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Original article

Evaluation of clinical prognosis and activities of daily living using functional independence measure in patients with hip fractures

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Abstract
Background. The functional independence measure (FIM) is an evaluation method of activities of daily living (ADL) that assesses motor functions and cognitive functions in the Uniform Data System. The FIM has recently been used to assess disability. The purpose of this study was to standardize criteria using the FIM for determining when and to where patients can be discharged following surgery for hip fracture.
Methods. Patients with hip fracture (n = 68) aged ≥65 years who underwent surgery at our hospital were classified by their residence at the time of injury (their own home, a hospital, or an elderly care facility) and by postoperative residence after discharge from hospital. We investigated the FIM of these patients before injury and at the time of discharge and retrospectively compared the results with the Japan Orthopaedic Association (JOA) hip score at the time of discharge.
Results. Patients who entered a facility after discharge following surgery demonstrated a reduction in motor function score on the FIM. Cognitive function scores in each group were not reduced postoperatively in the short term. The average reduction in scores on the FIM for patients who were discharged from hospital to their own home was 15.9 points, and it was 25.9 points for those who were injured in their own home and transferred to a facility after discharge. There was a significant correlation between the FIM and the JOA hip score at the time of discharge.
Conclusions. The FIM cannot determine whether such patients should be discharged to their home or transferred to a care facility. However, the motor function scores on the FIM are valid for assessing hip fracture patients and may be suitable as a standardized procedure for determining their postdischarge residence.

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Introduction

With regard to the prognosis of patients with hip fracture in Japan, Iga et al.[1] reported that 70% of patients had reduced walking ability after injury, and 25% of patients became confined to bed. Kitamura et al.[2] reported that hip fracture was a turning point for 19% of patients who lived in their home before injury, resulting in their living somewhere other than their own home after discharge from hospital. Many researchers have reported on the prognosis of hip fracture.[2–4] The main problems associated with hip fracture in Japan can be summarized by the following points. First, following an injury, participating in the activities of daily living (ADL) and the prognosis are poor. Second, if high-level dementia occurs concurrently, the patient's family members tend not to visit the patient as often. As there is a lack in the absolute number of hospitals or facilities meeting the physical and mental needs of patients, problems exist in the quality of nursing care and the medical insurance systems that support such patients. Therefore, it is difficult to compare international treatment programs or prognoses of hip fracture in an integrated fashion.[4–9]

During the early stages of treatment for hip fracture, when considering the various complications that can occur, the physician may have no objection to performing surgery and conducting rehabilitation. However, the prognosis of a patient is determined by factors such as the physical ability and mental state of the patient who is directly involved in ADL treatment, the family caring for the patient after discharge, the level of in-home care, and the medical/welfare system (hospital/facility and insurance system).

The FIM has recently been used to evaluate ADL functioning of patients (Table 1).[10–12] The FIM is the core of the Uniform Data System (UDS), which was developed in 1983 by a task force established by a collaboration of The American Academy of Physical

Table 1. Functional independent measure (FIM)

FIM (motor)	Self-care (42)	A. Eating
		B. Grooming
		C. Bathing
		D. Dressing: upper body
		E. Dressing: lower body
		F. Toileting
	Sphincter control (14)	G. Bladder management
		H. Bowel management
	Transfers (21)	I. Transfers: Bed, chair, wheelchair
		J. Transfers: toilet
		K. Transfers: tub or shower
	Locomotion (14)	L. Locomotion: walk/wheelchair
		M. Stairs
FIM (cognitive)	Comprehension (14)	N. Comprehension
		O. Expression
	Social cognition (21)	P. Social interaction
		Q. Problem solving
		R. Memory
	Total (126)	

Levels of scoring (points): Complete independence (timely, safely). (7), Modified independence (6), Supervision (5), Minimal assistance (subject 75%+) (4), Moderate assistance (subject 50%+) (3), Maximal assistance (subject 25%+) (2), Total assistance (subject 0%+) (1)

Medicine and Rehabilitation and the American Congress of Rehabilitation Medicine.[13] The UDS is composed of 22 items, such as ADL, duration of hospitalization, and hospital expenses incurred for medical rehabilitation. The FIM is an evaluation method capable of quantifying levels of ADL as a continuous function. However, only one report, by Petrella et al.,[14] has been conducted using the FIM for evaluating hip fracture.

Assessment by the FIM is important for patients with hip fracture as such an assessment can be used to facilitate a smooth transition or discharge from the primary hospital providing acute-stage treatment to a secondary or tertiary hospital/facility or home nursing care. Therefore, we performed a retrospective longitudinal study so as to determine the FIM score at which patients are able to return to their own homes and the score at which patients should be transferred to other facilities and compared these scores to the patients' Japan Orthopaedic Association (JOA) hip scores at discharge (Table 2).

Subjects and methods

The subjects were 68 patients aged 65 years or older (18 men, 50 women; mean age 83.2 ± 7.4 years, range 68–97 years) with hip fracture who underwent surgery by the same surgeon in our hospital at some point between May 2001 and March 2003. The mean age for the men was 78.4 ± 6.3 years (range 68–97 years), and the mean age for the women was 84.7 ± 7.1 years (74–94 years). Of 32 patients with femoral neck fractures, there were 9 men and 23 women; and of the 36 patients with trochanteric fractures, there were 9 men and 27 women. Of the 68 patients in this study, 24 underwent bipolar hip arthroplasty (BHP), 9 underwent cannulated cancellous screw (CCS) fixation, 18 underwent compression hip screw (CHS) fixation, and 17 underwent Gamma nail fixation.

These patients were classified into the following three groups: group A, resided in their own homes preinjury and after discharge from hospital; group B, resided in their own homes preinjury and in hospitals or facilities after discharge from hospital; and group C, resided in facilities or hospitals pre- and postinjury (Table 3).

Patient characteristics, including number of days in the hospital, number of days from injury to surgery, and number of days from injury to sitting in a wheelchair or independent standing in the three groups were investigated. Preinjury ADL and ADL at the time of discharge from hospital were evaluated by comparing the FIM for the three groups.

The FIM is composed of 18 items, each evaluated on a scale from 1 (Total assistance) to 7 (Complete independence), which generates a total score ranging from 18 to 126 points. Items assess Self-care (42 points), Transfers (21 points), Sphincter control (14 points), Locomotion (14 points), Comprehension (14 points), and Social cognition (21 points) (Table 1). After calculating the FIM of each group, comparisons of the preinjury FIM scores and scores at the time of discharge were made between groups. In addition, between-group differences of the preinjury FIM scores were compared with those at the time of discharge. The change in the FIM scores of patients with dementia was also

Table 2. Japan Orthopaedic Association (JOA) hip score

	Score	
	Maximum	40 points
A. Pain	Right	Left
A. None	40	40
B. Ignores	35	35
C. Slight	30	30
D. Moderate	20	20
E. Severe	10	10
F. Unbearable	0	0

(Notes)
A. No pain and/or no complaints relating to hip joint.
B. No pain. Inconstant symptoms including weary feeling or dullness.
C. No spontaneous pain. Some pain when walking (including slight pain when starting to walk or after walking for long distance).
D. No spontaneous pain. Some pain when walking but which disappears quickly after a short rest.
E. Spontaneous pain. Pain is severe when attempting to walk; it decreases after a rest.
F. Continuous pain during rest and/or at night.

	Maximum	20 points
B. Range of motion	Right	Left
Flexion arc	0–12	0–12
Abduction arc	0–8	0–8

(Notes)
Scores are detemined by multiplying 10° of motion in each arc by 1 point in flexion and 2 points in abduction. Range of contracture should be subtracted.
A flexion arc more than 120° is detemined as 12 points and the abduction arc more than 30° as 8 points.
Either flexion and abduction is measured in neutral position on rotation and described by its arc by passive motion.

	Maximum	20 points
C. Ability to walk		
A. Normal	20	
B. Slight limp	18	
C. Mild limp	15	
D. Severe limp	10	
E. Difficult to walk	5	
F. Impossible	0	

(Notes)
A. Able to walk long distance without limp. Able to walk fast.
B. Able to walk long distance including walking with a slight limp. Able to walk fast.
C. Able to walk 30 min or 2 km without support. Mild limp.
D. Able to walk 10–15 min or 500 m without support.
E. Able to do household activities. Difficult to do outdoor activities. Difficult to walk outdoors without bilateral supports.
F. Impossible or almost impossible to walk.

	Maximum	20 points	
D. Activities of daily life	Normal	Difficult	Impossible
A. Sitting on chair	4	2	0
B. Standing work (including housework) (note 1)	4	2	0
C. Squatting, standing up from sitting on the floor (note 2)	4	2	0
D. Going up and down stairs (note 3)	4	2	0
E. Getting into car or entering public transport	4	2	0

(Note 1)
Able to continue longer than 30 min
Need to take a rest; should be scored as "difficult"
Unable to continue longer than 5 min; should be scored as "impossible"
(Note 2)
Support needed; should be scored as "difficult"
(Note 3)
Handrail needed; should be scored as "difficult"

Total (100)

Table 3. Characteristics of patients

Category	Group A	Group B	Group C
Number of patients	45	14	9
Male	14	3	1
Female	31	11	8
Mean age (years)	81.3 ± 7.5	87.9 ± 5.7	85.3 ± 5.0
Femoral neck fractures (*n*)	15	6	6
Trochanteric fractures (*n*)	30	8	3
Mean length of hospital stay (days)	70.2 ± 34.7	81.6 ± 48.2	68.2 ± 35.9

investigated. We defined dementia as a score of 23 points or less on the Mini-Mental State Examination (MMSE): Orientation (10 points), Registration (3 points), Attention and Calculation (5 points), Recall (3 points), and Language (9 points).[15] Evaluations were performed in the same manner by one expert physiotherapist and one expert occupational therapist. Preinjury evaluations were performed by the same examiner through interviews with family members of the subjects.

It was critical that informed consent was received from family members three times by the surgeon (at the time of injury, before surgery, and immediately after surgery) and twice by the expert physiotherapist and the expert occupational therapist (at 1 and 2 months postoperatively). For each patient, the JOA hip score instrument was used to assess the time of discharge. These JOA hip scores (Table 2) were compared to the FIM score (Table 1).[16] The JOA hip score carries a maximum score of 100 and includes an evaluation of pain (0–40 points), range of movement (0–20 points), walking ability (0–20 points), and activities of daily living (0–20 points) (Table 2).

The Mann-Whitney U-test was used for statistical comparisons between groups A, B, and C and to determine differences between the preinjury FIM scores and scores at the time of discharge in group A. Statistical significance was established at the $P < 0.05$ level. Means are indicated as ±SD.

Results

Patient characteristics and postdischarge residence in each group

With regard to patient characteristics in each group, there were 45 patients in group A (14 men and 31 women, mean age 81.3 ± 7.5 years), 14 patients in group B (3 men and 11 women, mean age 87.9 ± 5.7 years), and 9 patients in group C (1 man and 8 women, mean age 85.3 ± 5.0 years) (Table 3). Of the patients who were in their own home before injury, 14 (26%) were transferred to a residence other than their own home after discharge from hospital because of the hip fracture.

Between-group comparisons of the number of days in hospital

The number of days in hospital was 70.2 ± 34.7 days (18–194 days) for group A, 81.6 ± 48.2 days (40–182 days) for group B, and 68.2 ± 35.9 days (18–107 days) for group C. No significant differences were observed between the groups (Table 3).

Interval from injury to surgery, sitting in a wheelchair, and independent standing

The number of days from injury to surgery was 5.6 ± 3.4 days (1–18 days) for group A, 6.3 ± 4.0 days (1–17 days) for group B, and 4.6 ± 1.4 days (2–6 days) for group C. The number of days from injury to sitting in a wheelchair (including assisted transfer) were 8.3 ± 6.1 days (3–40 days) for group A, 6.5 ± 2.1 days (4–11 days) for group B, and 7.6 ± 6.1 days (2–22 days) for group C. The number of postoperative days to independent standing was 10.0 ± 8.0 days (3–52 days) for group A, 11.1 ± 7.7 days (3–35 days) for group B, and 11.4 ± 5.7 days (6–22 days) for group C. No significant differences were observed between the groups (Table 4).

Between-group comparisons of FIM scores before injury and at the time of discharge

Preinjury total FIM was significantly lower in groups B and C when compared with group A ($P < 0.05$) (Table 5), with significant reductions found in both motor function and cognitive function ($P < 0.05$) (Table 5). Total FIM at the time of discharge from hospital was also significantly lower in groups B and C than in group A ($P < 0.05$) (Table 5), with significant reductions seen in both motor function and cognitive function ($P < 0.05$) (Table 5).

Table 4. Time[a] after surgery to after-treatment

Category	Group A	B	C
Time after fracture to surgery	5.6 ± 3.4	6.3 ± 4.0	4.6 ± 1.4
Time after surgery to transferring supine to sitting in wheelchair	8.3 ± 6.1	6.5 ± 2.1	7.6 ± 6.1
Time after surgery to standing only	10.0 ± 8.0	11.1 ± 7.7	11.4 ± 5.7

[a] Unit: days

Table 5. Comparison of FIM scores observed pre-injury and at the time of discharge in each group

Category	FIM component	Group A	B	C
Pre-injury FIM	Motor	79.4 ± 17.0*,**	64.6 ± 25.0*	50.1 ± 25.6**
	Cognitive	30.1 ± 8.1*,**	16.6 ± 9.8*	14.9 ± 9.5**
	Total function	109.1 ± 23.8*,**	81.2 ± 32.6*	64.5 ± 33.9**
Discharge FIM	Motor	68.7 ± 23.0*,**	38.8 ± 16.8*	25.7 ± 14.5**
	Cognitive	26.7 ± 10.8*,**	13.5 ± 8.1*	8.1 ± 3.8**
	Total function	94.9 ± 32.6*,**	54.2 ± 23.8*	33.0 ± 15.9**
Difference between pre-injury and discharge FIM	Motor	12.1 ± 17.9*,**	23.3 ± 19.7*	24.6 ± 17.9**
	Cognitive	3.7 ± 7.1	3.1 ± 3.4	5.4 ± 5.8
	Total function	15.9 ± 22.6**	25.9 ± 20.5	30.9 ± 23.3**

FIM, functional independence measure
* $P < 0.05$ (A vs B); ** $P < 0.05$ (A vs C)

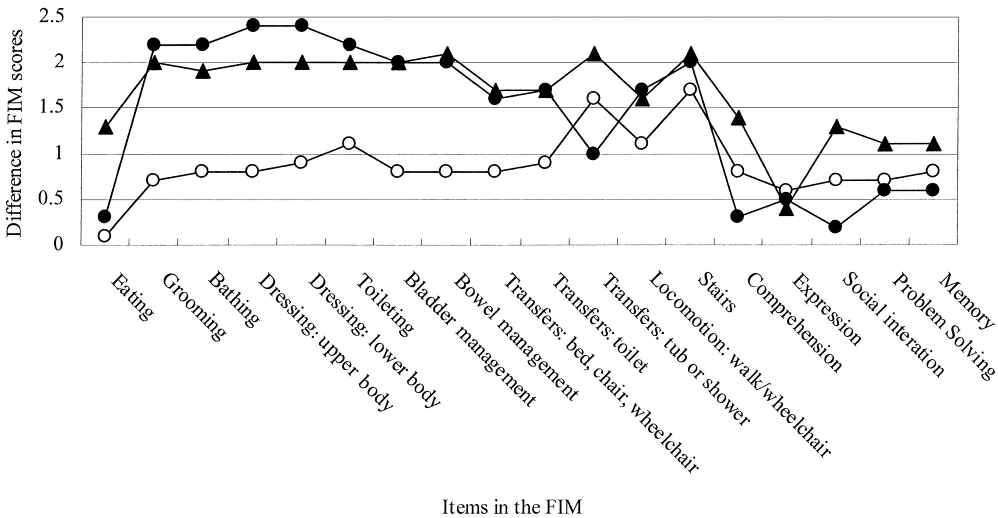

Fig. 1. Differences between the preinjury total functional independence measure (FIM) and total FIM at the time of discharge. For items of cognitive function, no significant differences were found. Examination of each motor-function item showed that Self-care (Grooming, Bathing, Dressing: upper body, Dressing: lower body, and Toileting) and Sphincter control (Bladder management) were significantly lower in Group B than in Group A. There were no significant differences in Transfer (to Bed, Chair, Wheelchair, Toilet, Tub or Shower) or in Locomotion (Walking/Wheelchair, Using stairs). *Open circles*, Group A; *solid circles*, Group B; *triangles*, Group C

The differences between the preinjury total FIM and total FIM at the time of discharge were significantly lower in group C than in group A ($P < 0.05$) (Fig. 1), whereas no significant difference was observed between groups A and B. Comparison of motor function alone revealed that the difference between preinjury FIM motor function and FIM motor function at the time of discharge was significantly lower in group B than in group A and was also significantly lower in group C than in group A ($P < 0.05$) (Fig. 1). On items of cognitive function, no significant differences were found. Examination of each motor function item revealed that Self-care (eating, grooming, bathing, dressing-upper body, dressing-lower body, toileting) and Sphincter control (bladder management) were significantly lower in group B than in group A; and there were no significant differences in Transfer (to bed, chair, wheelchair, toilet, tub, or shower) or Locomotion (walking/wheelchair, using stairs) (Fig. 1).

The preinjury FIM scores and scores at the time of discharge were 113.4 ± 20.4 and 94.6 ± 25.3 points, respectively, for male patients and 92.3 ± 33.5 and 73.1 ± 39.1 points, respectively, for female patients. There were no significant differences in FIM score between these two groups of patients. The preinjury FIM scores for patients with femoral neck fractures and at the time of discharge were 93.7 ± 32.4 and 67.6 ± 33.7 points, respectively; and for patients with trochanteric fractures they were 96 ± 33.8 and 82.4 ± 40.3 points, respectively. There were no significant differences in FIM score between these two groups of patients. Furthermore, the FIM scores for patients who underwent BHP preinjury and at the time of discharge were 98.4 ± 31 and 69.3 ± 36.3 points, respectively. For those who underwent CCS fixation, corresponding scores were 89.4 ± 32.6 and 67.6 ± 26.6 points, respectively. For patients who underwent CHS fixation, corresponding scores were 94.9 ± 36.2 and 83.2 ± 42.7 points, respectively; and for those who underwent Gamma nail fixation corresponding scores were 94.2 ± 31.9 and 67.6 ± 26.2 points, respectively. There were no significant differences in the preinjury FIM scores and scores at the time of discharge among these four groups of patients.

Between-group comparisons of JOA scores

The average postoperative JOA score was 42.4 ± 20.6 points (range 8–81 points), with male patients scoring an average of 42.3 ± 20.6 points (range 18–81 points) and female patients scoring an average of 42.9 ± 20.6 points (range 8–81 points). In terms of postdischarge residence, the average postoperative JOA scores were as follows: group A 50.5 ± 20.5 points (range 17–81 points); group B 28.8 ± 8.5 points (range 18–41 points); and group C 23 ± 5 points (range 8–28 points). The average postoperative JOA score for groups B and C was significantly lower than that for group A ($p < 0.05$), and there was no significant difference between groups B and C (Table 6). A significant correlation was observed between the FIM and the JOA scores ($r = 0.853$) ($P < 0.05$) (Fig. 2).

Table 6. JOA hip scores at the time of discharge

	Group		
Category	A	B	C
JOA hip score	50.5 ± 20.5*,**	28.8 ± 8.5*	23.0 ± 5.0**

* $P < 0.05$ (A vs B); ** $P < 0.05$ (A vs C)

Table 7. Change in FIM scores among dementia patients in group A

	Non-dementia	Dementia
Difference between pre-injury and discharge FIM	7.7 ± 14.8	31.2 ± 26.3*

Mini-Mental State Examination (MMSE) <24 determined the diagnosis of dementia
* $P < 0.01$ (Non-dementia vs Dementia)

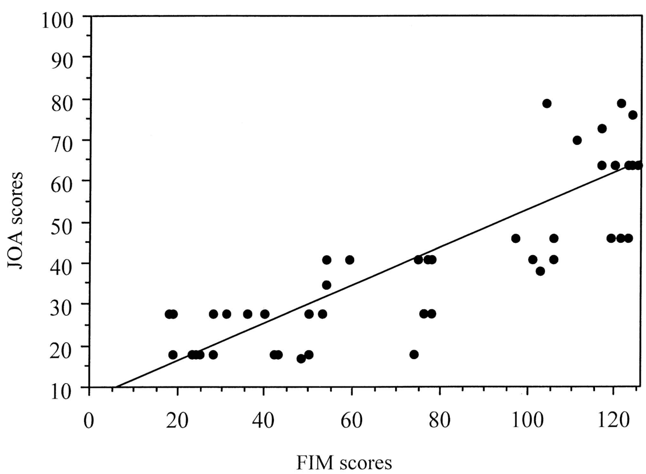

Fig. 2. A relationship between the FIM and Japan Orthopaedic Association (JOA). There was a significant correction ($r = 0.853$; $P < 0.05$)

Change in FIM scores of patients with dementia

Thirteen patients (29%) in group A and all patients in groups B and C had preoperative dementia. The difference between the preinjury FIM scores and the FIM scores at the time of discharge in group A was 31.2 ± 26.3 points in patients with dementia ($n = 36$) and 7.7 ± 14.8 points in patients without dementia ($n = 32$). the FIM scores were significantly lower ($P < 0.01$) in patients with dementia (Table 7).

Discussion

One of the purposes of treating a hip fracture is to prevent patients from becoming bedridden and to improve the quality of ADL, even if only a slight improvement is possible. To these ends, it is necessary to make the patients arise from bed as soon as possible after surgery, to encourage them to sit in a wheelchair, and to prevent complications such as pneumonia, urinary tract infection, and bedsores. In the present study, discharge from hospital was regarded as the endpoint.

In Japan, there are no standardized criteria for determining when patients can be discharged following surgery for hip fracture. In general, physical therapy and occupational therapy are carried out to improve transfer ability or walking ability, to determine a general discharge date, and to decide the postdischarge residence based on the acceptance of family members caring for the patient after discharge and in consideration of the short-term nature of hospitalization. When determining the postdischarge place of residence for patients with hip fracture, it is necessary not only to quantify patient disability but also to take into account the family, living, economic, individual, and social factors. In such a study design, the change in the FIM may lack validity in some aspects. Therefore, it is necessary to develop a valid discharge index and to determine the postdischarge residence using a method free from subjectivity.

Previous studies listed walking ability, dementia, age, and complications before and after injury as influencing factors when selecting the postdischarge residence for patients with hip fractures.[3,4,6,7,9] However, in ADL, it is necessary to evaluate all items except walking ability. For the ADL evaluation, the Barthel Index has been used extensively in cerebral stroke patients, though it is necessary to perform more detailed evaluations of ADL by adding consideration of communication, cognition, and action to the Index.[17] In regard to these factors, the FIM is the most useful method of evaluation.[18,19]

In patients who transferred to facilities, the FIM was already significantly reduced in each item of motor function or cognitive function before injury when compared with patients who returned to their own home after discharge. Thus, patients who transferred to facilities are likely to have reduced ADL before injury.

Evaluation of the ADL of patients before and after surgery using the FIM clarified that motor function was reduced. With regard to the difference in motor function before injury and at the time of discharge, the FIM was significantly reduced in patients who required transfer to a facility when compared with patients who returned to their home after discharge.

With regard to cognitive function, there is no evidence that the scores were reduced after surgery, and there was no difference in the preinjury FIM scores and scores at the time of discharge. Cognitive disorder, or more specifically dementia, did not progress during the short period after the development of hip fracture. Moreover, none of the patients without dementia before surgery developed dementia after the hip fracture (Fig. 1). Differences between preinjury total FIM and total FIM at the time of discharge in patients with dementia and in those without dementia revealed that patients with dementia showed a significant reduction when compared with those without it. The FIM scores revealed that the reduction in ADL after hip fracture is largely attributable to the presence or absence of dementia.

The most important factor in the classification of patients belonging to group B was insufficient family assistance. In other words, the postoperative reductions in not only locomotion but also self-care, transfer, and sphincter control were beyond the ability of families to care for their disabled family member. Consequently, the degree of the impact of surgery and rehabilitation on the place of postdischarge residence was low. Among the present patients with hip fracture, there was a significant correlation between the FIM and the JOA hip scores (Fig. 2), although it is difficult to evaluate the preinjury condition of each item of the JOA hip score for patients with hip fracture. Intervention during the early stages of rehabilitation involved encouraging patients with a hip fracture to sit in a wheelchair as soon as possible and to perform weight-bearing exercises. Physical therapy and occupational therapy were provided concurrently for all patients. The first goal of treating a hip fracture is the maintenance of mobility. Currently, we focus on stabilizing cognitive function with occupational therapy as much as possible. However, the difference between preinjury total FIM and total FIM at the time of discharge demonstrates that there is almost no change in cognitive function.

In this study, the difference in motor function in patients who returned to their home after discharge was 12.1 points. Limitations of current surgical treatments require that the assessment of patient disability occur as quickly as possible to establish effective rehabilitation programs that take into account family and social support systems. In addition to impairment and disability, the handicap is an important postoperative factor to consider. Accurate assessment of impairment and disability is necessary, and the results of such assessments need to be reflected in the rehabilitation program by assessing family, living, economic, individual, and social background factors. This applies to all orthopedic surgeries.

Motor function scores on The FIM make it possible to determine whether such patients should be discharged to their home or transferred to a care facility. Motor function scores on the FIM are valid for assessing hip fracture patients and may be suitable as a standardized procedure for determining postdischarge residence.

Conclusion

We discussed the prognosis and ADL of patients with hip fracture using the FIM instrument. Patients who suffered a hip fracture while living in their own home but who were later transferred to facilities for living already had reduced ADL before the hip fracture occurred. Motor function scores on the FIM are valid for assessing hip fracture patients and may be suitable as a standardized procedure for determining postdischarge residence.

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