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Original Article

Factors That Influence Functional Prognosis in Elderly Patients with Hip Fracture

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Abstract

The purpose of this study was to evaluate in aged patients with hip fracture, the degree of recovery at discharge and after discharge relative to the pre-fracture walking level, to clarify the factors involved in unsuccessful recovery. The patients were 189 patients aged 60 years and older who underwent surgery between 1988 and 1994. Patients who died within 1 year or lacked data on walking were excluded. Multiple logistic regression analysis was applied to data on the walking level before fracture, that at discharge, and the best walking level after discharge, to clarify factors involved in unsuccessful recovery. The rate of recovery to the pre-fracture level was 55.1% at discharge. Unsuccessful recovery at discharge was influenced by prior dementia, a history of cerebrovascular diseases, and an age of 85 or more years. Analysis showed an "after-discharge" recovery rate of 63.2%. Prior dementia and the residence outside one's own home influenced unsuccessful recovery rate.

These findings suggested that it is important to provide patients with such factors a more effective post-operative rehabilitation program not merely the standard rehabilitation program. In addition, a walking rehabilitation program should be offered to those who were re-hospitalized or admitted to other health care facilities.

Key words: elderly, functional prognosis, hip fracture, influence factor, Japanese

Introduction

The incidence of hip fractures in Japan was previously lower than in Western countries, but has increased markedly in recent years[1]. Furthermore, it has been shown that hip fracture profoundly impacts the physical, social, and economic welfare of the elderly[2–4]. Therefore, preventing the occurrence of such fractures as well as supporting the daily lives of elderly patients after discharge, has become an urgent issue.

The central objective of postoperative functional prognosis is to obtain the pre-fracture walking level, which is almost identical in Western countries and Japan[5]. There are many studies of functional prognoses of elderly patients with fractures based on the walking level of criterion of whether they could walk with or without a cane[6,7]. Koval et al. rejected these evaluation criteria, and, instead, proposed that walking ability level should be to walk outdoors and to live normally[8]. Such information, unfortunately, are lacking in Japan because there are many studies describing functional prognoses of fractures in elderly patients based on the recovery to pre-fracture walking ability and whether they could walk with or without a cane[9–12].

In the present study, therefore, elderly patients with fractures were classified based on the walking level criteria of whether they could walk outdoors or indoors. In addition, factors involved in the recovery of walking were clarified. We especially considered that information for establishing future measures in the community could be obtained by clarifying the prognosis course of these patients after discharge.

Subjects and Methods

Subjects

The subjects consisted of 286 elderly patients with fractures aged 60 years and over who were hospitalized for surgical treatment at the Department of Orthopaedic Surgery in Fukui Red Cross Hospital between 1988 and 1994. Of these patients, 7 patients with pathological fractures without osteoporosis and 16 patients who experienced re-fractures during the course of this study

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were excluded because the recovery process in these patients was considered to be different from that in other elderly patients. Therefore, the present study evaluated 263 patients.

Data collection

The investigation was performed in 1995 based on medical records and nursing records, and the following items were obtained: age, gender, the presence or absence of a spouse, hobbies, place of residence before fracture, types of fracture, date of admission, date of surgery, date of discharge, past histories (cerebrovascular diseases, cardiovascular diseases, carcinoma, and dementia), hemoglobin levels, total serum protein levels, and walking conditions before fracture and at the time of discharge.

Investigation of functional prognoses

Prognoses of patients were investigated by mailing a questionnaire to obtain information concerning the following items: walking ability at the time of discharge and investigation, best walking ability after discharge, place of residence after discharge, presence or absence of functional training after discharge, presence or absence of friends, and the presence or absence of family physicians. For patients who were dead at the time of investigation, information was obtained from their family members. Since the purpose and methods of this investigation were sufficiently described in the questionnaire, it was considered that informed consent was obtained when the questionnaire was returned. Insufficient or unclear answers to questions were reconfirmed by telephone interview.

Factors used in analysis

Based on the categorization proposals of Koval et al.[8] and Kishi et al.[13], the following categories of definitions of walking ability were utilized for this study: level 1 (they could walk and perform ADL's with or without a cane, indoors and outdoors), level 2 (they could walk and perform ADL's with or without a cane, indoors only), level 3 (with human assistance, they could walk and perform ADL's indoors only), level 4 (they could not walk even with assistance, but could perform ADL's with human assistance). The walking ability at the time of discharge and the best walking ability after discharge, were questioned by these categories. The walking abilities before fracture were obtained from the nursing record (medical record of present disease, level of ADL before fracture) and findings of previous mailing investigation.

Table 1 presents all the factors examined, categories of each factor, and numbers of the subjects in the categories. Since Koval et al. reported that 85 years and older patients were likely to show a decline in ambulatory ability[8], patients were divided into 2 groups: those aged 85 years and over, and those aged less than 85 years. Preoperative hemoglobin levels and serum total protein levels determined on the day nearest to the date before surgery were classified into 2 groups: those within a normal range and those below the normal range. Based on medical records, the presence or absence of past histories (cerebrovascular or cardiovascular diseases, and carcinoma) and preceding dementia were evaluated. The preoperative period was divided into two levels, 0–4 days and 5 days or more, according to the classification of Kenzora et al.[14]. In a standard rehabilitation program for patients with surgically treated for hip fracture in Japan, patients are encouraged to walk with a cane at about 40 days after surgery[15,16] and are regarded to be healed in 12 weeks. Therefore, we divided the duration of hospitalization into 3 levels: 40 days or less, 40 to 90 days, and more than 90 days of hospitalization. The period until the initiation of postoperative functional training was classified into 2 groups: less than 14 days and more than 14 days (mean duration; 11.5 days).

Statistical analysis

It was previously reported that patients with fractures can recover to the best walking level between 6 months and 1 year after surgery[17,18]. Therefore, the present study examined patients with fractures whose postoperative courses could be followed for more than 1 year. Those who died within 1 year after surgery were excluded from the study. The following analyses were performed.

1) Analysis of the unsuccessful recovery to the pre-fracture walking level

Sixteen factors were analyzed after dividing patients into the following 2 groups (Tables 2, 3): recovery group (those who could recover the pre-fracture walking level at the time of discharge and thereafter), and unsuccessful-recovery group (those who could not recover the pre-fracture walking level at the time of discharge and thereafter).

2) Analysis of the improvement in the walking level after discharge

Twenty factors were analyzed after dividing patients into the following 2 groups (Table 4): improved group (patients whose walking level improved after discharge) and non-improved group (those whose walking level did not improve after discharge).

Analyses were performed as follows: using chi-square test, univariate analysis was initially performed by testing the difference between criterion variables and factors of the respective categories. For the factors that demonstrated significant differences, odds ratios of unsuccessful recovery, of improvement recovery, and 95% confidence intervals were obtained using multiple logistic regression analysis[19,20]. Statistical differences were evaluated by chi-square test. These analyses were performed using the SAS System for Windows (Release 6.11, Cary, NC, USA).

Results

Basic properties

During the investigation, 256 valid responses were obtained from 263 patients (recovery rate: 97.3%). Responses to the questionnaire were obtained from 213 patients by mail, while responses from 43 patients were obtained by telephone interview. The median of the follow-up period was 3.2 years (range: 0.5 to 7.5 years). The mean age of the patients at admission was 78.8 years (76.9 years in males and 78.9 years in females). The male-to-female ratio was 1:3.2 (61 males and 195 females). When the type of fracture was evaluated, intracapsular fracture occurred in 85 patients, while extracapsular fracture occurred in 171 patients, and the ratio between the two fracture types was 1:2.

Among 256 patients, analyses were performed in 189 patients because 27 died within 1 year after surgery, the follow-up period was limited to less than 1 year in 29 patients, and information about walking level were missing in 11 patients. In these 189 patients, the mean age was 78.2 years (SD±8.01), 32 were aged 60 to 69 years, 71 were aged 70 to 79 years, 76 were aged 80 to 89

Table 1 Categories of potential factors influencing the recovery of walking were analyzed using chi-square test for univariate analysis

Factor (mean of 189 patients)	Category	Analysis 1[1] (185 patients)					Analysis 2[2] (113 patients)		
		At discharge			After discharge		Number	Improved rate (%)	p-value (χ^2 test)
		Number	recovery rate (%)	p-value (χ^2 test)	recovery rate (%)	p-value (χ^2 test)			
Age	<85 years	149	58.4	0.016	67.8	0.009	84	29.8	0.345
(78.2 years)	>=85 years	36	36.1		44.4		29	20.7	
Gender	Male	46	63.0	0.158	67.4	0.501	22	22.7	0.581
	Female	139	51.5		61.9		91	28.6	
Type of fracture	Intracapsular	66	60.6	0.183	66.7	0.472	40	27.5	0.991
	Extracapsular	119	50.4		61.3		73	27.4	
Pre-operative serum total	>6 g/dl	105	50.0	0.334	64.8	0.624	59	22.0	0.179
protein (6.1 g/dl)	<=6 g/dl	80	57.1		61.3		54	33.3	
Pre-operative hemoglobin	>11 g/dl	86	58.1	0.299	66.3	0.425	46	32.6	0.307
(10.9 g/dl)	<=11 g/dl	99	50.5		60.6		67	23.9	
Past history									
Cerebrovascular disease	Absent	157	58.6	0.003	67.5	0.004	85	31.8	0.072
	Present	28	28.6		39.3		28	14.3	
Carcinoma	Absent	171	52.6	0.175	62.1	0.509	105	29.5	0.071
	Present	14	71.4		71.4		8	0	
Cardiovascular disease	Absent	125	52.8	0.621	61.6	0.503	79	26.6	0.757
	Present	60	56.7		66.7		34	29.4	
Dementia	Absent	169	56.8	0.015	65.7	0.025	97	29.9	0.148
	Present	16	25.0		37.5		16	12.5	
Pre-operative period	<=5 days	89	59.6	0.149	65.2	0.601	50	26.0	0.761
(10.2 days)	>5 days	96	49.0		61.5		63	28.6	
Hospitalization period	<=40 days	35	40.0	0.106	51.4	0.217	30	27.9	0.769
(60.7 days)	>40 days <=90 days	125	59.2		67.2		68	23.3	
	>90 days	25	48.0		60.0		15	33.3	
The period until the initiation	<=14 days	147	54.4	0.844	65.3	0.252	89	31.5	0.065
of postoperative functional	>14 days	38	52.6		55.3			12.5	
training (11.5 days)							24		
Level of walking	Level 1	125	59.2	0.166	97.2	0.217			
before fracture[3]	Level 2	25	40.0		60.0				
	Level 3	35	45.7		51.4				
Level of walking	Level 1	76					—	—	—
at discharge[3]	Level 2	43					43	27.9	0.004
	Level 3	40					40	42.5	
	Level 4	26					30	6.7	
Outdoor hobby	Present	41	63.4	0.286	73.2	0.246	18	50.0	0.052
	Absent	128	53.9		63.3		79	26.6	
	Missing	16					16		
Spouse	Alive	84	54.8	0.860	66.7	0.378	48	35.8	0.102
	Dead	101	53.5		60.4		65	21.5	
Place of residence	Own home	161	57.1	0.029	65.8	0.058	88	31.8	0.05
before fracture	Others	24	33.3		45.8		25	12.0	
Place of residence	Own home	131			71.0	0.001	70	34.3	0.105
after discharge	Repeated hospitalization	12			25.0		12	16.7	
	Hospitalization	28			29.6		27	14.8	
	Missing	15					4		
Functional training	Present	98			58.2	0.341	65	30.8	0.440
after discharge	Absent	64			65.6		38	23.7	
	Missing	23					10		
Friends	Present	112			63.4	0.453	72	31.9	0.384
	Absent	49			57.1		30	23.3	
	Missing	24					11		
Family physicians	Present	113			64.6	0.425	70	25.7	0.107
	Absent	35			57.1		23	43.5	
	Missing	37					20		

1) Analysis 1: Recovery of the pre-fracture walking level and influencing factors at discharge and after discharge
2) Analysis 2: Improvement in the walking level at the time of discharge and thereafter and influencing factors
3) Category for level of walking
Level 1: They could walk and perform ADL's with or without a cane, indoors and outdoors.
Level 2: They could walk and perform ADL's with or without a cane, indoors only.
Level 3: With human assistance, they could walk and perform ADL's indoors only.
Level 4: They could not walk even with assistance, but could perform ADL's with human assistance.

Table 2 The walking level of pre-fracture and at the time of discharge

Pre-fracture[1)]	At time of discharge[1)]				
	Level 1	Level 2	Level 3	Level 4	Total
Level 1	74	**28***	**20***	**3***	125
Level 2	1	9	**11***	**4***	25
Level 3	1	6	9	**19***	35
Level 4	0	0	0	4**	4
Total	76	43	40	30	189

* These patients were categorized into an unsuccessful recovery groups who could not recover the pre-fracture walking level at the time of discharge (85 patients)

** These patients were excluded from the analysis because the walking level in these patients did not decrease further

1) Category for level of walking

Level 1: They could walk and perform ADL's with or without a cane, indoors and outdoors.

Level 2: They could walk and perform ADL's with or without a cane, indoors only.

Level 3: With human assistance, they could walk and perform ADL's indoors only.

Level 4: They could not walk even with assistance, but could perform ADL's with human assistance.

Table 3 The walking level of pre-fracture and the best walking level after discharge

Pre-fracture[1)]	The best walking level after discharge[1)]				
	Level 1	Level 2	Level 3	Level 4	Total
Level 1	84	**30***	**8***	**3***	125
Level 2	3	12	**6***	**4***	25
Level 3	4	3	11	**17***	35
Level 4	0	0	0	4**	4
Total	91	45	25	28	189

* These patients were categorized into an unsuccessful recovery group who could not recover the pre-fracture walking level after discharge (68 patients)

** These patients were excluded from the analysis because the walking level in these patients did not decrease further

1) Category for level of walking

Level 1: They could walk and perform ADL's with or without a cane, indoors and outdoors.

Level 2: They could walk and perform ADL's with or without a cane, indoors only.

Level 3: With human assistance, they could walk and perform ADL's indoors only.

Level 4: They could not walk even with assistance, but could perform ADL's with human assistance.

years, and 10 were aged 90 years or more. The follow-up period ranged between 1.1 and 7.5 years, the male-to-female ratio was 1:3.1, and the ratio of intracasular fracture to extracapsular fracture was 1:1.9.

Analysis 1: Unsuccessful recovery to the pre-fracture walking level and influencing factors at the time of discharge and after discharge.

Four Patients demonstrating a level 4 (they could not walk even with assistance, but could perform ADL's with human assistance) walking ability were excluded from this analysis because the walking level in these patients did not decrease further. A total of 185 patients were analyzed.

When the courses of patients were compared between the time of discharge (Table 2) and after discharge (Table 3), 85 patients (44.9%) could not recover to the pre-fracture walking level at discharge, while 68 patients (35.9%) could not recover to the pre-fracture walking level after discharge. Although 4 patients (2.1%) could not walk before fracture, the number of patients was increased to 28 after discharge. Moreover, the pre-fracture walking ability was evaluated as level 1 (they could walk and perform ADL's with or without a cane, indoors and outdoors) in 125 patients, and the number of such patients was markedly decreased to 91 (48.1%) after discharge.

Table 4 The walking level at the time of discharge and the best walking level after discharge

At discharge[1)]	The best walking level after discharge[1)]				
	Level 1	Level 2	Level 3	Level 4	Total
Level 1	76**	0	0	0	76
Level 2	**12***	31	0	0	43
Level 3	**3***	**14***	23	0	40
Level 4	**0**	**0**	**2***	28	30
Total	91	45	25	28	189

* These patients were categorized as the improved walking level after discharge group (31patients)

** These patients were excluded from the analysis because an improvement in the walking ability could not be expected in these patients

1) Category for level of walking

Level 1: They could walk and perform ADL's with or without a cane, indoors and outdoors.

Level 2: They could walk and perform ADL's with or without a cane, indoors only.

Level 3: With human assistance, they could walk and perform ADL's indoors only.

Level 4: They could not walk even with assistance, but could perform ADL's with human assistance.

Among 16 potential prognostic factors, 4 factors had significant influence on the recovery of the pre-fracture walking level at discharge, as shown in the central column of Table 1: age, past history of cerebrovascular disease, presence of preceding dementia, and the place of residence before fracture. Table 5 shows the odds ratios of unsuccessful recovery at discharge calculated for analysis of the 4 prognostic factors. Categories that showed significantly higher odds ratios than one were past history of cerebrovascular disease (odds ratio 3.48), preceding dementia (odds ratio 3.71), and 85 years and older (odds ratio 2.31).

Moreover, when univariate analysis was performed with regard to 20 factors that may influence the recovery of the pre-fracture walking level after discharge, significant differences were observed for the following 5 factors: age, past history of cerebrovascular disease, presence of preceding dementia, place of residence before fracture, and the place of residence after discharge (Table 1). As shown in right column of Table 5, the categories that showed odds ratios significantly higher than one were preceding dementia (odds ratio 3.72), repeated hospitalization after discharge (odds ratio 6.39), and continued hospitalization after discharge (odds ratio 7.42).

Analysis 2: Improvement in the walking level after discharge and influencing factors.

The walking level at discharge was compared with the best walking level after discharge; in addition, factors influencing the improvement of walking ability were clarified. In this analysis, 76 patients whose walking ability was evaluated as level 1 at the time of discharge were excluded, because the improvement in the walk-

Table 5 Odds ratios for each factor influence to unsuccessful recovery walking group were examined using multiple logistic regression analysis

Factor	Category	At the time of discharge				The best walking level after discharge			
		185 patients				170 patients[3]			
		Odds ratio	95% CI[1]		p-value[2]	Odds ratio	95% CI[1]		p-value[2]
			Lower	Upper			Lower	Upper	
Age	<=85 years	1				1			
	>85 years	2.31	1.06	5.19	0.038	1.56	0.64	3.72	0.316
Dementia	Absent	1.00				1			
	Present	3.71	1.18	14.21	0.038	3.72	1.12	13.48	0.035
Cerebrovascular disease	Absent	1				1			
	Present	3.48	1.42	9.19	0.008	2.63	0.98	7.18	0.054
Place of residence before fracture	Own home	1				1			
	Others	1.53	0.58	4.24	0.391	0.36	0.09	1.24	0.118
Place of residence after discharge	Own home					1			
	Repeated hospitalization					6.39	1.64	32.48	0.012
	Hospitalization					7.42	2.28	28.63	0.001

1) 95% confidence interval
2) Odds ratio was examined by chi-square test
3) Those who answered 15 questions with uncertainty were excluded from this analysis

Table 6 Odds ratios for each significant factor influencing the improved walking group after discharge were examined using multiple logistic regression analysis (adjusted age)

Factor	Category	Odds ratio	95% confidence interval		p-value[2]
			Lower	Upper	
Place of residence before fracture	Others	1			
	Own home	2.17	0.6	10.31	0.271
Level of walking at discharge[1]	Level 4	1			
	Level 3	8.21	1.96	56.62	0.01
	Level 2	4.03	0.93	28.81	0.09

1) Category for level of walking
Level 2: They could walk and perform ADL's with or without a cane, indoors only.
Level 3: With human assistance, they could walk and perform ADL's indoors only.
Level 4: They could not walk even with assistance, but could perform ADL's with human assistance.
2) Odds ratio was examined by chi-square test

ing ability could not be expected in these patients. Therefore, analysis 2 was performed in the remaining 113 patients.

The walking level was further improved in 31 patients (27.4%) after discharge (Table 4). As a result of univariate analysis it was demonstrated that the significant factors were the walking level at discharge and the place of residence before fracture (Table 1). As a result of multiple logistic regression analysis, the level 3 walking at discharge alone significantly influenced the improvement in the walking level of patients after discharge (odds ratio 8.21) (Table 6).

Discussion

The present study was a retrospective study on elderly patients with fractures who were surgically treated at a hospital in Fukui Prefecture over a 7-year period. The male-to-female ratio of the 189 patients was 1:3.1, and the frequency ratio of intracapsular fracture to extracapsular fracture was 1:1.9. A national investigation performed in 1991 revealed that the male-to-female ratio was 1:2.5 in fractured Japanese patients[1]. Prefectural studies performed in Tottori (1993)[21] and Niigata Prefectures (1989)[22] revealed that the frequency ratio of intracapsular fracture to extracapsular fracture was 1:2, which was almost identical to that obtained in the present study. The frequency of fractures in the present study was considered almost identical to that reported in other studies in Japan[1,21,22]. Therefore, it was suggested that the findings of the present study did not exhibit any systematic errors.

The findings of the present study were important because it was clarified that the walking level of patients with a minor fracture recovers to the pre-fracture level after discharge. The rate of patients who could recover the pre-fracture walking level was 55.1% at the time of discharge, and the rate of such patients was increased to 64.1% after discharge. In addition, the rate of patients who could not walk was 15.8% at discharge, but the rate of such patients was decreased to 14.8% after discharge. However, Takeshita et al. reported different findings[11]. They reported that the rate of patients who could recover the pre-fracture walking level was 68.8% at discharge, but the rate of such patients was decreased to 56.3% after discharge[11]. They also noted that the rate of patients who could not walk was 11.9% at discharge, but the rate of such patients was increased to 29.9% after discharge. Thus, their findings differed significantly from those of the present study because we evaluated whether patients with fracture could walk outdoors at the time of discharge and thereafter, while Takeshita et al. analyzed whether they could walk with or without a cane[11]. Previous studies frequently used the walking ability with or with-

out a cane as a criterion for the evaluation. However, the inability to walk outdoors is a great functional and social disadvantage for elderly people. Therefore, the findings of the present study may provide important information for establishing a better QOL in elderly patients with fractures.

In the present study, of 125 patients who could walk and performed ADL's with or without cane outdoors before fracture, 72.8% recovered to the pre-fracture walking level after discharge, while 2.4% could not walk. In Western countries, Koval et al. evaluated the walking ability in fracture patients who could walk outdoors before fracture, and reported that 41.3% could recover to the pre-fracture walking level 1–1.6 years after surgery, while 8% could not walk[8]. In addition, Mossey et al. reported that only 21% of such patients could recover the pre-fracture walking ability[23]. When the findings of the present study are compared with those of previous studies, the present findings showed very good outcomes with regard to the ratio of patients who could recover the pre-fracture walking level, and the ratio of patients who could not walk at all after surgery.

In the present study, however, 40% of patients with hip fracture could not recover to the pre-fracture walking level. Therefore, factors that influenced such cases of unsuccessful recovery should be clarified in future studies. Previous studies reported that the following issues were predictive factors of unsuccessful recovery to the pre-fracture walking level after hip fracture: poor pre-fracture walking ability requiring the assistance of a walking apparatus[8,23], the age of 85 years and over[1,5,8], the presence of preceding dementia[17], repeated hospitalization[17], the absence of communication with friends after discharge[17], and intracapsular fracture[8]. In the present study, the presence of preceding dementia, a past history of cerebrovascular diseases, and the age of 85 years and over influenced the unsuccessful recovery of the patients with hip fracture at the time of discharge. Furthermore, the presence of preceding dementia and the residence outside their own home after discharge influenced the final recovery rate of pre-fracture walking level after discharge. Social factors such as communication with friends after discharge and the types of fracture did not significantly influence recovery. These findings supported those of previous studies[1,5,8,17,23]. Moreover, these findings suggested that it is important to provide a more effective postoperative rehabilitation program to patients with such factors rather than to provide the standard postoperative rehabilitation program, and, in addition, to provide a walking rehabilitation program to those who were re-hospitalized or admitted to other health care facilities due to various reasons. In addition, the level of improvement in walking ability after discharge was higher in level 3 patients with lower walking ability at the time of discharge (excluding those who could not walk at all) than in level 2 patients with higher walking ability at the time of discharge. This finding was similar to that reported by Kitamura et al.[12] and Koval et al.[8] Therefore, an effective postoperative rehabilitation program should be actively provided to patients with hip fracture who showed lower walking ability at the time of discharge to avoid disability in walking after discharge.

This retrospective study had some limitations. Findings obtained before fracture and at discharge depended on limited medical records and the memories of patients themselves and their family members. Therefore, these findings were less reliable compared with those obtained by direct interview. Moreover, memory biases depending on the difference in the duration between the discharge from the hospital and the time of investigation or recall biases due to telephone interview might have influenced the findings of the present study. Furthermore, family members replied to the questionnaire instead of the patients themselves in 121 of all cases evaluated in this study. Although a previous study reported that similar findings could be obtained from representative subjects[24], the differences between patients themselves and representative subjects cannot be neglected.

Despite such limitations, the findings of this study on elderly patients with hip fracture provided important information because few previous Japanese studies evaluated whether patients with hip fracture could walk outdoors. In Japan, it is currently recommended to shorten the duration of hospitalization[25]. Therefore, it is important to clarify procedures of applying an appropriate postoperative rehabilitation program to patients with hip fracture depending on their background factors.

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