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# THE EFFECTS OF CLAM EXERCISE WITH VISUAL FEEDBACK ON THE HIP MUSCLE STRENGTH OF PATIENTS WITH CHRONIC STROKE

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***ABSTRACT--*** *The purpose of this study was to compare the strength of patients with chronic stroke following either clam exercise with visual feedback (feedback group) or clam exercise without visual feedback (control group).Fourteen subjects with chronic stroke were recruited from rehabilitation hospital. The subjects were divided into two groups: a feedback group (7 subjects) and a control group (7 subjects). They received 30 minutes of neuro-developmental therapy and clam exercise for 15 minutes, five times a week for three weeks. Muscle strength and walking ability were measured before and after the training period. Muscle strength was measured by Hand held dynamometer.The feedback group showed a significant improvement in hip abductor muscle strength and hip extensor muscle strength of the affected side (p<0.05).The results of this study showed that the clam exercise with visual biofeedback was more effective at improving hip muscle strength than the clam exercise without visual biofeedback. Therefore, in order to strengthening hip muscles of stroke patients, it is necessary to consider the trunk stability through the visual biofeedback.*

***Key Words--****Biofeedback unit, Clam exercise, Strength, Stroke*

## I. INTRODUCTION

Stroke patients experience balance and walking disorders due to multiple functional disorders. Looking at the gait characteristics of stroke patients, we can observe the asymmetric weight distribution and the weight shift by moving only the remaining muscles and walking due to muscle weakness (Ada et al., 2009; Eng & Tang, 2007; Pizzi et al., 2007). In particular, asymmetrical weight distribution and weight shift are associated with weakening of the hip abductor and hip extensor muscles (Kim et al., 2012).

In order to remedy this problem, a number of previous studies have been conducted to strengthen the hip abductor and the hip extensor. We reported that we could strengthen the hip abductor and hip extensor muscles by bridge exercise, or by walking sideways and one leg squat exercise (Bolgla & Uhl, 2005; Distefano et al., 2009; Dwyer et al., 2010; McBeth et al., 2012; Selkowitz et al., 2013). Through various interventions, we reported that the results of hip abductor and hip extensor muscle strengthening, improved the balance and walking ability of stroke patients (Mercer et al., 2009).

In particular, the clam exercise can be applied to selectively strengthen the hip abductor and the hip extensor. Willcox and Burden (2013) reported that clam exercise improves the muscle activity of the hip abductor and hip

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extensor muscles by the clam exercise. Chan et al. (2017) reported that clam exercise can be used to elicit trunk muscle activity in young adults.

Based on these previous studies, the clam exercise is effective for hip abductor and hip extensor muscle, trunk muscle activity. Particularly, the stroke patients, causing walking problems due to weakening of the abductor and extensor muscles of the hip may be considered to be selective muscle strengthening of the abductor and extensor muscles of the hip. However, in the case of stroke patients, when the clam exercise is applied to strengthen the hip abductor and hip extensor muscles in the side lying posture due to the weakening of the muscles of the trunk and the lower extremity, the lateral tilt compensation and trunk and pelvis rotation can be seen (Chaitow, 2013). Therefore, trunk stability is required to selectively strengthen the hip abductor and hip extensor muscles during clam exercise. Verification of effectiveness is rare.

Therefore, the purpose of this study, to provide the stability of the trunk through pressure biofeedback unit during clam exercise for the selective strengthening of the hip abductor and hip extensor muscle, the effect of the hip abductor and hip extensor muscle strength.

## II. METHOD

### *1. Participants*

The research subjects were 14 patients diagnosed with strokes at the hospital in Korea. The subjects sufficiently understood the study procedure and submitted informed written consent to participate in this study. The study was conducted in accordance with the Declaration of Helsinki.

The inclusion criteria for the subjects who had had a stroke were (1) more than 6 months after the onset of stroke and less than 2 years, (2) absence of neurotic diseases such as amblyopia, vertigo and abnormal vestibular function, (3) cognitive function allowing an understanding of researchers’ instructions, (4) Subjects had no orthopedic problems that could affect exercise in the lower limbs, (5) persons who have 3 or more points of muscular strength test for hip abductor and hip extensor muscles. Table 1 summarizes the subject’s general characteristics.

**Table 1:** General characteristics of subjects

| | feedback group[a]($n_1$=7) | control group[b]($n_2$=7) | p |
|---|---|---|---|
| Age (years) | 53.29±11.56[d] | 56.57±9.91 | 0.58 |
| Gender | | | |
| Male | 4 | 3 | |
| Female | 3 | 4 | |
| Side of lesion | | | |
| Right | 2 | 3 | |
| Left | 5 | 4 | |
| Height (㎝) | 166.86±10.59 | 162.14±9.91 | 0.41 |

| | | | |
|---|---|---|---|
| Weight (kg) | 62.86±7.82 | 66.14±12.56 | 0.57 |
| FMLE[c] (score) | 22.14±3.58 | 22.29±3.90 | 0.94 |

[a]Clam exercise with visual biofeedback, [b]Clam exercise,

[c]Fugl-Meyer assessment of low-extremity, [d]Mean±standard deviation

***2. Experimental tool and assessment***

A visual biofeedback (Stabilizer, Chattanooga Group Inc, USA) was used to provide trunk stabilization feedback when applying the clam exercise. The visual biofeedback unit consists of a bag into which the air is injected and a scale to check the pressure reading. Subjects placed the visual biofeedback device between the floor and the waist in a side lying position, holding the scale with one hand and checking it, adjusting the pressure to 40mmHg and maintaining the pressure between 35mmHg and 45mmHg during the clam exercise to keep the trunk stable (Mcbeth et al., 2012).

Hand-held dynamometer (J Tech Medical, USA) was used to evaluate the changes in muscle strength before and after intervention of hip abductor and hip extensor. The pressures appearing at the maximum isometric contraction of the abductor and the extensor muscles of the hip joint were measured (Mentiplay et al., 2015).

***3. Procedures***

Subjects of this study who participated were randomly assigned to two groups, which paired subjects with similar physical abilities, by using the Fugl-Meyer assessment of low-extremity. The feedback group consisted of 7 subjects, and the control group consisted of 7 subjects. Both the feedback group and the control group received neuro-development therapy. Then align the torso, pelvis and legs in a side lying position with the affected side up on the treatment bed. In order to perform the clam exercise, the hips should be bent 45° and the knees 90° and the heels of both legs should be placed together. During the clam exercise, a target bar was installed so that the hip abduction angle was 20° to maintain a constant knee height. Clam exercise for 15 minutes, five times a week, for three weeks.

The feedback group that provided feedback during the clam exercise applied a visual biofeedback. The control group using the clam exercise only instructed the investigator to maintain trunk alignment without providing visual feedback.

***4. Statistical analysis***

PASW 22.0 version for Window (PASW Inc., Chicago, IL, USA) was used for statistical analysis of the measured values of the subjects. Descriptive statistics were used to present each variable as mean ± standard deviation. The Kolmogorov-Smirnov test was used to test the normality. To examine the differences in general and the medical characteristics between the two groups, the independent *t*-test were used. To verify the differences within each group between pre-test and post-test strength, walking ability the paired *t*-test was used, and the analysis of covariance was used to verify the differences between the two groups. The significance level was set to 0.05.

# III. RESULTS

The results of a comparison before and after the training showed that both group's hip abductor strength of the affected side statistically significantly increased ($p<0.05$). After the training, the results of a comparison between the two groups showed that the feedback group's hip abductor strength of the affected side statistically significantly increased compared to the control group ($p<0.05$)(Table 2).

The results of a comparison before and after the training showed that both group's hip extensor strength of the affected side statistically significantly increased ($p<0.05$). After the training, the results of a comparison between the two groups showed that the feedback group's hip extensor strength of the affected side statistically significantly increased compared to the control group ($p<0.05$) (Table 2).

**Table 2:** Comparison of pre and post training outcome measures of muscle strength within and between groups

| | | feedback group[a] ($n_1$=7) | control group[b] ($n_2$=7) | p |
|---|---|---|---|---|
| Hip abductors (kg) | Pre | 17.66±4.69[c] | 17.10±4.99 | 0.01† |
| | Post | 22.10±5.47 | 18.97±4.73 | |
| | p | 0.00* | 0.00* | |
| Hip extensors (kg) | Pre | 18.01±5.60 | 18.99±7.51 | 0.04† |
| | Post | 23.54±7.98 | 20.88±6.49 | |
| | p | 0.01* | 0.02* | |

[a]Clam exercise with visual biofeedback, [b]Clam exercise,
[c]Mean±standard deviation,
significant difference between pre and post intervention within the group (*$p<0.05$),
significant difference between the change values among the groups (†$p<0.05$)

# IV. DISCUSSION

The purpose of this study was to examine the effects of the trunk stability control through the visual biofeedback on the muscle strength of the patients with stroke in the clam exercise.

As a result, the strength of hip abductor and hip extensor muscles following clam exercise was improved after intervention in both groups. Mercer et al. (2009) reported that increased muscle strength in hip abductor and hip extensor muscles is an important component of independent gait and balance recovery. Willcox and Burden (2013) reported that clam exercise in general adults improves muscle activity of hip abductor and hip extensor muscles. The study of Koh et al. (2016) also demonstrated that clam exercise was effective in improving muscle activity of the extensor muscle of the hip joint. In this study, the clam exercise was repeated in both groups, resulting in

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improved muscle strength of the hip abductor and hip extensor. In comparison, between the groups, the control of the trunk by providing pressure biofeedback unit during clam exercise was shown to be more effective in improving the muscle strength of the hip abductor and hip extensor.

The trunk stability is important. Because it plays a central role in the functional chain of activity and is the basis for limb movement. In particular, stabilization of the trunk was the result of increased muscle strength as the stability of the lower extremity joints, increased and the mobilization of muscle fibers (Akuthota & Nadler, 2004). In the study of Cynn et al. (2006), stabilizing the trunk by providing pressure biofeedback unit in the side lying posture and performing hip joint exercise were effective in improving the muscle activity of the hip abductor muscle. The result was a decrease in quadratus lumborum activity and a decrease in pelvic tilt. Based on this, the pressure biofeedback during clam exercise stabilizes the pelvis and lower back, decreases the activity of the quadratus lumborum, and suppresses the compensatory action. This is thought to be effective in strengthening the selective muscle strength of hip abductor and hip extensor.

The subjects in this study were able to apply the clam exercise directly to the affected side because the muscle strength of the affected side hip abductor and extensor muscles was above a certain standard. However, stroke patients with weak affected side muscle strength may have limitations in performing the correct posture. To compensate for this, the indirect method of applying the clam exercise to the unaffected side is needed to study the effect on the muscle strength change of the affected side. In addition, this study was limited to stroke patients who are hospitalized and continuously managed in hospitals. Therefore, this study may have limitations in applying to stroke patients in daily life. No validation was done for. Future studies will need to verify whether the effect persists based on more subjects.

## V. CONCLUSION

The use of visual biofeedback for clam exercise in stroke patients showed improved muscle strength by inhibiting the compensatory effects of the control of trunk stability and by selectively strengthening hip abductor and hip extensor muscles. Therefore, if the clam exercise is to be applied to strengthen the lower extremity muscles of the stroke patient, the trunk stability through the visual biofeedback should be considered.

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