doi: 10.2490/prm.20220010 Progress in Rehabilitation Medicine 2022; Vol. 7, 20220010

CASE REPORT

Spinal Cord Injury in Middle-aged and Older Adults Who Had Undergone Active Rehabilitation Treatment at a Remote Hospital: A Case Series

Shogo Okuji, PT [a] Yukio Mikami, MD, PhD [b] Yuta Sakurai, PT [a] Shohei Araki, PT [a] Takayuki Matsuda, OT [a] Izumi Yoshioka, MD [a] Motohiko Banno, MD, PhD [a,b] Kota Murai, MD [a,b] Yuki Sakata, MD [a,b] Ayana Ishigame, MD [a,b] Chika Sato, MD [a,c] and Fumihiro Tajima, MD, PhD [a,b]

Background: Middle-aged and older individuals with spinal cord injury (SCI) often require long-term care even after receiving rehabilitation treatment, making it difficult for them to return home. We retrospectively investigated our active rehabilitation treatment for patients with SCI. **Case:** Included in this case series were ten patients with SCI who were admitted to our general hospital (located in the southern part of Wakayama Prefecture) and who underwent active rehabilitation treatment. The participants were investigated retrospectively by access to electronic medical records. The Barthel index scores for discharged patients were determined at an outpatient clinic, and the community phase of rehabilitation management was recorded. The average age of the 10 patients was 67.4 ± 13.4 years, and the average period from onset to transfer to our hospital was 102.6 ± 69.9 days. The Barthel index scores significantly improved from 39.0 ± 30.9 at admission to 65.0 ± 28.2 at discharge ($P<0.05$). Among the seven patients who were discharged to their homes, six had cervical SCI. Some patients with American Spinal Injury Association impairment scale grades A and B at admission could be discharged home, and their Barthel index scores were maintained after discharge. **Discussion**: Even in a remote rural hospital, the activities of daily living of patients with SCI improved, and seven of the ten patients were discharged home. The activities of daily living of the discharged patients were maintained. To achieve these results, active rehabilitation treatment conducted by rehabilitation specialists is important.

Key Words: activities of daily living; spinal cord injury; treatment efficacy

INTRODUCTION

Japan is a super-aged society, with 28.4% of the population aged ≥65 years. The percentage of older people is expected to exceed 30% in 2025 and 39.9% in 2060.[1,2] In recent years, the number of spinal cord injuries (SCIs) caused by falls in middle-aged and older people has increased in Japan. The age-specific morbidity rate of SCI has changed from the conventional bimodal nature of young and older people to a monomodal distribution around middle-aged people.[3–5] Because the rate of cervical SCI is higher in middle-aged and older people,[4,5] and some older people have multiple disabilities,[6] rehabilitation treatment is sometimes difficult. As a result, the physical function and activities of daily living (ADL) of such patients often do not improve significantly.[7] Therefore, in urban areas, middle-aged and older people with SCI are generally treated at convalescent rehabilitation hospitals after acute treatment and after treatment in a hospital specializing in SCI.[8] There are two hospitals that specialize in SCI in Hokkaido and Fukuoka in Japan; moreover, there

Received: September 27, 2021, Accepted: January 24, 2022, Published online: March 1, 2022
[a] Department of Rehabilitation Medicine, Nachi-Katsuura Onsen Hospital, Wakayama, Japan
[b] Department of Rehabilitation Medicine, Wakayama Medical University, Wakayama, Japan
[c] Department of Rehabilitation Medicine, Onagawa Regional Medical Center, Miyagi, Japan
Correspondence: Yukio Mikami, MD, PhD, Department of Rehabilitation Medicine, Wakayama Medical University, Kimiidera 811-1, Wakayama 641-8509, Japan, E-mail: ymikami@wakayama-med.ac.jp
Copyright © 2022 The Japanese Association of Rehabilitation Medicine

This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial No Derivatives (CC BY-NC-ND) 4.0 License. http://creativecommons.org/licenses/by-nc-nd/4.0/

is a large regional disparity in the number of beds available in convalescent hospitals. Tokyo has the highest number of beds, followed by Osaka and Fukuoka.[9] However, if there is a delay after the onset of injury, treatment is often more difficult[10]; indeed, some patients are still physically disabled after rehabilitation treatment. These patients often require nursing care and it is, therefore, difficult to discharge them.[11,12] Providing sufficient care for older people is a social problem in Japan, and the lack of support from the younger generation makes it more difficult for them to be discharged home.[13]

In Japan, the long-term care insurance system was established in 2000,[14,15] and the number of people requiring long-term care services in 2019 exceeded 6.8 million. Among these, 551,000 were undergoing outpatient rehabilitation, and 120,000 were undergoing home visit rehabilitation.[16] In many cases, middle-aged and older people with SCI who have been discharged home continue to live at home while making use of social resources and services.

The town of Nachikatsuura is located 170 km south of Wakayama City and has a population of 14,607; 42.1% of the population are aged ≥60 years, and 35.7% of elderly people live alone. Furthermore, it includes several villages surrounded by mountains and the sea. It sometimes may take more than an hour by car to get to a location where a medical examination can be performed. Moreover, there are no hospitals specializing in spinal cord injury or convalescent rehabilitation hospitals nearby. Many local families consist only of older people, and receiving family support is often difficult for those requiring long-term care. Nachi-Katsuura Onsen Hospital is the general hospital in charge of the community's medical care and has four full-time rehabilitation doctors. Furthermore, active rehabilitation treatment in the hospital is delivered by rehabilitation-related professionals with specialized knowledge and skills. We performed active rehabilitation treatment for 10 middle-aged and older patients with SCI who were transferred to our hospital. This study aimed to retrospectively investigate and report the results of inpatient treatment and activity after discharge using medical records and to determine the effects of active rehabilitation treatment by rehabilitation specialists on middle-aged and older adults.

CASE

Ten patients with SCI who were admitted to our hospital between April 2014 and March 2016 and who received active rehabilitation treatment were included in this case series. The study included serial cases; however, nine patients who underwent regenerative spinal cord treatment and one who died during hospitalization from unrelated complications were excluded. Patient data were obtained from the hospitalization ledger, and the following items were obtained from electronic medical records: the physical function/Barthel index (BI) score at admission, length of hospital stay, rate of discharge, physical function/BI score at discharge, BI score at the outpatient clinic (patient living at home), and continuation of rehabilitation after discharge.

The demographic characteristics of the patients are presented in **Table 1**. We included seven male and three female participants with an average age of 67.4 ± 13.4 years. The period (mean ± SD) from SCI to transfer to our hospital was 102.6 ± 69.9 days. Seven patients had cervical SCI and three had thoracic SCI. The causes of the SCI were trauma in eight patients and disease in two patients. The AIS grades were A in two patients, B in two patients, C in two patients, and D in four patients. On admission, two patients had a tracheal tube, four patients had a urinary catheter, and one patient had a pressure ulcer.

This study was approved by the Nachi-Katsuura Onsen Hospital Ethics Committee (#R3-2). This research was explained to the patients, and written informed consent was obtained from all individual participants who were included in the study.

Rehabilitation Program

Rehabilitation doctors reassessed the cause of the SCI and its initial treatment and daily examined the level and degree of SCI. Furthermore, complications and comorbidities were confirmed. In addition to daily medical examinations, blood tests and imaging tests such as spinal magnetic resonance imaging; cervical, chest, and abdominal X-ray examinations; and cystography were performed as appropriate. Respiratory management; nutrition therapy; drug treatment for pain, spasticity, and dysuria; and pressure ulcer treatment were performed daily.

Individual physical therapy (maximum 3 h/day, 5 days/week), endurance training (Borg scale 13–15, 30–40 min/day), and muscle strengthening training (Borg scale 13–15, 40–50 min/day) were provided to all the patients, and transfer training (Borg scale 12–13, 30–40 min/day) and walking training (Borg scale 13–15, 50–60 min/day) were provided depending on the patient's needs. For individual occupational therapy (maximum 2 h/day, 5 days/week), endurance training (Borg scale 13–15, 20–30 min/day) and muscle strengthening training (Borg scale 13–15, 20–30 min/day) were provided to

Copyright © 2022 The Japanese Association of Rehabilitation Medicine

Table 1. Demographic characteristics of the patients

Patient	Age (years)	Sex	Chief diagnosis	Level of SCI	Cause of SCI	AIS	Period from onset to admission (days)	Other problems at admission
1	76	M	Thoracic injury	Th2	Trauma	B	119	Tracheal tube, urinary catheter
2	67	M	Cervical injury	C5	Trauma	D	56	
3	79	F	Cervical injury	C7	Cervical myelopathy	D	59	
4	88	F	Cervical injury	C5	Trauma	C	89	
5	52	M	Cervical injury	C6	Trauma	D	212	
6	62	M	Thoracic injury	Th12	Trauma	C	35	Urinary catheter
7	83	F	Cervical injury	C5	Trauma	D	54	
8	50	M	Cervical injury	C7	Trauma	B	240	
9	61	M	Thoracic injury	Th8	Pyogenic spondylitis	A	63	Pressure ulcer, urinary catheter
10	56	M	Cervical injury	C7	Trauma	A	99	Tracheal tube, urinary catheter

AIS, American Spinal Injury Association impairment scale.

all the patients. Furthermore, with emphasis on items with low BI scores, ADL/instrumental ADL training for returning home, such as floor movement training, feeding training, toileting training (e.g., movement and suppository insertion), and wheelchair transfer training, was provided depending on the patient. Physical function and ADL were measured and recorded by physiotherapists and occupational therapists at admission and discharge. For patients returning home, nurses and caregivers shared information with the therapists and conducted ADL training (60–80 min/day), such as feeding training, self-urinary catheterization guidance, bathing training, and dressing training, in the ward.

Rehabilitation treatment was performed daily during hospitalization for a maximum of 4–5 h per day. Individual training for up to 3 h was supervised by a therapist, and the remaining time was used for training under the guidance and supervision of doctors and nurses or for self-training such as stretching, push-up practice, and wheelchair maneuvering. In addition, rehabilitation staff and medical social workers visited the homes of patients about to be discharged and provided consultations on family guidance and housing modifications (**Figs. 1 and 2**).

Statistical Analysis

The Mann–Whitney test was performed to determine the differences in BI scores between admission and discharge, between admission and the outpatient clinic (i.e., the patient is living at home), and between discharge and the outpatient clinic (patient living at home). Data analysis was conducted using JMP Pro version 14.1 (SAS Institute Japan, Tokyo, Japan), and $P<0.05$ was considered statistically significant.

Findings

All the patients were admitted to the general ward, and seven were later transferred to the long-term medical care ward during hospitalization. After a patient moved to the long-term medical care ward, the doctor usually documented the reasons for continuing rehabilitation, indicating a possibility of improvement in ADL.

As a result of active rehabilitation treatment, the tracheal tube was removed in one of the two intubated patients. Moreover, self-urinary catheterization was established in all four catheterized patients, and the pressure ulcer was cured in the affected patient. Slight improvements in muscle strength were observed in all the patients, and no deterioration in paralysis was observed.

Table 2 shows the changes in BI scores between admission and discharge. The BI scores improved significantly from 39.0 ± 30.9 at admission to 65.0 ± 28.2 at discharge ($P<0.05$). Standing up from the floor, sitting for long periods, and self-transfer to a wheelchair were achieved by six of seven patients, four of six patients, and five of eight patients, respectively, who could not perform these activities before rehabilitation.

Seven patients were eventually discharged home, one was transferred to another hospital, and two were admitted to

Copyright © 2022 The Japanese Association of Rehabilitation Medicine

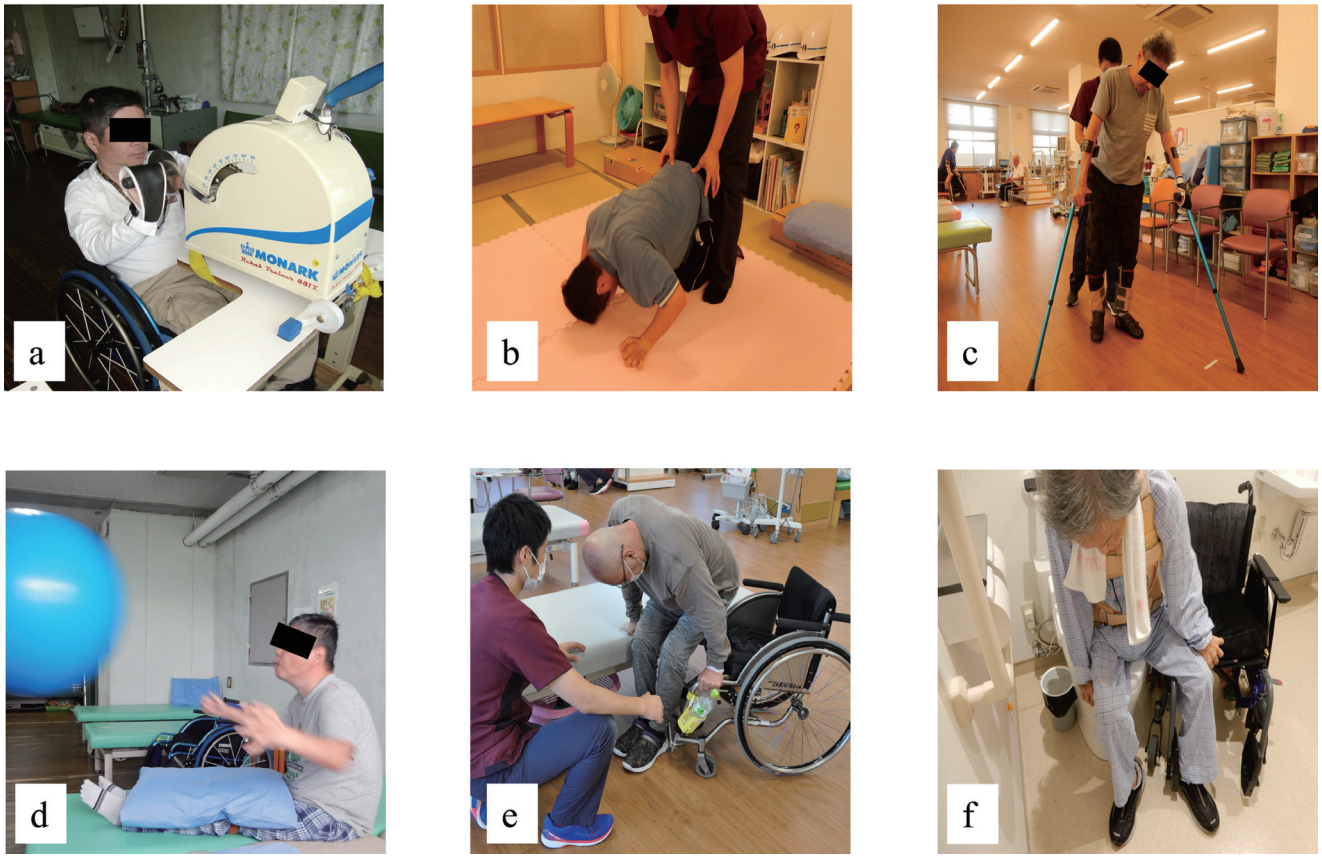

Fig. 1. Active rehabilitation program supervised by a therapist: (a) endurance training, (b) muscle strengthening training, (c) walking training, (d) floor movement training, (e) transfer training, and (f) toileting training.

a facility. The average length of hospital stay was 259.8 ± 190.3 days. The levels of SCI at admission for the patients discharged home were C5 in two patients, C6 in one patient, C7 in three patients, and Th12 in one patient. Their AIS grades at admission were A, one patient; B, one patient; C, two patients; and D, three patients. Six of the seven patients had cervical SCI, and even some patients with AIS grades A and B at admission were discharged to home.

On 880.6 ± 400.5 days after discharge, five of the seven patients who were discharged home had undergone continued rehabilitation covered by long-term care insurance. The other two patients continued self-training and their BI scores were maintained after discharge (**Fig. 3**).

DISCUSSION

In this study, we report the results of active rehabilitation treatment and management in patients with SCI at a remote general hospital. The background of the patients with SCI at our hospital was similar to that of SCI patients in a national survey.[3–5] However, the elapsed time from SCI to transfer to our hospital was long, making treatment difficult in many cases. Because our hospital is located in a medically depopulated area in the southern part of Wakayama Prefecture and no convalescent rehabilitation hospital is available in this area, many patients were transferred from an acute care hospital after long-term treatment. In Japan, a comprehensive community care system is being promoted, but in depopulated areas, medical and long-term care resources are scarce, and regional disparities exist in medical and long-term care services.[17] Providing unique treatment and long-term care services that take advantage of the characteristics of the region within the scope of medical and long-term care policy is necessary for our hospital. Therefore, we aimed to increase the number of rehabilitation doctors, deepen multidisciplinary cooperation, and support regional medical care.

In this study, the results were favorable even though our facility is in a remote rural area in Japan. In urban areas in Japan, Yokoyama et al. reported that 17 patients with traumatic SCIs with paraplegia (mean age, 57.2 ± 10.0 years),

Copyright © 2022 The Japanese Association of Rehabilitation Medicine

Fig. 2. Active rehabilitation program guided by nurses and self-training: (a) self-urinary catheterization guidance, (b) push-up training, (c) wheelchair training, and (d) home visit.

for whom admission was delayed for 68.1 ± 32.9 days after injury, received inpatient rehabilitation treatment for 2 h/day, 5 days/week, for 115.6 ± 35.8 days at a hospital specializing in SCI, and the Functional Independence Measure (FIM) score improved from 74.1 ± 14.0 at admission to 107.2 ± 11.1 at discharge.[18] Furthermore, Tanaka et al. reported that 154 patients with cervical SCI (mean age, 67.1 ± 12.7 years) whose admission was delayed for 49.1 (34.0–60.0) days after injury received inpatient rehabilitation treatment for 3 h/day for 119.7 (71.3–146.5) days in a convalescent rehabilitation hospital in Japan; their FIM score had improved by 23.0 (6.5–34.0) points at discharge from 58.0 (38.0–73.8) at admission.[19] In a Canadian study, the effects of rehabilitation on middle-aged and older patients with quadriplegia (mean age, 50 ± 17 years) and paraplegia (mean age, 48 ± 18 years) resulting from subacute cervical SCI and SCI were investigated. The quadriplegia patients underwent 53 (44–62) min of physiotherapy and 44 (26–54) min of occupational therapy for 110 ± 51 days, whereas the paraplegia patients underwent 54 (45–59) min of physiotherapy and 34 (12–48) min of occupational therapy for 85 ± 38 days at a SCI rehabilitation hospital in an urban area. As a result, the SCIM III scores in patients with paraplegia and quadriplegia, respectively, improved from 50.7±17.0 to 66.6±17.1 points and from 32.7±23.8 to 52.3±27.8 points.[20] In Italy, rehabilitation treatment for subacute SCI in middle-aged and elderly patients significantly improved the BI at discharge compared to admission.[21] As mentioned previously, our facility has four full-time rehabilitation doctors, and regular training is organized for therapists, nurses, and caregivers. Rehabilitation doctors routinely perform appropriate disease and risk management. At our hospital, under the consultation of a rehabilitation doctor and in addition to active exercise therapy by therapists, intensive training was conducted to improve BI items with low scores. The nurses and caregivers who were responsible for maintaining physical function and improving ADL actively participated. However, the number of rehabilitation doctors in Japan is insufficient. Most of these doctors are available only in acute and convalescent hospitals in urban areas; consequently, the uneven distribution of doctors is a problem.[22] The availability of four rehabilitation doctors in a remote general hospital is rare. However,

Copyright © 2022 The Japanese Association of Rehabilitation Medicine

Table 2. Changes in Barthel index scores during hospitalization

Item	Patient																			
	1		2		3		4		5		6		7		8		9		10	
	Adm	Dis	Adm	Dis	Adm	Dis	Adm	Dis	Adm	Dis	Adm	Dis	Adm	Dis	Adm	Dis	Adm	Dis	Adm	Dis
Feeding	10	10	5	10	10	10	5	10	10	10	10	10	10	10	10	10	10	10	5	10
Transfers	0	5	5	15	10	15	5	15	15	15	0	15	15	15	15	15	0	10	0	10
Grooming	0	0	0	0	5	5	0	0	5	5	0	5	0	5	5	5	5	5	0	0
Toilet use	0	0	0	5	5	10	0	5	10	10	0	10	10	10	5	10	5	5	0	0
Bathing	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0
Walking	0	0	10	10	10	15	0	15	15	15	5	10	15	15	5	5	5	5	5	5
Climbing stairs	0	0	0	5	0	10	0	5	10	10	0	0	5	10	0	0	0	0	0	0
Dressing	0	0	5	5	5	10	0	5	5	10	0	10	5	10	10	10	0	0	0	0
Fecal incontinence	0	0	0	0	10	10	0	10	10	10	0	5	10	10	0	5	0	0	0	5
Urinary incontinence	0	0	5	5	10	10	0	10	10	10	0	10	10	10	5	10	0	5	0	5
Total	10	15	30	55	65	95	10	75	90	95	15	80	80	95	55	65	25	40	10	35
Change	+5		+25		+30		+65		+5		+65		+15		+10		+15		+25	
Discharge	Another hospital		Home		Home		Facility		Home		Home		Home		Home		Facility		Home	

Adm, at admission; Dis, at discharge.
Gray cells indicate improvement and favorable results.

Copyright © 2022 The Japanese Association of Rehabilitation Medicine

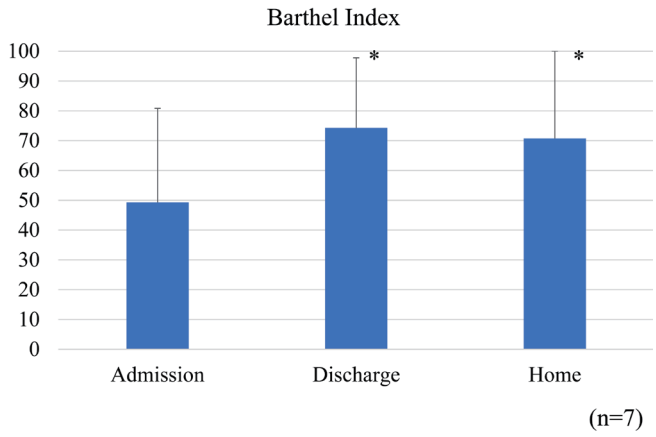

Fig. 3. Changes in Barthel index scores for the seven patients discharged home. The Barthel index scores were significantly higher after the active rehabilitation program and were maintained after discharge to home. *P <0.05 vs. at admission

rehabilitation doctors are needed in local hospitals not only to treat diseases and injuries but also to improve ADL, which can lead to satisfactory results as shown in the current study.

In this study, the BI score was maintained after discharge. Because our hospital is a local hospital, we work closely with local family doctors and care managers whose important roles are funded by long-term care insurance. Therefore, the medical care information of the patients can be sufficiently transmitted to the staff funded by long-term care insurance, thereby assuring a smooth transition from rehabilitation covered by medical insurance to rehabilitation covered by long-term care insurance. After discharge, patients are regularly followed up by a rehabilitation doctor for the evaluation of the SCI and ADL. Therefore, maintenance of the BI was achieved by instructing the patients and caregivers about changes in the ADL and training methods at the time of outpatient re-examination. In Japan, collaboration between medical care staff and long-term care staff is a topic of interest in the field of rehabilitation medicine.[23] In particular, the training programs and evaluation methods used by the rehabilitation staff funded by medical insurance are sometimes not completely communicated to the rehabilitation staff funded by long-term care insurance. In addition, for rehabilitation covered by long-term care insurance, methods consistent with rehabilitation covered by medical insurance have not been established, and scientific rehabilitation programs and evaluations are scarce. In general, the ADL of older people with SCI who are discharged usually deteriorate. This leads to complications and an increase in the level of care required, thereby shortening the patient's lifespan.[24] However, good cooperation at our hospital was promoted by taking advantage of the characteristics of the small catchment area, and this led to the maintenance of ADL in discharged SCI patients.

This study has several limitations. First, although the functional differentiation of medical institutions is progressing in Japan,[25,26] when the participants were admitted, all were treated in the general ward. If hospitalization was prolonged for some patients, they were transferred to the long-term medical care ward. In this study, long-term, high-frequency, high-intensity rehabilitation treatment was performed, but the therapist calculated the minimum required set. The remaining time was used for self-training or training by a nurse under the supervision of a rehabilitation doctor. Recently, the long-term medical care ward in our hospital was adapted to become a ward for patients with disabilities.[27] Improving ADL in older people with SCI may take a long time. In contrast to general and convalescent wards, no restrictions on the length of hospital stay are placed on wards for patients with disabilities. In addition to improving the ADL, preparations for home life, such as providing family guidance, home visit nursing, and service adjustment (including home visit rehabilitation before discharge), can be arranged. Second, during rehabilitation management funded by long-term care insurance, performing rehabilitation treatment equivalent to that covered by medical insurance is institutionally difficult.[15] However, active self-training was combined to maintain activity in patients. Third, the BI was used as an evaluation outcome measure of activities in this study. The FIM is often used in convalescent rehabilitation hospitals, but the BI is often used in the community phase.[19,28] In the current study, consistent evaluations of changes in activities from hospitalization to the patient living at home were possible using the BI.

In the future, we believe that further improvements in physical function and ADL can be obtained by further collaboration with the regional acute-phase hospitals and by shortening the period from onset to transfer. Furthermore, increasing the number of rehabilitation doctors is necessary, which may be facilitated by actively accepting visits by medical students and residents and advocating for the necessity of rehabilitation medicine. Moreover, regular education of rehabilitation-related staff and increasing the number of specialists with knowledge and skills with regard to the treatment of people with SCI are warranted. Finally, we should deepen the collaboration between medical care staff and long-term care staff, promote the transmission of

Copyright © 2022 The Japanese Association of Rehabilitation Medicine

information to patients, and promote shared rehabilitation management and evaluation methods for people with SCI.

In conclusion, the ADL of the 10 SCI patients who received active rehabilitation treatment improved, and the majority of the patients were discharged home, including middle-aged and older patients with SCI who had been injured for a long time. Furthermore, the ADL of patients with SCI who returned home were maintained. To achieve these results, it is important that patients receive active rehabilitation treatments by rehabilitation-related professionals with specialized knowledge and skills and management by rehabilitation doctors.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest.

REFERENCES

1. United Nations: World population prospects 2019 – volume II: demographic profiles. UN; 2020. https://www.un-ilibrary.org/content/books/9789210046435. Accessed 10 Jul 2021.
2. Arai H, Ouchi Y, Toba K, Endo T, Shimokado K, Tsubota K, Matsuo S, Mori H, Yumura W, Yokode M, Rakugi H, Ohshima S: Japan as the front-runner of super-aged societies: perspectives from medicine and medical care in Japan. Geriatr Gerontol Int 2015;15:673–687. DOI:10.1111/ggi.12450, PMID:25656311
3. Shingu H, Ohama M, Ikata T, Katoh S, Akatsu T: A nationwide epidemiological survey of spinal cord injuries in Japan from January 1990 to December 1992. Paraplegia 1995;33:183–188. PMID:7609973
4. Katoh S, Enishi T, Sato N, Sairyo K: High incidence of acute traumatic spinal cord injury in a rural population in Japan in 2011 and 2012: an epidemiological study. Spinal Cord 2014;52:264–267. DOI:10.1038/sc.2014.13, PMID:24513725
5. Miyakoshi N, Suda K, Kudo D, Sakai H, Nakagawa Y, Mikami Y, Suzuki S, Tokioka T, Tokuhiro A, Takei H, Katoh S, Shimada Y: A nationwide survey on the incidence and characteristics of traumatic spinal cord injury in Japan in 2018. Spinal Cord 2021;59:626–634. DOI:10.1038/s41393-020-00533-0, PMID:32782342
6. Huang SW, Wang WT, Chou LC, Liou TH, Lin HW: Risk of dementia in patients with spinal cord injury: a nationwide population-based cohort study. J Neurotrauma 2017;34:615–622. DOI:10.1089/neu.2016.4525, PMID:27539630
7. Wirz M, Dietz V, European Multicenter Study of Spinal Cord Injury (EMSCI) Network: Recovery of sensorimotor function and activities of daily living after cervical spinal cord injury: the influence of age. J Neurotrauma 2015;32:194–199. DOI:10.1089/neu.2014.3335, PMID:24963966
8. Okamoto T, Ando S, Sonoda S, Miyai I, Ishikawa M: "Kaifukuki Rehabilitation Ward" in Japan. Jpn J Rehabil Med 2014;51:629–633. DOI:10.2490/jjrmc.51.629
9. Kaifukuki Rehabilitation Ward Association: Number of convalescent beds by prefecture. http://www.rehabili.jp/publications/sourcebook/graf/graf4.pdf
10. Wirth B, van Hedel HJ, Kometer B, Dietz V, Curt A: Changes in activity after a complete spinal cord injury as measured by the Spinal Cord Independence Measure II (SCIM II). Neurorehabil Neural Repair 2008;22:145–153. DOI:10.1177/1545968307306240, PMID:18496904
11. Gulati A, Yeo CJ, Cooney AD, McLean AN, Fraser MH, Allan DB: Functional outcome and discharge destination in elderly patients with spinal cord injuries. Spinal Cord 2011;49:215–218. DOI:10.1038/sc.2010.82, PMID:20697421
12. Cifu DX, Seel RT, Kreutzer JS, McKinley WO: A multicenter investigation of age-related differences in lengths of stay, hospitalization charges, and outcomes for a matched tetraplegia sample. Arch Phys Med Rehabil 1999;80:733–740. DOI:10.1016/S0003-9993(99)90219-8, PMID:10414754
13. Haya MA, Ichikawa S, Wakabayashi H, Takemura Y: Family caregivers' perspectives for the effect of social support on their care burden and quality of life: a mixed-method study in rural and sub-urban central Japan. Tohoku J Exp Med 2019;247:197–207. DOI:10.1620/tjem.247.197, PMID:30890666
14. Iwagami M, Tamiya N: The long-term care insurance system in Japan: past, present, and future. Japan Med Assoc J 2019;2:67–69. DOI:10.31662/jmaj.2018-0015, PMID:33681515
15. Ministry of Health, Labour and Welfare of Japan: Long-term care insurance in Japan. https://www.mhlw.go.jp/english/topics/elderly/care/index.html. Accessed 10 Jul 2002.

Copyright © 2022 The Japanese Association of Rehabilitation Medicine

16. Ministry of Health, Labour and Welfare of Japan. Report of long-term care insurance. https://www.mhlw.go.jp/topics/kaigo/osirase/jigyo/m21/2104.html. Accessed 10 Jul 2021.
17. Matsumoto M, Kimura K, Inoue K, Kashima S, Koike S, Tazuma S: Aging of hospital physicians in rural Japan: a longitudinal study based on national census data. PLoS One 2018;13:e0198317. DOI:10.1371/journal.pone.0198317, PMID:29856807
18. Yokoyama O, Sakuma F, Itoh R, Sashika H: Paraplegia after aortic aneurysm repair versus traumatic spinal cord injury: functional outcome, complications, and therapy intensity of inpatient rehabilitation. Arch Phys Med Rehabil 2006;87:1189–1194. DOI:10.1016/j.apmr.2006.05.017, PMID:16935053
19. Tanaka M, Momosaki R, Wakabayashi H, Kikura T, Maeda K: Relationship between nutritional status and improved ADL in individuals with cervical spinal cord injury in a convalescent rehabilitation ward. Spinal Cord 2019;57:501–508. DOI:10.1038/s41393-019-0245-9, PMID:30700852
20. Zbogar D, Eng JJ, Miller WC, Krassioukov AV, Verrier MC: Movement repetitions in physical and occupational therapy during spinal cord injury rehabilitation. Spinal Cord 2017;55:172–179. DOI:10.1038/sc.2016.129, PMID:27752057
21. Scivoletto G, Morganti B, Ditunno P, Ditunno JF, Molinari M: Effects on age on spinal cord lesion patients' rehabilitation. Spinal Cord 2003;41:457–464. DOI:10.1038/sj.sc.3101489, PMID:12883544
22. Ishikawa M: Changes in the characteristics of rehabilitation physicians over two decades: analysis of national physician census surveys in Japan. Prog Rehabil Med 2020;5:n/a. DOI:10.2490/prm.20200012, PMID:32789280
23. Shibuta H, Abe T, Miyamoto H, Hagihara A: Interaction effects of in-hospital rehabilitation and the use of community-based services after hospital discharge on patients' subsequent functional abilities. J Rehabil Med 2016;48:307–315. DOI:10.2340/16501977-2055, PMID:26841715
24. Frankel HL, Coll JR, Charlifue SW, Whiteneck GG, Gardner BP, Jamous MA, Krishnan KR, Nuseibeh I, Savic G, Sett P: Long-term survival in spinal cord injury: a fifty year investigation. Spinal Cord 1998;36:266–274. DOI:10.1038/sj.sc.3100638, PMID:9589527
25. Sugiyama M, Kondo K, Jeong S, Shiraishi N, Matsumoto D, Hayashi T, Tanaka H: Effect of care capacity on stroke patients' recovery in activities of daily living: a multi-hospital study. J Stroke Cerebrovasc Dis 2020;29:105187. DOI:10.1016/j.jstrokecerebrovasdis.2020.105187, PMID:32912554
26. Kinoshita S, Abo M, Okamoto T: Effectiveness of ICF-based multidisciplinary rehabilitation approach with serial assessment and discussion using the ICF rehabilitation set in a convalescent rehabilitation ward. Int J Rehabil Res 2020;43:255–260. DOI:10.1097/MRR.0000000000000421, PMID:32496283
27. Miura K: Comparison of larger and smaller groups on a ward for physically handicapped children on interaction in the "present" game. Percept Mot Skills 1993;77:200–202. DOI:10.2466/pms.1993.77.1.200, PMID:8367242
28. Matsuda T, Iwagami M, Suzuki T, Jin X, Watanabe T, Tamiya N: Correlation between the Barthel Index and care need levels in the Japanese long-term care insurance system. Geriatr Gerontol Int 2019;19:1186–1187. DOI:10.1111/ggi.13777, PMID:31746527

Copyright © 2022 The Japanese Association of Rehabilitation Medicine