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Effects of Task-Oriented Training According to Stroke Lesion Location: A Pilot Study

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ABSTRACT

Background: Task-oriented training is a widely used rehabilitation approach for individuals with stroke, emphasizing functional task practice and active problem-solving. However, clinical outcomes may vary according to stroke lesion location, and evidence regarding lesion-specific effects of task-oriented training remains limited. This pilot study aimed to examine the effects of a task-oriented training program on activities of daily living and upper extremity motor function according to stroke lesion location.

Methods: Four individuals with stroke participated in a six-week task-oriented training program administered five times per week for 30 minutes per session. Participants met inclusion criteria of preserved cognitive function (MMSE-K ≥ 20) and functional independence (modified Rankin Scale ≤ 3). Training tasks were selected from standardized activities and individualized by adjusting task difficulty. Outcome measures included the Korean Modified Barthel Index (K-MBI), Manual Function Test (MFT), and Fugl-Meyer Assessment (FMA). Pre- and post-intervention outcomes were compared descriptively.

Results: All participants demonstrated improvements in functional performance following the intervention, although the magnitude and pattern of improvement differed across lesion locations. Improvements in activities of daily living and upper extremity motor function were not uniform, with discrepancies observed between functional independence and motor recovery measures.

Conclusion: The results suggest that the therapeutic effects of task-oriented training may differ according to stroke lesion location. Lesion-specific considerations may be essential for optimizing task-oriented rehabilitation strategies. Larger-scale studies are warranted to confirm these findings.

KEYWORDS: Stroke, Task-oriented training, Lesion location, Upper extremity function, Activities of daily living.

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INTRODUCTION

Stroke is primarily characterized by hemiplegia and can cause a wide range of impairments, including sensory, motor, perceptual, cognitive, and language deficits, depending on the location, etiology, and size of the lesion. Among patients with stroke, approximately 85% experience hemiplegia, and more than 69% present with upper extremity functional impairment (Luke, Dodd, & Brock, 2004).

To improve upper extremity motor control and function in patients with stroke, various novel therapeutic approaches have been implemented, including robot-assisted rehabilitation, constraint-induced movement therapy (CIMT), and mirror therapy. However, these therapeutic approaches require substantial labor and financial resources, making long-term and continuous application difficult in clinical settings.

In most clinical settings, task-oriented training is applied as a functional approach model based on systems theory for individuals with neurological impairments. This approach adopts task-specific strategies that facilitate learning and adaptation to changing environments. Task-oriented training enables patients to practice the abilities necessary to achieve task goals and enhances adaptability across diverse situations, thereby promoting problem-solving skills and the application of effective compensatory strategies (Carr & Shepherd, 2003).

Unlike repetitive training of isolated movements, task-oriented training consists of functional activities in which related systems interact cooperatively, allowing training to be conducted efficiently and effectively (Shumway-Cook & Woollacott, 2007). As an intervention aimed at improving cognitive function and activities of daily living in patients with stroke, the task-oriented approach assumes that learning occurs when patients actively engage in problem-solving through functional tasks rather than repeatedly practicing normal movement patterns (Mathiowetz, 2004). In other words, this approach emphasizes learning through active attempts at solving assigned problems with a focus on functional tasks, rather than repetitive practice of normal movement patterns (Kim, Kim, & Park, 2003).

Although most studies have reported positive effects of task-oriented training, Joo (2024) reported that improvements in gait function following task-oriented training lacked sustainability. The lack of task diversity and specificity made it difficult to maintain training effects over the long term due to task learning effects (Lee, 2017). Additionally, psychological factors were not considered during task-oriented training (Lee, 2017), and it was difficult to determine whether trained activities were actually applied during activities of daily living (Sung, 2016).

These limitations are thought to result from insufficient consideration of lesion-specific and intrinsic neurological characteristics. Recently, various studies have been conducted to establish appropriate rehabilitation interventions according to stroke lesion location. Therefore, the purpose of this study was to investigate the effects of task-oriented training according to stroke lesion location and to provide evidence for comprehensive rehabilitation treatment strategies for patients with stroke.

MATERIALS AND METHODS

1) Participants

This study was conducted at M Hospital in Seoul, Republic of Korea, for six weeks from March 12 to June 25, 2021, after obtaining approval from the Institutional Review Board of G University (IRB No. 1044396-202102-HR-034-01). All participants were fully informed of the purpose and procedures of the study and provided written informed consent prior to participation. Four participants who met the inclusion and exclusion criteria were enrolled.(table 1)

Inclusion criteria were as follows:

1. Diagnosis of stroke
2. MMSE-K score of 20 or higher, with the ability to understand instructions and communicate
3. Modified Rankin Scale score of 3 or lower
4. No orthopedic conditions other than stroke

Exclusion criteria were as follows:

1. Complaints of dizziness, nausea, or vomiting
2. Severe perceptual, cognitive, or language impairments preventing comprehension of verbal instructions, making evaluation and intervention impossible
3. Presence of psychiatric disorders

Table 1. General characteristics of subjects

Participant	Gender	Age (yr)	Onset (mo)	Diagnosis
Participant 1	F	77	1	Rt. hemiplegia d/t posterior cerebral artery ICH
Participant 2	M	47	1	Lt. hemiplegia d/t pontine infarction
Participant 3	F	52	1	Lt. hemiplegia d/t basal ganglia ICH
Participant 6	M	66	2	Rt. hemiplegia d/t thalamic ICH

2) Participant Selection Instruments

1) Mini-Mental State Examination–Korean Version (MMSE-K)

The MMSE-K is a standardized Korean version of the Mini-Mental State Examination translated by Kwon and Park (1989). It is easy to administer, requires only 5–10 minutes, has minimal practice effects, and allows repeated measurements over time to observe changes during disease progression. The MMSE-K has demonstrated reliability and validity for screening moderate to severe dementia and is the most widely used cognitive assessment tool in Korea (Shin, 2010). The intra-rater reliability is 0.96, and inter-rater reliability is 0.86 (Kang, 2006). In this study, participants with MMSE-K scores of 20 or higher were included.

2) Modified Rankin Scale (mRS)

The modified Rankin Scale is a functional assessment tool used to evaluate the degree of disability after stroke, particularly in activities of daily living (Wilson et al., 2002). Scores range from 0 (no symptoms) to 6 (death). In this study, participants with mRS scores of 3 or lower were included.

3. Outcome Measures

1) Korean Modified Barthel Index (K-MBI)

The Korean Modified Barthel Index (K-MBI), translated and adapted by Jung et al. (2007) from the original Modified Barthel Index developed by Shah, Vanclay, and Cooper (1989), was used to assess activities of daily living in patients with stroke. The K-MBI consists of 11 items: personal hygiene, bathing, feeding, toileting, stair climbing, dressing, bowel control, bladder control, ambulation, wheelchair use, and chair/bed transfer. The wheelchair item is assessed only when ambulation is not possible, resulting in a total of 10 items. Each item is scored on a 5-point Likert scale, ranging from complete independence to inability to perform the task. Scores range from 5 to 15 per item, with a maximum total score of 100. Jung et al. reported high construct validity, inter-rater reliability (0.93–0.98), and internal consistency (Cronbach's $\alpha = 0.84$).

2) Manual Function Test (MFT)

The Manual Function Test was developed to measure changes in upper extremity motor function in patients with stroke. It is widely used to assess short-term changes during neurological recovery and consists of four upper limb movement items, two grasp strength items, and two finger manipulation items. Both upper extremities are evaluated to predict functional recovery levels. The MFT demonstrates excellent reliability, with inter-rater reliability of 0.993 and intra-rater reliability of 0.994 (Kim, 1994).

3) Fugl-Meyer Assessment (FMA)

The Fugl-Meyer Assessment, developed by Fugl-Meyer et al. (1975), evaluates motor function, balance, sensation, and joint function following stroke. Both sides of the body are assessed, with each item scored from 0 to 2 (0 = unable to perform, 1 = partially performed, 2 = fully performed). The total score ranges from 0 to 100, with 66 points allocated to upper extremity motor function (33 items) and 34 points to lower extremity motor function. The degree of recovery can be expressed as a percentage. The FMA has demonstrated high inter- and intra-rater reliability (r = 0.96) (Duncan, Probst, & Nelson, 1983).

4. Intervention Methods

1) Task-Oriented Training Program

The task-oriented training program consisted of functional tasks performed in activities of daily living. Standardized tasks with difficulty levels ranging from 0.2 to 0.7 were selected from the Assessment of Motor and Process Skills (AMPS). Tasks applicable in both hospital and home settings were selected through participant consultation and validated by one occupational therapy professor and two occupational therapists with more than seven years of clinical experience.

Task difficulty was adjusted based on the participant's ability by modifying bilateral or unilateral hand use. When tasks were too easy, more advanced tasks were introduced to extend task duration. Additionally, task difficulty was adjusted by changing object size, weight, and environmental conditions. Each task was performed for 5 minutes, with 1 minute allocated for transition and preparation between tasks. Interventions were administered by three occupational therapists with more than seven years of clinical experience, five times per week, for 30 minutes per session (Figure 1).

Figure 1. Examples of Task-Oriented Training Activities

Task	Task oriented program	example
Taking a beverage from the refrigerator and pouring it into a cup	Taking a beverage from the refrigerator and pouring it into a cup (Task difficulty adjusted by bottle size and amount of liquid)	
Washing cups	Washing cups using dish detergent and a sponge (Task difficulty adjusted by cup or tumbler size)	
Vacuum cleaning	Vacuum cleaning floors, curtains, and furniture (Task difficulty adjusted by transitioning from floor-level to overhead cleaning)	
Folding and stacking towels	Folding and stacking towels (Task difficulty adjusted by bilateral or unilateral hand use and sitting or standing posture)	

Using chopsticks	Using chopsticks to pick up 1 × 1 cm blocks, beans, and pins (Task difficulty adjusted by type of chopsticks used)	

RESULTS

1. Korean Modified Barthel Index (K-MBI)

Activities of daily living assessed using the K-MBI demonstrated that Participant 1 showed the greatest improvement, with scores increasing from 43 at baseline (pre-test) to 81 post-intervention, representing an increase of 38 points (88.37%). Participant 2 showed the smallest improvement, with scores increasing from 60 to 78 (30%). Participants 3 and 4 showed improvements of approximately 33.33% (Table 2).

Table 2. The difference between pre and post test in Korean Modified Barthel Index

Subject	mo	Pre test	Post test	variance	percent		M ± SD	Min.	Max.
1	1	43	81	38	88.37%	Pre test	17 ± 4.5	11	24
2	1	60	78	18	30%	Post test	21.3 ± 6.2	12	27
3	1	63	84	21	33.33%	Point	4.3 ± 3.4	1	9
4	7	39	52	13	33.33%				

2. Manual Function Test (MFT)

Upper extremity function assessed using the MFT revealed that Participant 4 showed the greatest improvement, with scores increasing from 17 at baseline to 26 post-intervention (52.94%). Participant 1 showed the smallest improvement, with an increase of 3 points (12.5%). Participants 2 and 3 showed improvements of approximately 20% and 50%, respectively (Table 3).

Table 3. The difference between pre and post test in Manual Functional Test

Subject	mo	Pre test	Post test	variance	percent		M ± SD	Min.	Max.
1	1	24	27	3	12.5%	Pre test	17 ± 4.5	11	24
2	1	20	24	4	20%	Post test	21.3 ± 6.2	12	27
3	1	16	24	8	50%	Point	4.3 ± 3.4	1	9
4	7	17	26	9	52.94%				

3. Fugl-Meyer Assessment (FMA)

Upper extremity motor function assessed using the FMA demonstrated that Participant 4 showed the greatest improvement, with scores increasing from 65 at baseline to 92 post-intervention (41.53%). Participant 3 showed the smallest improvement, with an increase of 3 points (3.57%). Participants 1 and 2 showed improvements of 5.43% and 13.41%, respectively.(table 4)

Table 4. The difference between pre and post test in Fugl-Meyer Assessment Scale

Subject	mo	Pre test	Post test	variance	percent		M ± SD	Min.	Max.
1	1	92	97	5	5.43%	Pre test	74.5 ± 13.1	60	92
2	1	82	93	11	13.41%	Post test	83.1 ± 14.4	63	97
3	1	84	87	3	3.57%	Point	8.6 ± 9.5	3	27
4	7	65	92	27	41.53%				

DISCUSSION

Effective rehabilitation interventions should be goal-directed and closely related to real-life situations so that learned activities can be transferred to daily living under diverse conditions. Carr and Shepherd (2003) reported that task-oriented training for patients with stroke consists of functional tasks that enhance actual daily performance and enable effective training of diverse functional activities.

Movement emerges from the interaction between the individual, the task, and the environment. Movement is organized according to environmental demands and task requirements, and individuals generate movement to meet task demands within a given environment (Shumway-Cook & Woollacott, 2007). Furthermore, environmental factors and learning alter the efficiency of pre-existing neural pathways, resulting in the acquisition of specific abilities (Kandel, 1991).

This study aimed to examine the effects of task-oriented training according to stroke lesion location. Although all participants were diagnosed with stroke, lesion locations differed among participants, as shown in Table 1.

To evaluate outcomes, activities of daily living were assessed using the K-MBI, and upper extremity function was assessed using the MFT and FMA. Participant 1 demonstrated a marked improvement in ADL performance, with a 38-point increase in K-MBI scores, whereas improvements in upper extremity motor function were modest (MFT: +3 points; FMA: +5 points). Previous studies suggest that motor skill learning occurs in two stages: an initial fast-learning phase involving acquisition of task-related motor programs, followed by a slower learning phase involving gradual neural reorganization (Grafton et al., 1995; Seitz & Roland, 1992). The substantial improvement in K-MBI scores in Participant 1 may reflect consciously mediated movement strategies used to complete functional tasks.

Kusoffsky et al. (2001) reported that impaired voluntary motor control leads to temporal and spatial discoordination during task performance, limiting continuous trajectory adjustments of the hand toward a target. Consequently, even when clinical upper limb function scores are high, spontaneous use of the affected hand may remain suppressed. In this study, Participant 2 demonstrated greater improvements in upper extremity motor scores than Participant 1; however, improvements in ADL performance were limited, likely due to reduced involvement of the affected limb during bimanual daily activities.

Participant 3 demonstrated substantial improvements in upper extremity function, with increases of 21 points in K-MBI, 8 points in MFT, and 3 points in FMA. Villablanca et al. (1975) reported that the basal ganglia contribute to postural control through interaction with the environment and integrate higher-level cognitive processes with movement control. Purposeful activity requires integration of movement preparation and task recognition. However, due to the small lesion size in Participant 3, interpretation of lesion-specific effects remains limited.

Participant 4 demonstrated improvements of 13 points in K-MBI, 9 points in MFT, and 27 points in FMA. However, because participants with perceptual impairments were excluded by the selection criteria, the clinical significance of these findings for Participant 4 is limited.

Previous studies have suggested that use of the affected hand is associated not only with sensorimotor cortex activation but also with increased bilateral activation of distal regions such as the cerebellum and premotor cortex (Lammers et al., 1997).

Boyd and Winstein (2001) reported that explicit knowledge acquired prior to physical practice provides a significant advantage for implicit motor learning in individuals with stroke-related brain lesions. Understanding the interaction between these learning mechanisms is critical, as motor skill reacquisition is a key component of functional recovery after stroke. Therefore, establishing strategies to facilitate explicit knowledge acquisition prior to task-oriented training may enhance rehabilitation outcomes.

This study has several limitations. The small sample size (n = 4) limits generalizability to the broader stroke population. Additionally, it was not possible to fully control participants' daily activities outside of therapy sessions, and the effects of concurrent physical and occupational therapy could not be completely excluded. Nevertheless, the findings suggest that the effects of task-oriented training vary according to stroke lesion location and pre-morbid motor learning experience. Future studies will focus on developing task-oriented training programs tailored to specific lesion characteristics.

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