

Relationship between dressing and motor function in stroke patients: a study with partial correlation analysis

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Abstract. [Purpose] The aim of the present study was to elucidate which motor functions are most or more important for dressing performance before and after rehabilitation. [Subjects] Seventy-nine first episode stroke patients in a hospital convalescent rehabilitation ward. [Methods] The relationships between motor function of the affected upper and lower limbs, unaffected side function, trunk function, balance, cognitive function, and independence level in dressing were examined at admission and discharge using partial correlation analysis. [Results] Independence level of dressing correlated with motor function of the affected upper limb and balance at admission, but correlated only with balance at discharge. [Conclusion] Balance function was strongly associated with level of dressing independence. The effect of gross motor function of the affected upper and lower limbs on the level of independence in dressing may thus be smaller than originally expected. Enhanced balance ability can be important for learning single-handed actions of self-dressing during rehabilitation.

Key words: Stroke, Balance, Dressing

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INTRODUCTION

Previous reports indicated that 41% of patients require assistance dressing 1 month after a stroke, and 36% continue to require assistance 2 years after a stroke^{1, 2)}. Various complex physical and cognitive functions are involved in dressing independence³⁾, which makes it difficult for patients with stroke to dress independently^{1, 2)}. Dressing is an important activity of daily living (ADL) for both, health management and participation in social life. Independence in dressing is considered necessary to maintain dignity and self-esteem, and imparts a sense of accomplishment⁴⁾. Independence in dressing at the time of hospital discharge is strongly associated with home ADL independence 5 years post-stroke⁵⁾. Patients must be able to dress independently before returning home.

Motor impairments have been reported to have a greater effect on ADL independence than visual perception dysfunction and cognitive disorders in stroke patients^{6, 7)}. Thus, it is important to elucidate the relationship between motor impairments and the level of independence in dressing to properly examine effective rehabilitation strategies to improve dressing skills. Previous studies have reported that gross motor function of the affected upper and lower limbs^{3, 8)}, vertical orientation in the seated position⁸⁾, abdominal muscle strength⁹⁾, extensor strength of the unaffected knee⁸⁾, and balance¹⁰⁾ are factors related to the level of independence in dressing in stroke patients. However, it is unclear which motor function is strongly related to dressing performance. Therefore, the relationship between dressing independence and physical function has not been adequately discussed.

The purpose of the present study was to examine which motor functions are related to dressing performance. In addition, this study examined the change in these relationships before and after intensive rehabilitation. To the best of our knowledge, there has been no report investigating these relationships. The results of this study may be used to guide rehabilitation interventions for dressing after stroke.

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SUBJECTS AND METHODS

This study used a retrospective design. We evaluated 79 patients with stroke who were hospitalized and discharged from a hospital convalescent rehabilitation ward (Table 1). The inclusion criteria were as follows: diagnosis of a first episode of cerebral hemorrhage or infarction, diagnosis of unilateral supratentorial hemispheric lesion, at least 2 weeks from onset to the time of admission, and at least a 2-week stay in the hospital convalescent rehabilitation ward. Exclusion criteria were orthopedic disease, and missing records of important assessments from the time of admission or discharge. All patients received a conventional stroke rehabilitation program, including occupational and physical therapy, and speech therapy if needed. Therapy addressed various issues as needed, such as ADLs, arm activities, balance and gait training, and speech and cognition. Patients received therapy 7 days a week, 2 to 3 h per day on weekdays and Saturdays, and 1 h on Sundays and national holidays. Informed consent was not required because the design of our study was retrospective without intervention. However, instead of informed consent, our protocol was considered by the institutional ethics review board of Northern Fukushima Medical Center (No.56) and Tohoku Fukushi University (RS141201), and approved.

We retrospectively gathered and analyzed data from electronic medical records at both admission and discharge. The Stroke Impairment Assessment Set (SIAS)¹¹⁾ items for motor function were used to assess motor function of the affected side; SIAS items were used to assess trunk function and quadriceps strength on the unaffected side. The Simple Test for Evaluating Hand Function (STEF)¹²⁾ was used to assess the unaffected side, and the Berg Balance Scale (BBS)¹³⁾ was used to assess balance. Cognitive function was assessed using items from the SIAS visuospatial cognitive function domain and the Functional Independence Measure¹⁴⁾ (FIM). The FIM was used to measure ADL performance related to level of independence in dressing.

In the present study, the total score for the knee-mouth test and finger function test (SIAS items for motor function) was used to assess motor function of the affected upper limb; the total score for the hip flexion test, knee extension test, and foot-pat test (items for motor function) was used to assess motor function of the affected lower limb; and the total score for the verticality test and abdominal muscle strength test (SIAS items for trunk function) was used to assess trunk function. The lowest score on FIM for dressing the upper and lower body was used for the level of independence in dressing.

The relationship between cognitive and physical functions and the FIM dressing scores was examined using Spearman's rank simple correlation analysis and partial rank correlation analysis. Partial correlation analysis was used to avoid statistical confounding. For instance, most stroke patients develop comparable motor impairment in the upper and lower limbs¹⁵⁾. Therefore, partial correlation analysis is required to avoid the problem of multicollinearity and to obtain suitable results in which the possibility of a spurious correlation is eliminated. Partial correlation analysis used cognitive and physical function and age as control factors.

Table 1. Stroke-related characteristics of study subjects

	Mean \pm SD
Age (years)	69.8 \pm 14.1
Male (%)	60.8
Right side hemiparesis (%)	48.1
Time post-stroke at admission (days)	34.7 \pm 14.2
Time post-stroke at discharge (days)	92.7 \pm 35.3
Length of hospital stay (days)	58.0 \pm 28.9

The statistical software used was SPSS Statistics 22.0 (IBM, Chicago, IL, USA) and the level of significance was set at 5%.

RESULTS

The outcomes of each assessment at admission and discharge are shown in Table 2. The FIM score for dressing (1–7 points) was 3.7 \pm 2.2 points at admission and 5.3 \pm 2.1 points at discharge. The results of the simple correlation analysis and partial correlation analysis are shown in Table 3. The simple correlation analysis revealed that the FIM score for dressing at admission was negatively correlated with age and positively correlated with each measure of cognitive and physical function. The same results were obtained for the FIM score for dressing at discharge.

The results of the partial correlation analysis revealed that the FIM score for dressing at admission was positively correlated with motor function of the affected upper limb ($r_s = 0.42$, $p < 0.01$) and BBS ($r_s = 0.51$, $p < 0.01$). However, the FIM score for dressing at discharge was only positively correlated with BBS ($r_s = 0.57$, $p < 0.01$).

DISCUSSION

There were two major findings in this study. The first was that the level of dressing independence was associated with balance and motor function of the affected upper limb at admission, whereas it was associated only with balance function at discharge. The second was that the factors associated with independence in dressing were different between admission and discharge.

The results of the present study suggest that the performance of dressing is associated with motor function of the affected upper limb and balance at admission, but only balance at discharge. Clinically, learning to dress through actions involving only the unaffected hand is inadequate for sufficient rehabilitation. Many patients require the use of both hands to pass their arms through sleeves, close buttons and fasteners, and raise or lower undergarments. Alternatively, many patients encountered at discharge are able to dress themselves with one hand by learning compensation techniques with the unaffected upper limb. The fact that motor function of the affected upper limb was associated with the level of independence in dressing at admission but not at discharge may reflect the course of learning single-handed actions.

Balance was found to be strongly correlated with the

Table 2. Results of each evaluation at admission and discharge

	Admission	Discharge
Dressing item of FIM	3.7 ± 2.2	5.3 ± 2.1
Affected motor function		
Affected U/L function item of SIAS (0–10)	4.9 ± 3.5	5.8 ± 3.3
Affected L/L function item of SIAS (0–15)	9.2 ± 5.3	11.1 ± 4.5
Trunk function item of SIAS (0–6)	4.3 ± 1.8	5.1 ± 1.2
Unaffected side function		
Quadriceps strength item of SIAS (0–3)	2.5 ± 0.8	2.7 ± 0.7
Simple test for evaluating hand function (0–100)	77.2 ± 23.2	87.9 ± 12.9
Balance		
Berg Balance Scale (0–56)	26.4 ± 18.4	39.9 ± 16.3
Cognitive function		
Visuospatial deficit item of SIAS (0–3)	2.6 ± 0.8	2.8 ± 0.6
FIM cognitive (5–35)	26.4 ± 7.9	29.1 ± 6.4

FIM: Functional Independence Measure; SIAS: Stroke impairment assessment set; U/L: Upper Limb; L/L: Lower Limb

Table 3. Simple and partial correlation analysis between index of dressing and functions in stroke patients

	Simple correlation		Partial correlation	
	Admission	Discharge	Admission	Discharge
Age	−0.23**	−0.32**	ns	ns
Affected U/L function	0.62**	0.42**	0.42**	ns
Affected L/L function	0.63**	0.46**	ns	ns
Trunk function	0.67**	0.58**	ns	ns
Quadriceps strength	0.52**	0.49**	ns	ns
STEF	0.50**	0.54**	ns	ns
Berg Balance Scale	0.83**	0.84**	0.51**	0.57**
Visuospatial deficit	0.27*	0.42**	ns	ns
FIM cognitive	0.50**	0.59**	ns	ns

Values are Spearman rank coefficients. * $p < 0.05$, ** $p < 0.01$.

FIM: Functional Independence Measure; STEF: Simple test for evaluating hand function; U/L: Upper Limb; L/L: Lower Limb

performance of dressing at both admission and discharge. Decreased balance function resulted in a fear of falls both in patients and caregivers. In other words, those with decreased balance function may have consciously or subconsciously reduced their level of independence in favor of safety despite being able to perform tasks. The above findings suggest that balance needs to be addressed and learning of activities needs to include repetitive dressing training in order to improve performance. Therefore, training focused on balance ability can be important for learning of single-handed actions of self-dressing during rehabilitation.

Previous studies examining the relationship between dressing and motor function in patients with stroke highlighted the importance of gross motor function of the affected upper and lower limbs³. Walker & Lincoln³ examined the relationship between the level of independence in dressing at admission and gross motor function of the affected upper and lower limbs in patients 1 month after stroke, and reported they were significantly correlated. Furthermore,

Bernspang⁶ found a simple correlation between the level of independence in self-care, including dressing, and gross motor function of the affected side in acute-phase stroke patients. The present study seemingly supported this finding by a single correlation between the level of independence in dressing and motor function of the affected upper and lower limb at admission. However, a partial correlation, which can avoid spurious results, was not found between motor function of the affected limb and the level of independence, except for the affected upper limb at admission. This suggests that improvement in motor function of the affected side does not necessarily contribute to a higher level of independence in dressing. This is consistent with a previous study by Fujita et al.¹⁶, reporting that the impact of upper limb function impairments on ADL may be lower than expected.

While many authors have demonstrated that visuospatial cognition and visual perception are correlated with the level of independence in dressing^{3, 8, 17, 18}, a partial correlation between visuospatial cognition and dressing performance was

not observed in the present study. This is probably because the impact of visuospatial deficits on dressing performance is lower than that of physical functions. However, careful interpretation is required because few patients had visuospatial deficits in the present study.

There were several limitations. First, stroke patients in this study showed a wide range of demographics and stroke characteristics. Second, this study had a small sample size and all patients were from one facility. Third, no psychosocial variables were addressed. Additional investigation is warranted to evaluate these issues.

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