Effects of mental practice on stroke patients’ upper extremity function and daily activity performance

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Abstract. [Purpose] The purpose of this study was to evaluate the effects of mental practice on stroke patients’ upper extremity function and activities of daily living (ADL). [Subjects and Methods] In this study, 29 stroke patients were randomly assigned to two groups: an experimental group (n=14) and a control group (n=15). The experimental group performed 10 minutes of mental practice once a day, 5 days a week for 2 weeks in combination with conventional rehabilitation therapy. For the control group, general rehabilitation therapy was provided during the same sessions as the experimental group. The Action Research Arm Test (ARAT) and the Fugl-Myer assessment (FMA) were used to measure upper extremity function, and the Modified Bathel Index (MBI) was used to measure daily activity performance. [Results] After the intervention, the mental practice group showed significant improvements in upper extremity function on the affected side and ADL scores compared to the control group. [Conclusion] The results of this study demonstrate mental practice intervention is effective at improving stroke patients’ upper extremity function and daily activity performance. In follow-up studies, securing a greater number of experimental subjects, and evaluation of the intervention’s therapeutic durability are required.

Key words: Mental practice, Upper function, Stroke

INTRODUCTION

Stroke is an illness causing disability due to an interruption in the blood supply to the brain or a hemorrhage in the brain tissue caused by cerebrovascular disease, cardiac disorder, or diabetes. As a cause of hemiparesis, it is one of the leading causes of functional limitation and disability3. Functional disability of stroke patients shows different aspects depending on the area and scope of damage, and it is commonly accompanied by various disabilities such as motor disturbance, sense disturbance, cognitive disorders, and speech disorder2.

Especially in hemiplegic stroke patients, serious disabilities arise in the upper and lower extremities of one side. Quality of life markedly declines as daily activities become limited due to asymmetrical walking patterns, decrease in walking speed, and lack of fine motor skills of synkinesis in the upper extremity caused by increase in muscle tension of the damaged side and decreased muscle strength5. Thus, general rehabilitation training for hemiplegic stroke patients focuses on functional improvement and strengthening of the muscles in the upper and lower extremities of the damaged side.

For the improvement of upper and lower functions, physical therapy and occupational therapy provide training for muscle and functional improvement and fine motor. However, for most patients, such rehabilitation training has many constraints of time, place, and expense. Accordingly, in recent studies, clinical methods, such as mental practice for improvement of the upper and lower functions, have been suggested8.

Mental practice is a method of learning motor skills and enhancing performance by means of imagining movements in the head without moving the body9. Recently, mental practice intervention, as a method of learning and enhancing motor skills, have been introduced to such diverse fields as sports psychology, cognitive psychology, and medical science6. The merits of this intervention are that the patient’s concentration and motivation can be enhanced without regard to time or place, and that training is possible without expensive equipment7. A recent study reported that in a comparison of neuroscience actual performance of par-
ticular motor tasks and imagining the movements, the brain region activated when the two tasks were performed and the degrees of activation were similar\(^8\).

In many of the recent studies of mental practice, improvements in various areas of upper extremity function and daily activity performance of hemiplegic stroke patients have been reported; however, since these studies lacked a control group or had a small number of subjects, it is difficult to generalize their results. Also, the duration of therapy, number of applications, and treatment times of each session varied across the studies, making it difficult to decide how to apply therapy in general clinical situations\(^9\).

Hence, this study evaluated the effects of mental practice performed in combination with conventional rehabilitation therapy on hemiplegic stroke patients over a duration of time suitable for general clinical situations: 10 minutes once a day, 5 days a week, for 2 weeks.

**SUBJECTS AND METHODS**

The subjects for this study were 29 patients who were receiving hospital treatment for hemiplegia at I Hospital and K Hospital in Korea. The subjects were chosen from among volunteer patients who understood the objectives and content of this study and showed an intent to actively participate in this study. All the subjects and their guardians agreed to participate in the experiment and they provided written informed consent prior to their participation in the study in accordance with the ethical principles of the Declaration of Helsinki.

The general selection criteria of the subjects for this study were as follows: hemiplegia for over 6 months; scores of over 24 points on the Korean version of the Mini-Mental State Examination; average scores below 2.26 in the movement imagery mental test; no communication problems; hemineglect; or hearing or vision disorders. Additionally, subjects were only included if, under conditions of pronation and flexing of the wrist, they could display function of at least 20° extension of the wrist, and at least 10° extension of the metacarpophalangeal joint, while being able to hold and put down an object with the affected side.

The general characteristics of the subjects are noted in Table 1.

The 29 stroke patients participating in the experiment were randomly allocated to the experimental and control groups. The experimental group received conventional occupational therapy for 20 minutes per session, once a day, 5 times a week, and carried out mental practice for 10 minutes at the start of each session. The control group received conventional occupational therapy and physical therapy 30 minutes per session, once a day, 5 times a week, for 2 weeks.

Mental practice was conducted in an occupational therapy room with a quiet atmosphere, while the subjects’ physical and psychological states were stable in order to maintain the subjects’ attention and concentration. All the training programs were 10 minutes in length and were recorded in advance. The programs used in training were: turning a page, putting beans, and stacking plastic cups.

The mental training comprised 3 stages: first, the prepara-

| Table 1. General characteristics of the subjects | Mental practice | CON |
|-----------------------------------------------|-----------------|-----|
| Gender (Male/Female)                          | 10/4            | 11/4|
| Age (years)                                   | 60±10.9         | 58±11.7|
| Onset (months)                                | 18±11.7         | 16±11.1|
| Paretic side (Right/Left)                     | 10/4            | 11/4|

Continuous variables are shown as mean ± standard deviation (SD). CON: control group

The subjects’ ADL was measured using the Modified Barthel Index (MBI). The MBI is designed to measure the degree of independence of subjects’ ADL and consists of a total of 15 specific ADL motions.

SPSS ver. 18.0 was used to calculate the means and standard deviations. Descriptive statistics were used to analyze the general subject characteristics. Using the independent t test, differences in upper function scores between the 2 groups were investigated. In all analyses, significance was accepted at values of p<0.05.

This study had a pre- and post-test with control group design for an intervention of 2 weeks. Using clinical measures, pre- and post-test measurements were obtained one day before and after the training.

Functional movements of the upper extremities were assessed using clinical measures, the Action Research Arm Test (ARAT) and the Fugl-Meyer Assessment of Upper Extremity (FMA-UE) section. The Fugl-Myer assessment is a performance-based measure and one of the most widely used clinical assessments of upper extremity motor impairment; it is also disease-specific. It measures 3 independent impairments balance, sensation, and voluntary movement of the upper and lower extremities. All items are scored on a 3-point ordinal scale, ranging from 0 to 2. This study used the FMA-UE section, which have a maximum possible score of 66\(^{10}\). The inter-rater reliability of the upper limb section has been reported to range from 0.96 to 0.97, and the test-retest reliability of the upper limb section has been reported to be 0.97 in chronic stroke survivors\(^{11}\). The ARAT is a criterion-referred assessment for evaluating specific changes in upper limb function after cortical damage. It consists of 19 items divided into 4 subscales measuring functional movements, such as grip, pinch, grasp, and gross movement. The performance of each item is rated on a 4-point scale, ranging from 0 to 3, with 57 as the maximum obtainable score. For post-hemiplegic stroke patients, the inter- and intra-rater reliabilities have both been reported to be 0.99\(^{12}\). The subjects’ ADL was measured using the Modified Barthel Index (MBI). The MBI is designed to measure the degree of independence of subjects’ ADL and consists of a total of 15 specific ADL motions.
RESULTS

Table 2 shows the upper extremity function and ADL scores before and after the mental practice. The mental practice showed significant improvements (p<0.05) in ARAT, MBI, and FMA-UE of the affected side compared to the control group.

| Mental practice | Pre-test | Post-test | Pre-test | Post-test |
|-----------------|----------|-----------|----------|-----------|
| ARAT*           | 48.7±9.5 | 51.5±9.0  | 49.1±9.9 | 49.0±9.9  |
| FMA-UE*         | 42.0±7.5 | 46.5±8.1  | 50.8±10.3| 50.7±10.1|
| MBI*            | 71.3±12.6| 72.7±12.4 | 66.2±12.7| 66.2±12.6|

All variables are shown as mean ± standard deviation (SD). CON: control group. *p<0.05. ARAT: Action Research Arm Test, FMA-UE: Fugl-Meyer Assessment of Upper Extremity, MBI: Modified Barthel Index

DISCUSSION

The objectives of this study were to address the issues raised by pilot studies regarding the application of mental practice for stroke patients, to select proper protocols for mental practice intervention that are easily applicable in general clinical situations from among the various mental practice protocols which have elicited improved upper extremity function, and to verify them.

The subjects of this study performed mental practice for 10 minutes, once a day, 5 times a week, in combination with general rehabilitation therapy. Our results are in agreement with Page et al., who showed there were improvements in upper extremity function when mental practice training protocols were performed by stroke patients\(^{13}\). They also support the results of Page et al., who noted that the improvements in upper extremity function were enhanced when conventional neurological rehabilitation therapy and mental training were conducted in combination for stroke patients\(^{14}\). In this study, there were significant improvements not only in improved upper extremity function, but also in daily activity performance of the mental training subjects. This agrees with study results of Muller et al., who reported improvement of daily activity performance after mental training\(^{15}\).

In terms of therapy duration, frequency, and time, this study observed significant improvements in upper extremity function of the subjects after performance of 10 minute sessions, once a day, 5 times a week, for 2 weeks. However, Choi et al. conducted mental training for 5 minutes per session, 6 times for 6 days, and reported that there was almost no improvement effect on upper extremity function\(^{16}\). Apart from their study, most other studies which have reported significant improvements in upper extremity function after mental training, mostly conducted for a period of over 2 but less than 6 weeks, at frequencies of therapy of 3 to 5 times a week, with treatment times ranging from 10 minutes to 3 hours per session\(^{17}\). When implementing mental training for improved upper extremity function, we suggest the optimal therapy mode is 10 minutes of therapy time, 5 times a week for 2 weeks, as performed in this study.

Limitations of this study include difficulty in generalizing the results of this study to all stroke patients because of the small number of subjects in this study, and the lack of assessment of long-term maintenance effects. Future studies should recruit greater numbers of subjects and perform a follow-up evaluation.

REFERENCES

1. Sharp SA, Brouwer BJ: Isokinetic strength training of the hemiparetic knee: effects on function and spasticity. Arch Phys Med Rehabil, 1997, 78: 1231–1236. [Medline] [CrossRef]
2. Ozdemir F, Birtane M, Tabatabaei R, et al.: Cognitive evaluation and functional outcome after stroke. Am J Phys Med Rehabil, 2001, 80: 410–415. [Medline] [CrossRef]
3. Brouwer B, Culham EG, Liston RA, et al.: Normal variability of postural measures: implications for the reliability of relative balance performance outcomes. Scand J Rehabil Med, 1998, 30: 131–137. [Medline] [CrossRef]
4. Warner L, McNeill ME: Mental imagery and its potential for physical therapy. Phys Ther, 1988, 68: 516–521. [Medline]
5. Jackson PL, Lafleur MF, Malouin F, et al.: Potential role of mental practice using motor imagery in neurologic rehabilitation. Arch Phys Med Rehabil, 2001, 82: 1133–1141. [Medline] [CrossRef]
6. Choi JH, Choi YW, Nam KS, et al.: Effect of mental training on the balance control ability of healthy subject. J Phys Ther Sci, 2010, 22: 51–55. [CrossRef]
7. Dunsby A, Dickstein R, Marcovitz E, et al.: Home-based motor imagery training for gait rehabilitation of people with chronic poststroke hemiparesis. Arch Phys Med Rehabil, 2008, 89: 1580–1588. [Medline] [CrossRef]
8. Lafleur MF, Jackson PL, Malouin F, et al.: Motor learning produces parallel dynamic functional changes during the execution and imagination of sequential foot movements. Neuroimage, 2002, 16: 142–157. [Medline] [CrossRef]
9. Nilsen DM, Gillen G, Gordon AM: Use of mental practice to improve upper-limb recovery after stroke: a systematic review. Am J Occup Ther, 2010, 64: 695–708. [Medline] [CrossRef]
10. Fugl-Meyer AR, Jääskö L, Leyman I, et al.: The post-stroke hemiplegic patient. 1. a method for evaluation of physical performance. Scand J Rehabil Med, 1975, 7: 13–31. [Medline]
11. Platz T, Pinkowski C, van Wijck F, et al.: Reliability and validity of arm function assessment with standardized guidelines with the Fugl-Meyer Test, Action Research Arm Test and Box and Block Test: a multicentre study. Clin Rehabil, 2005, 19: 404–411. [Medline] [CrossRef]
12. Van der Lee JH, De Groot V, Beckerman H, et al.: The intra- and inter-rater reliability of the action research arm test: a practical test of upper extremity function in patients with stroke. Arch Phys Med Rehabil, 2004, 85: 14–19. [Medline] [CrossRef]
13. Page SJ, Levine P, Leonard AC: Effects of mental practice on affected limb use and function in chronic stroke. Arch Phys Med Rehabil, 2005, 86: 399–402. [Medline] [CrossRef]
14. Page SJ, Levine P, Leonard A: Mental practice in chronic stroke: results of a randomized, placebo-controlled trial. Stroke, 2007, 38: 1293–1297. [Medline] [CrossRef]
15. Müller K, Büttetsch CM, Seitz RJ, et al.: Mental practice improves hand function after hemiparetic stroke. Restor Neurol Neurosci, 2007, 25: 501–511. [Medline]
16. Choi YI, Lee YJ, Park SH, et al.: The effects of the mental practice to unilateral neglect in person with stroke, single subject research design. J KSOT. 2005, 13: 1–14.