Effects of Computer-assisted Cognitive Rehabilitation Training on the Cognition and Static Balance of the Elderly

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Abstract. [Purpose] The purpose of this study was to investigate the effects of a six-week-long computer-assisted cognitive rehabilitation training program on the improvement of cognition and balance abilities of the elderly. [Subjects] Thirty healthy elderly people, aged 65 to 80, were randomly assigned either to the training group (n=15) or the control group (n=15). [Methods] Cognitive functions were evaluated using MMSE-K, and the BioRescue AP 153 (RMINGENIERIE, France) was used to examine subjects’ changes in static balance. [Results] The MMSE-K score showed a significant change over the course of the treatment period in the training group, but not in the control group. The sway area and sway path length decreased significantly in the training group, but it did not show any changes in the control group. [Conclusion] Computer-assisted cognitive rehabilitation training is an effective intervention method for the improvement of the cognition and balance abilities of the elderly. Key words: Computer-assisted cognitive rehabilitation, Cognition, Static balance

INTRODUCTION

Cognitive treatments using computers, which began with memory training, are being widely used these days3). Computer-assisted cognitive rehabilitation has advantages, in that it provides personalized treatment based on a subject’s neuropsychological pattern to stimulate impaired areas3). A computer-assisted cognitive rehabilitation training program consists of exercises focused on visual reaction, visual scanning, attention, information processing speed, memory, and problem solving. These exercises can not only provide flexibility and adjustment within a treatment regimen, but may also shorten treatment time. They also provide a means for objectively measuring subject’s performance as well as providing instant feedback3). The causes of decreasing cognitive information processing speeds among the elderly include the decrease in the number of brain cells, the weakening of motor nerve cells, and a decrease in general activity4). Cognitive dysfunction begins with memory decline and is accompanied by miscalculation, disorientation, misjudgment, and comprehension disability, all of which greatly affect daily life5).

Balance is the ability to maintain the body’s center of gravity within the support base with minimal sway6). The sensory process undertaken during balancing refers to the interaction among the somatic senses, including proprioception, visual sense, and stereotactic input from the vestibular system7). One study of cognition and balance reported that the reduction of balance ability due to aging is associated with cognitive function8). Furthermore, in a study of senses and balance, with patients divided into different age groups, Colledge et al.9) reported that the reduction of balance ability with aging was associated with the slowing of central information processing speed.

With the above in mind, this study was conducted to investigate the effects of computer-assisted cognitive rehabilitation training on cognition and balance ability, an area closely related to daily living activities of the elderly, and to present a therapeutic program for reduced cognitive function and a safe therapeutic approach for elderly people who have difficulty engaging in physical exercise.

SUBJECTS AND METHODS

Thirty typical elderly people between the ages of 65 and 80 were randomly assigned to a computer-assisted cognitive rehabilitation training group of 15 subjects or a control group of 15 subjects. A description of the purpose and
had significantly improved after the intervention, com-
K, sway area and sway path length of the training group
end of the intervention are shown in Table 2. The MMSE-
2). the training showed a significant difference (p<0.05) (Table
able between the training group and the control group after
significantly different (p>0.05). A comparison of the vari-
- (p<0.05). However, the values of the control group were not
pared with their respective values before the intervention
significance was chosen as 0.05 for all analyses.
the paired t-test was conducted. The level of statistical sig-
pare the foot pressure training before and after the program,
was done using SPSS 12.0 for Windows. In order to com-
subjects and the differences between the two groups. This
characteristics are summarized in Table 1.
intervention used by the computer-assisted cogni-
tive rehabilitation group was the visual interruption training
found in the RehaCom program and the visual construction ability program of the attention training program. The sub-
jects performed these exercises for 30 minutes per session, three sessions per week, for six weeks. For measurement purposes, their cognitive function was measured using the Korean version of the Mini Mental State Examination (MMSE-K), and their static balance was measured with the balance measurement system, BioRescue AP 153 (RMING-
ENIERIE, France). Data analyses were undertaken using
the independent t-test to analyze the characteristics of the
subjects and the differences between the two groups. This
was done using SPSS 12.0 for Windows. In order to com-
pare the foot pressure training before and after the program,
the paired t-test was conducted. The level of statistical sig-
nificance was chosen as 0.05 for all analyses.

**RESULTS**

The MMSE-K scores and balance ability at the start and
end of the intervention are shown in Table 2. The MMSE-
K, sway area and sway path length of the training group
had significantly improved after the intervention, com-
pared with their respective values before the intervention
(p<0.05). However, the values of the control group were not
significantly different (p>0.05). A comparison of the vari-
able between the training group and the control group after
the training showed a significant difference (p<0.05) (Table
2).

| Table 2. Comparison of variables between pre- and post-inter-
vention in each group |
|----------------------|-----------------|-----------------|
| Variable             | Training group  | Control group   |
|                      | Pre             | Post            |
| MMSE-K (score)*     | 26.0 ± 2.2      | 26.1 ± 1.6      |
| Sway area (mm²)*    | 65.6 ± 7.0      | 66.5 ± 35.0     |
| Sway path length (mm²)* | 28.3 ± 5.9   | 29.2 ± 5.9      |
|                      | 23.8 ± 2.0*     | 27.5 ± 5.5      |
| Mean ± SD            |                 |

**DISCUSSION**

The cognitive function of the elderly plays a key role in
the independent performance of functional activities in-
cluding daily living abilities. The evaluation and treat-
ment of the reduced cognitive function of typical elderly
people due to normal aging, and the cognitive damage due
to neurological diseases such as dementia, is critical for the
maintenance of independent living and the quality of life
of elderly people. Damage to a person's attention, concen-
tration, and memory affect his or her problem-solving and
inferance abilities.

In general, clinical therapies for the cognitive func-
tions of the elderly include psychological approaches such
as music therapy and reminiscence therapy, cognitive aids
to compensate for cognitive impairment and computer-
assisted cognitive rehabilitation training programs used in
clinical settings for cognitive rehabilitation of brain-injury patients, the elderly, and dementia patients
have been confirmed in many studies. According to
Gunther et al., some of the effects that appear immedi-
ately after computer-assisted cognitive rehabilitation training
continue even after five months, and they proposed the
use of computer-assisted cognitive rehabilitation programs
to treat and prevent cognitive defects among the elderly. On
the other hand, research has found that the application
of a computer-assisted cognitive rehabilitation program
achieved significant improvement in various cognitive areas
of traumatic brain-injury patients, but no difference
was found in a control group which received a traditional
therapy.

In this study, a six-week-long computer-assisted cogni-
tive rehabilitation training program was carried out using
elderly subjects, and its effects on the subjects' cognition
and balance were investigated. The MMSE-K score for the
period of treatment showed significant differences in the
training group, but not in the control group. To sustain the
ability to balance, an appropriate response to environmental changes needs to be followed instantaneously, and a proper response can be made possible by quick information processing abilities, which heavily rely on selective attention.

For this reason, the sway area and distance also decreased
significantly in the training group, but not in the control
group. Based on these results, we conclude that a computer-
assisted cognitive rehabilitation program can be used as a therapeutic approach restoring the cognitive functions and balance abilities of elderly people who have limitations on their physical activities due to aging. Furthermore, this approach can be used as an alternative clinical program for

| Table 1. General characteristics of the subjects |
|-----------------------------------------------|
| **Sex (n)** | **Age (yr)** | **Height (cm)** | **Weight (kg)** |
| Training group (n=15) | Male: 6 | 72.8 ± 3.8 | 160.3 ± 7.3 | 59.6 ± 8.9 |
|                    | Female: 9 |                       |                       |
| Control group (n=15) | Male: 7 | 71.7 ± 5.6 | 160.3 ± 8.1 | 61.8 ± 9.3 |
|                    | Female: 8 |                       |                       |
| Mean ± SD          |                 |                       |                       |
preventing the decline of cognitive function of, and falls by, the elderly.

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