

Original Article

Influence of patients' walking ability at one-week post-proximal femur fracture surgery on the choice of discharge destination in Japan

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Abstract. [Purpose] With the innovation of healthcare delivery systems, a need for early determination of patients' discharge outcomes arises after proximal femur fracture surgery, to reduce the burden on healthcare infrastructure. Several studies have examined the extent of walking ability early in the postoperative period to predict the outcome destination. In this study, as an additional validation of these studies, we examined the effect of walking ability on the hospital discharge prognosis of patients in the first week after proximal femur fracture surgery in Japan. [Participants and Methods] Medical records of 228 patients with proximal femur fractures, aged ≥ 75 years old, admitted between April 2015 and March 2019, were retrospectively analyzed. The objective variable was discharge destination. The main evaluation factor was walking ability one-week post-surgery. [Results] Good walking ability and the company of a relative living together one week post-surgery were significant determining factors of discharge destination. [Conclusion] The ability to walk and the presence of a co-resident one week after surgery increased the likelihood of proximal femur fracture patients to be discharged directly to home. Our findings may help rehabilitation professionals make better decisions regarding discharge destination.

Key words: Proximal femur fracture, Discharge destination, Walking ability

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INTRODUCTION

Hip fractures are one of the most common types of fractures in elderly people and are associated with decreased bone density. It is estimated that by 2050, 4.5 million people will suffer from hip fractures worldwide¹⁾. Proximal femur fractures are a major type of fracture and are associated with increased medical costs and decreased quality of life¹⁾. Perioperative care for patients with proximal femur fractures has shown improvement worldwide, and early rehabilitation has been actively introduced to minimize postoperative decline in physical function²⁾. Functional differentiation in healthcare systems allows medical institutions to provide efficient, high-quality care by specializing in a particular disease or stage. In acute care, the introduction of clinical pathways as a part of discharge support is becoming popular, and cooperation with regional medical centers enables hospitals to rapidly identify the most suitable discharge destination for patients.

Japan has an established long-term care insurance system that allows elderly people to receive appropriate support in their daily lives according to their level of independence and physical and mental functions. In acute care, a support system called the "community comprehensive care system", supported by the long-term care insurance system, facilitates community support projects and networks to ensure that elderly people transition smoothly from acute care back into society.

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Thus, in the acute phase of medical care, early independence in performing activities of daily living is promoted throughout the perioperative period. After discharge from the hospital, an environment where patients receive continuous home-based support is considered more favorable.

However, the rate of patients returning home from acute care hospitals after proximal femur fracture surgery has been declining each year, and most patients are transferred to rehabilitation facilities or nursing homes^{3, 4}. As the need for home-based medical and nursing care increases, the socioeconomic burden on patients also increases, leading to public health problems, as such services are frequently not covered by insurance. Therefore, postoperative patients with proximal femur fractures in acute care settings require prompt and accurate decisions to be made about their discharge destinations.

Salar et al. examined factors related to postoperative patients' return to home with proximal femur fractures from acute care hospitals and reported that good mobility before the injury and the presence of a relative living together at the time of discharge had a significant impact on the likelihood of returning home soon after surgery⁵. A patient's preinjury physical function and whether they live with a relative are important factors in determining their discharge destination following acute care for proximal femur fractures. In some areas of the United Kingdom, efforts are being made to package discharge support after classifying patients according to the severity of their injuries based on their pre-injury mobility.

Approximately 20% of patients with proximal femur fractures develop complications after hospitalization, with postoperative delirium and postoperative pneumonia being reported as factors that strongly influence the chances of prolonged hospitalization and mortality after 30 days^{6, 7}. Therefore, it is necessary to consider patients' physical functions when determining their discharge destination. Suzuki et al. investigated the relationship between postoperative physical function and outcome in patients with proximal femur fractures and reported that the group of patients who were discharged directly from the acute care hospital to their homes had significantly higher ambulation ability and Barthel Index (BI) scores at the time of discharge compared with the group of patients who were discharged to a rehabilitation facility⁴. BI is a scale used to measure a person's mobility and ability to perform activities of daily living independently; higher BI scores indicate a greater ability to function independently. Evaluation of different postoperative functions at new time points is necessary. Early postoperative physical function is a valuable determinant of patient discharge, this study aimed to establish a clinical index to support discharge planning by examining the influence of walking ability one week after surgery on the discharge outcome of patients with proximal femur fractures.

PARTICIPANTS AND METHODS

Patients above the age of 75 years who were admitted to our hospital between April 2015 and March 2019 and diagnosed with a proximal femur fracture were included in this study. The inclusion criteria included those living at home at the time of injury and those prescribed physical therapy after surgery. The exclusion criteria included patients who died during hospitalization, those who required conservative therapy or postoperative release after injury, those transferred to another hospital due to complications, and those with incomplete medical records.

Information was collected retrospectively from the patients' medical records. Participants' age, gender, and body mass index at admission, as well as their walking ability before the injury, and co-resident status were recorded. Previous dementia, postoperative pneumonia, and postoperative delirium diagnoses were also identified. In addition, the type of fracture (femoral neck fracture or femoral diaphyseal fracture) and surgical procedure (bipolar hip replacement, total hip arthroplasty, or open reduction internal fixation) were noted.

The following data were also collected: preoperative waiting days, postoperative hospitalization days, walking ability one week after surgery, BI at discharge, and discharge destination (home or rehabilitation facilities).

Participants in this study were assigned to the 'home' group if they were discharged directly from the acute care ward to their home; otherwise, they were assigned to the 'transfer' group. This study defined the transfer group as those transferred to a rehabilitation facility or admitted to a nursing home. Histories of dementia were confirmed from the patients' medical records. Postoperative delirium was considered positive if the patient heard strange voices, showed nocturnal elevation, self-disconnected venous or urinary catheters, or appeared disorientated within 48 hours after surgery. Medical records confirmed the presence or absence of co-residents in the same household. Finally, walking ability one week after surgery was judged according to the Functional Ambulation Categories (FAC); a score of three, ambulation dependent on supervised walking, or higher was considered "good", and a score of two, ambulation dependent on physical assistance, or lower was considered "poor".

Participants in the home and transfer groups were compared. The Shapiro–Wilk test was used to confirm normality, the t-test was used to confirm normality of continuous variables, and the Wilcoxon rank-sum test was used to confirm non-normality. For categorical variables, the χ^2 test was performed.

We defined potential confounders that could intervene in the causal relationship between walking ability and postoperative outcome at one week. The selected confounding variables were age, fracture morphology, dementia, postoperative pneumonia, postoperative delirium, and preoperative walking ability, which have been shown by previous studies to affect postoperative outcomes^{4, 6, 7}. The relationship between walking ability one week postoperatively and the defined confounders was tested by comparing the groups to derive a propensity score; nominal logistic regression analysis using the forced input method was performed with the dependent variable being walking ability one week postoperatively and the independent variable being

the defined confounders. To determine the diagnostic accuracy of the defined confounders in predicting walking ability, the area under the curve (AUC) was calculated from the receiver operating characteristic (ROC) curve along with the propensity score.

Nominal logistic regression analysis using the propensity score direct correction method was performed to examine whether walking ability during the first week after surgery affected the choice of discharge destination. The dependent variable was the discharge destination, the independent variable was walking ability one week postoperatively, and the covariate was the presence or absence of a relative living together. The other variables were the propensity score and confounders (age, type of fracture, dementia, postoperative pneumonia, postoperative delirium, and walking ability before injury). Finally, odds ratios (ORs) for each item were calculated to test the influence of the ability to walk one week after surgery and the presence of a co-resident. JMP® ver11.4 (SAS Institute Inc., Cary, NC, USA) was used as the analysis software, and the statistical significance level was set at 5% or less for all items.

The ethics committee of our institution approved this study, which conformed with the guidelines of the Declaration of Helsinki. All participants in this study gave their informed consent to undergo the procedures. Our hospital implemented an opt-out system to protect the interests of patients when obtaining informed consent for the retrospective study.

RESULTS

The results of the comparison between the two groups are shown in Table 1. In this study, we adjusted for confounding factors to examine the effect of walking ability one week postoperatively on determining the discharge outcome. The results of the analysis are shown in Table 2. In the nominal logistic regression analysis to test the significance of the model itself, the χ^2 test revealed a $p < 0.01$, and the ROC curve showed an AUC of 0.71, indicating a moderate estimation ability. Finally, the results of the adjusted nominal logistic regression analysis using the propensity score direct correction method showed that walking ability one week postoperatively and the presence of a co-resident were associated with a significantly increased likelihood of a patient being discharged home, with ORs of 1.9 and 4.6, respectively (Table 3).

DISCUSSION

This study showed that walking ability in patients with proximal femur fracture one week postoperatively significantly affected the determination of the discharge destination. A proximal femur fracture is one of the most common fractures in older people, and the weakening of physical function due to surgical treatment and perioperative complications should be

Table 1. Comparison between groups in the discharge destination

	Home group (n=110)	Hospital transfer group (n=118)
Characteristics		
Age (years)	86.2 ± 6.1	88.0 ± 6.7*
Gender (female: %)	86 (78.1%)	86 (72.8%)
Body mass index (kg/m ²)	20.1 ± 3.5	20.4 ± 3.7
Walking ability before injury (independence: %)	99 (90.0%)	95 (80.5%)*
Co-residents (Yes: %)	97 (88.1%)	82 (69.4%)**
Medical history Complication		
Dementia (Yes: %)	22 (20.0%)	36 (30.5%)
Postoperative pneumonia (Yes: %)	2 (1.8%)	4 (3.3%)
Postoperative delirium (Yes: %)	16 (14.5%)	19 (16.1%)
Progress Information		
Type of fracture (femoral neck fracture: %)	65 (59.0%)	64 (54.2)
Surgical procedure (BHP/THA/ORIF: %)	55 (50%)/0 (0%)/55 (50%)	53 (44.9%)/1 (0.4%)/64 (52.1%)
Preoperative waiting days	2.1 ± 1.9	2.1 ± 1.9
Postoperative hospitalization days	40.0 ± 16.6	39.7 ± 17.7
Walking ability one week after surgery (FAC3≤: %)	49 (44.5%)	34 (28.8%)**
Barthel Index at discharge	75.6 ± 22.7	58.0 ± 24.6**

t-test, Wilcoxon signed-rank test * $p < 0.05$, ** $p < 0.01$.

Categorical data are presented as number of cases and frequency in percentage (%); or, for data with continuous distribution, as mean ± standard deviation.

BHP: bipolar hip replacement; THA: total hip arthroplasty; ORIF: open reduction internal fixation; FAC: functional ambulation categories.

Table 2. Patient characteristics grouped according to their walking ability one week after surgery

	Walking ability (FAC3≤) (n=83)	Walking ability (FAC≤2) (n=145)
Characteristics		
Age (years)	86.1 ± 6.9	87.7 ± 6.2
Gender (female: %)	58 (69.8%)	114 (78.6%)
Body mass index (kg/m ²)	21.0 ± 3.4	19.8 ± 3.6**
Walking ability before injury (independence: %)	79 (95.1%)	115 (79.3%)**
Co-residents (Yes: %)	58 (72.5%)	117 (81.8%)
Discharge (home: %)	49 (59.0%)	61 (42.0%)**
Medical history Complication		
Dementia (Yes: %)	15 (18.0%)	43 (29.6%)
Postoperative pneumonia (Yes: %)	1 (1.2%)	5 (3.5%)
Postoperative delirium (Yes: %)	10 (12.0%)	25 (17.2%)
Progress information		
Type of fracture (femoral neck fracture: %)	61 (73.4%)	68 (46.9)**
Surgical procedure (BHP/THA/ORIF: %)	54 (65.0%)/1 (1.2%)/28 (33.7%)	54 (37.2%)/0 (0%)/91 (62.7%)
Preoperative waiting days	2.0 ± 1.8	2.2 ± 2.0
Postoperative hospitalization days	36.8 ± 15.4	41.6 ± 18.0**
Barthel Index at discharge	78.1 ± 18.2	59.9 ± 26.4**

t-test, Wilcoxon signed-rank test *p<0.05, **p<0.01.

Categorical data are presented as number of cases and frequency in percentage (%); or, for data with continuous distribution, as mean ± standard deviation;

BHP: bipolar hip replacement; THA: total hip arthroplasty; ORIF: open reduction internal fixation; FAC: functional ambulation categories a bipolar hip replacement.

Table 3. Factors affecting the likelihood of a patients' discharge directly home one week after proximal femur fracture surgery

	Odds ratio
Walking ability one week after surgery	1.9*
Co-residents	4.6**
Dementia	0.5
Postoperative pneumonia	0.6
Postoperative delirium	0.7
Walking ability before surgery	2.3
Type of fracture	0.7
Propensity score	—

Model χ^2 test: p<0.01, *p<0.05, **p<0.01.

considered when determining the discharge destination. This study proposes that the ability to walk one week after surgery may be a useful clinical indicator to determine the outcome.

This study analyzed 228 patients who were discharged from an acute care hospital to their home or another healthcare facility. In the comparison between the home and transfer groups, there were statistically significant differences between the participants' mean ages, the extent of pre-injury ambulation independence, living arrangement status, walking ability one-week post-surgery, and BI scores at discharge in the two groups. Younger age at injury, greater pre-injury ambulation ability, faster recovery of physical function one week after surgery, and greater independence in activities of daily living (higher BI score) at discharge were significantly related to direct discharge home. As these results are like those of previous studies, we believe the participants in this study captured the characteristics of most patients with proximal femur fractures^{5, 8}). In contrast, there was no significant difference in complications between the two groups in this study. In a previous study of hip fracture patients, the incidence of complications was reported to be significantly higher in the rehabilitation facility and nursing home groups than in the return-to-home group⁸). This difference in results may have been caused by a difference in the criteria used to assign certain medical conditions. This study determined postoperative delirium based on clinical behavioral observations, and the attending physician diagnosed postoperative pneumonia. Therefore, it is necessary to reconsider and verify the evaluation methods and diagnostic criteria used in the future.

In this study, we used the propensity score direct correction method to adjust for confounding factors to examine the effect of a patient's walking ability one week after surgery on determining their discharge destination. We found significant differences in the relationship between the primary endpoint of walking ability one week after surgery and the six confounding factors specified, including ambulation before the injury and fracture morphology. Although there were no significant differences in mean age and dementia status of the patients in the two groups, there was a definite trend in both groups, suggesting a partial relationship between walking ability and confounding factors one week after surgery. In our study, the estimated ability of confounders intervening in the causal relationship between walking ability and outcome one week after surgery was 0.71 from the AUC. This means that the effect of confounders in this study could be adjusted with moderate accuracy. Quantifying the confounding relationship between walking ability and confounders one week postoperatively should increase the value of adjusting the propensity score in subsequent analyses.

The results of nominal logistic regression analysis using the propensity score direct correction method showed that a patient's walking ability one week after surgery affected their discharge outcome. Van Dartel et al. developed a prediction model for the discharge of patients with hip fractures from an acute care hospital directly to their homes⁸). Results of the model indicated that older age, decreased mobility before the injury, use of walking aids, decreased Katz Index score, decreased American Society of Anesthesiologists score, history of dementia, use of general anesthesia, and insertion of intramedullary implants were significantly associated with a reduced likelihood of being discharged directly home. The accuracy of the prediction model was reported to be 38% in the home discharge group. Therefore, the ability of preoperative patient status and surgical information to predict home discharge from an acute care hospital is limited, and these factors do not necessarily reflect postoperative patient status consistently. Our study demonstrated the benefit of using a patient's walking ability one week after surgery as a factor in determining their discharge destination. Moreover, BI at discharge was significantly higher in the group with 'good' walking ability one week after surgery, indicating that walking assessment scores determined one week after surgery are related to the degree of independence in daily life activities that patients display before discharge. Therefore, in patients with proximal femur fractures, the ability to walk one week after surgery is a useful clinical indicator for determining their discharge destination as it accurately reflects the recovery of physical function. Salar et al. reported that the presence of co-residents in a patient's home at the time of discharge was significantly associated with an increased likelihood of the patient being discharged directly home from an acute care hospital after surgery for proximal femur fracture⁵). The results of our study were like those of the aforementioned study. However, in our study, the presence of a relative living together was shown to be a more important predictor of being discharged home than the ability to walk one week after surgery. The mean BI score at discharge for the home group in this study was 78.1 points, and it is generally expected that any patient who is discharged home directly will require minimal aid. As the presence of a relative living together may compensate for the patient's lack of functional mobility at discharge and have a direct influence on the determination of the discharge destination, we believe that, as shown by our results, it may be a stronger predictor of home discharge than walking ability one week after surgery.

One of the limitations of this study is that the FACs were used to evaluate walking ability, which may be different from the actual walking ability in daily life situations because FAC evaluates walking ability in a straight line. Postoperative delirium was diagnosed based on behavioral observations, and postoperative pneumonia was diagnosed by the attending physician. However, we cannot deny the possibility of systematic errors in these criteria; thus, a further limitation of this study is that we may not have been able to classify the disabilities appropriately.

In this study, a patient's ability to walk one week after surgery significantly influenced their discharge outcome. However, we could not evaluate the patients' physical function in terms of functional impairments, such as joint range of motion, muscle strength, and balance ability between groups. In addition, co-resident status was determined using medical records, and, therefore, we were unable to evaluate the specific caregiving abilities of the patients' co-residents. As these two points were proven useful as clinical indicators in this study, it is vital to conduct a more detailed evaluation in a subsequent study.

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There are no conflicts of interest to declare.

REFERENCES

- 1) Veronese N, Maggi S: Epidemiology and social costs of hip fracture. *Injury*, 2018, 49: 1458–1460. [[Medline](#)] [[CrossRef](#)]
- 2) Sanchez-Munoz E, Lozano-Hernanz B, Velarde-Garrido DV, et al.: Key factors influencing clinical and functional outcomes in extracapsular proximal femur fractures: the role of early weight-bearing—one-year follow-up cohort of 495 patients. *Med Glas*, 2021, 18: 280–286. [[Medline](#)]
- 3) Nanjayan SK, John J, Swamy G, et al.: Predictors of change in 'discharge destination' following treatment for fracture neck of femur. *Injury*, 2014, 45: 1080–1084. [[Medline](#)] [[CrossRef](#)]
- 4) Suzuki K, Aoyama H, Nanke H: The Clinical Pathway with Regional Alliance (CPRA) system for proximal femoral fractures in the southern region of Ibaraki prefecture: comparison of the proportion of patients who return to living at home from acute care and rehabilitation (kaihukuki) hospitals. *J Rural Med*, 2019, 14: 58–63. [[Medline](#)] [[CrossRef](#)]
- 5) Salar O, Baker PN, Forward DP, et al.: Predictors of direct home discharge following fractured neck of femur. *Ann R Coll Surg Engl*, 2017, 99: 444–451. [[Medline](#)] [[CrossRef](#)]

- 6) Lawrence VA, Hilsenbeck SG, Noveck H, et al.: Medical complications and outcomes after hip fracture repair. *Arch Intern Med*, 2002, 162: 2053–2057. [[Medline](#)] [[CrossRef](#)]
- 7) Stahl CC, Funk LM, Schumacher JR, et al.: The relative impact of specific postoperative complications on older patients undergoing hip fracture repair. *Jt Comm J Qual Patient Saf*, 2021, 47: 210–216. [[Medline](#)]
- 8) van Dartel D, Vermeer M, Folbert EC, et al. Dutch Hip Fracture Audit (DHFA) Group: Early predictors for discharge to geriatric rehabilitation after hip fracture treatment of older patients. *J Am Med Dir Assoc*, 2021, 22: 2454–2460. [[Medline](#)] [[CrossRef](#)]