Comparison of Effectiveness of Motivative Exercise with Passive Exercise by fNIRS

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Abstract
One physical therapist (PT) gives exercise at rehabilitation. We call the exercise “passive exercise”. Since most of stroke patients become hemiplegia patients, they can perform the exercise operating devices by the healthy side. We call this system “motivative exercise”. In this report, the difference of effectiveness between passive exercise and motivative exercise are shown by brain function measurement. Activating sites in brain are measured by fNIRS through both exercises.

Keywords: Motivative exercise, Passive exercise, Rehabilitation, fNIRS

1. Introduction
Recently, number of stroke patients have been increasing in many countries including Japan, because of rapidly aging. Most of stroke patients require occupational rehabilitation. In the present rehabilitation system, one physical therapist (PT) gives exercise to one patient. We call this system “passive exercise”. On the other hand, one PT can give exercise to many patients using some simple devices. Since most of stroke patients become hemiplegia patients, they perform the exercise operating devices by the healthy side. We call this system “motivative exercise”. We have reported as the results of many studies that this motivative exercise is equivalently efficient for medical treatment. The purpose of this study is to clarify the effectiveness of the motivative exercise with reciprocating motion in a cross direction for knee extension and flexion, and the plantar flexion and dorsiflexion of the ankle1, 2).

2. Materials and Methods
In order to compare the effectiveness of the motivative exercise with that of the passive exercise, changes to the oxyhemoglobin in the brain are measured by Near-Infrared Spectroscopy (fNIRS), which is FOIRE-3000 by Shimazu Corporation. A knee exercise as shown in Fig. 1 and an ankle exercise are performed as passive exercise. A knee exercise as shown in Fig. 2 and an ankle exercise as shown in Fig. 3 are similarly performed as motivative exercise with devices. The devise in Fig. 2 is called “Pata”, and that in Fig. 3 is called “Koro”. Both exercises are performed with the time of rest and task. The task cycle for each patient is set 20 seconds rest from a start, the next is set 30 seconds task, the next is 20 seconds rest, and the rest and task are performed for three cycles. This experiment is performed for 11 subjects (6 women, 5 man, Age 75-95 years old, the average age 82.8 years old)

Fig. 1 Passive exercise          Fig. 2 Device 1: Pata           Fig. 3 Device 2: Koro
3. Result

Activating sites in brain are shown in Fig. 4 at the passive and motivative exercises by fNIRS. The results as shown in Figs. 4-1 and 4-2 are measured at passive exercise, and those as shown in Figs. 4-3 and 4-4 are measured at motivative exercise. Although the size and intensity of activating sites are different from both exercises, activation in brain at each exercise is confirmed by fNIRS3).

![Fig. 4 Exercises for the reciprocating motion in a cross direction of the knee](image)

4. Conclusion

The purpose of this study is to clarify the effectiveness of the motivative exercise by measuring the activating sites in brain by fNIRS. The motivative exercise is a kind of rehabilitation through self-exercise. The exercise is performed with the simple devices, that “Pata” and “Koro” are used in this research. Both devices are operated by the movement of the unaffected (healthy) side, in order to move the affected side of body. Brain is similarly activated by passive and motivative exercises, although the intensity and activated positions are a little different.

5. Discussion

The results of this study show that the motivative exercise with simple devices are similarly effective to the passive exercise by PT. Although the most of the present rehabilitation is performed by passive exercise, the rehabilitation system will collapse because of rapid increase of elder persons. We think that the motivative exercise can prevent the collapse of rehabilitation system in aging population. The motivative exercise enable the stroke patients to perform in-home the rehabilitation, and enable the small hospital to hire PTs, and therefore increases job opportunity for PTs.

Reference

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