J. Phys. Ther. Sci.
25: 1475–1477, 2013

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

Yoon Mi Lee, PhD, PT[1)], Chel Jang, PhD, PT[2)], In Hye Bak, MS, OT[1)],
Joo Soo Yoon, MS, PT[3)*]

[1)] *Department of Occupational Therapy, Gumi University, Republic of Korea*
[2)] *Department of Occupational Therapy, Kyungnam College of Information and Technology, Republic of Korea*
[3)] *Department of Physical Therapy, College of Rehabilitation Science, Daegu University: 15 Jillyang, Gyeongsan-si, Kyeongbuk 712-714, Republic of Korea*

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

(This article was submitted May 15, 2013, and was accepted Jun. 20, 2013)

INTRODUCTION

Cognitive treatments using computers, which began with memory training, are being widely used these days[1)]. Computer-assisted cognitive rehabilitation has advantages, in that it provides personalized treatment based on a subject's neuropsychological pattern to stimulate impaired areas[2)]. 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 feedback[3)]. 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 activity[4)]. Cognitive dysfunction begins with memory decline and is accompanied by miscalculation, disorientation, misjudgment, and comprehension disability, all of which greatly affect daily life[5)].

Balance is the ability to maintain the body's center of gravity within the support base with minimal sway[6)]. The sensory process undertaken during balancing refers to the interaction among the somatic senses, including proprioception, visual sense, and stereotactic input from the vestibular system[7)]. One study of cognition and balance reported that the reduction of balance ability due to aging is associated with cognitive function[8)]. 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

*Corresponding author. Joo Soo Yoon (e-mail: orange1237@hanmail.net)

Table 1. General characteristics of the subjects

	Sex (n)	Age (yr)	Height (cm)	Weight (kg)
Training group (n=15)	Male: 6 Female: 9	72.8 ± 3.8	160.3 ± 7.3	59.6 ± 8.9
Control group (n=15)	Male: 7 Female: 8	71.7 ± 5.6	160.3 ± 8.1	61.8 ± 9.3

Mean ± SD

Table 2. Comparison of variables between pre- and post-intervention in each group

Variable		Training group	Control group
MMSE-K (score)*	Pre	26.0 ± 2.2	26.1 ± 1.6
	Post	29.3 ± 0.7*	26.6 ± 1.8
Sway area (mm^2)*	Pre	65.6 ± 7.0	66.5 ± 35.0
	Post	43.8 ± 31.3*	62.9 ± 27.2
Sway path length (mm^2)*	Pre	28.3 ± 5.9	29.2 ± 5.9
	Post	23.8 ± 2.0*	27.5 ± 5.5

Mean ± SD

methods of the study was provided to all the participants, and the experiments were conducted after the participants had read and signed an informed consent form. Subject characteristics are summarized in Table 1.

The intervention used by the computer-assisted cognitive rehabilitation group was the visual interruption training found in the RehaCom program and the visual construction ability program of the attention training program. The subjects 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 (RMINGENIERIE, 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 compare the foot pressure training before and after the program, the paired t-test was conducted. The level of statistical significance 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, compared 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 variable between the training group and the control group after the training showed a significant difference ($p<0.05$) (Table 2).

DISCUSSION

The cognitive function of the elderly plays a key role in the independent performance of functional activities including daily living abilities[10]. The evaluation and treatment 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, concentration, and memory affect his or her problem-solving and inference abilities[11].

In general, clinical therapies for the cognitive functions 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[12]. The effects of 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[12, 13]. According to Gunther et al.[14], some of the effects that appear immediately 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, Chen et al.[15] reported 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 cognitive 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 be followed instantaneously, and a proper response can be made possible by quick information processing abilities[9], 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

preventing the decline of cognitive function of, and falls by, the elderly.

REFERENCES

1) Glisky EL, Schacter DL, Tulving E: Learning and retention of computer-related vocabulary in memory-impaired patients: method of vanishing cues. J Clin Exp Neuropsychol, 1986, 8: 292–312. [Medline] [CrossRef]
2) Talassi E, Guerreschi M, Feriani M, et al.: Effectiveness of a cognitive rehabilitation program in mild dementia (MD) and mild cognitive impairment (MCI): a case control study. Arch Gerontol Geriatr, 2007, 44: 391–399. [Medline] [CrossRef]
3) Zoltan B: Vision, Perception and Cognition, 3rd ed. New Jersey: SLACK, 1996.
4) Crossman ER, Szafran J: Change with age in the speed of information intake and discrimination. Experientia Suppl, 1956, 4: 128–135.
5) Rhee JA, Jung HG: A study on the depression and cognitive impairment in the rural elderly. Korean J Prev Med, 1993, 26: 412–429.
6) Nichols DS, Miller L, Colby LA, et al.: Sitting balance: its relation to function in individuals with hemiparesis. Arch Phys Med Rehabil, 1996, 77: 865–869. [Medline] [CrossRef]
7) Di Fabio RP: Sensitivity and specificity of platform posturography for identifying patients with vestibular dysfunction. Phys Ther, 1995, 75: 290–305. [Medline]
8) Stelmach GE, Phillips J, DiFabio RP, et al.: Age, functional postural reflexes, and voluntary sway. J Gerontol, 1989, 44: B100–B106. [Medline] [CrossRef]
9) Colledge NR, Cantley P, Peaston I, et al.: Ageing and balance: the measurement of spontaneous sway by posturography. Gerontology, 1994, 40: 273–278. [Medline] [CrossRef]
10) Carpenter GI, Hastie CL, Morris JN, et al.: Measuring change in activities of daily living in nursing home residents with moderate to severe cognitive impairment. BMC Geriatr, 2006, 6: 7. [Medline] [CrossRef]
11) Owen AM, Downes JJ, Sahakian BJ, et al.: Planning and spatial working memory following frontal lobe lesions in man. Neuropsychologia, 1990, 28: 1021–1034. [Medline] [CrossRef]
12) Gontkovsky ST, McDonald NB, Clark PG, et al.: Current directions in computer-assisted cognitive rehabilitation. NeuroRehabilitation, 2002, 17: 195–199. [Medline]
13) Lynch B: Historical review of computer-assisted cognitive retraining. J Head Trauma Rehabil, 2002, 17: 446–457. [Medline] [CrossRef]
14) Günther VK, Schafer P, Holzner BJ, et al.: Long-term improvements in cognitive performance through computer-assisted cognitive training: a pilot study in a residential home for older people. Aging Ment Health, 2003, 7: 200–206. [Medline] [CrossRef]
15) Chen SH, Thomas JD, Glueckauf RL, et al.: The effectiveness of computer-assisted cognitive rehabilitation for persons with traumatic brain injury. Brain Inj, 1997, 11: 197–209. [Medline] [CrossRef]