)	
	Before	After	Before	After
7-item BBS-3P (score)	21.6 ± 0.5	23.2 ± 0.5*	22.0 ± 1.7	23.5 ± 1.0
TUG (m/s)	20.1 ± 2.3	17.4 ± 2.0*	26.79 ± 3.2	23.6 ± 3.3*
10mWT (m/s)	18.3 ± 2.6	16.5 ± 2.3	25.9 ± 1.0	22.1 ± 3.6
6MWT (m)	168.1 ± 24.4	197.7 ± 22.2*	134.8 ± 22.2	150.7 ± 20.1*
Step-length (cm) (affected side)	34.5 ± 4.2	35.5 ± 3.6†	29.2 ± 3.6	27.44 ± 2.2
Step-length (cm) (unaffected side)	31.5 ± 4.8	35.1 ± 3.6†	26.6 ± 5.5	23.5 ± 2.5

Value are means ± SE. Paired t-test: \*,  $p < 0.05$ . Independent t-test: †,  $p < 0.05$ . USS: unstable support surface, SSS: stable support surface

from static balance ability, dynamic balance, and endurance. However, the comparison between groups showed that the training was even more ineffective on unstable support surfaces. In a previous study on increasing balance ability through unstable support surfaces, Bayouk et al.<sup>8)</sup> said that balance ability was enhanced when there were environmental changes and visual block in task-oriented training on unstable support surfaces. Bonan et al.<sup>13)</sup> reported enhancement of balance ability through control of vision, somatic senses, and vestibular senses. Furthermore, a study on inducement of a symmetrical posture through unstable support surfaces by Taube et al.<sup>7)</sup> reported that there were significant differences in postural control ability when subjects were asked to maintain their posture on a wobble board and various types of soft mats. Patel et al.<sup>14)</sup> stated that stability in the anteroposterior direction increased and the that balance ability was enhanced when postural sway after standing on an unstable support surface was analyzed. Onigbinde et al.<sup>15)</sup> obtained similar results in that enhancement of static and dynamic balance ability resulted from training on unstable support surfaces. However, the outcome of such studies not only show the effect of sit to stand training but also reveal the contributions of visual control, somatic sense input, and vestibular senses, which represent other intervention variables.

Although the therapy approach of providing various treatment environments during sit to stand training, setting therapy goals for controlling asymmetrical posture, and creating a symmetrical posture is effective, there is a need for an exercise that is simple and less risky when a patient wants to engage in a stable exercise outside the treatment room. In conclusion, sit to stand training using unstable support surfaces is effective for improving static and dynamic balance ability and for enhancing gait execution ability and endurance in the treatment room environment. On the other hand, sit to stand training using stable support surfaces is not as effective as when unstable support surfaces are used, but the former is a simple and stable exercise with less risk of falls. It can also be performed alone by the patient in order to improve endurance and dynamic balance ability, and therefore, it is considered a useful exercise for self-directed treatment that can be performed alone by the patient outside the treatment room. Further studies should be conducted on these simple exercise methods as forms of

self-directed treatment that the patients can perform with or without assistance.

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