

# The effects of cognitive rehabilitation on Alzheimer's dementia patients' cognitive assessment reference diagnosis system performance based on level of cognitive functioning

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**Abstract.** [Purpose] The purpose of this study is to apply cognitive rehabilitation according to Alzheimer's disease (AD) patients' level of cognitive functioning to compare changes in Cognitive Assessment Reference Diagnosis System performance and present standards for effective intervention. [Subjects] Subjects were 30 inpatients diagnosed with AD. Subjects were grouped by Clinical Dementia Rating (CDR) class (CDR-0.5, CDR-1, or CDR-2, n = 10 per group), which is based on level of cognitive functioning, and cognitive rehabilitation was applied for 50 minutes per day, five days per week, for four weeks. [Methods] After cognitive rehabilitation intervention, CARDS tests were conducted to evaluate memory. [Results] Bonferroni tests comparing the three groups revealed that the CDR-0.5 and CDR-1 groups showed significant increases in Delayed 10 word-list, Delayed 10 object-list, Recognition 10 object, and Recent memory performance compared to the CDR-2 group. In addition, the CDR-0.5 group showed significant decreases in Recognition 10 word performance compared to the CDR-1 group. [Conclusion] Cognitive rehabilitation, CDR-0.5 or CDR-1 subjects showed significantly greater memory improvements than CDR-2 subjects. Moreover, was not effective for CDR-2 subjects.

**Key words:** Alzheimer's, Cognitive rehabilitation, Clinical dementia rating

(This article was submitted May 12, 2015, and was accepted Jun. 9, 2015)

## INTRODUCTION

Alzheimer's disease (AD) is a common degenerative brain disease that causes dementia. AD causes amyloid- $\beta$  protein to be deposited in brain tissues, which generate senile plaques and tau protein. The generated substance is hyper-phosphorylated, causing damage to brain nerve cells<sup>1)</sup>. Clinical symptoms of AD include decline in cognitive abilities, memory impairment, and speech impairment, and damage to cognitive and speech areas becomes more extensive as the disease progresses<sup>1)</sup>. At the beginning of AD, there are difficulties understanding and expressing appropriate words, and damage to vision and perception occurs as the disease progresses<sup>1)</sup>. Although no perfect preventive or treatment method has been found thus far for this disease, receiving cognitive rehabilitation as soon as possible is important for relieving symptoms or reducing the speed of disease

progress. Recently, cognitive rehabilitation has been applied to patients with diverse diseases because it can be tailored to patients' cognitive abilities and it provides accurate and immediate feedback about its effectiveness<sup>2)</sup>. A previous study reported that cognitive rehabilitation in AD patients slowed the progression of cognitive impairments<sup>3)</sup>. Cognitive rehabilitation may produce different outcomes based on the degree cognitive impairment. Cognitive rehabilitation should produce more effective outcomes in subjects with mild versus severe cognitive impairments. However, no study has examined the effect of cognitive rehabilitation based on level of cognitive functioning. The purpose of the present study was to apply cognitive rehabilitation with AD patients with different levels of cognitive functioning to compare changes in Cognitive Assessment Reference Diagnosis System (CARDS) performance and present standards for more effective intervention.

## SUBJECTS AND METHODS

Subjects were 30 inpatients diagnosed with Alzheimer's dementia. Subjects were eligible if their Clinical Dementia Rating (CDR) was 0.5–2, and their Mini-Mental State Examination-Korea (MMSE-K) score was 23 points or lower (Cha et al., 2014). This study was approved by the

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**Table 1.** General and medical subject characteristics (N = 30)

	CDR-0.5 (n = 10)	CDR-1 (n = 10)	CDR-2 (n = 10)
Age (years)	73.42±6.23 <sup>§</sup>	69.12±6.14	75.47±4.52
Time since onset (months)	25.12±13.78	22.43±10.04	27.51±13.4
Weight (kg)	60.18±9.63	63.79±10.38	65.19±8.31
Height (cm)	165.48±11.12	161.62±9.48	166.73±7.92
Gender (male/female)	6/4	5/5	7/3
MMSE-K	15.23±5.12	16.13±4.27	14.53±4.92

<sup>§</sup>Mean ± SD, MMSE-K: mini-mental state examination-Korea

**Table 2.** Comparison of CARDS scores between groups (N = 30)

	CDR-0.5 (n = 10) <sup>a</sup>	CDR-1 (n = 10) <sup>b</sup>	CDR-2 (n = 10) <sup>c</sup>	
Delayed 10 word-list				
pre	22.85±20.58 <sup>§</sup>	7.05±11.59	7.27±11.03	/
post	41.42±29.11**	28.23±13.33**	5.45±10.35	a, b > c
Delayed 10 object-list				
pre	5.71±9.75	1.17±3.32	0.90±3.01	/
post	41.42±20.35**	26.47±13.20**	2.72±6.46	a, b > c
Recognition 10 word				
pre	65.71±16.18	24.70±33.18	28.18±33.41	/
post	34.28±27.60**	8.23±15.90**	10.00±23.66**	a > b
Recognition 10 object				
pre	31.42±22.67	34.11±21.23	37.27±14.89	/
post	64.28±15.11**	57.64±19.21**	35.45±28.41	a, b > c
Recent memory				
pre	64.57±35.76	33.11±25.64	25.00±15.62	/
post	72.57±26.41*	52.47±23.63**	30.00±14.83*	a, b > c

<sup>§</sup>mean±SD, \*p<0.05, \*\*p<0.01, CDR: clinical dementia rating, CARDS: cognitive assessment reference diagnosis system

University Institutional Review Board and all the subjects understood the purpose of this study and provided their written informed consent prior to their participation in the study, in accordance with the ethical standards of the Declaration of Helsinki. Subjects were categorized as CDR-0.5, CDR-1, or CDR-2 (n = 10 per group) based on level of cognitive functioning. General subject characteristics are shown in Table 1. The tester provided instructions before the intervention so that subjects could adapt to the computers and manipulate the mouse by themselves. The cognitive rehabilitation program is designed to improve memory, and consists of items that target visual and perceptual attention, attentive discrimination capacity, attentive tracing, attention maintenance, simple recognition memory, simple spatial memory, sequential recall memory, sequential language recall memory, and combined recall memory. This program was used 50 minutes per day, five times per week, for four weeks.

The CARDS is a cognitive battery that includes seven memory tests and five non-memory tests. The five memory tests used in this study were recognition 10 word, delayed 10 word-list, recent memory, delayed 10 object-list, and recognition 10 object. The test-retest reliability and inter-rater reliability were very high (0.74–0.99<sup>2</sup>). The CDR is a tool

for evaluating the severity of dementia. The CDR evaluates six dimensions: memory, orientation, judgment and problem solving, social activities, in-house life and hobbies, hygiene and brush up, on 5-point scales. A score of 0 is normal, 0.5 is questionable dementia, 1 is mild, 2 is moderate, 3 is severe, 4 is profound, and 5 is terminal. Inter-rater reliability was very high (0.89<sup>3</sup>). Paired t-tests were used to compare memory performance before and after cognitive rehabilitation. Groups were compared with a one-way ANOVA. In addition, a post hoc test was performed using Fisher's least significance difference (LSD) test. The statistical significance level was set at  $\alpha = 0.05$ .

## RESULTS

After the intervention, the CDR-0.5 and CDR-1 groups showed significant decreases in Recognition 10 word performance (p<0.01), and significant increases in all other measures (p<0.05). The CDR-2 group showed significant decreases in Recognition 10 word performance (p<0.05), and significant increases in Recent memory. Bonferroni tests revealed that the CDR-0.5 and CDR-1 groups showed significant increases in performance on the Delayed 10 word-list, Delayed 10 object-list, Recognition 10 object, and Recent

memory tests ( $p < 0.01$ ) compared to the CDR-2 group. In addition, the CDR-0.5 group showed significant decreases in Recognition 10 word performance compared to the CDR-1 group ( $p < 0.01$ ) (Table 2).

### DISCUSSION

The present study was conducted to examine the effects of four weeks of cognitive rehabilitation on AD patients' CARDS performance, and present more effective intervention times according to level of cognitive functioning. Hoffmann et al. (1996) found that the CDR-0.5 group showed the greatest improvements in cognitive functions and daily living activities after cognitive rehabilitation, followed by the CDR-1 group and the CDR-2 group<sup>4</sup>). The results of the present study indicate that after cognitive rehabilitation, CDR-0.5 or CDR-1 subjects showed significantly greater memory improvements than CDR-2 subjects. Moreover, cognitive rehabilitation was not effective for CDR-2 subjects. This is consistent with the results of a study that reported that dementia symptoms were correlated with cognitive impairments and that the speed of memory recovery varies with AD patients' level of cognitive functioning<sup>5</sup>). The results of this study suggest that cognitive rehabilitation can be an effective treatment for CDR-0.5 (questionable dementia) or CDR-1 (mild) patients. However, cognitive rehabilitation is not sufficiently effective for CDR-2 dementia patients. Therefore, other cognitive rehabilitation methods may be more appropriate for these patients. CARDS recognition 10 word scores decreased significantly over the course of the study. This is consistent with a previous study that found that

AD patients experienced decreases in their ability to distinguish between different words and to accurately understand the meanings of words compared to patients with other types of dementia, and had lower recognition 10 word scores<sup>6, 7</sup>). Because the number of subjects in the present study is small, the results may not generalize to all AD patients, and the evaluation methods based on level of cognitive functioning were not quantitative, nor did they evaluate implicated brain areas. Future studies should address these limitations by including more subjects and considering long-term effects.

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