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Original Paper

Relationship between Discharge Destination and ADL Improvement in Patients with Femoral Neck Fractures: An Analysis Using DPC Data

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Key words: activities of daily living (ADL) improvement, femoral neck fracture, discharge destination, diagnosis procedure combination (DPC) data, rehabilitation

Abstract

In Japan's super-aged society, where individuals aged 65 and above make up about 30% of the population, the management of conditions like femoral neck fracture in the elderly is critical. This study analyzed DPC data from 21 medical institutions in Okayama Prefecture for the fiscal years 2020-2021 to explore the relationship between discharge ADL (Activities of Daily Living) improvement and discharge destination in patients with femoral neck fracture. The study included 593 patients, with 82.1% showing ADL improvement at discharge. Multivariate logistic regression revealed that ADL improvement significantly increased the odds of discharge to home (OR 10.015, 95% CI: 2.239-44.801, p=0.003), whereas other facilities did not show a significant association (OR 1.657, 95% CI: 0.396-6.931, p=0.489). Factors like age, length of hospital stays, and the number of rehabilitation sessions were significantly associated with discharge destination. Specifically, the odds of home discharge decreased with age (85-94 years: OR 0.268, 95% CI: 0.157-0.460, p<0.001) and increased with the number of rehabilitation sessions (≥32 sessions: OR 31.396, 95% CI: 13.366-73.746, p<0.001). These findings underscore the importance of early and intensive rehabilitation in improving ADL and enhancing the likelihood of home discharge for elderly femoral neck fracture patients.

1. Introduction

Japan is a super-aged society, with individuals aged 65 and older comprising about 30% of the total population[1]. As of 2021, 64% of hospitalized patients were aged 75 or older. Additionally[2], a survey on end-of-life care awareness indicates that many people wish to spend their final days at home[3]. However, due to concerns about the burden on family members and anxiety about illness, many elderly individuals opt for hospitalization or admission to care facilities.

To ensure that the elderly can live comfortably in familiar communities, there is a growing need to enhance home healthcare and visiting rehabilitation services, fostering integrated medical and care systems involving local residents[4]. Many elderly patients suffer from chronic conditions such as hypertension, diabetes, angina, and dementia in addition to the primary disease requiring treatment. Acute events like

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femoral fractures or strokes necessitate hospitalization for acute care.

Elderly patients experience rapid declines in ADL (Activities of Daily Living) scores due to prolonged bed rest, making bedside rehabilitation and ADL care crucial. Without appropriate rehabilitation during hospitalization, there is a high likelihood of deteriorating care levels. Particularly, conditions involving physical restraints like femoral fractures or strokes significantly impact prognosis, necessitating appropriate treatment and rehabilitation from early hospitalization stages.

With age-related declines in physical and cognitive functions, elderly patients face challenges in managing complex chronic diseases[4]. Falls in such physical conditions often result in injuries even from low-energy trauma, with femoral fractures being a representative example.

Femoral fractures are primarily classified into neck fractures and trochanteric fractures[5]. Neck fractures are intracapsular, while trochanteric fractures are extracapsular, leading to differences in surgical approaches due to varying hemodynamic and biomechanical factors[5].

In Japan, the annual incidence of femoral neck and trochanteric fractures was 175,700 cases in 2012, with 37,600 cases in men and 138,100 in women, making the incidence in women about 3.7 times higher[5]. Osteoporosis due to decreased bone density, particularly postmenopausal estrogen decline in elderly women, increases the risk of femoral neck fractures[6].

As a general treatment for femoral neck fractures, surgical treatment is chosen in most cases because the outcome of surgical treatment is superior to that of other more conservative treatments[5]. Surgical treatments involve osteosynthesis and hemiarthroplasty[5]. Postoperatively, early ambulation and rehabilitation are crucial to prevent disuse syndrome and promote ADL recovery[7]. However, elderly patients with femoral fractures face several challenges, including high risks of postoperative complications like pneumonia, thrombosis, and infections, necessitating careful management in patients with multiple comorbidities[8]. Additionally, patients with dementia may experience delayed rehabilitation progress, often extending ADL recovery times[9].

Postoperative outcomes in Western countries typically involve discharge home or transfer to rehabilitation facilities within 5-10 days post-surgery[5]. Although the hospitalization period in acute care hospitals in Japan has significantly shortened, it still averages around 20-40 days. Contributing factors include the spacious and step-free nature of Western homes, facilitating the use of walkers and wheelchairs, and well-established home visit systems by physical therapists, occupational therapists, and nurses, ensuring adequate care and rehabilitation at home[10].

However, the most significant factor is the insurance limitations on covered medical periods in Western countries, making long-term hospitalization in acute care hospitals practically impossible[11]. Similarly, Japan's medical insurance payment system restrictions are making long-term hospitalization in acute care hospitals difficult, leading to a functional division between hospitals performing surgery and those providing postoperative rehabilitation.

This system, called DPC/PDPS (Diagnosis Procedure Combination/Per-Diem Payment System), is a form of Japan's medical fee system, and is particularly adopted by hospitals that provide acute care. In this system, patients are classified into specific diagnosis groups based on the diagnosis and procedure, and a comprehensive flat-rate fee is paid per day according to the length of hospitalization. This system aims to shorten the length of hospital stays and promote efficient treatment, so medical institutions need to provide efficient medical care with an awareness of the average length of hospital stays. Therefore, it is important to develop a treatment plan that allows patients to be discharged at the appropriate time, and seamless rehabilitation with affiliated hospitals is necessary.

DPC data is medical fee claim data and is also evaluation data for medical institutions' medical performance and cost management. However, since it does not include individual symptoms of patients, there is a certain limit to analyzing detailed clinical conditions, but it is standardized information that is used to improve the efficiency of the entire medical system and for policy planning.

In this study, we aimed to clarify the relationship between cases of improvement in ADL at the time of

discharge and discharge destination in patients with femoral neck fractures using DPC data.

2. Methods

2.1 Subjects

The subjects of this study were cases with "the primary disease for which the most medical resources were used" coded as [S7200: Femoral Neck Fracture] from the Form 1 (information on patient attributes and disease conditions) DPC data collected from 21 medical institutions in Okayama Prefecture for the fiscal years 2020 and 2021.

2.2 Methods and analysis items

The method and analysis items included "age," "gender," "length of hospital stays," "route of admission (admission from home, transfer from another medical institution, admission from nursing/welfare facilities)," "whether transported by ambulance" (hereinafter referred to as ambulance admission), "criteria for determining the independence level of daily living for elderly with dementia" (hereinafter referred to as dementia), "ADL score at admission," "ADL score at discharge." Additionally, from the F-file (detailed information on procedures), we extracted [H002 Orthopedic Rehabilitation Fee], [K081 Artificial Femoral Head Insertion (hip)], [K073 Open Reduction and Internal Fixation of Intra-articular Fractures], and [K046 Open Reduction and Internal Fixation of Fractures]. The ADL scores at admission and discharge were converted to the Barthel Index (Table 1), defining [Total ADL Score at Admission] - [Total ADL Score at Discharge] ≤ 0 as "cases with improved ADL at discharge," and the discharge destination as "home," "medical facility," or "other facility."

2.3 Statistical analysis

To examine the relationship between "improved ADL at discharge" cases and "discharge destination," we used a logistic regression model to calculate odds ratios and their 95% confidence intervals.

For statistical analysis, the "ADL score (Barthel Index)" was classified into four groups: 85 points or more (independent), 60 to less than 85 points (partial assistance), 40 to less than 60 points (almost full assistance), and less than 40 points (full assistance). "Age" was classified into four groups (65-74 years, 75-84 years, 85-94 years, 95 years or older). "Dementia" was classified into two groups (none/Rank I, II to IV/M). "Length of Hospital Stays" was classified into four groups (14 days or less, 15-30 days, 31-60 days, 61 days or more). "Day of Rehabilitation Initiation" was classified into three groups (up to 2 days, 3-6 days, 7 days or more), and "Number of Rehabilitation Sessions" was classified into three groups (up to 12 sessions, 13-31 sessions, 32 sessions or more). The classifications for "Day of Rehabilitation Initiation" and "Number of Rehabilitation Sessions" were based on quartiles (less than the first quartile, first to less than the third quartile, and third quartile or more). All statistical analyses were conducted using Stata software/IC14.2.

3. Results

Figure 1 shows the number of patients analyzed in this study. Excluding patients such as those who died during hospitalization, the number of target patients was 593. Among them, the number of "cases with unknown items," excluded due to any of the 10 ADL score items at admission or discharge being input as an unknown value "9," was 230.

Table 2 shows the ADL scores at discharge and the background (analysis items) of femoral neck fracture cases (target cases). Among the 593 target cases, the number of cases with improved ADL at discharge was 487 (82.1%). The average age was 84.19 years, 84.07 years for the improved ADL group, and 84.72 years for the non-improved group. In the age categories, the most common was 85-94 years with 268 cases (45.2%), followed by 75-84 years with 185 cases (31.2%). By gender, there were 133 males (22.4%) and 460 females (77.6%). The average length of hospital stays was 32.86 days, with the improved ADL group averaging 34.98 days, and the non-improved group averaging 23.16 days. In other category-specific items, for "Length of

Table 1 Admission ADL input values and Barthel Index (BI) scores in Form 1

Category	Form 1 Value*	BI Score (points)	Observation
Feeding	2	10	Independent: *Able to consume food placed within reach from a tray or table without assistance, may use assistive devices if necessary, and completes meals in appropriate time*
	1	5	Partial assistance: *Requires assistance for activities like cutting food*
	0	0	Total assistance: *Fully dependent*
Transfers bed-to-chair-and-back	3	15	Independent: *Able to approach the bed safely with a wheelchair, apply brakes, raise footrests, transfer to bed, lie down, get up, position the wheelchair appropriately, and sit independently*
	2	10	Partial assistance: *Requires partial assistance or supervision at some stage*
	1	5	Seat maintenance: *Can sit but requires full assistance for transfers*
	0	0	Total assistance: *Fully dependent*
Grooming	1	5	Independent: (*washing face, brushing teeth, grooming hair, shaving*)
	0	0	Total assistance: *Requires partial or full assistance*
Toilet use	2	10	Independent: *Manages clothing and cleaning up, including portable commode care*
	1	5	Partial assistance: *Requires partial assistance, such as support for using toilet paper*
	0	0	Total assistance: *Fully dependent*
Bathing	1	5	Independent: (*using bathtub or shower*)
	0	0	Total assistance: *Fully dependent*
Mobility on level surfaces	3	15	Independent: *Can Walk more than 45 meters, use of assistive devices is allowed except for wheelchair and walker*
	2	10	Partial assistance: *Can walk 45 meters on a flat surface with assistance or supervision*
	1	5	Wheelchair: *Unable to walk but can operate a wheelchair independently for at least 45 meters*
	0	0	Total assistance: *Fully dependent*
Stair negotiation	2	10	Independent: *Use of handrails or cane is allowed*
	1	5	Partial assistance: *Requires assistance or supervision*
	0	0	Total assistance: *Fully dependent*
Dressing	2	10	Independent: *Including wearing shoes, handling zippers, and orthotic devices*
	1	5	Partial assistance: *Requires partial assistance but can manage at least half independently within appropriate time*
	0	0	Total assistance: *Fully dependent*
Bowel control	2	10	Independent: *No incontinence, able to handle enemas and suppositories*
	1	5	Partial assistance: *Occasional incontinence, requires assistance with enemas and suppositories*
	0	0	Total assistance: *Fully dependent*
Bladder control	2	10	Independent: *No incontinence*
	1	5	Partial assistance: *Occasional incontinence, may require assistance with urinals*
	0	0	Total assistance: *Fully dependent*

**Enter "9" if unknown source:*

2020 DPC Impact Evaluation Survey Implementation Guide, p. 76,
Industrial University of Occupational and Environmental Health: Barthel Index
(http://www.uoeh-u.ac.jp/kouza/rihabiri/femur/download/files/fdecisiontable.pdf,)
partially modified

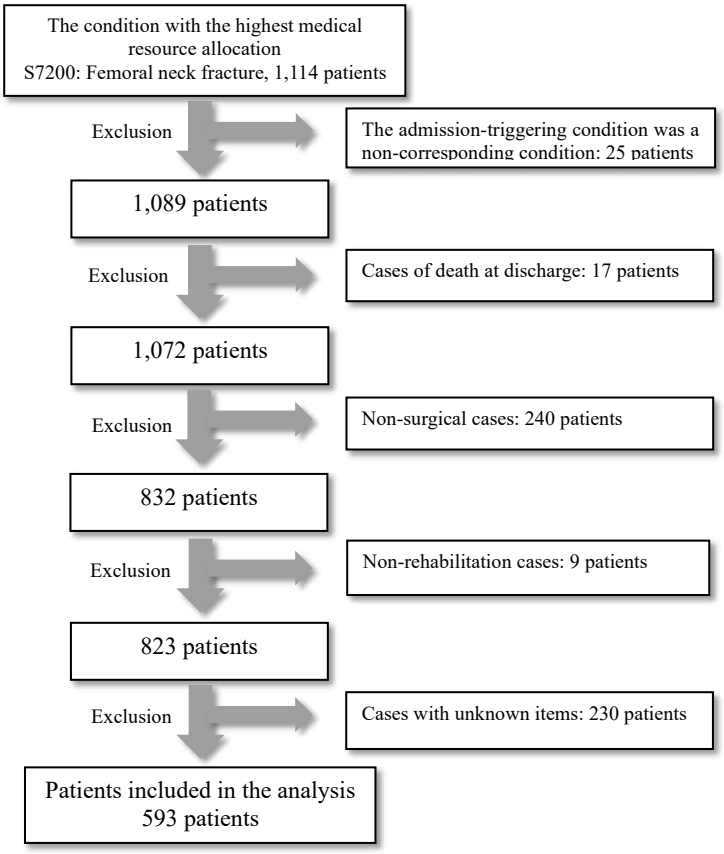

Figure 1 Patients analyzed

Hospital Stays," 15-30 days was the most common with 321 cases (54.1%), for "Start Day of Rehabilitation" (from the day of admission), 3-6 days was the most common with 310 cases (52.3%), and for "Number of Rehabilitation Sessions," 13-31 sessions was the most common with 317 cases (53.5%).

Table 3 shows the BI scores and detailed items of ADL at admission and discharge for femoral neck fracture cases (target cases). The average BI score at admission was 21.72 points (standard deviation 28.73), and the average BI score at discharge was 49.20 points (standard deviation 31.66). For the improved ADL group, the average BI score was 53.84 points (standard deviation 31.03), while for the non-improved group it was 27.88 points (standard deviation 25.08). At admission, the most common BI score was below 40 points with 473 cases (79.8%), and for detailed items, the most common fully assisted categories were: "Grooming" with 501 cases (84.5%), "Bathing" with 544 cases (91.7%), "Mobility on Level Surfaces" with 496 cases (83.6%), and "Stair Negotiation" with 520 cases (87.7%). For the improved ADL group at discharge, the most common BI score was below 40 points with 165 cases (27.8%), and for detailed items, the most common fully assisted categories were: "Grooming" with 277 cases (46.7%), "Bathing" with 411 cases (69.3%), "Mobility on Level Surfaces" with 169 cases (28.5%), and "Stair Negotiation" with 251 cases (42.3%).

Table 4 shows the results of univariable and multivariable analysis adjusting for age and gender (Model 1) and analysis items (Model 2) on the relationship between cases with improved ADL at discharge and discharge destinations for femoral neck fracture cases (target cases). In Model 1, the odds ratio for home discharge in cases with improved ADL was 8.000 (95% CI: 3.385-18.908, $p<0.001$), and the odds ratio for other facilities was 2.586 (95% CI: 1.307-5.118, $p=0.006$). In Model 2, the odds ratio for home discharge in cases with improved ADL was 10.015 (95% CI: 2.239-44.801, $p=0.003$), and the odds ratio for other facilities was 1.657 (95% CI: 0.396-6.931, $p=0.489$).

Table 5 shows the relationship between home discharge cases and their backgrounds for femoral neck fracture cases (target cases). The odds ratio for the age category 85-94 years was 0.268 (95% CI: 0.157-0.460,

Table 2 ADL improvement at discharge and patient background in cases of femoral neck fracture

	ADL improvement					
	None		*Present*		*Total*	
Target cases	106	17.9%	487	82.1%	593	100%
Age (average)	(84.72 years)		(84.07 years)		(84.19 years)	
65-74 years	16	15.1%	72	14.8%	88	14.8%
75-84 years	30	28.3%	155	31.8%	185	31.2%
85-94 years	50	47.2%	218	44.8%	268	45.2%
95 years ~	10	9.4%	42	8.6%	52	8.8%
Gender						
Male	34	32.1%	99	20.3%	133	22.4%
Female	72	67.9%	388	79.7%	460	77.6%
Length of stays (average)	(23.16 days)		(34.98 days)		(32.86 days)	
-14 days	23	21.7%	28	5.7%	51	8.6%
15-30 days	66	62.3%	255	52.4%	321	54.1%
31-60 days	13	12.3%	133	27.3%	146	24.6%
61 days-	4	3.8%	71	14.6%	75	12.6%
Admission route						
From home	72	67.9%	361	74.1%	433	73.0%
Transfer from another medical facility	21	19.8%	44	9.0%	65	11.0%
Admission from care/welfare facility	13	12.3%	82	16.8%	95	16.0%
Ambulance transport						
None	40	37.7%	197	40.5%	237	40.0%
Present	66	62.3%	290	59.5%	356	60.0%
Dementia						
0 - I	48	45.3%	256	52.6%	304	51.3%
II - V	58	54.7%	231	47.4%	289	48.7%
Surgery type						
Internal fixation surgery (hip)	16	15.1%	62	12.7%	78	13.2%
Internal fixation surgery (femur)	14	13.2%	92	18.9%	106	17.9%
Hemiarthroplasty (hip)	76	71.7%	333	68.4%	409	69.0%
Start of rehabilitation						
-2days	50	47.2%	125	25.7%	175	29.5%
3-6days	47	44.3%	263	54.0%	310	52.3%
7days-	9	8.5%	99	20.3%	108	18.2%
Number of rehabilitation sessions (average)	(15.69 sessions)		(25.89 sessions)		(24.07 sessions)	
-12 sessions	47	44.3%	90	18.5%	137	23.1%
13-31 sessions	49	46.2%	268	55.0%	317	53.5%
32 sessions-	10	9.4%	129	26.5%	139	23.4%
Discharge destination						
Home	6	5.7%	142	29.2%	148	25.0%
Medical facility	89	84.0%	257	52.8%	346	58.3%
Other facilities	11	10.4%	88	18.1%	99	16.7%

Table 3 BI and detailed items of ADL at admission and discharge in cases of femoral neck fracture

		Admission ADL		Discharge ADL		ADL improvement			
						None		*Present*	
		593	100%	593	100%	106	17.9%	487	82.1%
BI (Total score)									
	85 points or above (independent)	53	8.9%	122	20.6%	4	3.8%	118	24.2%
	60-85 points (partial assistance)	16	2.7%	123	20.7%	12	11.3%	111	22.8%
	40-60 points (mostly assistance)	51	8.6%	112	18.9%	19	17.9%	93	19.1%
	Below 40 points (total assistance)	473	79.8%	236	39.8%	71	67.0%	165	33.9%
	Average score		21.72		49.20		27.88		53.84
	Standard deviation		28.73		31.66		25.08		31.03
Feeding	*Independent*	157	26.5%	301	50.8%	27	25.5%	274	56.3%
	Partial assistance	307	51.8%	240	40.5%	59	55.7%	181	37.2%
	Total assistance	129	21.8%	52	8.8%	20	18.9%	32	6.6%
Transfers bed-to-chair-and-back	*Independent*	54	9.1%	163	27.5%	5	4.7%	158	32.4%
	Partial assistance	66	11.1%	291	49.1%	46	43.4%	245	50.3%
	Seat maintenance	61	10.3%	71	12.0%	32	30.2%	39	8.0%
	Total assistance	412	69.5%	68	11.5%	23	21.7%	45	9.2%
Grooming	*Independent*	92	15.5%	224	37.8%	14	13.2%	210	43.1%
	Total assistance	501	84.5%	369	62.2%	92	86.8%	277	56.9%
Toilet use	*Independent*	66	11.1%	182	30.7%	10	9.4%	172	35.3%
	Partial assistance	72	12.1%	223	37.6%	32	30.2%	191	39.2%
	Total assistance	455	76.7%	188	31.7%	64	60.4%	124	25.5%
Bathing	*Independent*	49	8.3%	79	13.3%	3	2.8%	76	15.6%
	Total assistance	544	91.7%	514	86.7%	103	97.2%	411	84.4%
Mobility on level surfaces	*Independent*	51	8.6%	128	21.6%	4	3.8%	124	25.5%
	Partial assistance	32	5.4%	170	28.7%	18	17.0%	152	31.2%
	Wheelchair	14	2.4%	52	8.8%	10	9.4%	42	8.6%
	Total assistance	496	83.6%	243	41.0%	74	69.8%	169	34.7%
Stair negotiation	*Independent*	47	7.9%	65	11.0%	0	0.0%	65	13.3%
	Partial assistance	26	4.4%	184	31.0%	13	12.3%	171	35.1%
	Total assistance	520	87.7%	344	58.0%	93	87.7%	251	51.5%
Dressing	*Independent*	57	9.6%	130	21.9%	8	7.5%	122	25.1%
	Partial assistance	86	14.5%	261	44.0%	37	34.9%	224	46.0%
	Total assistance	450	75.9%	202	34.1%	61	57.5%	141	29.0%
Bowel control	*Independent*	135	22.8%	264	44.5%	26	24.5%	238	48.9%
	Partial assistance	85	14.3%	147	24.8%	22	20.8%	125	25.7%
	Total assistance	373	62.9%	182	30.7%	58	54.7%	124	25.5%
Bladder control	*Independent*	131	22.1%	264	44.5%	26	24.5%	238	48.9%
	Partial assistance	87	14.7%	147	24.8%	20	18.9%	127	26.1%
	Total assistance	375	63.2%	182	30.7%	60	56.6%	122	25.1%

Table 4　Relationship between discharge ADL improvement cases and discharge destination in cases of femoral neck fracture

	ADL improvement cases		Model 1					Model 2				
			OR	95%CI			*p*	OR	95%CI			p
Discharge destination	487											
Home	142	29.2%	8.000	3.385	-	18.908	0.000	10.015	2.239	-	44.801	0.003
Medical facility	257	52.8%	Reference									
Other facility	88	18.1%	2.586	1.307	-	5.118	0.006	1.657	0.396	-	6.931	0.489

Model 1: *Adjusted for gender and age*

Model 2: *Adjusted for gender, age, length of hospital stays, route of admission, dementia, type of surgery, day rehabilitation started, number of rehabilitation sessions, and admission ADL (feeding, transfers bed-to-chair-and-back, grooming, toilet use, bathing, mobility on level surfaces, stair negotiation, dressing, bowel control, bladder control)*

Table 5 Relationship between home discharge cases and their background in femoral neck fracture cases

	OR	95%CI			p
Age (average)					
65-74 years	Reference				
75-84 years	0.711	0.421	-	1.200	0.201
85-94 years	0.268	0.157	-	0.460	0.000
95 years ~	0.302	0.131	-	0.697	0.005
Gender					
Male	0.657	0.405	-	1.065	0.088
Female	Reference				
Length of stays (average)					
-14 days	Reference				
15-30 days	1.652	0.554	-	4.927	0.368
31-60 days	10.888	3.640	-	32.565	0.000
61 days-	18.233	5.795	-	57.367	0.000
Admission route					
From home	Reference				
Transfer from another medical facility	0.150	0.053	-	0.425	0.000
Admission from care/welfare facility	0.148	0.058	-	0.376	0.000
Ambulance transport					
None	Reference				
Present	0.733	0.498	-	1.081	0.117
Dementia					
0 - I	Reference				
II - V	0.811	0.540	-	1.218	0.313
Surgery type					
Internal fixation surgery (hip)	1.302	0.750	-	2.259	0.349
Internal fixation surgery (femur)	1.299	0.794	-	2.126	0.298
Hemiarthroplasty (hip)	Reference				
Start of rehabilitation					
-2days	Reference				
3-6days	2.237	1.383	-	3.617	0.001
7days-	2.060	1.139	-	3.723	0.017
Number of rehabilitation sessions (average)					
-12 sessions	Reference				
13-31 sessions	4.060	1.783	-	9.242	0.001
32 sessions-	31.396	13.366	-	73.746	0.000
Discharge BI					
85 points or above (independent)	Reference				
60-85 points (partial assistance)	0.189	0.107	-	0.334	0.000
40-60 points (mostly assistance)	0.116	0.059	-	0.226	0.000
Below 40 points (total assistance)	0.089	0.050	-	0.157	0.000

p<0.001), the odds ratio for a hospital stays of 31-60 days was 10.888 (95% CI: 3.640-32.565, p<0.001), the odds ratio for transfer from another medical facility was 0.150 (95% CI: 0.053-0.425, p<0.001), and the odds ratio for 32 or more rehabilitation sessions was 31.396 (95% CI: 13.366-73.746, p<0.001). Additionally, for the "BI score at discharge," all categories had p<0.001.

4. Discussion

4.1 Summary of results

In this study, we examined the relationship between cases of improved ADL at discharge and discharge destinations in patients with [S7200: Femoral Neck Fracture] collected from 21 medical institutions in Okayama Prefecture using 2020 and 2021 DPC data, specifically Form 1 data (patient attributes and conditions) and F file data (detailed information on medical procedures).

The results showed that among the 593 cases of femoral neck fractures, 487 cases (82.1%) had improved ADL at discharge, and 148 cases (25.0%) were discharged to home (Table 2). A quantitative response relationship was particularly demonstrated between cases with improved ADL at discharge and their discharge destinations (Table 4). This suggests that improvement in ADL by the time of discharge may influence the discharge destination for patients with femoral neck fractures.

4.2 ADL at discharge in femoral neck fracture patients

The ADL improvement rate at discharge in this study was 82.1%. Additionally, the mean Barthel Index (BI) score of cases with ADL improvement at discharge was 53.84 (standard deviation 31.03), which increased compared to the mean BI score of 21.72 (standard deviation 28.73) at admission.

Femoral neck fractures are one of the serious injuries frequently occurring in the elderly, and the improvement in ADL after injury is directly related to the patient's quality of life. According to previous studies, the quality and duration of rehabilitation significantly impact ADL improvement[12]. Furthermore, early rehabilitation intervention has been reported to contribute to ADL improvement[13].

The quality of rehabilitation also greatly influences ADL improvement. In the study by Nordström et al. (2018)[14], it was reported that patients who received specialized rehabilitation programs showed significant improvement in their ADL scores, particularly when comprehensive rehabilitation involving multidisciplinary collaboration was implemented. Conversely, patients with comorbidities such as diabetes, heart disease, and respiratory diseases tend to have slower rehabilitation progress[15]. Nutritional status is also an important factor, and it has been shown that receiving nutritional support enhances the effectiveness of rehabilitation. Regarding ADL improvement in patients with femoral neck fractures, Tokunaga et al. reported that an increase of one training unit leads to a 1.4 to 2-point higher motor Functional Independence Measure (FIM) score at discharge[16].

In this study, the group with ADL improvement at discharge had more cases with an earlier "Rehabilitation Start Date" and a higher number of rehabilitation sessions than the group without ADL improvement, supporting previous studies that showed rehabilitation start date and frequency influence ADL score improvement. Although cognitive impairment has been reported to affect ADL decline[17], no significant difference in "Dementia" was observed in this study. Therefore, multiple factors, such as early rehabilitation intervention, rehabilitation quality, and patients' health status, are associated with the improvement in ADL scores at discharge in patients with femoral neck fractures.

4.3 Discharge destinations of femoral neck fracture patients

Choosing a discharge destination plays an important role in the patient's recovery process. In this study, "Home" was chosen for 148 patients (25.0%), "Medical Facility" for 346 patients (58.3%), and "Other Facilities" for 99 patients (16.7%). As age increased, the odds ratio of "Home" decreased, and for those aged 85 years or older, it was 0.268 (95% CI: 0.157-0.460, p<0.001), showing a tendency for discharge to "Medical Facilities" or "Other Facilities" to increase (Table 5).

Moreover, the odds ratio of "Home" increased with a higher number of "Rehabilitation Sessions", being 4.060 (95% CI: 1.783-9.242, $p<0.05$) for 13-31 sessions and 31.396 (95% CI: 13.366-73.746, $p<0.001$) for 32 or more sessions, indicating a significant difference between "Home" discharge and "Rehabilitation Sessions". Factors related to returning home (home discharge) have been reported to include ADL independence and the presence of cohabiting family members[18].

Discharge to home allows patients to recover in a familiar environment with the support of family and friends, providing psychological stability. Additionally, it has been reported that high ADL prior to injury, acquisition of walking ability at discharge, and good excretion control increase the likelihood of home discharge[19]. Particularly, high scores in FIM items such as self-care, transfers, mobility, and excretion control at discharge are cited as factors. However, living at home requires adequate caregiving support and rehabilitation services, and a lack of support at home poses a risk of delayed recovery[20].

4.4 Relationship between ADL at discharge and discharge destinations in femoral neck fracture patients

Previous studies on the relationship between ADL at discharge and discharge destinations for patients with femoral neck fractures have indicated the following points. Patients with high ADL scores are suited for discharge to home, and their quality of life improves with family or home care support[21]. Patients with moderate ADL scores benefit from discharge to rehabilitation facilities, where professional rehabilitation can be expected to improve ADL[22]. Patients with low ADL scores are safely discharged to care facilities that provide 24-hour care, although significant ADL improvement might be difficult[23].

In this study, we analyzed the relationship between ADL improvement at discharge and discharge destinations and found that the odds ratio for "home" discharge was significantly higher in the group with ADL improvement at discharge. Additionally, significant differences were observed between cases discharged home with BI scores of 85 or higher and those with scores below 85 at discharge. These results indicate that cases with independent self-care support the findings of previous studies. Furthermore, significant differences were observed between "home from home" admission routes and other groups. This result also suggests the influence of independent ADL before injury and cohabitation with family. Therefore, these research findings indicate that ADL improvement promotes home discharge in patients.

4.5 Characteristics of this study (using DPC data)

This study analyzed extracted input items from DPC data, Format 1 items, and F-file data, where the results were significantly influenced by the input accuracy. Therefore, the number of "cases with unknown items" excluded due to unknown values "9" being entered was 230, which cannot be evaluated. However, it is considered significant that clinical evaluations with high accuracy were demonstrated from the data entered in DPC data Format 1 items.

Recently, many clinical evaluation papers using DPC data have been published. In studies like this one, using femoral neck fracture patients as models, reports have been made by hospital bed scale, facility function[24], and nurse staffing level[25]. The characteristics of DPC data include detailed information on the patient's diagnosis, treatment, surgery, medication, and rehabilitation, allowing for comprehensive understanding and evaluation of treatment outcomes[26]. Additionally, since DPC data is standardized nationwide, comparative analysis between regions and facilities is possible, contributing to the evaluation of treatment effects and the improvement of medical service quality[27].

4.6 Limitations of this study

This study has several limitations. Firstly, since the target patients were limited to medical institutions in Okayama Prefecture, caution is needed in generalizing the results. In addition, due to the characteristics of DPC data, it was difficult to grasp detailed clinical information about patients, such as their physical and treatment environment, including the contents of their rehabilitation programs, and the specific support provided after discharge.

Moreover, it is impossible to eliminate the impact of ADL score input errors and unknown values, necessitating caution in interpreting the results.

5. Conclusion

This study analyzed the relationship between ADL improvement at discharge and discharge destinations for patients with femoral neck fractures using DPC data. ADL improvement at discharge and discharge destinations were related. Factors related to home discharge included ADL independence, the number of rehabilitation sessions, and admission from home.

Due to the characteristics of DPC data, it was challenging to grasp detailed treatment content and patients' living environments, and it is impossible to eliminate the impact of ADL score input errors and unknown values, necessitating caution in interpreting the results.

Ethical considerations

In this study, we used only existing data that did not include any new information, and individual data use agreements were made with the data holders (each medical institution) through a "memorandum of understanding on data handling" and "consent form" for the use of anonymized processed information. This study was approved by the Ethics Committee of Kawasaki University of Medical Welfare (approval number 21-108).

Conflict of interest

The authors declare no conflict of interest.

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