Effect of computerized cognitive rehabilitation
program on cognitive function and activities of
living in stroke patients

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Abstract. [Purpose] The objective of this study was to examine the effect of cognitive rehabilitation using a computer on cognitive function and activities of daily living in stroke patients presenting impairment of cognitive function. [Subjects] Forty-six stroke patients were divided into two groups (a training group and control group) through random assignment. [Methods] The training group received rehabilitation therapy and an additional computerized cognitive rehabilitation program using The RehaCom software 30 minutes/day, 5 times/week for 5 weeks. The control group received only rehabilitation therapy including physical and occupational therapy. A comparative analysis on all subjects was conducted before and after the experiment using a cognitive test and activities of daily living test. [Results] After 5 weeks of therapy, the training group presented statistically significant improvement in cognitive function assessment items of digit span, visual span, visual learning, auditory continuous performance, visual continuous performance, and others compared with the control group but did not present statistically significant improvement in activities of daily living. [Conclusion] It was revealed through this study that computerized cognitive rehabilitation with the RehaCom program results in improvement in cognitive function and can be used as a treatment tool beneficial to stroke patients presenting cognitive impairment.

Key words: Computerized cognitive rehabilitation, Cognitive function, Activities of daily living

INTRODUCTION

Cognitive function refers to the ability to understand events that occur in our daily living and ability to make decisions and adapt in a variety of environments3). Impairment in cognitive function is a common symptom in stroke patients, and it brings about difficulties in concentration, memory, and problem solving ability. It not only acts as the biggest impairment for daily living but also acts as the impairment for rehabilitation in local society2, 3). In the case of conducting cognitive rehabilitation using a computer, it is easier to induce motivation for therapy because direct feedback can be given to patients regarding the performance result in comparison with cognitive rehabilitation, and this type of training can not only provide flexibility but may also shorten treatment time4, 5). A previous study suggested that cognitive rehabilitation using a computer has an effect on cognitive function in patients with brain damage, and other previous studies suggested that continuous computerized cognitive rehabilitation for 5 months or longer improves the cognitive ability of elderly individuals with low cognitive ability6, 7). Therefore, numerous studies have been conducted on computerized cognitive rehabilitation. In particular, many studies have been conducted with themes concerning attention and memory, and such studies and interests have been concentrated on basic cognition level. However, given that there has been a increase in attention paid to improvement of cognitive function and activities of daily living, there has been a lack of study on the degree of improvement in cognitive function resulting from computerized cognitive rehabilitation and its effect on daily living.

Therefore, the objective of this study was to verify the effect of computerized cognitive rehabilitation by comparing the level of cognitive improvement between a general rehabilitation therapy group and computerized cognitive rehabilitation group and examining the effect of improved cognitive level on activities of daily living.

SUBJECTS AND METHODS

The experiment in this study was conducted with 46 stroke patients who were receiving in-patient rehabilitation.
therapy at Inje University Hospital from Oct. 2013 to Mar.
2014. The participants understood the objective of this study
and provided written informed consent prior to participation
in the study. The study was approved by the ethics committee
of the Inje University Institutional Review Board for Clinical
Studies. The participants were randomly divided into a
training group of 23 patients and a control group of 23 pa-
tients. The training group received rehabilitation therapy and
an additional computerized cognitive rehabilitation program
using the RehaCom software 30 minutes/day, 5 times/week
for 5 weeks. The control group received only rehabilitation
therapy, including physical and occupational therapy.

The Computerized Neuropsychological Test (CNT) was
used for assessment of cognitive function, and the Functional
Independence Measurement (FIM) was used for assessment
of activities of daily living.

In regard to the CNT, 7 tests, the digit span test, verbal
learning test, visual span test, visual learning test, auditory
continuous performance test, visual continuous performance
test, and trail making test, were used in the assessment to mea-
sure the degree of cognitive function). The FIM is composed
of 13 items regarding 4 lower domains of physical function,
self-care, sphincter control, transfers, and locomotion, and 5
items regarding 2 lower domains of cognitive function, com-
munication and social cognition. The responses are recorded
on a 7-point Likert scale, and 1–5 points and 6–7 points are
considered to indicate a dependent state in which assistance
is required and an independent state in which assistance is
not required, respectively. The total number of points is cal-
culated by adding the points together for each question, with
the total ranging from 18 to 126 points; a higher total number
of points signifies a greater capacity to perform activities of
daily living independently (5). The inter-rater reliability of
the FIM has been found to be between 0.83 and 0.99, and the
test-retest reliability has been found to be between 0.48 and
0.93). Cognitive assessment and activities of daily living
assessment were conducted before and 5 weeks after the
start of computerized cognitive rehabilitation.

The RehaCom software (Hasomed GmbH, Magdeburg,
Germany) was used for computerized cognitive rehabilita-
tion; the treatment sessions lasted 30 min and were held 5
times/week for total of 5 weeks. The cognitive training pro-
gram employed was composed of attention, focus, memory,
spatial imagination, visual impairment, and visuomotor co-
orrelation. Computerized cognitive rehabilitation together
with rehabilitation therapy was conducted for the training
group, and rehabilitation therapy only was conducted for the
control group.

The paired t-test was conducted for comparison of dif-
fferences between the computerized cognitive rehabilitation
group and control group in each test, and the level of statisti-
cal significance was set as α=0.05. The PASW Statistics for
Window software (Version 18.0, SPSS Inc., Chicago, IL,
USA) was used for statistical processing of data.

RESULTS

There were 8 male and 15 female study participants in the
training group, and their average age and post-onset duration
were 53.2 years and 11.8 months, respectively. There were
9 male and 14 female participants in the control group, and
their average age and post-onset duration were 56.3 years
and 10.7 months, respectively (Table 1).

Comparison of the results from before and after therapy
revealed that training group presented statistically signifi-
cant improvement in digit span, visual span, visual learning,
auditory continuous performance, and visual continuous
performance (p<0.05) (Table 2). However, computerized
cognitive rehabilitation did not result in statistically signifi-
cant difference between before and after therapy in verbal
learning, trail making, and functional independence measure
(p>0.05) (Table 2).

Comparison of the results from before and after therapy
revealed that the control group did not present statistically
significant difference in any of the assessment items includ-
ing digit span, verbal learning, visual span, visual learning,
auditory continuous performance, visual continuous per-
formance, trail making, functional independence measure
(p>0.05) (Table 2).

DISCUSSION

In this study, the effect of therapy using a computerized
cognitive rehabilitation system (called RehaCom) was
examined. The RehaCom computerized cognitive rehabilita-
tion system used in this study is composed of 20 detailed
training programs for effective rehabilitation of cognitive
function impairment. These programs are designed to work
together and are composed of not only special and basic
items but also a variety of items that closely mimic reality.
In comparison with cognitive rehabilitation the strengths of
rehabilitation with RehaCom are that it enables adjustment
of difficulty based on the task performance capacity of the
patient, immediate feedback, reduction in time spent by the
therapist once the patient learns the therapy task, and main-
tenance of objective and continuous information concerning
performance results. The objective of RehaCom is effec-
tive and economic therapy for patients, and all RehaCom
therapy programs enable this objective, as they are based on
academically verified theory.

The present study was conducted based on the results of
preceding studies; although there was no statistically sig-
ificant difference in cognitive ability between the training
group and control group in each test item before therapy,
there was improvement in cognitive assessment after therapy.
Thus, the present study revealed that computerized cogni-
tive rehabilitation has effect on improvement of cognitive
function in stroke patients (p<0.05). In particular, it resulted
in improvement in digit span, visual span, visual learning,
auditory continuous performance, and visual continuous performance. Furthermore, its results are similar to those of Chen et al. and Lee et al., who suggested that computerized cognitive rehabilitation is effective for recovery of cognitive function of patients presenting cognitive impairment after brain damage when conducted together with rehabilitation therapy. However, although the training group presented a high increase in average points compared with the control group in the activities of daily living scale, no statistically significant difference was found before and after the experiment. Since other physical aspects are incorporated with cognitive aspects for the activities of daily living scale, it would have been difficult for a short-term cognitive treatment of (5 weeks) to result in a significant difference in activities of daily living.

A limitation of this study was implementation of computerized cognitive rehabilitation with adjustment of difficulty based on the performance of each subject rather than according to the targets of the subjects. Moreover, it was difficult to examine whether or not the improvement in the cognitive domain of activities of daily living was due to pure improvement in cognitive function because the physical domain was included together with cognitive domain in the total points for the activities of daily living assessment.

The results of the present study revealed that computerized cognitive rehabilitation is effective for recovery of cognitive function in stroke patients who present cognitive impairment. In future studies, it is necessary to conduct studies with subjects classified by post-onset duration of stroke, damaged area, and cognitive function.

### Table 2. Comparison of variables between before and after therapy in each group

| Variable                              | Training group | Control group |
|---------------------------------------|----------------|---------------|
| Digit span test (score) Before         | 3.62±1.35      | 3.72±1.23     |
|                                      | After          | 4.32±1.32*    | 3.86±1.41     |
| Verbal learning test (score) Before    | 3.55±2.12      | 3.54±2.08     |
|                                      | After          | 3.65±2.35      | 3.58±2.26     |
| Visual span test (score) Before        | 3.61±1.08      | 3.62±1.20     |
|                                      | After          | 4.56±1.52*    | 3.67±1.52     |
| Visual learning test (score) Before    | 4.21±1.46      | 4.31±1.43     |
|                                      | After          | 4.66±1.84**   | 4.43±1.66     |
| Auditory continuous performance test (sec) Before | 0.55±0.22      | 0.52±0.12     |
|                                      | After          | 0.45±0.34*    | 0.49±0.52     |
| Visual continuous performance test (sec) Before | 0.56±0.24      | 0.54±0.18     |
|                                     | After          | 0.46±0.33*    | 0.50±0.68     |
| Trail making test (sec) Before         | 71.62±22.31    | 68.48±25.54   |
|                                      | After          | 65.68±24.51   | 67.36±22.50   |
| Functional Independence Measure (score) Before | 73.34±20.51    | 75.56±19.65   |
|                                          | After          | 84.25±22.50   | 80.36±18.25   |

Means±SD.  
*Significant difference p<0.05.  ** Significant difference p<0.01

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