

Impact of the Convalescent Rehabilitation Medical Hospital System on Functional Recovery in Stroke Patients: A Retrospective Cohort Study

Kyung-Sub Choi, Bong-Sik Woo and Dae-Hwan Lee

Convalescent
Rehabilitation on
Recovery in
Stroke Patients

ABSTRACT

Objective: To investigate whether the implementation of the convalescent rehabilitation medical hospital system was associated with improved functional outcomes in stroke patients undergoing post-acute rehabilitation.

Study Design: A Retrospective cohort study

Place and Duration of Study: This study was conducted at the Rehabilitation department, IM Rehabilitation Hospital, from May 15, 2025, to December 22, 2025.

Methods: This study was a retrospective cohort study using electronic medical records (EMR). Stroke patients admitted to a rehabilitation hospital within 90 days after stroke onset were included. Participants were divided into two groups according to the implementation of the convalescent rehabilitation medical hospital system: patients treated before implementation (Group 1, n=107) and patients treated after implementation (Group 2, n=52). Functional outcomes were evaluated at admission, 4 weeks, and 8 weeks using the Mini-Mental State Examination (MMSE), Modified Barthel Index (MBI), and Hand Function Test (HFT).

Results: The improvement in activities of daily living was significantly greater in Group 2 than in Group 1 (MBI change: 12.39 ± 11.83 vs. 2.92 ± 4.87 , $p < 0.001$; Cohen's $d = 1.21$). Upper limb function also showed greater improvement in Group 2 (HFT change: 2.59 ± 3.74 vs. 0.87 ± 2.58 , $p = 0.004$; Cohen's $d = 0.57$). However, changes in cognitive function measured by MMSE did not differ significantly between the groups ($p = 0.055$).

Conclusion: The implementation of the convalescent rehabilitation medical hospital system was associated with greater improvements in activities of daily living and upper limb function in stroke patients. These findings suggest that structured intensive rehabilitation during the post-acute recovery phase may enhance functional outcomes after stroke.

Key Words: Stroke, Rehabilitation, Convalescent rehabilitation, Activities of daily living, Electronic medical records

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INTRODUCTION

Stroke is a major neurological disorder caused by an interruption of cerebral blood flow or rupture of cerebral vessels, leading to focal ischemic or hemorrhagic injury and subsequent neuronal damage. Stroke commonly results in persistent impairments across multiple domains, including motor and sensory function, cognition, language, swallowing, and

emotional regulation. These deficits substantially limit functional independence and reduce quality of life ⁽¹⁾.

A substantial proportion of stroke patients experience limitations in mobility and activities of daily living following the onset of the disease. Hemiparesis, a common sequela of stroke, causes motor and sensory impairments on the contralateral side of the body. In particular, upper limb dysfunction directly interferes with activities of daily living (ADL), including personal hygiene, dressing, and feeding. Impairments in finger control and object manipulation further restrict instrumental activities of daily living (IADL), such as meal preparation, community participation, and return to work ⁽²⁾. Lower limb impairments are also common and often involve muscle weakness, spasticity, and impaired motor coordination. These deficits lead to asymmetric weight bearing, abnormal gait patterns, decreased postural stability, and an increased risk of falls. In addition, cognitive impairments frequently occur after stroke and may affect attention, memory, and executive function, thereby limiting participation in

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rehabilitation and delaying reintegration into independent living.

Early and intensive rehabilitation is considered essential for improving functional recovery after stroke. During the early recovery phase, neural plasticity is highly active, and repetitive, task-oriented training can facilitate reorganization of neural networks and enhance functional restoration^(3,4). Intensive rehabilitation programs can therefore contribute not only to improvements in motor performance but also to gains in balance, gait ability, cognitive function, and independence in daily activities.

However, the Korean healthcare system has historically been organized around acute medical care, which has limited the provision of continuous and structured rehabilitation during the post-acute recovery phase after stroke⁽⁵⁾. Following acute treatment, many patients are discharged from tertiary hospitals at an early stage, while the healthcare delivery system for post-acute rehabilitation has not been sufficiently established. As a result, access to intensive rehabilitation during the critical recovery phase after stroke has remained limited⁽³⁾.

This policy was introduced to address these challenges. In 2017, the Korean Ministry of Health and Welfare established the convalescent rehabilitation medical hospital system under Article 18 of the Act on the Right to Health for Persons with Disabilities and Access to Medical Services⁽⁶⁾. The system was designed to provide intensive rehabilitation during the subacute recovery phase, particularly for patients with neurological conditions such as stroke. For stroke patients, the period between approximately 30 and 90 days after onset is considered a critical recovery phase during which neural plasticity is highly active. Intensive and task-oriented rehabilitation during this period is known to play a crucial role in promoting functional recovery. The convalescent rehabilitation medical hospital system therefore aims to provide structured multidisciplinary rehabilitation during this optimal recovery window. Within this system, patients can receive up to 16 units (approximately 4 hours) of rehabilitation therapy per day through coordinated services including physical therapy, occupational therapy, and speech therapy. These interventions are designed to improve motor function, cognitive function, communication ability, and independence in activities of daily living^(6, 7). By ensuring continuity of rehabilitation following acute hospital care, the system seeks to reduce gaps in rehabilitation services and enable stroke patients to receive intensive therapy during the most critical phase of recovery.

Despite the policy significance of this system, empirical evidence evaluating its clinical effectiveness remains limited. In particular, few studies have quantitatively examined functional recovery by comparing patient outcomes before and after the implementation of the

convalescent rehabilitation system. Therefore, the purpose of this study was to investigate the impact of the convalescent rehabilitation medical hospital system on functional recovery in stroke patients by comparing changes in cognitive function, activities of daily living, and upper limb function between patients treated before and after the implementation of the system.

METHODS

This study was designed as a retrospective cohort study using electronic medical records (EMR) to compare functional recovery in stroke patients before and after the implementation of the convalescent rehabilitation medical hospital system. Clinical data were collected at three time points: at admission, 4 weeks after admission, and 8 weeks after admission. Changes in cognitive function, activities of daily living, and upper limb function were analyzed over time and compared between the two groups.

The study included patients who were admitted to IM Rehabilitation Hospital and diagnosed with stroke. Only patients who were admitted within 90 days after stroke onset and received inpatient rehabilitation treatment were considered for inclusion in the study. Participants were divided into two groups according to the implementation of the convalescent rehabilitation medical hospital system. Group 1 consisted of patients who received rehabilitation treatment before the implementation of the system, whereas Group 2 consisted of patients who were treated after the implementation.

Patients were eligible for inclusion if they met the following criteria: a confirmed diagnosis of stroke, admission within 90 days after stroke onset, hospitalization for at least 8 weeks, and availability of functional assessment data at three time points (at admission, 4 weeks after admission, and 8 weeks after admission). Patients were excluded if they had severe cardiovascular disease, progressive neurodegenerative disease, or psychiatric disorders that could affect rehabilitation outcomes. Patients were also excluded if they were unable to cooperate with the evaluation procedures, had a Glasgow Coma Scale score below 12, or were able to ambulate independently at the time of admission.

Both groups received multidisciplinary rehabilitation treatment. The rehabilitation program consisted of physical therapy, occupational therapy, speech therapy, and robot-assisted gait training. Physical therapy focused on lower extremity strengthening, balance training, gait training, mat exercises, and neurodevelopmental treatment. Occupational therapy was performed to improve upper limb function through grasping exercises, manipulation tasks, and activities of daily living training. Robot-assisted gait training was performed using devices such as Morning Walk, Lokomat, and Andago to facilitate early standing and

repetitive weight-shifting training. Group 1 received a total of 15 treatment units per day, with each unit consisting of 15 minutes of therapy. Group 2 received intensive rehabilitation treatment according to the convalescent rehabilitation medical hospital system. Cognitive function was evaluated using the Mini-Mental State Examination (MMSE). Activities of daily living were assessed using the Modified Barthel Index (MBI). Upper limb function was evaluated using the Manual Function Test (HFT). Continuous variables were summarized as mean ± standard deviation. All statistical analyses were performed using SPSS for Windows (version 25.0, IBM Corp., Armonk, NY, USA). Longitudinal changes in MMSE, MBI, and HFT across admission, 4 weeks, and 8 weeks were analyzed using linear mixed-effects models including group, time, and group-by-time interaction terms. In addition, analysis of covariance (ANCOVA) was performed to compare post-intervention (8-week) outcomes between groups after adjusting for baseline values. Baseline demographic and clinical variables were compared using the independent t-test, chi-square test, or Mann-Whitney U test, as appropriate.

RESULTS

The baseline characteristics of the participants are presented in Table 1. A total of 159 patients were included in the study, with 107 patients in Group 1 (before implementation) and 52 patients in Group 2 (after implementation). The mean age was significantly lower in Group 2 than in Group 1 (66.62 ± 15.77 vs. 73.41 ± 12.98 years, $p = 0.008$). There was no significant difference in sex distribution between the two groups ($p = 0.113$). The proportion of patients

diagnosed with cerebral infarction was higher than that of cerebral hemorrhage in both groups, with no significant difference between groups ($p = 0.276$). The mean length of hospital stay was significantly shorter in Group 2 than in Group 1 (116.44 ± 48.68 vs. 318.42 ± 305.62 days, $p < 0.001$) (Table No.1).

Table No.1: General characteristics of subjects

Contents	Group 1 (n=107)	Group 2 (n=52)	p
Age	73.41 ± 7.43	66.62 ± 15.77	0.008*
Sex (male/female)	50 / 57	32 / 20	0.113
Diagnosis (ischemic/hemorrhage)	63 / 44	36 / 16	0.276
Length of stay (day)	318.42 ± 305.62	116.44 ± 48.68	< 0.001*

For cognitive function, MMSE scores were higher in Group 2 than in Group 1 at all times points. However, the difference between the groups reached statistical significance only at 8 weeks ($p = 0.055$). For activities of daily living, MBI scores were significantly higher in Group 2 than in Group 1 at admission, 4 weeks, and 8 weeks (all $p < 0.001$). The effect size increased over time, reaching a large effect at 8 weeks (Cohen's $d = 1.21$). Similarly, upper limb function measured by HFT was significantly higher in Group 2 than in Group 1 at all times points ($p = 0.004$ at admission, $p = 0.002$ at 4 weeks, and $p = 0.004$ at 8 weeks) (Table No.2).

Table No.2: Changes in functional outcomes at admission, 4 weeks, and 8 weeks

Measure	Time points	Group 1 (n=107)	Group 2 (n=52)	p	Cohen' d
MMSE (point)	Admission	17.05 ± 9.63	20.56 ± 7.67	0.090	0.33
	4 weeks	18.07 ± 10.35	21.46 ± 7.58	0.058	0.39
	8 weeks	18.81 ± 9.61	22.81 ± 6.87	0.055	0.45
MBI (score)	Admission	32.05 ± 24.91	51.90 ± 19.87	<0.001***	0.86
	4 weeks	32.84 ± 25.23	57.81 ± 21.83	<0.001***	1.02
	8 weeks	34.97 ± 25.33	64.29 ± 22.15	<0.001***	1.21
HFT (score)	Admission	10.68 ± 11.01	18.35 ± 7.60	0.004**	0.69
	4 weeks	10.94 ± 11.24	19.73 ± 7.19	0.002**	0.73
	8 weeks	11.55 ± 11.31	20.94 ± 6.46	0.004**	0.57

In the linear mixed-effects model, significant group-by-time interactions were observed for MBI and HFT

scores, indicating that functional recovery trajectories differed significantly between the two groups over the

Table No.3: Linear mixed-effects model results for changes in MMSE, MBI, and HFT scores

Contents	Group effect β	p	Time effect β	p	Time x group β	p
MMSE	3.147	0.050	0.641	0.100	0.419	0.381
MBI	15.254	<0.001***	-3.267	<0.001***	4.730	<0.001***
HFT	6.887	<0.001***	-0.429	0.137	0.863	<0.001***

8-week follow-up period. In contrast, no significant group-by-time interaction was found for MMSE scores, suggesting that cognitive recovery patterns did not

differ significantly according to implementation status (Table No.3).

Table No.4: ANCOVA results for post-intervention MMSE, MBI, and HFT scores adjusted for baseline value and age

Contents	Group effect			Adjust for baseline			Adjust for age		
	F	p	Partial η^2	F	p	Partial η^2	F	p	Partial η^2
8-week MMSE	1.167	0.282	0.007	931.218	<0.001***	0.857	4.539	0.035**	0.028
8-week MBI	44.453	<0.001	0.223	1173.540	<0.001***	0.883	2.618	0.108	0.017
8-week HFT	13.106	<0.001	0.078	1611.628	<0.001***	0.912	0.886	0.348	0.006

After adjusting for baseline MMSE and age using ANCOVA, no significant difference was observed between the groups in MMSE scores at 8 weeks (F = 1.167, p = 0.282, partial η^2 = 0.007). Baseline MMSE was a significant predictor of the 8-week outcome (F = 931.218, p < 0.001), and age also showed a significant but small effect (F = 4.539, p = 0.035). After adjusting for baseline MBI and age using ANCOVA, the post-implementation group showed significantly higher MBI scores at 8 weeks compared to the pre-implementation group (F = 44.453, p < 0.001, partial η^2 = 0.223). Baseline MBI was a significant predictor of the 8-week outcome (F = 1173.540, p < 0.001), whereas age was not significantly associated with MBI scores (F = 2.618, p = 0.108). After adjusting for baseline HFT and age using ANCOVA, the post-implementation group showed significantly higher HFT scores at 8 weeks compared to the pre-implementation group (F = 13.106, p < 0.001, partial η^2 = 0.078). Baseline HFT was a significant predictor of the outcome (F = 1611.628, p < 0.001), whereas age was not significantly associated with HFT scores (F = 0.886, p = 0.348) (Table No.4)

DISCUSSION

The present study investigated the impact of the convalescent rehabilitation medical hospital system on functional recovery in stroke patients using electronic medical record data. The main findings of this study were that patients who received rehabilitation treatment after the implementation of the convalescent rehabilitation system showed significantly greater improvements in activities of daily living and upper limb function compared with patients treated before the implementation of the system. However, improvements in cognitive function did not differ significantly between the two groups.

One of the most notable findings of this study was the significant improvement in activities of daily living measured by the MBI. The change in MBI scores was significantly greater in the post-implementation group than in the pre-implementation group, with a large effect size. This result suggests that the structured and intensive rehabilitation provided under the convalescent rehabilitation medical hospital system may contribute

substantially to improving functional independence in stroke patients (5, 7, 8). Activities of daily living are considered one of the most important indicators of functional recovery after stroke, as they directly reflect a patient's ability to perform essential self-care tasks and participate in daily life (8-10).

Upper limb function measured by the HFT also showed significantly greater improvement in the post-implementation group, with a moderate effect size. Recovery of upper limb function after stroke is often challenging due to complex motor control requirements and the high prevalence of persistent hemiparesis. The greater improvement observed in the post-implementation group may be associated with increased intensity and multidisciplinary rehabilitation approaches, including task-oriented occupational therapy and robot-assisted gait training, which may indirectly promote upper limb functional use during rehabilitation (6, 11).

In contrast, the change in cognitive function measured by the MMSE did not differ significantly between the two groups. Cognitive recovery after stroke is influenced by multiple factors, including lesion location, severity of brain injury, and premorbid cognitive status (12). Furthermore, cognitive improvement often occurs over a longer period compared with motor recovery (13). Therefore, the relatively short observation period of eight weeks in this study may not have been sufficient to detect significant differences in cognitive outcomes between the two groups.

Another important finding of this study was the significant reduction in the length of hospital stay observed after the implementation of the convalescent rehabilitation medical hospital system. This difference should be interpreted in the context of changes in the rehabilitation delivery system in Korea. Prior to the implementation of the convalescent rehabilitation system, inpatient rehabilitation often continued for prolonged periods without a standardized framework for intensive rehabilitation or structured discharge planning. In contrast, the convalescent rehabilitation system introduced a structured rehabilitation model with defined treatment intensity and a clearer transition pathway following the subacute rehabilitation phase (5-7). These changes may have contributed to a more

efficient rehabilitation process and earlier discharge while maintaining functional recovery. By providing intensive rehabilitation during the critical recovery period after stroke, the system may facilitate earlier functional improvement and transition to community-based care^(7, 14). Therefore, the shorter length of hospital stay observed in the post-implementation group may reflect changes in healthcare policy, admission criteria, and discharge planning processes rather than rehabilitation efficiency alone.

In the linear mixed-effects model, significant group effects were observed for MBI and HFT, indicating overall superior functional performance in the post-implementation group. Significant group-by-time interactions were also identified for MBI and HFT, suggesting that improvements over time were greater in the post-implementation group. However, no significant group-by-time interaction was found for MMSE. To further control for baseline differences, ANCOVA was performed using the 8-week score as the dependent variable and adjusting for baseline values and age as covariates. After adjustment, MBI and HFT remained significantly higher in the post-implementation group, whereas MMSE did not differ significantly between groups⁽¹⁵⁾. Although significant baseline differences were observed between the groups, particularly in age and initial functional status, these were statistically controlled using ANCOVA. The persistence of significant group differences in MBI and HFT after adjustment suggests that the observed effects are unlikely to be solely explained by baseline imbalance. Despite these findings, several limitations should be considered when interpreting the results of this study. First, this study was conducted using a retrospective design based on electronic medical records from a single rehabilitation hospital, which may limit the generalizability of the findings. Second, baseline differences between the two groups, particularly in age, may have influenced the observed outcomes. Third, the study evaluated functional outcomes over a relatively short follow-up period of eight weeks, which may not fully capture long-term recovery patterns after stroke. Nevertheless, this study provides meaningful evidence regarding the potential clinical benefits of the convalescent rehabilitation medical hospital system for stroke patients. The findings suggest that structured and intensive rehabilitation during the post-acute recovery phase may play an important role in improving functional outcomes, particularly in activities of daily living and upper limb function.

CONCLUSION

The present study demonstrated that the implementation of the convalescent rehabilitation medical hospital system was associated with greater improvements in activities of daily living and upper limb function in stroke patients. These findings suggest that structured and intensive rehabilitation during the post-acute phase

may play an important role in enhancing functional recovery after stroke. Further multicenter prospective studies are needed to confirm these findings.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Kyung-Sub Choi, Bong-Sik Woo, Dae-Hwan Lee
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Agreement to accountable for all aspects of work:	All the above authors

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