INTRODUCTION

Femoral neck and trochanteric fractures are injuries that often occur when elderly people fall. In previous Japanese studies, falls accounted for 20% of all incident reports in psychiatric patients, with economic losses resulting from falls averaging ¥720 billion annually. In Japan, the admission period for mental illness (average 267.7 days) is approximately 9.5 times longer than that for other illnesses (average 28.2 days). During long-term admission for mental illness, disuse syndrome progresses because of nonuse, motor functions decrease, aging progresses, Parkinsonism may occur due to the influence of antipsychotic drugs, patients experience difficulty in waking due to the effects of

Objective: A total of 183 patients admitted to five hospitals for proximal femoral fractures and psychiatric disorders were examined to determine whether their physical function could be improved by rehabilitation and to identify factors that affected home discharge. Methods: We conducted surveys to collect data regarding patients’ age, sex, type of mental illness, location at time of injury, complications, Charlson Comorbidity Index, Global Assessment of Functioning scale scores, surgical technique, time from surgery to the start of rehabilitation at the target hospital, rehabilitation duration, results of cognitive function tests (e.g., the Mini Mental Status Examination), walking ability before the injury, final walking ability, functional independence measure (FIM) of the patient’s activities of daily living at the start and end of treatments, and discharge destinations. Results: The motor function index showed a significant improvement from an average of 36.0 points at admission to an average of 53.0 points at discharge. Overall, 47.9% of patients who were able to walk before injury could regain gait ability. The discharge rate to the patient’s home was 15.8%. Conclusions: The gait reacquisition rate for patients with femoral neck fractures and mental illness admitted to a psychiatric ward was 47.9%, which was lower than that reported in previous studies, but higher than that for dementia patients. Binomial logistic regression analysis identified the following predictive items for home discharge: whether the fracture occurred at home, FIM cognition item scores at admission, and total and motor item scores at discharge. The derived equation had a high hit rate of 80.9%.
sleep medications, and the risk of falls increases. However, many previous Japanese studies on fracture treatment have excluded patients with mental illness, and there are few reports specifically targeting patients with mental illness internationally. In Japan, physical therapists often do not work with psychiatric patients; therefore, the actual condition and treatment effects are not clear.

We investigated the degree of motor function improvement after physical therapy in patients with mental illness in a mental ward and examined the gait reacquisition rate, the home outcome rate, and a predictive formula derived using logistic analysis.

**METHODS**

**Ethics**

Based on the Declaration of Helsinki, this study obtained approval from the following ethics committees: Akitsu Kounoike Hospital Research Ethics Committee (approval code: Kou 19–012), Hirakawa Hospital Research Ethics Committee (approval code: 30–01), and the Hospital Bando Research Ethics Committee (approval code: 201904001). At cooperating research facilities that did not have an ethics review organization, the survey was conducted with the approval of each facility based on the approval of the Research Ethics Committee of Akitsu Kounoike Hospital. Furthermore, the survey was conducted only on subjects who gave full written consent at the research facility.

**Participating Hospitals**

This study included five hospitals which admitted 334 patients with mental illnesses who also experienced femoral neck or trochanteric fractures and underwent physical therapy. We conducted surveys to collect data regarding patients’ age, sex, type of mental illness, location at the time of injury, complications, Charlson Comorbidity Index (CCI), Global Assessment of Functioning (GAF) scale scores, surgical procedures, time from surgery to the start of rehabilitation at the target hospital, rehabilitation duration, results of cognitive function tests [Mini Mental Status Examination (MMSE)], walking ability before injury, final walking ability, functional independence measures (FIM) of the patients’ activities of daily living at the start and end of treatments, and discharge destinations. Patients with missing data, those discharged from the hospital, and those who developed other diseases were excluded. Ultimately, 183 patients were included in this study. Walking with a cane was considered as self-supported walking.

We analyzed changes in motor function during hospitalization and the factors affecting home discharge. The motor function scores on admission and at discharge were compared. The items compared between those able to walk and not able to walk at discharge included FIMs at the beginning and end of the study (total score of motor items, total score of cognitive items, and overall total score), patient age, the time from surgery to the start of rehabilitation at the target hospital, the rehabilitation duration, and average CCI values. Furthermore, patients were separated into two groups depending on whether they were capable of walking before femoral fracture. We calculated the walking reacquisition rate from the number of people who were ultimately able to walk. For patients with dementia, we compared the gait reacquisition rate to that of patients in previous studies. We conducted statistical analyses using paired $t$-tests and $\chi^2$ independence tests.

For each survey item, we compared the group of patients who were discharged to their homes with the group of patients who were not discharged to their homes using Student’s $t$-test, Welch’s $t$-test, or the $\chi^2$ independence test, as appropriate. For items that showed significant differences between the two groups, a binomial logistic regression analysis was performed with the discharge outcome destination (to the patient’s home/to locations other than the patient’s home) as the dependent variable and the items for which significant differences were noted between the two groups as independent variables. Statistical analyses were performed using JSTAT for Windows 7, and the significance level was set at 5%.

**RESULTS**

The detailed patient data are shown in Table 1. The average patient age was 73.0 years, and the patient population included 55 men and 128 women. Among the psychiatric disorders, dementia was most commonly observed (n=80), followed by schizophrenia (n=60) and depression (n=29). Before the femoral neck or trochanteric fractures occurred, 140 of the patients were able to walk, and 43 were unable to walk. The CCI showed that dementia was the most frequent comorbidity (n=80), followed by diabetes (n=8), and chronic lung diseases (n=6). One hundred and eleven patients suffered the hip fracture in the hospital. The number of femoral neck fractures (n=159) was approximately 6.6 times higher than that of trochanteric fractures (n=24). The numbers of surgical procedures were nearly identical for osteosyntheses and artificial head replacements. The duration of physical therapy was on average 131.5 days, but the standard devia-
The admission MMSE score averaged 15.6 points and the GAF score averaged 35.2 points. The average motor FIM score at admission was 36.0 points, with 18.3 points for cognitive items, whereas the average motor score at discharge was 53.0 points, with 19.9 points for cognitive items, i.e., 72.9 points in total. The discharge values for all three FIM scores were significantly improved compared to the admission values (P<0.001). At the end of the study, 70 patients could walk, whereas 113 patients could not walk. The details of the 140 patients who were able to walk before their hip fracture are shown in Table 2, and the details of the 43 patients who were not able to walk before their hip fracture are shown in Table 3.

Of the 140 patients who were able to walk before suffering hip fracture, 67 were able to walk independently to a greater degree after therapy, and the walking reacquisition rate was therefore 47.9%. Of the 43 people who could not walk before their injuries, 3 were able to walk after therapy, i.e., a walk reacquisition rate of 7.0%.

At the end of physical therapy, 29 patients were discharged.
home, 41 were discharged to other facilities, 60 patients were transferred to other hospitals, 50 patients continued to be hospitalized at our hospital, and 3 patients were discharged to other locations. The home discharge rate was 15.8%. The survey items that showed strongly significant differences (P<0.001) in terms of discharge destination between the home discharge and nonhome discharge groups were FIM cognitive item scores at the time of admission and FIM cognitive, motor, and total scores at the time of discharge (Table 4).

A binomial logistic regression analysis showed significant differences when comparing the place where the injury occurred and also identified other criteria that predict the discharge destination as the patient’s home or other location. Consequently, the place where the injury occurred, the initial cognitive FIM scores, the initial total FIM scores, and the

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Table 2. Demographic data, disease profile, therapy duration, FIM scores, and outcomes for patients able to walk before injury (n=140)

| Age (years) | 72.4±11.5 | Injury location |
|------------|-----------|----------------|
| Sex        |           |                |
| Male       | 44        | Home           |
| Female     | 96        | Institution    |
|            |           | Hospital       |
| Mental illness type | Fracture type |
| Dementia   | 58        | Femoral neck fracture |
| Alcoholism | 3         | Femoral trochanteric fracture |
| Schizophrenia | Surgical technique |
| Depression, manic depression | 24 | Osteosynthesis |
| Neurosis   | 4         | Artificial head replacement |
| Mental retardation | 6 | Physical therapy start time from surgery (days) 39.7±56.3 |
| Disorders of psychological development | 1 | Physical therapy duration (days) 138.2±102.7 |
| CCI (multiple answers accepted) | GAF score 36.8±16.1 |
| Chronic lung disease | 4 | FIM scores |
| Rheumatic disease | 1 | At admission: Motor 39.0±19.8 |
| Diabetes mellitus with complications | 7 | At admission: Cognitive 19.2±6.8 |
| Kidney disease | 0 | At admission: Total 58.1±23.7 |
| Congestive heart failure | 0 | At discharge: Motor 58.3±22.3*** |
| Dementia | 58 | At discharge: Cognitive 20.9±7.6*** |
| Mild liver disease | 2 | At discharge: Total 79.2±28.4*** |
| Hemiplegia, paraplegia | 1 | Ability to walk at end of study |
| Malignant tumor | 4 | Able to walk 67 |
| Moderate/severe liver disease | 1 | Unable to walk 73 |
| AIDS, HIV | 0 | Discharge location from hospital |
| Metastatic solid tumor | 0 | Home 26 |
| Average | 0.9±1.1 | Institution 31 |
| Max/min | 4/0 | Change of hospital 46 |
|                |            | Continued hospitalization 34 |
|                |            | Other 3 |

***P<0.001 compared with admission.
The prediction formula was score = –7.078 + 2.146 × injury home + 0.179 × start cognitive score – 0.047 × start total score + 0.057 × final motor score. To predict the outcome as home or nonhome, first calculate the score from the prediction formula, and then calculate $P = \frac{1}{1+\exp(-1 \times \text{score})}$ to determine the probability $P$ of each patient. If $P<0.5$, it is classified as the dependent variable being 0, i.e., nonhome discharge, and if $P>0.5$, it is classified as the dependent variable being 1, i.e., home discharge. The predictive value of this prediction formula was 80.9%. The odds ratios were 8.55 for the injury location, 1.20 for the start cognition score, 0.95 for the start total score, and 1.06 for the final motor score.

### DISCUSSION

In Japan, femoral neck and trochanteric fractures are known as fragile fractures that may occur when an elderly person falls; consequently, these events result in large economic losses. Medical treatment guidelines have been developed for these injuries, and various studies are being conducted to include factors such as age, life prognosis, and functional prognosis. Measures to prevent the occurrence of fragile fractures such as the administration of therapeutic

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**Table 3.** Demographic data, disease profile, therapy duration, FIM scores, and outcomes for patients who could not walk before injury ($n=43$)

| Age (years) | 74.9±11.1 | Injury location |
|-------------|-----------|----------------|
| Sex         |           |                |
| Male        | 11        | Home           |
| Female      | 32        | Institution    |

| Mental illness type | Fracture type           |          |
|---------------------|-------------------------|----------|
| Dementia            | Femoral neck fracture   | 36       |
| Alcoholism          | Femoral trochanteric fracture | 7       |
| Schizophrenia       | Surgical technique      |          |
| Depression, manic depression | Osteosynthesis       | 26       |
| Neurosis            | Artificial head replacement | 17      |
| Mental retardation  | Physical therapy start time from surgery (days) | 109.3±494.8 |
| Disorders of psychological development | Physical therapy duration (days) | 109.6±70.5 |

| CCI (multiple answers accepted) | GAF score | 30.2±7.4 |
|--------------------------------|-----------|----------|
| Chronic lung disease           | 2         | FIM scores |
| Rheumatic disease              | 1         | At admission: Motor | 26.4±13.1 |
| Diabetes mellitus with complications | 1         | At admission: Cognitive | 15.4±7.3 |
| Kidney disease                 | 0         | At admission: Total | 41.8±18.5 |
| Congestive heart failure       | 1         | At discharge: Motor | 36.1±16.7*** |
| Dementia                        | 22        | At discharge: Cognitive | 16.4±7.2*** |
| Mild liver disease             | 0         | At discharge: Total | 52.5±2.2*** |
| Hemiplegia, paraplegia         | 0         | Ability to walk at end of study | 3       |
| Malignant tumor                | 0         | Able to walk | 3       |
| Moderate/severe liver disease  | 0         | Unable to walk | 40      |
| AIDS, HIV                      | 0         | Discharge location from hospital |          |
| Metastatic solid tumor         | 0         | Home | 3       |
| Average                        | 1.1±1.0   | Institution | 10      |
| Max/min                        | 3/0       | Change of hospital | 14      |
|                                |           | Continued hospitalization | 16      |

***P<0.001 compared with admission.
agents for osteoporosis are also under consideration, and patient prognoses appear to be gradually improving.

However, when these fractures coincide with mental illness, neither life-functional prognoses nor the effects of physical therapy are typically examined. In particular, diseases other than dementia are rarely examined. Medical institutions in Japan are differentiated by their bed functions, and rehabilitation for physical disorders is mainly provided in departments other than psychiatric wards, and no specialized interventions are performed in psychiatric departments. Patients who have mental illnesses along with poor cognitive function, mental symptoms, and poor treatment compliance and who are treated in hospitals lacking mental illness treatment facilities do not fit into a recognized framework, and they therefore miss the opportunity to undergo rehabilitation. In addition, because physical therapists are not often located in psychiatric departments, treatments for functional improvements are usually not provided. Undergoing rehabilitation increases the possibility of being able to live independently. During the period of hospitalization, the amount of activity (e.g., walking and muscle strengthening) further decreases, and, therefore, the amount of assistance that the patient requires does not decrease.

In this study, only patients with mental illness were selected and examined at multiple centers. Among the patients, the major difference from the published Japanese guidelines was the ratio of femoral neck to trochanteric fractures. According to the guidelines, the ratio of the number of femoral neck fractures to the number of trochanteric fractures is 1.3:1.7, but in this study the number of femoral neck fractures was 6.7 times greater. Although the reasons for this were not fully investigated, it is possible that it was caused by the characteristics of the medicines taken by patients with mental illnesses, e.g., drug-induced Parkinsonism, influences on postural reflex disorders, or other side effects.

After rehabilitation intervention, motor function significantly improved in this patient group. This implies that even when patients suffer from mental illness, it is still possible for them to recover from injuries by receiving treatment; therefore, it is worthwhile to offer rehabilitation to patients in an attempt to improve their overall function. Because three non-walking patients were able to regain the ability to walk independently, it is thought that providing physical rehabilitation is useful in positively affecting the patients’ overall physical functioning.

The gait reacquisition rate of the current study is shown in Table 5 along with the results of previous studies. Some of these previous studies separately analyzed the results for patients with and without dementia. Furthermore, a crosstabulation table was prepared for these previous studies, and the results of chi-square tests are shown in Table 5. Compared with the nondementia group or the group including nondementia and dementia patients, the results show that the gait reacquisition rate was significantly lower in the current study. Compared with the gait reacquisition rates found in dementia-limited groups in previous studies, the rate in the current study (67 of 140 patients) was significantly higher. However, the gait reacquisition rate in the current study was lower than that in healthy groups and in elderly groups that included dementia patients in previous studies. It is possible

| Table 4. Analysis of factors potentially correlated with the ability to walk at the end of the study (n=183) |
|-------------------------------------------------|-----------------|-------------------------------|
| Ability to walk                                  | Inability to walk |
| Age (years)                                     | 69.07±12.1      | 73.75±10.76                  |
| Physical therapy start time from surgery (days)  | 42.0±63.8      | 58.69±267.33                  |
| Physical therapy duration (days)                | 159.48±10.18   | 126.9±93.4                    |
| MMSE score                                      | 20.76±5.71     | 14.37±7.11                    |
| GAF score                                       | 39.93±18.53    | 34.47±13.95                   |
| FIM scores                                      |                 |                               |
| At admission: Motor                             | 44.03±23.15    | 34.5±17.93                    |
| At admission: Cognitive                        | 22.72±6.41     | 17.44±6.90                    |
| At discharge: Total                            | 66.76±27.27    | 51.94±22.13                   |
| At discharge: Motor                            | 72.0±22.64     | 49.47±21.4                    |
| At discharge: Cognitive                        | 25.83±7.83     | 18.73±7.16                    |
| At discharge: Total                            | 97.83±29.55    | 68.21±26.77                   |
| CCI Average                                    | 0.48±0.81      | 1.05±1.15                     |

***P<0.001 **P<0.01 *P<0.05. NS, not significant.
that dementia may be a factor that inhibits reacquisition of gait.

The gait reacquisition rate of patients included in this study was also compared with previous studies in patients with femoral neck fractures with mental illness. Because there were two previous studies, a cross-tabulation table was created for each and chi-square tests were performed; the results are shown in Tables 6 and 7. Moreover, when compared with the results of these two previous studies in patients with mental illness, our results were significantly higher than one and significantly lower than the other.

The return-to-home rate in this study was 15.8%. The predictive items for home discharge were as follows: whether the place of injury was the home, FIM cognitive item scores and the total score at admission, and motor item scores at discharge. Our findings indicate that admission due to injuries occurring at home, high cognitive FIM scores at admission, and high motor item scores at discharge increase the possibility of a home discharge, a conclusion congruent with the results of other studies. However, many patients in the five centers were already hospitalized and could not walk at the time of their injuries; therefore, preventive measures prior to falling and experiencing a fracture should be targeted at patients with mental illness.

There are some limitations to this study. Although the possibility of functional improvement has been shown, the degree of functional improvement was not examined in detail, and this will need to be investigated in future studies. Moreover, the time required for functional improvement in patients with mental illness was longer than that in patients without mental illness. In the future, it will be necessary to consider approaches that can shorten this time. Moreover, it

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Table 5. Cane walking or the walking without using a cane of reacquisition rate in patients after femoral neck fractures in Japanese studies

| Age (years)   | Nondementia group** | Dementia group |
|--------------|---------------------|---------------|
|              | n | Ability to walk | Ability to walk | n | Ability to walk | Ability to walk |
|              | (n) | (%) | (%) | (n) | (%) | (%) |
| Current study| Mean 73.0 | 103 | 43 | 41.7 | 80 | 27 | 33.8 |
| Wakasugi, et al. | 60–69 | 24 | 22 | 91.7 | 2 | 0 | 0 |
|              | 70–79 | 67 | 45 | 67.2 | 11 | 4 | 36.4 |
|              | 80–89 | 113 | 59 | 52.6 | 34 | 6 | 17.6 |
|              | 90–99 | 25 | 4 | 16.0 | 17 | 0 | 0 |
| Total        | 229 | 130* | 56.8 | 64 | 10* | 15.6 |
| Ichimura, et al. | Under 84 | 247 | 185 | 74.9 | 148 | 86 | 58.1 |
|              | Over 84 | 148 | 86 | 58.1 | 23 | 13* | 39 |
| Total        | 395 | 271* | 68.6 | 87 | 6* | 23.1 |
| Kubota, et al. | Mean 82.0 | 59 | 41* | 69.0 | 34 | 13* | 39 |
| Hisazaki, et al. | Mean 86.3 | 181 | 135* | 74.6 | 100 | 70* | 70.0 |
| Suzuki, et al. | Mean 82.3 | 42 | 34* | 81.0 | 26 | 6* | 23.1 |
| Imajima, et al. | Mean 87.8 | 100 | 70* | 70.0 | 90 | 60* | 60 |
| Terajima, et al. | Mean 83.2 | 127 | 89* | 70.1 | 126 | 87 | 74* |
| Kitamura, et al. | Mean 76.8 | 87 | 74* | 85.1 | 127 | 80 | 64* |
| Imai, et al. | Mean 78.9 | 12 | 12* | 100.0 | 21 | 8* | 38.1 |
| Narita, et al. | Mean 81.4 | 104 | 60* | 57.7 | 127 | 30* | 23.6 |

* After creating a cross-tabulation table, a significant difference was confirmed by the chi-square test.
**If the dementia column is blank, this group includes dementia patients.
• Includes walking while grasping the handrail.
• Dementia is predominant in the group who were unable to walk.
• Extracted subjects who were able to walk alone or walk with a cane before injury.
• Dementia was more common in the nonindependent group but not significant by age- or gender-adjusted logistic analysis.
• Able to walk alone outdoors, able to walk alone outdoors with a helper, able to walk alone indoors.
is highly likely that a strong home support system will facilitate the return of the patient back to their home after admission if the patient came from home originally. In the case of patients with mental illness, their families need to cooperate with the treatment for the patients’ physical illness as well as mental illness and to strengthen and improve the family support functions.19) In this study, we did not consider the support function of the family, so we propose to investigate this factor in future studies. Moreover, more detailed analysis of dementia is needed. In addition to the patient’s age and pre-injury walking function, not only the type of disease, but also the characteristics and severity of the disease, HDS-R scores, and symptoms (specific core symptoms, peripheral symptoms) should be further considered in the future.

**CONCLUSION**

The gait reacquisition rate for patients with femoral neck fractures and mental illness admitted to a psychiatric ward was 47.9%, which was lower than that reported in previous studies, but higher than that reported for dementia patients. The home outcome rate was 15.8%. The predictive items for home discharge were whether the injury occurred at home, the cognition item scores and the total FIM score at admission, and the motor item FIM scores at discharge. The predictive equation derived from binomial logistic regression analysis had a high hit rate of 80.9%.

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