ADL Restored Independently by Rehabilitation in the Patients with Femoral Bone Fracture

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Abstract

Objective: Rehabilitation achievement can assist recovery from acute fracture to the level of routine activities of daily living.

Design: The study designed to analyse existing indicators of Functional Independence Measure (FIM) for rehabilitation effectiveness and efficiency by gaining functional activity in patients with femoral bone (HIP) fracture.

Setting: Optimum level (more than two hours per day including morning and afternoon session) of physical exercises, advancement health care nursing services, and motivation, keeping up satisfied environmental conditions of rehabilitation.

Participants: Among 483 patients who were admitted with HIP fracture between January, 2017 and January 2019, 309 patients who had rehabilitation between 20-90 days without other exclusive comorbidities to hamper the exercise were analysed.

Interventions: Not applicable.

Results: The average motor FIM (mFIM) score on admission was 41.8 ± 0.7 that indicated the 13 individual mFIM average score were 3.2. The individual mFIM score required 6 for performing daily activity independently.

Main Outcomes Measures: Achievement of the average mFIM score were 74.1±1.0 which implied the individual mFIM score average was 5.7 at discharge. The rehabilitation effectiveness of mFIM was 68.9 ± 1.4, cFIM was 39.6 ± 2.3 and tFIM was 66.2 ± 1.5. Circadian functional efficiency of rehabilitation was 0.51 ± 0.01 for mFIM, 0.07 ± 0.00 for cFIM and 0.58 ± 0.02 for tFIM.

Conclusion: The rehabilitation data implies that the motor function of FIM improved satisfactory and equally well even the senior group of patients (>70 y/o) as well as the cognitive function of FIM during the hospitalization, and that most of the patients were able to perform daily activities independently at home. Furthermost important factor was that 72% of patients were able to return to their home.

Key words:

Femoral bone fracture; Functional independence measurement (FIM); Activities of daily living (ADL); Rehabilitation effectiveness (REs)

Abbreviations mFIM: motor FIM; cFIM=cognitive FIM; tFIM=total FIM; AFG=Absolute functional gain; RFG=Relative Functional Gain; Rey=Rehabilitation Efficiency; LOS-EFF=Length-of-stay efficiency; Adm-FIM=Admission FIM; DC-FIM=Discharge FIM

Introduction

Bone fracture is a universal problem, especially in elderlies. A femoral fracture is a partial or complete, and solitarily or manifold breaks in the bone. Worldwide, a fragility fracture is estimated to occur every 3 seconds. This amounts to almost 25,000 fractures per day or 9 million per year [1]. Fragility fractures usually occur as a result of a fall from standing height, and are common; 1 in 2 women over 50 years of age will suffer one and 1 in 5 men [2-4]. Particularly, hip fracture remains a major socio-economical problem [5]. After a hip fracture, around 80% of patients were unable to carry out at least one independent activity of daily living (ADL) [6], and might cause permanent disability and dependency, with a mortality rate of 20% to 30% during the first year after the fracture [7].

Rehabilitation is a goal-oriented and time-limited process that focuses on making a functionally impaired person reaches an optimal mental, physical and social level [8]. Even though the principal goals of management are a return to a pre-event functional level and the

prevention of recurrent fractures, 50% of survivors fail to regain their former levels of autonomy and mobility [7]. Exercise has been shown to be helpful in reducing impairments, functional limitations, and disability in elderly people who are healthy [9-11]. The Functional Independence Measure (FIM) [12] is a technique used for evaluating activities of daily living (ADL). Improvement of ADL is used to compare the outcomes of FIM. The results of FIM indicate to what extent an individual is capable of independent ADL.

The purpose of present studies is to evaluate the level of functional independence of daily life by active rehabilitation. We determined functional gains by using the parameters calculated from the FIM.

Methods

Study population

In this study we collected the data from 483 patients with femoral hip fracture who were admitted at Seisei Rehabilitation Hospital (in Shizuoka, Japan) between January 2017 and January 2019, and selected 309 patients from them for analysis whose age were over 21 years old without dementia and hospitalization period were 20-90 days. One hundred fifty eight patients (27 patients who stayed <20 days and 131 patients who stayed >90 days, and 16 patients associated with other medical complications, socio-medical and/or financial reasons) were excluded (Table 1).

1	No. of patients total	483
2	No. of patients of analytical group (20-90days for rehabilitation)	309
3	No. of patients of non-analytical group	158
i)	No. of patients of non-analytical group (<20days for rehabilitation)	-27
ii)	No. of patients of non-analytical group (>90days for rehabilitation)	-131
4	No. of patients associated with other medical complications	16

Table 1: Study population

Classification of femoral bone fracture

1	Femoral bone neck fracture	177
i).	Right neck fracture	118
ii).	Left neck fracture	59
2	Femoral bone trochanteric fracture	103
i).	Right trochanter fracture	43
ii).	Left trochanter fracture	60
3	Femoral bone shaft fracture	29
	Total	309

Table 2: Classification of femoral bone fracture

Herein the femoral fracture was mainly classified as three groups which was subjected; i) neck fracture 177 patients; including right femoral neck 118 patients and left femoral neck 59 patients, ii) femoral trochanteric fracture 103 patients; including right femoral trochanter

43 patients and left femoral trochanter 60 patients, and iii) as femoral shaft fracture were 29 patients (Table 2).

Rehabilitation practices

Method of rehabilitation practices and instruments are described in the Table 3.

Item No. & Abbreviated Description	Explanation of Rehabilitation Plan
i) Type of exercise and equipment	HUR：Finland, Inter Reha Co. (www.irc-web.co.jp) Red Cord: Norway, Inter Reha Co. (www.irc-web.co.jp) Ergometer & Treadmill: USA, Inter Reha Co (www.irc-web.co.jp)
ii) Qualification, teaching/ supervising experience	Therapists are required to have education and practical training which are given for 3-4 years at the college or junior college, and license after national examination as the therapists. In hospitals, young therapists are generally required further practical training under senior therapists for a couple of years.
iii) Way of exercise performance	Rehabilitation is performed with 3 sets of exercise, cognitive and/or speech training with short time of intermissions every 20 minutes in the morning and in the afternoon, under one-to-one supervision for each patient, totally more than 2 hours every day, all year around.
iv) Supervision of exercise	Each patient performs exercise under supervision of the individual therapist who is further supervised by the senior therapist.
v) Measurement and reporting system of rehabilitation	Exercise log and next plan are recorded every month in patient's medical record, and the results were explained to the patient/family at each step. At the same time, future exercise plan and/or suggestions about home renovation if necessary.
vi) Motivation up	After patients have the periodic checks of muscle strength and balance capability, the results were explained with figures and graphs to understand easily, and they are encouraged to precede to the next level the rehabilitation training.
vii) Indicator of step up	Depending on the result of periodic checks of muscle strength and balance test performed every 2 weeks, and the degree of improvement on FIM parameters are indicators to go to the next stage.
viii) Illustration of exercise plan	We use the QOLCP (Quality Of Life Continuing Plan) which illustrates muscle strength and balance in the circle diagram and the ladder. This 'Rehab-note' with QOLCP makes to understand the degree of physical ability and improvement visually and easy to understand for the patient and the family.
ix) Content of home program	In the regular conference performed every 3 weeks, therapists and physicians discuss about the post-discharge program with information of therapists and/or social workers who visited the patients' house and assessed the home condition.
x) Non-exercise components	Many elderly patients (average age are approximately 77 years) have various life-related disease, and some related advise about these diseases are given by the physician and nursing staffs, other than the daily activities.

xi) Adverse events	Incidents/accidents during the rehabilitation are only few, usually falling or slipping at the time of transposition between the bed and the wheelchair.
xii) Setting in which exercise are performed	All floors from the 3rd to 7th floor (250 beds in total) were set up for the purpose of rehabilitation of the patients with bone fracture and cerebrovascular accidents, with the same type of rehabilitation machines and equipment.
xiii) Content of exercise	Each patient undertakes rehabilitation with the supervision of individual therapist 1-to-1under the senior therapist. One unit of exercise is 20 minutes.
xiv-xv) Tailored program for the individual patient and starting level for exercise	After obtaining the clinical data from the referred acute hospital and the initial evaluation of physical evaluation performed at our hospital, the therapists select the appropriate type of exercise and its level and frequency for rehabilitation according to the order of physician.
xvi) Evaluation of rehabilitation	Daily evaluation after each exercise and cognitive training, minor modifications was added to the exercise schedule, but if major modifications were required, they would discuss the matter with the physician each time other than regular conference.

Table 3: Rehabilitation practices

Assessment of motor and cognitive functional status

We used the FIM for the assessment of motor and the cognitive functions [13]. Patients were evaluated on admission and before discharge by the same rehabilitation team (composed of a physician and a group of nurse, physiotherapist, occupational therapist, speech therapist and nutritionist).

Mathematical analysis

We designed correlation coefficient for categorical variables, and the descriptive statistics for continuous variables.

For mathematical analysis as defined as below, we used; (i) absolute functional gain (AFG) [14]: AFG≥20 was considered a clinically important difference [15], (ii) rehabilitation effectiveness (REs) [16] or relative functional gain (RFG) shows the percentage of the premorbid functional capacity recovered at discharge, in relation to what had been lost on admission to rehabilitation hospital [17-19]. A RFG ≥35 % means that the patient has recovered at least one third of the functional loss observed [20-22], (iii) rehabilitation efficiency (REy) and/or length-of-stay efficiency (LOS-EFF) [16] for dependent variables. REy index shows functional gain per day [17,21].

$$AFG = (DC - Adm)FIM$$

$$REs = \frac{(DC - Adm)FIM}{(Max - Adm)FIM}X100\%$$

$$REy = \frac{(DC - Adm)FIM}{(DC - Adm)Date}$$

Adm: Admission, DC: Discharge

Results

Demographics of the patients with hip fracture

Average age of the whole group was 81.8 ± 0.5 (21-98) years old, comprised of 95 (30.7%) male and 214 (69.3%) female patients. The average number of days from injury to surgery was 4.9 ± 0.3, and of surgery to rehabilitation hospitalization was 22.6 ± 0.8. The average number of days from rehabilitation hospitalization to discharge was 75.0 ± 1.3 (Table 4).

1	Age range (years)	21-98
2	Mean age ± SD (years)	81.8 ± 0.5
3	Male	95 (30.7%)
4	Female	214 (69.3%)
5	Average number of days from injury to surgery	4.9 ± 0.3
6	Average number of days from surgery to rehabilitation hospitalization	22.6 ± 0.8
7	Average number of days from rehabilitation hospitalization to discharge	75.0 ± 1.3

Table 4: Demographic information of HIP fracture patients

Factors that influence ADL improvement

We analysed FIM due to the main outcome for evaluation of activities of daily living (ADLs). FIM is one of the established systems for assessing the level of disability to perform safely as (mFIM): self-care (6 items), sphincter control (2 items), mobility (3 items), locomotion (2 items) and (cFIM): communication (2 items), and social cognition (3 items). The average mFIM score on admission was 41.8 ± 0.7, and that score at discharge was 74.1 ± 10, consequently, the percentage of improvement was 77.3, the average cFIM score on admission was 24.6 ± 0.4, and the average cFIM score at discharge was 28.9 ± 0.4, subsequently, the percentage of improvement was 17.5 and the average tFIM score on admission was 66.4 ± 1.0, and the average tFIM score at discharge was 103.0 ± 1.3 with the percentage of improvement was 81.7% (Table 5).

FIM	Mean	Standard Deviation	Confidence Level (95%)
mFIM			
Adm	41.8 ± 0.7		
DC	74.1 ± 1.0		
Gain	32.3 ± 0.7	12.0	1.3
cFIM			
Adm	24.6 ± 0.4		
DC	28.9 ± 0.4		
Gain	4.3 ± 0.3	4.7	0.5
tFIM			
Adm	66.4 ± 1.0		
DC	103.0 ± 1.3		
Gain	36.6 ± 0.8	14.2	1.6

Table 5: Factors that influence ADL improvement

The absolute functional gain

The absolute functional gain (AFG) was calculated as previously described in the method. The average AFG; mFIM was 32.3 ± 0.7, cFIM was 4.3 ± 0.3, and total FIM was 36.6 ± 0.8 along with the standard deviation were 12.0, 4.7, and 14.2 as well as the confidence level of 95% were 1.3, 0.5 and 1.6, respectively for mFIM, cFIM and tFIM (Table 5). The percentile rate of improvement of AFG was also analysed that showed mFIM 35.5%, cFIM 12.3% and tFIM 26.6% (Figure 1).
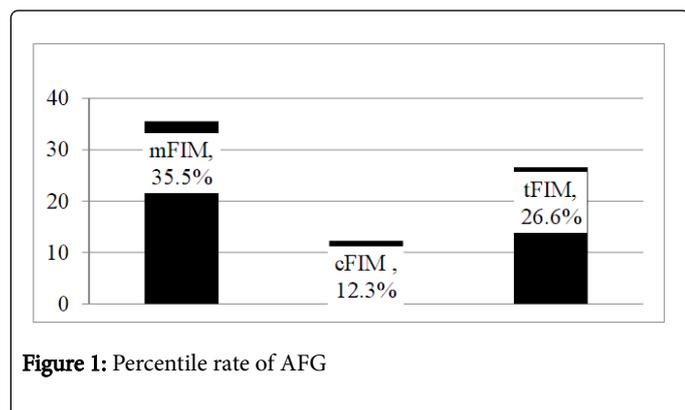

Figure 1: Percentile rate of AFG

A correlation coefficient was observed during hospitalization between admission FIM and discharge FIM. The linear relation was $R^2=0.61$ (Figure 2) which supposed to be relatively good correlation for functional independence.
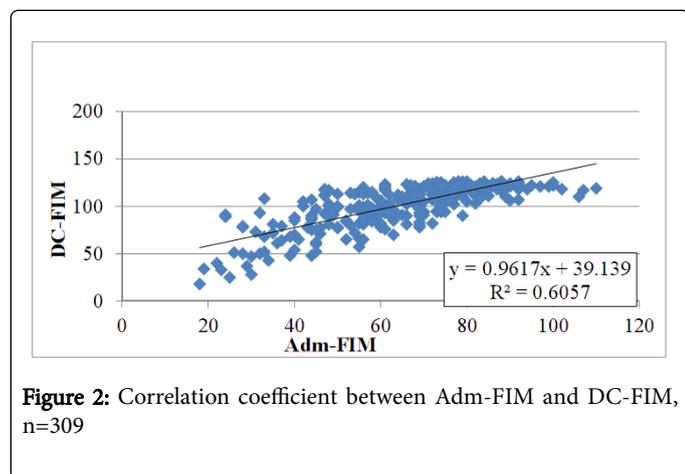

$$y = 0.9617x + 39.139$$
$$R^2 = 0.6057$$

Figure 2: Correlation coefficient between Adm-FIM and DC-FIM, n=309

Relative functional gain

FIM	Mean	Standard Deviation	Confidence Level (95%)
Rehabilitation Effectiveness (REs)			
mFIM	68.9 ± 1.4	25.2	2.8
cFIM	39.6 ± 2.3	40.6	4.5
tFIM	66.2 ± 1.5	26.1	2.9

Table 6: Relative functional gain

Rehabilitation effectiveness (REs) quantified as a percentage reflecting the proportion of potential improvement categorically attained during rehabilitation, it was calculated using the formula (ii). The average (REs) was 68.9 ± 1.4 for mFIM, 39.6 ± 2.3 for cFIM and 66.2 ± 1.5 for tFIM, whereas the standard deviation was 25.2, 40.6 and 26.1 respectively for mFIM, cFIM and tFIM (Table 6).

Functional efficiency of rehabilitation

Finally, the REy values suggested that circadian functional efficiency of rehabilitation was performed moderately. The average rehabilitation efficiency was 0.51 ± 0.01 for mFIM, 0.07 ± 0.00 for cFIM and 0.58 ± 0.02 for tFIM while the standard deviations were 0.29, 0.09 and 0.33 respectively for mFIM, cFIM and tFIM (Table 7).

FIM	Mean	Standard Deviation	Confidence Level (95.0%)
Rehabilitation Efficiency (REy)			
mFIM	0.51 ± 0.01	0.29	0.03
cFIM	0.07 ± 0.00	0.09	0.01
tFIM	0.58 ± 0.02	0.33	0.04

Table 7: Circadian functional efficiency of rehabilitation

Classified as age

Further we classified the cases into two groups depending on the age, the junior group<70 years old (45 patients) and the senior group ≥ 70 years old (264 patients). As illustrated, individual parameters of FIM scores indicated that all parameters improved by rehabilitation in both group, but the percentage improvement belonging to the senior group showed better in 8 parameters among thirteen parameters of FIM (Figure 3).
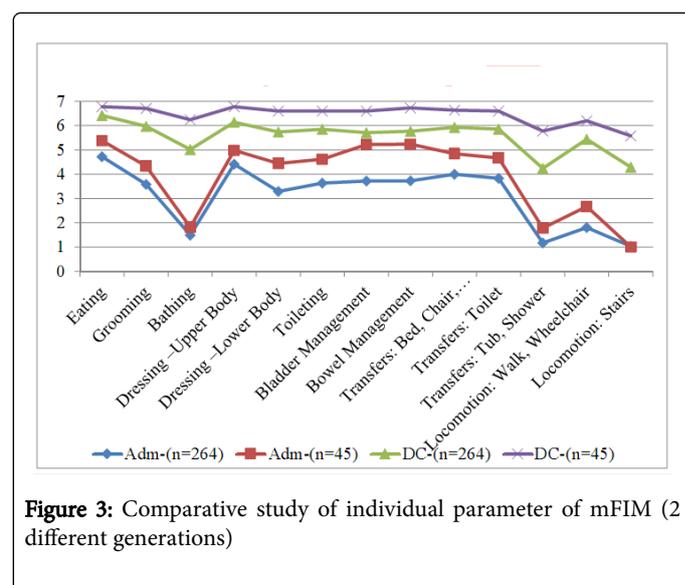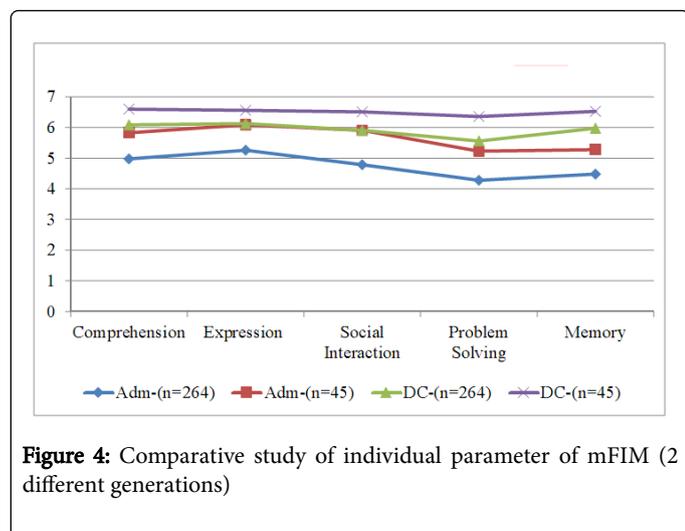

Figure 3: Comparative study of individual parameter of mFIM (2 different generations)

Obviously, the patients in the good initial functional state would have high capacity rather than those in the worse initial functional state for recovery. The individual parameters of cFIM demonstrated that the regaining scores of the junior group were clearly higher than those of the senior group, but the percentages of improvement rate were higher in senior group comparatively (Figure 4).

Figure 4: Comparative study of individual parameter of mFIM (2 different generations)

Factors that influence discharge to home

After distinguishable improvement associated with active rehabilitation (more than two hours per day including morning and afternoon session) with physical exercises, encouragement, virtuous health care nursing services, as well as pleasing eco-friendly environments of rehabilitation the destined patients; 72% returned to their home, 17% returned to elder health care centre, 7% returned to acute care hospital and 4% moved in various places (Figure 5).
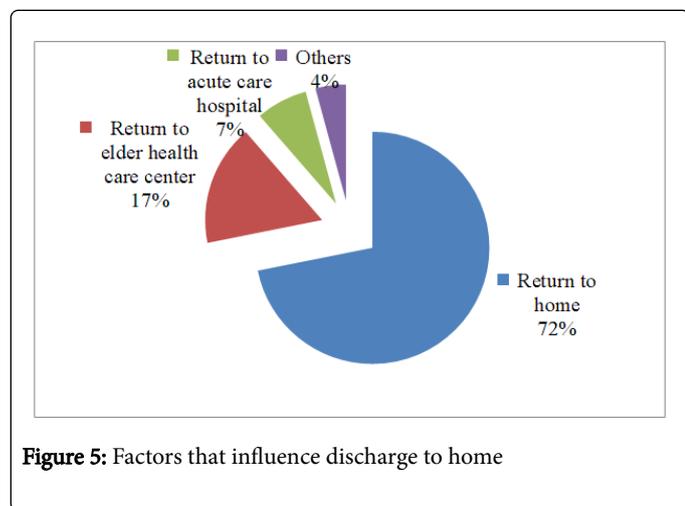
Figure 5: Factors that influence discharge to home

Discussion

Rehabilitation achievement is defined by restoration of ability to perform various routine works of activities of daily living. FIM motor outcomes differ due to cognitive and patient's background characteristics; (we hypothesized that whether the rate of improvement is associated with motivation, advancement health care nursing services, personnel and socio-economical, optimum practices of rehabilitations as well as pleasing environmental conditions that will be raised up to 80% and the absolute gain of overall motor FIM rate will be elevated to 40% and the functional effectiveness of motor FIM frequency will be upraised to 70% on the basis of age and sex) after average 12 weeks of rehabilitation during the hospitalization. The present study was analysed 309 patients, comprised of 95 (30.7%) male and 214 (69.3%) female with femoral hip fracture demonstrated significant improvement existing indicators of physical rehabilitation effectiveness and efficiency by gaining functional activity absolutely. All the patients were admitted on a wheelchair and/or bed with the motor dysfunction. The average mFIM score were 41.8 ± 0.7 which included the individual mFIM average score was 3.2 on admission. The individual mFIM graded 1~7 score for individual performance independently. Herein we achieved the average mFIM score were 74.1 ± 1.0 which included the individual mFIM average were 5.7 at discharge. The average functional gain was 32.3 ± 0.7 for mFIM as well as 4.3 ± 0.3 for cFIM, therefore, the total functional independence measure was 36.6 ± 0.8 clearly. The rehabilitation effectiveness of mFIM was 68.9 ± 1.4, cFIM was 39.6 ± 2.3 and tFIM was 66.2 ± 1.5. Circadian functional efficiency of rehabilitation was 0.51 ± 0.01 for mFIM, 0.07 ± 0.00 for cFIM and 0.58 ± 0.02 for tFIM and 72% patients were able to return to their home at discharge.

Conclusion

It is noticeable that the frequency of improvement rate most of the individual parameters belonging to the senior group were demonstrated significantly impressible along with the junior group in both part of the motor and cognitive FIM although the factors of mental and emotional states were not functionally well at initial stage in hospitalization due to the over aged (average age was 81.8 ± 0.5 years of old). Overall, this finding strongly suggests that the function of FIM improvement due to active rehabilitation during the hospitalization make them to be able to perform the activities of daily life independently at home.

Disclosure Statement

The authors declared no conflicts of interest.

Acknowledgements

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