



Original Article

## Factors influencing period from surgery to discharge in patients with femoral trochanteric fractures

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**Abstract.** [Purpose] The purpose of this study was to investigate factors influencing the period from surgery to discharge in patients with femoral trochanteric fractures. [Subjects and Methods] Sixty patients with femoral trochanteric fractures were investigated retrospectively. Based on the mean period from surgery to discharge ( $85.6 \pm 26.6$  days), the patients were divided into two groups: an under-85-day group (range, 29–78 days) and an over-85-day group (87–128 days). Age, gender, fracture type, presence of lesser trochanteric displacement, discharge destination, and walking ability were investigated. The relationship between these factors and the period from surgery to discharge was analyzed with logistic regression analysis. [Results] Age and lesser trochanteric displacement were significantly higher in the over-85-day group, and walking ability before fracture and at discharge were significantly lower in the over-85-day group. Logistic regression analysis showed that lesser trochanteric displacement and age were predictors of the length from surgery to discharge. Lesser trochanteric displacement were observed in 87.5% of these. Immediate displacement after surgery occurred in 57.8% of lesser trochanteric fractures, while 26.3% displaced 1 to 3 weeks after surgery. [Conclusion] This study revealed that lesser trochanteric displacement, higher age, and lower walking ability before fracture and at discharge were associated with longer hospitalizations in patients with femoral trochanteric fractures. Lesser trochanteric displacement were observed in 87.5% of lesser trochanteric fractures. These displacements occurred within 3 weeks after surgery in 84.1% of cases.

**Key words:** Femoral trochanteric fracture, Lesser trochanteric displacement, Period from surgery to discharge

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### INTRODUCTION

The number of patients who sustain femoral trochanteric fractures in Japan are increasing<sup>1)</sup>. Since the 1990s, when accelerated rehabilitation and algorithms for the treatment of proximal femoral fractures were developed<sup>2, 3)</sup>, efforts have been standardized to shorten hospitalization periods and reduce medical costs.

Among trochanteric fracture patients, 80.9% reported that they were able to walk independently by 3 months after surgery<sup>4)</sup>. In previous studies, age, postoperative complications, walking ability after surgery, and dementia had been reported as factors influencing the length of hospital stay (period from surgery to discharge) in patients with trochanteric fractures<sup>5, 6)</sup>. Early improvement of walking ability after surgery has been shown to shorten the length of stay<sup>6)</sup>. Fracture type has been cited as a factor that affects the walking ability of hip fracture patients at discharge<sup>7)</sup>.

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**Table 1.** Patient characteristics (n=60)

Survey items		n	Percentage (%)
Age (years)		84.5 ± 6.4	
Gender	Male	5	8.3
	Female	55	91.7
Fracture type	Stable	36	60.0
	Unstable	24	40.0
Period from surgery to discharge (days)		85.6 ± 26.6	

Age and period from surgery to discharge are presented as means ± SD.

We evaluated lesser trochanteric fracture as a factor influencing activities of daily living (ADL) and walking ability in patients with trochanteric fractures. The iliacus and psoas major muscles insert on the lesser trochanter of the femur and work to flex the hip joint, thus playing an important role in walking. Therefore, if the lesser trochanteric fragment is not reduced and fixed, there is a possibility that displacement will occur due to motions during ADL immediately after surgery. If displacement occurs, this can hinder walking ability or prolong the period until the ability to walk returns.

Kumar<sup>8)</sup> reported that the frequency of lesser trochanteric fracture with femoral trochanteric fractures was 76.7%, and the frequency of displacement of the lesser trochanteric fragment was 60.9%. However, the relationship between lesser trochanteric displacement and length of hospital stay is unclear, as is the relationship between lesser trochanteric displacement, walking ability, and successful return to ADL. Also, it is not known at which time point after surgery the lesser trochanteric fragment displaces.

Our hypothesis was that lesser trochanteric bone fragment displacement was a factor influencing the period from surgery to discharge, in addition to the factors previously reported. Therefore, the purpose of this study was to investigate factors influencing the period from surgery to discharge of patients with femoral trochanteric fractures, with particular attention being paid to lesser trochanteric fragment displacement.

## SUBJECTS AND METHODS

A retrospective analysis was performed of 60 patients who sustained femoral trochanteric fractures due to falls and underwent open reduction and internal fixation between April 2012 and July 2015 (Table 1). The patients were all able to walk indoors independently or lived at home prior to the injury. We excluded those with (1) pathological fractures due to malignant tumors, (2) trauma due to a traffic accident or a fall from height, (3) a discharge due to death or other systemic complications, (4) use of a wheelchair for mobility before injury, (5) a moderate or high degree of cognitive dysfunction (revised Hasegawa dementia rating scale score of 14 points or less, independence degree of daily living for the demented elderly rank III or less), (6) effects from a stroke, (7) missing data in their medical record, or (8) a refusal to participate in the research study. Data was collected retrospectively based on information in the medical record. Based on the mean period from surgery to discharge in all patients (85.6 days), the patients were divided into two groups; an under-85-day group (n=25, range, 29–78 days) and an over-85-day group (n=35, range, 87–128 days). The patients were discharged from the hospital if they were judged that their walking ability and ADL reached a plateau. Twenty-four Asian intramedullary hip screws (IMHS; Smith & Nephew Richards, Memphis, TN, USA), 14 Gamma3™ nails (Stryker, Kalamazoo, MI, USA), 5 INTERTAN™ nails (Smith & Nephew Richards, Memphis, TN, USA), 3 cephalomedullary nails (Zimmer, Warsaw, IN, USA), 3 Cephalo nails (Zimmer, Warsaw, IN, USA), 2 Intertrochanteric/Subtrochanteric Fixation systems (Zimmer, Warsaw, IN, USA), 1 Pertrochanteric nail system (Biomet, Warsaw, IN, USA), 1 T2 Recon Nailing system (Stryker, Kalamazoo, MI, USA), 1 Zimmer natural nail (Zimmer, Warsaw, IN, USA), 1 long Gamma3™ nails (Stryker, Kalamazoo, MI, USA), 1 MIJ nail (HOYA Technosurgical, Tokyo, Japan), 1 Inter blade nail (Japan MDM, Tokyo, Japan), 1 Omega Plus Ti Compression hip screw system (Stryker, Kalamazoo, MI, USA), and 2 compression hip screws (JAPAN MDM, Tokyo, Japan) were used for the operations.

Age, gender, fracture type (stable and unstable types, Evans classification<sup>9)</sup>), lesser trochanteric fracture +/- displacement, destination after discharge (home or institution), period from surgery to discharge, walking ability before fracture, and walking ability at discharge were evaluated. Based on the above, logistic regression analysis was performed with the following 4 independent variables: presence or absence of lesser trochanteric displacement, age, Mobility score before fracture, and Mobility score at discharge.

Regarding lesser trochanteric fragment displacement, we investigated the number of cases with displacement and the timing of displacement. We used anteroposterior and lateral X-rays of the hip joint to evaluate this. Displacement was considered to be present when the lesser trochanteric fragment was displaced 2 mm or more. The interpretation of the X-ray images was performed by an orthopedic surgeon and a physical therapist. The frequency and timing of the lesser trochanteric displacement were evaluated.

The Mobility score as described by Parker et al.<sup>10)</sup> was calculated to gauge walking ability before injury and at discharge. The Mobility score is a composite score of a person's ability to perform indoor walking, outdoor walking, and shopping, and

**Table 2.** Factors influencing period from surgery to discharge

Factors		Period from surgery to discharge	
		Under-85-day (n=25)	Over-85-day (n=35)
Gender	Male	3	2
	Female	22	33
Fracture type	Stable	18	18
	Unstable	7	17
Lesser trochanteric fragment displacement	Presence	5	16*
	Absence	20	19
Discharge destination	Home	25	30
	Institution	0	5
Cohabiting family	Presence	21	28
	Absence	4	7
Age		81 (74–88)	86 (82.5–89.5)**
Mobility score before fracture		8 (6–10)	4 (1.5–6.5)**
Mobility score at discharge		4.5 (3–6)	4 (2.5–5.5)*

\*p<0.05, \*\*p<0.01

Gender, fracture type, lesser trochanteric fragment displacement, discharge destination and cohabiting family described the number of patients.  $\chi^2$  test was used for comparisons. The median (interquartile range) was listed for age, Mobility score before fracture and Mobility score at discharge. The Mann-Whitney U test was used for comparisons.

**Table 3.** Logistic regression analysis for period from surgery to discharge

	Regression coefficient	p value	Odds ratio	95% confidence interval	
Lesser trochanteric fragment displacement	1.372	0.040	3.944	1.066	14.589
Age	0.163	0.004	1.177	1.053	1.316
Constant	-13.845	0.004	0.000		

Model  $\chi^2$  test p<0.001. Hosmer-Lemeshow test p=0.064.

Predictive value of the predicted value and the measured value was 73.3%.

provides a score from 0 to 3 (0=no ability to walk, 1=can walk with help from another person, 2=can walk with a walking aid, 3=can walk without difficulty) for each function and gives a total score from 0 (no ability to walk) to 9 (can walk independently without difficulty).

This study was conducted with the approval of the Ichihara Hospital Ethics Committee (approval number 1501) and Ibaraki Prefectural University of Health Sciences Ethics Committee (approval number 666).

To analyze the factors influencing the period from surgery to discharge, the  $\chi^2$  test and the Mann-Whitney U test were performed. Logistic regression analysis (variable reduction method as likelihood ratio test) was conducted with the item showing a significant difference between the two groups as the independent variable, and with the period from surgery to discharge as the dependent variable. In choosing the independent variable, after considering multicollinearity, the internal correlation between each variable was confirmed, and the variable was deleted when the correlation coefficient was 0.9 or more. Finally, the odds ratio of the items left in the regression model, the 95% confidence interval, and the discriminant predictive value of the whole model were calculated. For statistical analysis, IBM SPSS statistics version 22 (IBM, Armonk, NY, USA) was used and p values less than 0.05 were considered significant.

## RESULTS

Age and lesser trochanteric displacement were significantly higher in the over-85-day group than in the under-85-day group (p=0.005 and p=0.040, respectively), and walking ability before fracture and at discharge were significantly lower in the over-85-day group than in the under-85-day group (p=0.006 and p=0.044, respectively) (Table 2).

After logistic regression analysis, the presence or absence of lesser trochanteric displacement and age were selected as the factors influencing the period from surgery to discharge (p<0.001). The Hosmer-Lemeshow test results were compatible with p=0.064, and the discriminant predictive value of the predicted value and the measured value was 73.3% (Table 3).

Lesser trochanteric fracture was observed in 24 (40.0%) out of 60 patients, while lesser trochanteric displacement was observed in 21 (87.5%) of the 24 lesser trochanteric fractures. Three of the lesser trochanteric fractures were nondisplaced.

Regarding the timing of lesser trochanteric displacement, there were 19 of the 24 patients with a lesser trochanteric fracture on whom we were able to gather information on anteroposterior and lateral X-rays each week after surgery. Among

them, 11 patients (57.9%) had lesser trochanteric displacement immediately after surgery. At one, two, and three weeks postoperatively, 2, 1, and 2 additional patients had displacement, respectively. A total of 5 patients (26.3%) had confirmed displacement from the start of physical therapy to 3 weeks postoperatively. Three other patients (15.8%) did not show displacement until discharge.

## DISCUSSION

Our study revealed that lesser trochanteric fragment displacement and higher age were associated with a prolonged period from surgery to discharge in patients with femoral trochanteric fractures. Patients with lesser trochanteric displacement likely require longer hospitalization periods in comparison to those without displacement in order to obtain the walking ability required to be discharged home. In patients with unstable femoral trochanteric fractures, the recovery of walking ability has been reported to continue for 3 to 6 months postoperatively<sup>4</sup>. Those with lesser trochanteric displacement required a recovery period of 3 months or more after surgery in this study. Because the iliacus and psoas major muscles work to flex the hip joint and insert on the lesser trochanter, displacement of the lesser trochanter can lead to a delay in walking ability.

Holt et al.<sup>7</sup> reported that age, pre-injury mobility, complications, and fracture type were factors influencing walking ability at discharge, and that elderly patients with trochanteric fractures have a low walking ability at discharge. In our study, the period from surgery to discharge was longer in older patients. Increased age can also increase the risk of osteoporosis<sup>11, 12</sup>. Therefore, the risk of lesser trochanteric fracture and displacement are thought to increase in older patients. In addition, muscle mass decreases with age<sup>13</sup>, and walking ability before fracture and at discharge are also thought to decrease with age. Thus, increased age, lesser trochanteric displacement, and lower walking ability before fracture and at discharge are thought to be related.

There is a relationship between the period from surgery to discharge, the decline in walking ability, and maintenance of the living environment in the destination after discharge. It takes time to improve the living environment in the discharge destination. In order to live in and leave the home when walking ability may be poor following injury, it may be necessary to alter the living environment by installing handrails or removing steps. It is necessary for a home to be safe so that patients will not fall again after discharge from the hospital. However, because these changes take time, discharge from the hospital may be delayed. For planning for physical therapy, it is necessary to make changes in the home living environment as early as possible to assist with the early discharge of patients with lesser trochanteric displacement.

The frequency of lesser trochanteric fracture in patients with femoral trochanteric fracture was 40.0% in our study. Kumar<sup>8</sup> reported a much higher incidence of 76.7%. Our results may have been influenced by age and race. The frequency of lesser trochanteric displacement in patients with a lesser trochanteric fracture was 87.5%. Lesser trochanteric displacement was found in 57.9% of cases immediately after surgery, and it occurred in an additional 26.3% of the patients from 1 to 3 weeks after surgery, which is after postoperative physical therapy had begun. The frequency of accompanying displacement of the lesser trochanteric fragments was 60.9%, supporting the report of Kumar. However, Kumar did not address when the displacement of the lesser trochanteric fragments occurred. To our knowledge, ours is the first study to present the timeline of lesser trochanteric fragment displacement. The same treatment is carried out regardless of the presence or absence of a lesser trochanteric fracture, and treatments have not been carried out specifically for the lesser trochanteric fracture. However, novel physical therapy programs may be created that prevent displacement of the lesser trochanteric fragment by clarifying the frequency of lesser trochanteric fracture and the frequency and timing of lesser trochanteric displacement. In order to further shorten hospitalization periods, we focused on patients with lesser trochanteric fractures and the need for more effective physical therapy.

There were several limitations of this study. The Mobility score was used as an evaluation of walking ability, and a quantitative evaluation (such as a 10-m walking speed or timed "Up & Go" test) was not performed. Therefore, this study was limited in that it only evaluated range of movement, the use of aids, and the necessity of an assistant using the Mobility score. The number of patients in this study was small, and the study was retrospective in nature. Therefore, future prospective investigations that include a large number of patients are required to clarify the influence of lesser trochanteric displacement on walking ability and performance of ADL.

Lesser trochanteric fragment displacement, higher age, and lower walking ability before fracture and at discharge were associated with a prolonged period from surgery to discharge in patients with femoral trochanteric fractures. Among those with femoral trochanteric fractures, lesser trochanteric fractures were observed in 40%, and displacement of the lesser trochanteric fragment was found in 87.5% of those with a lesser trochanteric fracture. Displacement was present in 57.8% immediately after surgery, while displacement occurred 1–3 weeks after surgery in 26.3% of the patients.

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