Original Article

Effect of task-oriented activities on hand functions, cognitive functions and self-expression of elderly patients with dementia

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Abstract. [Purpose] This study investigates the effects of task-oriented activities on hand function, cognitive function, and self-expression of the elderly with dementia, and then identify the influencing factors on self-expression in sub-factors of dependent variables. [Subjects and Methods] Forty elderly persons were divided into two groups: intervention group (n=20) and control group (n=20). The interventions were applied to the subjects 3 times a week, 50 minutes per each time, for a total of five weeks. We measured the jamar hand dynamometer test for grip strength, the jamar hydraulic pinch gauge test for prehension test, nine-hole pegboard test for coordination test, and Loewenstein Occupational Therapy Cognitive Assessment-Geriatric Population for cognitive function, and self-expression rating scale for self-expression test. [Results] The task-oriented activities promoted hand function, cognitive function (visual perception, spatial perception, visuomotor organization, attention & concentration) and self-expression of the elderly with early dementia, and the factors influencing the self-expression were cognitive function (visual perception) and hand function (coordination). The study showed that the task-oriented program enabled self-expression by improving hand function and cognitive function. [Conclusion] This study suggested that there should be provided the task-oriented program for prevention and treatment of the elderly with early dementia in the clinical settings and it was considered that results have a value as basic data that can be verified relationship of hand function, cognitive function, and self-expression.

Key words: Dementia, Hand function, Task-oriented activities

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INTRODUCTION

In an aging society, dementia is one of the most serious social diseases that can occur to anyone. Since family, society, and the nation have to care for patients with dementia, it is critical to have appropriate preventive measures and early treatment of dementia. However, the degradation of cognitive functions in elderly patients with dementia is difficult to differentiate from that due to the normal aging process. In addition, the progress of symptoms is slow, which exacerbates the situation. Currently, no effective treatments have been found to recover the degradation in cognitive functions at the same level prior to the onset of the disease1). Thus, a study on various intervention measures to prevent the progression of symptoms is now needed to depart from the medical treatment-oriented services whereby dementia is only approached from the perspective of treating the disease. The statistics show that the severity of dementia in South Korea is classified into very mild (28.9%), mild
interactions between the nervous system and the cerebral cortex, which is the higher center responsible for developing and strengthening new synapse networks. Early diagnosis and intervention.

Although elderly patients with mild dementia will gradually lose interest in hobbies and intellectual activities and will lose concentration, expressiveness, thinking ability, and social behaviors by increasing execution abilities appropriate for specific tasks and environments, thereby inducing activation of cognitive functions and stimulating an undamaged part of the brain. Hands are responsible for 30% of all brain activities. Through touch and experiencing various objects directly, much information is delivered to the brain. In addition to stimulating and drawing on the brain’s functions, the hands also play an essential role in social interactions as symbols of communication and a means of expression. A single nerve cell that is responsible for hand movements is connected to another 1,000 to 3,000 nerve cells to induce interactions between the nervous system and the cerebral cortex, which is the higher center responsible for developing and strengthening new synapse networks. That is, hand movements affect the motor region in the cerebral cortex that requests active processing of sensory information as well as activation in the cognition-related region. If visual, auditory, tactile, and proprioceptive senses are employed appropriately within a given task activity based on the plasticity of the neural networks in the brain, it can help patients to recover their motor ability or learn new motor functions. Thus, a task-oriented activity that employs the hands as instrumental functions can improve the hand functions of elderly patients with dementia. This will also improve their cognitive functions through the thinking process where attention, understanding, judgment, and cognition are needed, which are all essential for completing tasks. Moreover, a task-oriented activity can embody internal desire, motivation, and thoughts in patients with structured themes, while taking a retrospect of their past life, thereby inducing empathic environments and spontaneous stories. Thus, the present paper conducted a study on a task-oriented activity that actively facilitates self-expression by stimulating brain functions and activating cognitive functions as a thinking process to complete tasks through repetitive hand activities that were productive and creative as well as intimate and familiar. The purpose of the present study was to apply the task-oriented activity program to elderly patients with mild dementia to determine its effect on self-expression and, consequently, identify the factors that affected self-expression.

SUBJECTS AND METHODS

The subjects in this study were elderly patients, 70 years or older, with mild dementia who agreed to participate in the study after providing fully informed consent. The selection criteria of the subjects were as follows: a score on the global deterioration scale (GDS) of 4 or lower, no visual and auditory disabilities, a mini-mental state examination-Korea (MMSE-K) score in the range of 18 to 21 points, and the ability to follow the researcher’s instructions. For the experimental group, selection criteria were those who consented not to participate in other physical and cognitive activity programs within the institution during the research period. The present study divided 40 elderly persons into a program group (n=20) who performed the task-oriented activities and a control group (n=20). The activities were performed three times a week for 50 minutes for five weeks, resulting in a total of 15 activity performances. The gender make-up in the task-oriented activity program group was 14 females and six males, and the age range was 80 to 85 years old. The chronic diseases included three of diabetes mellitus, four of hypertension, and one of low back pain. The gender make-up in the control group was 16 females and four males, and the age range was 80 to 85 years old. The chronic diseases were two of diabetes mellitus, seven of hypertension, and three of low back pain.

For the grip-strength test, the JAMAR hand dynamometer was used. This test measured changes in the hands’ grip force after trauma or disease. The measured postures were shoulder joint adduction, elbow joint flexed at 90°, forearm in a neutral position, wrist extension at 0–30°, and ulnar deviation at 0–15°. The measured value was the mean of the three measurements and its unit was in kilograms (kg). If the subjects felt tired, 30 seconds of rest was given between measurements. The dominant hand was measured first. For the prehension test, a pinch gauge (JAMAR hydraulic pinch gauge) was employed. This test measured the muscle strength of the fingers via a three-jaw pinch by making the index and middle fingers in opposition to the thumb, a tip pinch in which the tips of the index finger and thumb are in contact with each other, and a lateral pinch.
in which the thumb opposes the lateral side of the index finger to make a key-gripping shape. The measured postures were shoulder joint adduction, elbow joint flexed at 90°, forearm in a neutral position, wrist extension at 0–15°, and ulnar deviation at 0–15° while sitting in a chair. The measured value was the mean of the three measurements and its unit was in kg. If the subjects felt tired, 30 seconds of rest were given between measurements. The dominant hand was measured first. For the coordination test, a nine-hole pegboard test was conducted. The used tools were a wooden stick (32 mm in length and 9 mm in diameter) and a wooden plate with nine holes (a gap of 15 mm and a 3 × 3 array of holes). In this measurement method, the subjects inserted nine wooden sticks in each of the nine holes one at a time and then removed the nine sticks one at a time, regardless of the order of insertion and removal. The completion times were measured. The dominant hand was measured first. For the cognition test, the Loewenstein Occupational Therapy Cognitive Assessment-Geriatric Population (LOTCA-G) was conducted. The measured items consisted of 24 items: orientation (two), visual perception (four), spatial perception (three), motor praxis (three), visuomotor organization (six), thinking operations (two), memory (three), and attention and concentration (one). The score of each item can range from one to four, with the exception of the orientation items whose score ranges from one to eight. The higher the score, the better the cognitive functions. For the self-expression test, the self-expression rating scale was conducted. The items consisted of 20 questions: verbal self-expression (nine questions), vocal self-expression (seven questions), and non-verbal self-expression (four questions). In the present study, they were modified to passive attitude (eight questions), relational attitude (five questions), and emotional attitude (three questions). The scale was scored from one point to five points. The higher the score, the worse the self-expression. In reverse, the lower the score, the better the self-expression.

The task-oriented activity program consisted of: 1) large motor activities using both hands, stretching, grasping and releasing; 2) small motor activities using both hands, stretching, grasping/gripping, releasing, and manipulating; and 3) self-expression activities that expressed one’s own thoughts and emotions naturally through stretching, grasping/gripping, releasing, manipulation, and the use of both hands.

RESULTS

A difference in hand functions before and after the activities showed that the experimental group had a significant difference (Table 1) (p<0.05). A difference in cognitive functions before and after the activities showed that the experimental group had a significant difference in visual perception, spatial perception, visuomotor organization, and attention and concentration among the items in the LOTCA-G (Table 2) (p<0.05). Furthermore, a significant difference was also revealed in self-expression before and after the activities (Table 3) (p<0.05). The factors that affected self-expression were coordination of hand functions and visual perception in cognitive functions (Tables 4, 5) (p<0.05).

DISCUSSION

The task-oriented activity helps one to express his or her own emotions and freely make requests, which improves cognitive functions and stimulates the brain by facilitating a thinking process needed to perform a task. In addition, by using suitable tasks that positively affect the hand functions of elderly patients with dementia, the frequency of hand use and sensory awareness are increased. The purpose of the present study was to apply the task-oriented activity program to elderly

Table 1. Comparison of the change in hand function

| Area               | Experimental group (N=20) | Control group (N=20) |
|--------------------|--------------------------|----------------------|
|                    | Pre  M ± SD   | Post M ± SD   | Pre  M ± SD   | Post M ± SD   |
| Grip strength (kg) | Rt  8.13 ± 1.97 | 11.15 ± 3.00*  | 9.50 ± 2.55  | 9.36 ± 2.28  |
|                    | Lt  8.73 ± 3.23 | 11.88 ± 4.15*  | 9.63 ± 2.71  | 9.53 ± 2.48  |
| Lateral            | Rt  2.98 ± 1.84 | 5.18 ± 2.24*  | 3.60 ± 1.30  | 3.48 ± 0.79  |
| Tip                | Lt  4.47 ± 1.53 | 6.43 ± 2.06*  | 4.10 ± 1.04  | 3.59 ± 1.03  |
| Coordination (sec) | Lt  4.67 ± 1.94 | 6.45 ± 1.72*  | 3.68 ± 1.46  | 3.63 ± 1.11  |
|                    | Rt  2.75 ± 1.22 | 3.63 ± 1.34*  | 2.68 ± 0.66  | 2.46 ± 0.71  |
|                    | Lt  2.40 ± 0.85 | 3.23 ± 0.62*  | 2.78 ± 1.33  | 2.42 ± 0.90  |
|                    | Lt  42.70 ± 13.93 | 34.25 ± 9.54* | 41.95 ± 9.36 | 45.40 ± 11.49 |

*Jamar hand dynamometer, *Jamar hydraulic pinch gauge, *Nine-hole pegboard
*paired t-test, *p<0.05
patients with mild dementia to determine its effect on self-expression and, consequently, identify the factors that affected self-expression.

The task-oriented activity program improved the hand functions (grip strength, prehension, and coordination) of elderly

Table 2. Comparison of the change in cognitive

| Subarea                        | Experimental       | Control          |
|--------------------------------|--------------------|------------------|
|                                | Pre               | Post             | Pre            | Post          |
| Orientation                    | 12.95 ± 1.67      | 12.35 ± 2.13     | 13.30 ± 1.49   | 12.20 ± 2.50  |
| Visual perception              | 11.30 ± 1.34      | 12.05 ± 1.54*    | 11.75 ± 1.12   | 11.50 ± 1.05  |
| Spatial perception             | 9.05 ± 1.57       | 9.95 ± 1.43*     | 9.50 ± 1.76    | 9.55 ± 1.96   |
| Praxis                         | 10.45 ± 2.16      | 10.70 ± 1.26     | 10.25 ± 1.07   | 10.55 ± 0.83  |
| Visuomotor organization        | 10.05 ± 2.11      | 11.30 ± 3.11*    | 10.75 ± 1.41   | 9.65 ± 2.23   |
| Thinking operations            | 2.40 ± 0.68       | 2.65 ± 0.75      | 2.90 ± 0.85    | 2.50 ± 0.69   |
| Memory                         | 6.80 ± 2.55       | 7.45 ± 1.47      | 6.75 ± 1.16    | 6.35 ± 1.18   |
| Attention & concentration      | 2.25 ± 0.55       | 3.60 ± 0.50*     | 2.75 ± 0.79    | 2.50 ± 0.61   |
| Total                           | 58.45 ± 6.35      | 70.05 ± 6.16*    | 61.20 ± 4.84   | 63.70 ± 4.04  |

\[\text{Loewenstein Occupational Therapy Cognitive Assessment-Geriatric Population}\]

*paired t-test, *p<0.05

Table 3. Comparison of the change in self-expression

| Subarea                      | Experimental       | Control          |
|------------------------------|--------------------|------------------|
|                              | Pre               | Post             | Pre            | Post          |
|                              | M ± SD            | M ± SD           | M ± SD         | M ± SD        |
| Passive expression           | 15.55 ± 5.60      | 12.55 ± 2.52*    | 13.20 ± 2.19   | 14.10 ± 2.94  |
| Emotional expression         | 12.00 ± 4.79      | 9.05 ± 2.26*     | 12.60 ± 2.96   | 12.35 ± 2.70  |
| Nonverbal expression         | 14.85 ± 3.66      | 10.00 ± 2.08*    | 13.10 ± 2.13   | 13.30 ± 1.59  |
| Active expression            | 9.05 ± 2.52       | 7.55 ± 1.73*     | 8.05 ± 1.54    | 8.55 ± 1.54   |
| Total                        | 51.45 ± 11.51     | 40.75 ± 4.61*    | 46.95 ± 5.20   | 48.30 ± 5.50  |

*Self-expression rating scale
*paired t-test, *p<0.05

Table 4. The effect of hand function on self-expression

| Variable                  | B     | SE     | β      | t     | p     |
|---------------------------|-------|--------|--------|-------|-------|
| (Constant)                | 28.29 | 2.66   | 10.63  | 0.000 |       |
| Rt. coordination          | 0.364 | 0.075  | 0.753  | 4.855 | 0.000*|
| R²                        | 0.567 |        |        |       |       |
| Adjusted R²               | 0.543 |        |        |       |       |
| F                         | 23.56 |        |        |       |       |

*Stepwise multiple regression, *p<0.05

Table 5. The effect of cognitive function on self-expression

| Variable                  | B     | SE     | β      | t     | p     |
|---------------------------|-------|--------|--------|-------|-------|
| (Constant)                | 69.222| 5.835  | 11.521 | 0.000 |       |
| Visual perception         | -2.197| 0.481  | -0.733 | -4.572| 0.000*|
| R²                        | 0.537 |        |        |       |       |
| Adjusted R²               | 0.512 |        |        |       |       |
| F                         | 20.904|        |        |       |       |

*Stepwise multiple regression, *p<0.05
patients with mild dementia. The large motor activities, such as bouncing a ball on a parachute, throwing a bean bag, striking bowling pins, stacking cups, and four-season background color stamping, improved hand gripping and picking ability by naturally stimulating dynamic and stable movements of global muscles. The small motor and self-expression activities, such as making paper fans, wall-hanging props, mosaics, multi-purpose racks, masks, eco bags, and self-portraits, plaster molding, body painting, and pantomime, improved the sophistication and delicacy of hand movements by controlling the materials' properties, direction, and intensity through local muscle-oriented activities. Previous studies on the hand functions of elderly patients with dementia reported that both their cognitive functions and hand functions degraded, as their physical movements were decreased due to weakened muscle strength and myostrophy\textsuperscript{13}. Roland\textsuperscript{12} reported that when hand movements such as simple flexion and extension of the right index finger were performed, blood flow increased in the primary motor and somatic sensory areas of the cerebral hemisphere on the opposite side, and hand functions improved by the continuous finger movements due to an increase in blood flow in the premotor and motor association areas in both cerebral hemispheres. Furthermore, horticultural therapy, a repetitive task activity where tactile stimulation and somatic sensations are most strong, improved grip strength and prehension, while hand knitting improved micro movements of the fingers, which support the results of the present study. The previous studies improved the functional use of the hands by inducing repetitive hand movements, whose attributes were mostly related to a single task. In contrast, the present study improved hand function by providing new experiences through various task activities where the level of difficulty could be controlled. Furthermore, large motor activities induced stability in the trunk and upper limbs to affect facilitation of hand functions at the distal end.

The task-oriented activity program improved the cognitive functions of elderly persons with mild dementia (visual perception, spatial perception, visuomotor organization, and attention and concentration). The present researchers demonstrated the task activities for each session, and the subjects practiced the activities once or twice to increase their understanding and participation in the activities. The final results of the tasks were shown to the subjects first while explaining the task goals, processes, and methods to facilitate the motivation of the training and perception of the tasks. At the final stage, the subjects had time to recollect past episodes among the task activities and share their stories and empathetic support. Furthermore, as the present program progressed from small motor to self-expression activities, cognitive functions and self-expression were emphasized further by letting the subjects recollect past experiences and perform task activities along with delicate hand functions. Previous studies on cognitive functions of elderly persons with dementia reported that brain functions only improved by increasing the agility of the fingers or movements that at least maintained the fingers. This is because a considerable part of the brain’s cell tissue is involved with motor nerves that move the fingers and effect their sensation\textsuperscript{13}. Thus, hand movements stimulated the frontal lobe, thereby affecting mental functions to a high level. Furthermore, other studies reported that expressive media activities, such as making a human facemask, face painting, or doll making, improved memory registration and recollection, attention and concentration, calculation, and verbal and visuospatial abilities in the sub-areas of cognitive functions\textsuperscript{14}, while a variety of artistic task-oriented activities supplemented the cognitive deficiency of elderly persons with dementia and helped vague thoughts and feelings to go away, which support the results of the present study\textsuperscript{15}. Accordingly, the present study’s activity program of small motor and self-expression tasks facilitated cognitive and execution functions by using various materials for small motor tasks that recalled past experiences and memories, thereby inducing the elderly patients with dementia to express his/her thoughts and feelings.

The task-oriented activity program improved the self-expression of elderly persons with mild dementia. The subjects in the present study made an effort to express their thoughts and feelings by recollecting episodes such as past memories, experiences, feelings, and reminiscences through task activities such as making a facemask of a favorite person, expressing vocabulary using body movements, drawing a favorite place on an eco bag, and making a clay self-portrait while looking at themselves in the mirror. Initially, the subjects were unfamiliar or unnatural with regard to task expression, but as the session continued, the subjects became more confident about their task outcomes, expressing, “Is it pretty?” “Isn’t it excellent?” or “Please take a picture of this!” At the final stage, the subjects shared their stories with other subjects about their task outcomes. Previous studies on the self-expression abilities of elderly persons with dementia showed that group art therapy through painting caused appropriate movements in global and local muscles of both hands to facilitate brain activation, and promoted self-expression and communication abilities by expressing images and reflecting natural internal feeling, thoughts, mindfulness, and experiences\textsuperscript{16}. Kim\textsuperscript{17} claimed that group art therapy with a recollection technique, such as making a wish, and recalling childhood memories or happy years from the past, improved visual and verbal self-expression ability, while a structural recollection technique, such as drawing a picture of one’s childhood, making fish in the sea, or decorating fruit trees together, was also successful in terms of self-expression with an empathetic attitude and mind that naturally recollected past days, which also support the results of the present study\textsuperscript{18}. Accordingly, the task-oriented activity program based on memory and reminiscence in the present study helped the elderly people with mild dementia to come up with past memories, experiences, and recollections to facilitate task activities, and promoted self-expression through a natural and flexible thinking process by sharing their stories and empathizing about task outcomes.

The factors that affected the self-expression of the elderly people with mild dementia were coordination of the right hand in hand functions and visual perception in the cognitive functions. The task activities in each session of the present study required the use of both hands in most cases, and induced an increase in fine coordination, particularly with the small motor activities, thereby improving performance and the completion of tasks. The self-expression tasks mainly focused on making or drawing to express the subjects’ thoughts or feelings. As sessions progressed, the outcomes of the task evolved from two...
dimensional to three dimensional, resulting in integrating visual perception functions. A study by Chung19 presented that coordination trained through large motor activities facilitated activities that required micro-manipulation, and using the hands actively processed various sensory information, thereby activating not only motor-related regions in the cerebral cortex but also cognitive and perception functions efficiently. Jang20 also reported that activities of drawing objects of various shapes were effective to induce restrained emotions of elderly people with dementia, and to prevent vague feelings and thoughts and cognitive deficiency, which support the results of the present study. Thus, the task-oriented activity program in the present study increased the coordination and visual perception of elderly people with mild dementia, thereby positively affecting the visual and spatial expression of their thoughts and emotions. Furthermore, memory and attentive concentration among the cognitive functions of elderly people with mild dementia deemed to affect the recollection of task order, experiences, and memories from the past to express the outcome of the task, although the result was not statistically significant. In future studies, repetitive studies that prove a functional relationship between other cognitive components that can affect the self-expression of elderly people with dementia are needed. Thus, the task-oriented program in the present study improved the hand and cognitive functions of elderly people with mild dementia to enable their self-expression. In conclusion, the task-oriented program is proposed as an intervention program for the prevention and treatment of clinical dementia, and valuable as foundational data that can verify a relationship between hand and cognitive functions and the ability for self-expression.

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