The Effects of Group Action Observation Training for Patients with Chronic Stroke on the Balance and Gait

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Purpose The purpose of this study was to evaluate the effects of Group Action Observation Training for patients on chronic stroke patient's balance and gait. Subjects 16 patients with chronic stroke were divided into collective training group and individual training group, enforced action observation and physical training. ***Methods*** The training program was for 4 weeks, 5 days a week, 30 minutes per session, and the session consisted of observation for 15 minutes and physical training for 15 minutes. BT4 and BBS were inspected for measuring the balancing ability, and in order to measuring the walking function 10MWT, F8WT, and DGI were inspected. All measurements and tests were implemented before and after the training. ***Results*** The results of this study, in case of the measurement with using BT4, the collective training group's posterior stability limit has significantly increased($p<.05$). However, comparison of the variation according before and after training within groups was not significant between groups.($p<.05$). In case of BBS, both groups had improved significantly before and after, however, there were no significant difference between the groups($p<.05$). After training, there was significant improvement within the groups with DGI score, time and the number of steps inside the evaluation items of 10MWT and F8WT. There was no significant difference in the comparison of the variation between groups($p<.05$). ***Conclusion*** In order to increase opportunity to access effective treatment to more patients, various studies should be conducted related to the method of group action observation training.

Key words Stroke, Group Action Observation Training, Balance, Gait

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I. Introduction

Stroke Patients usually has a permanent disability such as hemiplegia which paralyzed one side of the body in the sagittal plane, as well as functional activities and activities of daily living are limited to independent living and social participation.[1] One of the main goals in the treatment of hemiplegia patients is to improve the balance and gait.[2] The physical therapy for the improvement of balance and gait is applied to aerobic and strengthening exercises, task specific training or a variety of ways, such as gait training using a treadmill.[3] The theoretical premise of this approach is that positive neural plasticity occurs through repeated and active training of limb paralysis.[4] Plasticity which causes changes in the central nervous system with stimulation and environmental effects, Plasticity of connectome is an activity inside cerebral cortex which changes the functional organization through experience. In order to recovering damaged functions or acquirement of new techniques, the plastic changes within connectome, taking control of physical activity, is necessary and should be properly utilized with visual, perceptional, and proprioceptive information.[5] In addition, the need for a cognitive approach is proposed for setting the target of the action to promote the movement effect.[6]

Recent therapy for stroke suggests action observation training: AOT, added with various perceptions and cognitive approach, on generally conducted physical therapy in order to maximize patient's potential.[5] Action observation training observes the motion and trains by imitation. After observing action

with purpose, one repeatedly imitates the motion for training. During the observation, through activity of mirror neuron, cortex excitability in primary motor area increases and through symbolizing the observed aspect, it forms kinesthetic memory by imitation.[7] Through this, activity of brain region which is responsible for physical activity, increases so that it is reported as an effective therapy approach which can increase the physical function.[8]

Collective treatment is a treatment program provided for two or more participants. Collective exercise gives a motivation through interacting with the partner, setting a higher goal, and gives better understanding and effects on the assignment through observing others, which in a way increases the physical technique.[9] One of the effective application method of collective exercise is to organize each section of the exercise, circulates one specific section or exercises with the partner in turn.[10]

According to study about action observation training, observation of action and methods to training are done with individual training condition where therapist and patient conduct training one on one. To achieve maximum concentration, one on one training condition for both therapist and patient is ideal. However, if you want to enforce action observation training in a fixed program in addition to general physical therapy, individual conditions does not give an opportunity of training for many patients. When proposing the home program after discharge, it is difficult that patient progress and control the whole process of self-training. In addition, when practice the actual action after observed the action, the guidance of a therapist is needed to increase the efficiency of movement and remind the purpose of the training. Also the study of group action that aimed patients with stroke should precede in order to plan and implement a program for stroke patients living in the community on jurisdiction. Therefore, practical and efficient therapeutic model for stroke patients should be proposed and studied continually in diverse aspects.[11]

This study was enforced group action observation training targeted at chronic stroke patients to recognize the impact on gait ability and balance function, review the feasibility of group action observation training and propose a variety of therapeutic models.

II. Materials and Methods

1. Participants

This study included 20 people who were diagnosed with stroke and admitted to the B hospital where in Suwon at least six months. Participants can walk more than 10m and MMSE-K is 21 points or more[12], hear a description of the study and sign a participation agreement. After evaluating before the training by using the measurement tool of balance ability and gait ability, groups were randomly divided into collective training group(n_1 =10) and individual training group(n_2=10). Among 20 participants, 16(n_1=8, n_2=8) have participated in the study excluding 3 of giving up and 1 for discharge.

2. Method of study

Every subjects are admitted to the hospital and received physical therapy included strengthening exercises and functional training. Training was performed in a physiotherapy clinic for 30 minutes at once, five days a week for four weeks. Participants participated in the training according to the set time, the training progressed twice for each 4 participants dividing into group action observation training group and individual action observation training group, and the individual training group was progressed 8 times for each participant. Programme and content of all training were same and training presenter was the same person.

1) Training method

Action observation was watching a movie with a 20-inch monitor sitting on a chair in a quiet room. The composition of the movie is posture and gait that performed in daily life, shot in the front, back, side to observe the movement from various angles. Each video was first played with the general speed and the second one was played with twice slower speed and again the third one was played with the general speed, so that one could specifically observe the actions. Among in total 20 videos, one observed some

videos consistently for 13 minutes, and after 2 minutes of break time, one was trained for 15 minutes with the similar contents inside the video. During the action observation therapist explain in the necessary part in order to increase the understanding of the action to increase the concentration for watching movies. During the physical training, when there is a necessary action for individual patient's balance ability, the researcher and the research assistant or the guardian could give a help. Individual training group was physical training one-on-one and group training group was training with researcher and research assistant. Level of physical training was conducted in accordance with activity levels of the participants, if it is difficult to perform all of the connected part of action, then divided into part to practice (Level 1), If patients perform the connected action but assist is necessary or balance is unstable, then repeatedly practice the connected action (Level 2), If they performed connected action by themselves, then setting the level of difficulty to increase the frequency of action or reduce the time (Level 3).

3. Measurement

1) Measurement of balance ability

(1) Balance measurement

BT4 was used to evaluate the ability to balance. Subjects gave the front stood straddling the leg 30 degrees. Open the eyes and maintaining a centured position for 30 seconds to measure the distance and the center of the body examined the static balance. Furthermore, one was made to move one's weight in every direction and measured with the stability limit distance of the movement of weight within the standing position with two legs. In this study, measuring three times and the average value was used.

(2) BBS(Berg Balance Scale)

BBS is a functional tool for evaluating the balance control ability. Maintaining the position, position control by voluntary activity, responses to external pitch, were considered as 3 aspects in order to estimate the functional standing balance of position change, standing and sitting. Measure the 14 items with 5-point scale, 56 points is the maximum score and higher score means good balance and lower risk of falls.

2) Measurement of gait ability

(1) 10MWT(10M Walking Test)

While moving comfortably for 10m toward straight way, as a method to evaluate the gait time, 14m of straight line was indicated on the road and each 2m for the front and end of the road were set as acceleration and reduction point, which were not counted within the evaluation, and evaluated the gait speed inside the 10m parts of the middle. Time measurement using the timer was measured in seconds.

(2) F8WT(Figure of 8 Walk Test)

F8WT is a tool to measure the curve gait ability that walking figure of eight around the cone. F8WT's measuring element is time, number of steps, the accuracy, and the spontaneity. Subjects are select a driving direction between the central of cones and started to walk in a comfortable speed to come back to the starting position at the beginning. This study measure the time and number of steps of the measuring element.

(3) DGI(Dynamic Gait Index)

DGI consists of 8 entries such as walking, walking while the change of speed, Rotate the head horizontally and vertically during Walking, walking while the axis rotation, pass and fetch the obstacle, stair climb and so on. It is a 4-point scale and maximum score is 24 and lower score means larger damage of functional move ability.

4. Statistical analysis

Analysis of the data and test hypothesis used in this study was PASW/PC ver. 18.0 for Window which is statistical program. General characteristics of the subjects were using descriptive statistics and the comparison between before and after the training among the groups was conducted with paired t-test, in order to compare the differences between groups in accordance with the training method independent sample t-test was performed. Every statistical level of significance was set at α = .05.

III. Results

The characteristics of participants are following table 1. In case of the measurement with using BT4, the collective training group's posterior stability limit has significantly increased(p<.05). However, comparison of the variation according before and after training within groups was not significant between groups(p<.05). In case of BBS, both groups had improved significantly before and after, however, there were no significant difference between the groups(p<.05)(Table 2). After training, there was significant improvement within the groups with DGI score, time and the number of steps inside the evaluation items of 10MWT and F8WT (Figure 1). There was no significant difference in the comparison of the variation between groups(P<.05) (Table 3).

IV. Discussion

This study implemented Group Action Observation Training for patients with hemiplegia due to stroke to measure the balance and gait ability, and compared the effects of training methods in order to offer the training method that can improve the balance and the gait ability on stroke patients. As a result of this study,
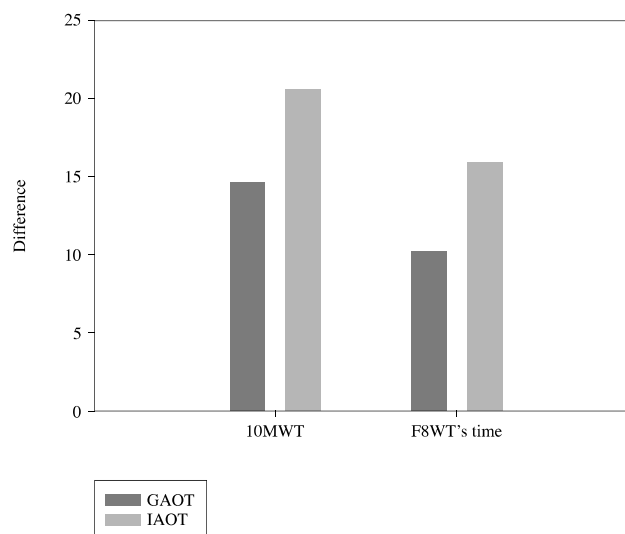

Figure 1. Difference of gait function

the group action observation training had effects on the balance and gait for the hemiplegia patients due to the brain stroke.

Balance is the process of adjustment and adaptation of sustainable posture to maintain the center of gravity in the basal plane.[13] Factors affecting the balance are visual information, proprioceptive sense, activity of the vestibular, recognition, etc and there is a static balance and dynamic balance.[14]

To evaluate static balance using BT4, measured unrest position and stability limit. Before the training for

Table 1. General characteristics of participant

	GAOT (N=8)	IAOT (N=8)
Gender	male(N=6) female(N=2)	male(N=2) female(N=6)
Age (year)	52.88±9.58	55.75±12.06
Height (cm)	172.03±8.25	157.20±11.39
Weight (kg)	67.93±9.66	55.64±8.1
Onset period (month)	24.50±16.75	27.75±17.63
Type of stroke	cerebral infarction(N=4) cerebral hemorrhage(N=4)	cerebral infarction(N=3) hemorrhage(N=5)
Affected side	right(N=5) left(N=3)	right(N=5) left(N=3)
MMSE-K(score)	28.13±2.16	25.50±2.97

Note. Values are mean±S.D.
GAOT : Group Action Observation Training
IAOT : Individual Action Observation Training

Table 2. Comparison of balance ability

	GAOT (N=8)				IAOT (N=8)				
	Pre-test	Post-test	Difference (post-pre)	pa	Pre-test	Post-test	Difference (post-pre)	pa	pb
BT4									
sway distance	388.62± 151.96	322.83± 102.15	−65.80± 101.62	0.11	468.76± 101.60	391.16± 94.02	−77.60± 110.59	0.88	0.83
sway area	324.48± 124.50	258.13± 157.81	−66.35± 122.50	0.17	387.79± 144.51	308.56± 149.63	−79.23± 172.98	0.24	0.87
anterior stability limit	2.19± 1.16	2.27± 1.15	0.08± 1.38	0.87	0.49± 1.39	0.47± 2.15	−0.02± 1.82	0.98	0.90
posterior stability limit	4.37± 0.85	5.00± 0.64	0.63± 0.63	0.04*	4.90± 1.13	5.13± 1.58	1.04± 1.42	0.08	0.47
left stability limit	4.34± 1.27	4.53± 1.03	0.19± 0.91	0.57	3.35± 1.42	4.48± 1.25	1.13± 1.62	0.09	0.94
right stability limit	4.81± 1.05	5.14± 0.60	0.33± 1.12	0.43	3.69± 1.29	3.78± 1.11	0.89± 0.96	0.80	0.65
BBS	36.00± 8.02	50.00± 5.18	14.00± 13.05	0.00**	32.50± 5.48	48.50± 3.42	16.00± 2.98	0.00**	0.33

Note. Values are mean±S.D
GAOT=Group Action Observation Training, IAOT= Individual Action Observation Training
awihtin-group comparison, bbetween-group comparison.
* p<0.05, ** p<0.001.

Table 3. Comparison of gait function

	GAOT (N=8)				IAOT (N=8)				
	Pre-test	Post-test	Difference (post-pre)	pa	Pre-test	Post-test	Difference (post-pre)	pa	pb
10MWT	37.38± 21.10	22.83± 12.14	−14.56± 15.16	0.03*	48.05± 22.37	27.48± 15.79	−20.56± 13.51	0.00*	0.42
F8WT									
time	30.20± 13.55	19.88± 9.48	−10.32± 8.11	0.01*	37.24± 15.97	21.25± 10.05	−15.99± 9.72	0.00*	0.23
step	41.50± 17.63	27.00± 9.73	−14.50± 13.05	0.02*	37.50± 10.38	24.50± 5.07	−13.00± 8.09	0.00*	0.79
DGI	12.38± 3.85	18.50± 4.87	6.13± 2.85	0.00**	9.63±4 .69	16.50± 5.16	6.88± 3.87	0.00*	0.67

Note. Values are mean±S.D.
GAOT=Group Actionion Observation Training, IAOT=Individual Action Observation Training.
10MWT=10m Walking Test, F8WT=Figure of 8 Walking Test, DGI=Dynamic Gait Index
awihtin-group comparison, bbetween-group comparison.
* p<0.05, ** p<0.001.

the participants, through the stability limitation evaluation, compared with the standard of general person who has an angle of 6~8 of the front side, an angle of 4 of the rear, flank of angle 8[15], those of participants did not meet up to the standard excluding the rear angle. In the collective training group, there is a significant improvement in the rear movement distance within the stability limitation after the training. The contents of video observation and physical training is about gait for a variety of environments, so did not focus on balance training that considered significant improvement in the stability limit distance did not appear in a variety direction. Before and after the action observation training, participants' BBS average score

significantly increased. In this study, the contents of the training is related to gait that participants' task performance and dynamic balancing ability is improved because of improvement of gait ability.

Many stroke patients recover the gait ability, but lack of endurance and walking speed is slow[16] so using the more energy than ordinary person when walking.[17] Gait training in stroke care, it is important to enable the movement in the local community and Social participation. In case of general person, one's gait velocity should be within 1.1~1.5 m/s for the independent movement in various environments[18], but those of patients with brain stroke are from 0.23 m/s to 0.73 m/s, as a matter fact, it is way below for the independent social gait.[19] Furthermore, the gait at household or local community, going around the table, avoiding the obstacles or curve ability to turn around the corner .is necessary.[20]

After analyzing 10MWT, F8WT's time and the number of walk and DGI, both groups had significant improvement before and after the training. The contents of the video and physical training inside the results above are focused on gait on various environmental conditions so that it turned out to have significant improvement in the gait ability.

As a study evaluating balance ability after action observation training, observed action of chronic brain stroke patients for 10 minutes.[21] Then, the group was divided into two, where action one observation training group was physically trained for 10 minutes, while the other was trained for 10 minutes with 5 minutes break time and one again for 10 minutes physical training. After 3 weeks, both groups were evaluated with dynamic balance ability, sit to stand(STS) 5 times and stand up to walk. As a result, in case of 5 times STS, both groups had significant improvements, stand up to walk was noticeable within the action observation training group, the former. In order to find out the influence on brain wave, gait ability and dynamic balance of brain stroke patients, conducted a training for 4 weeks.[22] After the training, stand up to walk and functional arm stretch remarkably improved, and dynamic balance ability has improved too. Furthermore, gait speed, longitudinal velocity, paralytic

length, paralytic stride length, paralytic support ability, paralytic outturn support have improved significantly which led to better gait ability. According to, after 6 weeks of training, agitation extent of standing position, distance, central movement of every direction, stand up to walk inspection had remarkable improvement, gait speed, longitudinal velocity, no paralytic length, stride length showed significant improvement so that the action observation training is effective for improving balance ability of brain stroke patients.[23] The reason why this study did not have noticeable difference of balance ability compared to Kim's study is thought to be the level of cognitive level by selected participants, and difference between uniform training regardless of considering cognitive level.[24] and others trained 4 weeks for the purpose of gait functional improvement in order to analyze them by using 10MWT, F8WT, DGI and Gaitrite. As a result, functional evaluation score of action observation training group, and stance phase time for gait improved and compared to each group, there was a significant change.

Based on these results, the training method of using mirror neuron system is continuously suggested as the alternative for brain stroke remedy. In this study hemiplegia patients after stroke were conducted with group action observation training, so that they have shown improvement in gait and balance function. Like the preceding study, by showing the improved results of balance and gait ability before and after the training, we have proved the effects of group action observation training in a sense of stroke patient remedy. However, the participants inside this study are from those who are receiving care in the hospital. Thus, there is no comparison group who did not have received action observation training. Accordingly, we cannot precisely know whether the improvement is from the action observation training or from different treatment from the hospital. Moreover, the treatment time and individual activity other than the training session were not controlled enough, nor the number of participants was enough, nor the training time was sufficient to generalize and interpret the patients with stroke. Consequently, by upgrading these kinds of problems, various study related to action observation

training should be continuously conducted.

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