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# Effectiveness of Post-Acute Rehabilitation on Functional Outcome after Hip Fracture


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Original Article

# Effectiveness of Post-Acute Rehabilitation on Functional Outcome after Hip Fracture

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Objective: We investigated the effectiveness of functional recovery after 2-week post-acute rehabilitation in elderly people with hip fractures.

Design: We divided the patients (N = 129) into 2 groups: the post-acute care (PAC) group (N = 90) that received 2-week in-hospital rehabilitation and the control group (N =39) that were discharged immediately. Outcomes were measured according to the Barthel Index (BI) score.

Results: The BI scores at 2 weeks, 3 months, and 6 months were higher in the PAC group than those in the control group, especially for transfer and mobility. Males, aged less than 80 years old, or who had received hemiarthroplasty showed more improvement than that of the other patients. Patients with moderate initial functional status showed the most improvement after receiving the PAC program. All patients in the control group showed decreased BI scores after discharge.

Conclusion: Functional recovery in patients with hip fracture was significantly better in the PAC group, especially for ambulation and transfer. ( Tw J Phys Med Rehabil 2019; 47(1): 11 - 20 )

**Key Words:** Barthel Index; hip fracture; outcome; post-acute care; rehabilitation

## INTRODUCTION

Hip fracture is an important cause of mortality and disability in the elderly in Taiwan. The reasons are that elderly people have a major risk of hip fractures because of the increased incidences of osteoporosis and falls, and there is a high risk of mortality after hip fracture. [1]In 2013, the population aged >65 years was 2,694,406 in Taiwan, which was 11.52% of the total population.As the mean age of the population increases, the number of hip fractures will continue to increase. Additionally, numerous studies have reported a high risk of mortality after hip fracture. [2-6] Therefore, methods to decrease mortality and increase functional recovery after hip fracture are an important area of research.

A meta-analysis and a randomized control trial have shown that extended exercise programs had a positive impact on physical function.[7-8] However, those studies focused on out-patient rehabilitation and home-based programs. There has been no randomized controlled trial that has investigated the effects of in-patient rehabilitation

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programs after hip fracture.

A retrospective study in Taiwan revealed a low rate (32.8%) of in-patient rehabilitation after hip fracture.[9]This low rate can be explained by the fact that the National Health Insurance in Taiwan does not pay for in-patient rehabilitation after hip fracture. Therefore, only patients with multiple comorbidities receive in-hospital rehabilitation. Very few randomized controlled trials have investigated early interdisciplinary rehabilitation after hip fractures, and in 1such trial, the effects could not be clearly demonstrated.[10]

The primary goal of this study was to determine the effects on functional recovery of a post-acute rehabilitation program in patients with hip fractures to persuade the National Health Insurance program to contain the cost of rehabilitation for hip fractures. The secondary goal was to investigate factors that might influence functional recovery, such as sex, age, surgery type, and initial functional status.

## MATERIALS AND METHODS

This study was a prospective, case control trial with 2 groups: the post-acute care group (PAC) that received in-hospital comprehensive rehabilitation for 2 weeks and the control group that did not receive any in-hospital rehabilitation. The PAC group received rehabilitation through a program administered by the Taipei City Hospital Yang Ming Branch. The comprehensive in-hospital rehabilitation program included general lower limb exercise training, activities of daily living (ADL) training, and an educational program on self-management. This study was approved by the ethics committee of Taipei City Hospital (TCHIRB-1020430) and was registered as a clinical trial (NCT 01934946).

### Participants

The participants were patients initially recruited from all branches of Taipei City Hospital and Taipei Veterans General Hospital. All patients had just been discharged from the hospital after acute hospital care. All of the eligible patients had to (1) have a primary diagnosis of hip fracture, (2) have been discharged from an orthopedic ward and have received surgery of hemiarthroplasty or open reduction with internal fixation (ORIF), (3) be ≥65 years, (4) have functional impairment, (5) have stable vital signs and no need for invasive and progressive treatment, and (6) be willing to participate and give consent.

Patients were excluded if they met any of the following criteria: (1) any severe neuromuscular disease (such as stroke and spinal cord injury) known to influence physical function; (2) had medical contraindications for exercise, such as severe heart failure and active cancer; (3) could not understand the verbal instructions of study procedures.

The patients were divided into 2 groups. The assignment of the patients to the groups depended on their medical condition after surgery as determined by the initial hospital and the willingness of the patients and their family to receive post-acute hospitalization.

A total of 310 patients were enrolled in this study; 154 did not meet the inclusion criteria and were excluded. The remaining 156 patients were divided into 2 groups. The PAC group included 115 patients, and the control group included 41 patients. During hospitalization of the PAC group, unexpected medical problems developed, which contributed to some patients dropping out of the PAC plan:5 patients with nosocomial infections, 17 patients who wished to be discharged halfway, 1 patient with a heart problem, 1 patient diagnosed as having lung cancer, and 1 patient who was referred to the gynecology ward for managing prolapse of the uterus. Therefore, 25 patients dropped out in the PAC group and 2 patients technically dropped out of the control group because they were lost to follow-up (Figure 1).

### Measurement

The BI was evaluated 4 times in both the PAC group and control group: immediately after surgery (baseline), 2 weeks after rehabilitation in the hospital, and 3 and 6 months after discharge.

The PAC group was divided into 3 subgroups according to the initial Barthel Index (BI) scores, which included mild (40–60), moderate (20–39), and severe (<20) groups. We used the functional index (FI) to compare the improvement in the severity of the different groups. The FI value was calculated according to the following formula:

$$\frac{\text{4th BI score - 1st BI score}}{\text{100 - 1st BI score}} \times 100\%$$

to determine the degree of improvement in ADL. We also analyzed the improvement in each specific item of the BI in the PAC group and control group.

## Statistical Analysis

Statistical analysis was performed by using IBM SPSS v21 and Student's *t*-test, analysis of variance (ANOVA), Pearson's chi-square test, logistic regression, and the generalized estimating equation (GEE). The GEE was performed specifically for longitudinal data to analyze the factors associated with patients' ADL by inputting four measured BI scores as independent variables. All p values <0.05 were taken as indicative of statistical significance.

Table 1. Demography of hip fracture patients (n=129)

| | | PAC | | Control | | p value |
|---|---|---|---|---|---|---|
| Gender | | n | % | n | % | |
| | male | 41 | 45.60% | 14 | 35.90% | p=0.205 |
| | female | 49 | 54.40% | 25 | 64.10% | |
| Age | | 81.3±7.1 (year) | | 81.8±8.9 (year) | | |
| | 65-80 | 38 | 42.20% | 15 | 38.50% | p=0.421 |
| | ≥80 | 52 | 57.80% | 24 | 61.50% | |
| Stay days | | 14.9±4.3 | | 0 | | |
| Surg form [a] | | | | | | |
| | ORIF | 39 | 43.30% | 23 | 56.70% | p=0.041 |
| | hemiarthroplasty | 51 | 56.70% | 14 | 37.80% | |

[a] There was no surgical form obtained in 2 participants.

Table 2. Longitudinal tracking of Barthel index with PAC patients characters by GEE method

| | beta | 95% Wald CI | aOR (*Exp*(B)) | p value |
|---|---|---|---|---|
| Gender | | | | |
| Male | 1.7 | (-2.31~5.73) | 5.5 | p=0.404 |
| Female | 0[a] | | 1 | |
| Age | | | | |
| 65~80 | 2.85 | (-1.24 ~ 6.94) | 17.3 | p=0.172 |
| ≥80 | 0[a] | | 1 | |
| Surg Form | | | | |
| ORIF | -2.94 | (-6.79~0.91) | 0.1 | p=0.134 |
| Hemiarthroplasty | 0[a] | | 1 | |

Longitudinal tracking 4 times for PAC defined as admission, 2w, 3m, and 6m.

Table 3. FI value of three different initial status

| Initial Status (1st Barthel index) | Control (n=39) | PAC (n=89) |
|---|---|---|
| Severe (<20) | -11.7% (n=5)[a] | 90.5% (n=58)[c] |
| Moderate (20~39) | -17.3% (n=17)[a] | 97.2% (n=25)[c] |
| Mild (40~60) | -43.6% (n=17)[b] | 94.2% (n=6)[c] |
| p value | p=0.035 | p=0.098 |

$$\text{FI value} = \frac{\text{4th time of BI - 1st time of BI}}{\text{100 - 1st time of BI}} \times 100\%$$

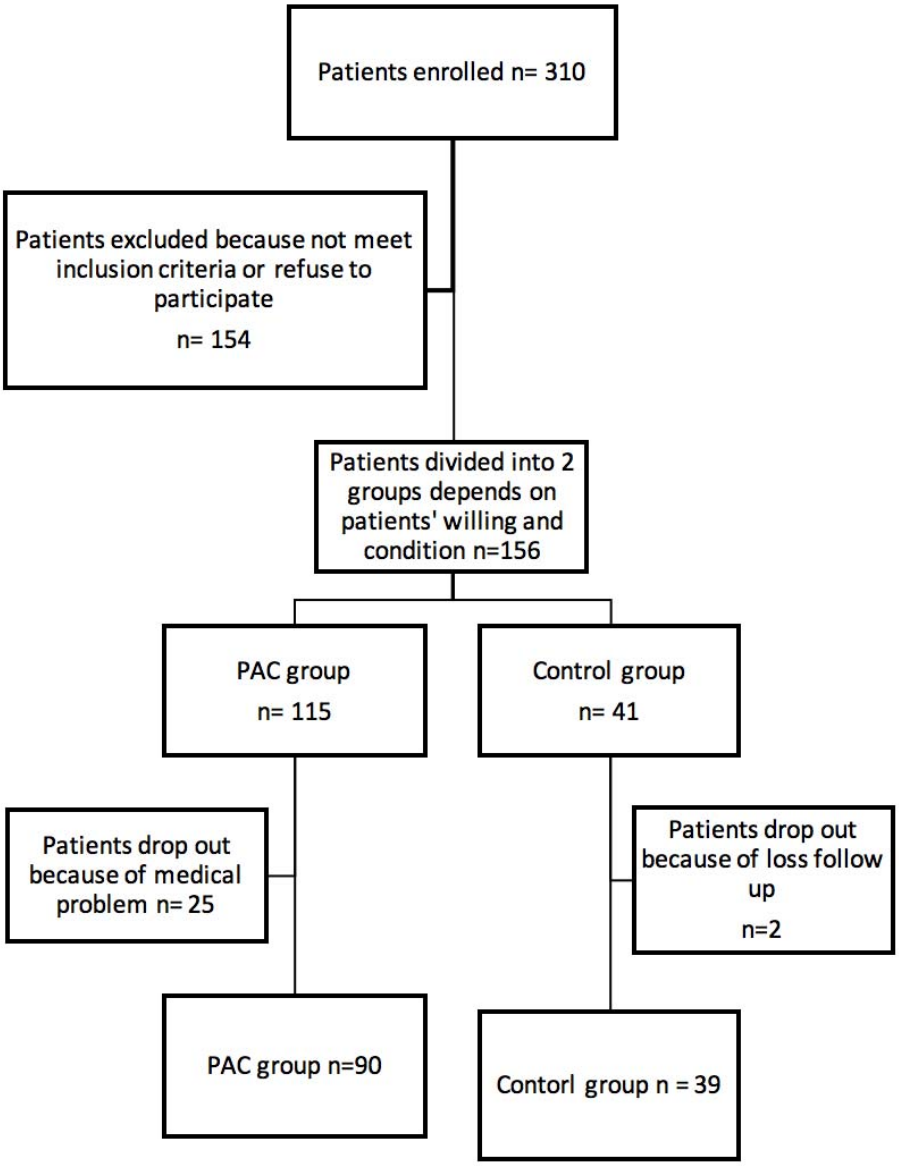


Figure 1. Flowchart of trials. One hundred twenty-nine patients were eligible for and completed the assessment in this study.

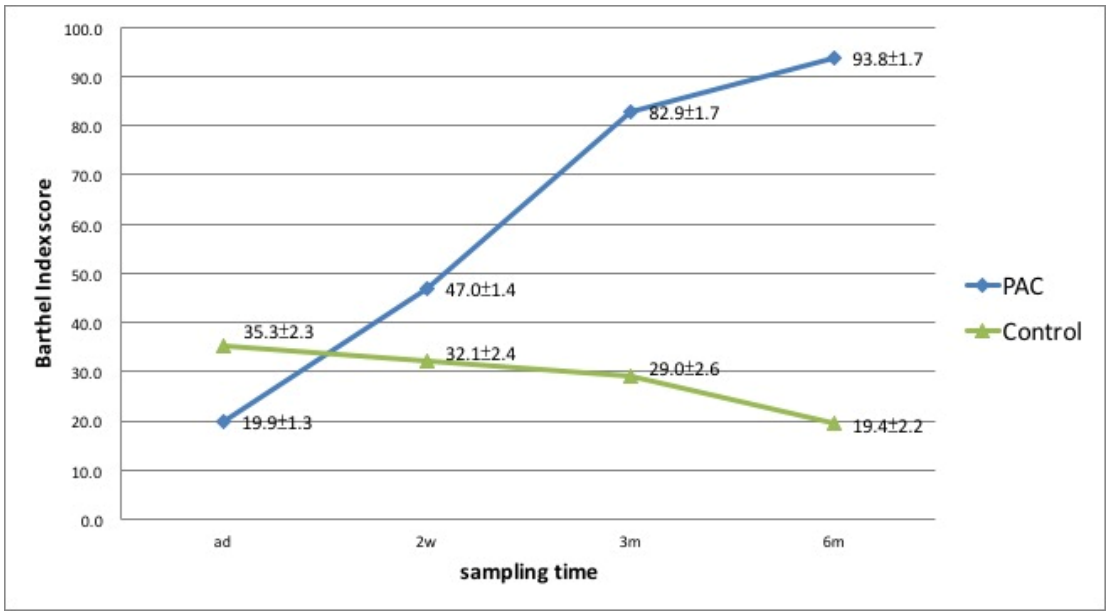


Figure 2. Comparison of the Barthel Index scores between the PAC and control groups. The improvement in functional outcomes in the patients with hip fracture is better in the 2-week PAC group than that in the control group at the 2-weeks, 3-months, and 6-months follow-up. Furthermore, the mean BI scores in the PAC group reached 93.8 points at the 6-month follow-up. On the other hand, the BI scores of control group decreased from the initial value of 3.3 point after discharge.

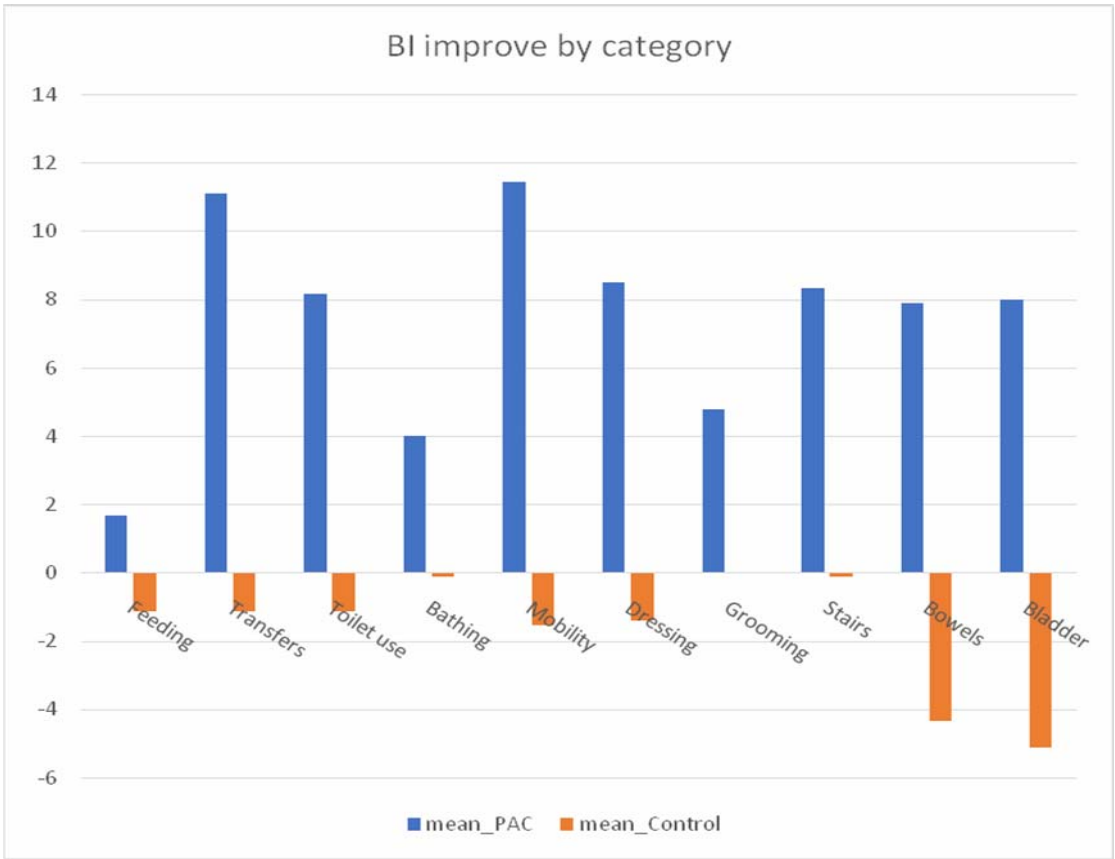


Figure 3. Degree of improvement in BI by category. The most improvement in the PAC group was observed for the items of transfers and mobility. In the control group, every BI item had decreased at the follow-up.

## RESULTS

A total of 129 hip fracture patients were included in this study. Among them, 90 patients received PAC rehabilitation, and 39 were discharged immediately (control group) after surgery without rehabilitation. Background demographic analysis revealed the proportion of the patients numbers between the PAC and control groups when they were stratified by sex, age, and surgery type (Table 1). The mean ages of the patients in the PAC and control groups were 81.3 ±7.1 and 81.8±8.9 years, respectively. There were no significant differences in the baseline data between the PAC and control groups.

There was a significant difference in the mean BI scores between the PAC group before and 2 weeks after in-hospital rehabilitation(19.9 points and 47.0 points, respectively) ($p<0.01$) (Figure 2). Furthermore, the mean BI score in the PAC group reached 93.8 points at the 6-month follow-up. On the other hand, the mean BI score of the control group was 35.3 points initially but decreased following discharge.

After longitudinal tracking for 3 time points(at 2 weeks, 3 months, and 6 months after discharge), the BI scores of the control group decreased to 19.4 points after 6 months (Figure 2). In the PAC group, a sub-analysis was performed. An advanced linear regression method, GEE analysis, was performed specifically for longitudinal data to analyze the influence of PAC on the patients' ADL by inputting BI scores measured at four time points as independent variables. GEE analysis indicated that the male patients (adjusted odds ratio; aOR=5.5; p=0.404) had a higher level of ADL than that of the female patients. The patients between 65 and 80 years old (aOR=17.3; p=0.172) had a higher level of ADL than that of those ≥80 years old. Comparing different hip fracture surgery types, recovery was better after hemiarthroplasty than after ORIF (aOR=0.1; p=0.134) although the difference was not statistically significant (Table 2).

In both the PAC and control groups, the initial functional statuses after surgery were stratified into 3 sub-groups: mild, moderate, and severe, using scores of BI. The extent to which functional status improved at 6 months after rehabilitation was also measured. The functional statuses for all 3 subgroups in the PAC group improved at 6 months after rehabilitation. The moderate functional status (BI = 20–39) subgroup of the PAC group showed the greatest improvement among the 3 subgroups at 6 months after rehabilitation. However, the BI scores for all subgroups in the control group decreased at 6 months after rehabilitation (Table 3).

We analyzed each specific item of the BI for both the PAC and control groups. The results showed that the most improvement in the PAC group was observed for transfers (mean increase = 11.11) and mobility (mean increase = 11.44). In the control group, all BI items showed decreased scores at the follow-up (Figure 3).

## DISCUSSION

This study showed that the improvement in functional outcome of the patients with hip fracture was better in the PAC group than in the control group at the 2-weeks, 3-months, and 6-months follow-ups (Figure 2), especially in the performance of mobility and transfers (Figure 3). On the other hand, in the control group, the BI scores significantly decreased at the 3 follow-up time points (Figure 2). Comprehensive rehabilitation training enhanced the function of ADL, and the educational program of self-management contained in the 2-week rehabilitation program might account for the continuing improvement after longitudinal tracking in the PAC group.

The current trend in rehabilitation medicine is to provide patients with comprehensive and multidisciplinary care in a hospital, and the benefit of this approach has been proved in many studies.[11-12] Many studies, including meta-analyses,have shown the positive effects of rehabilitation after hip fractures compared with the outcome without rehabilitation. The results of the present study are consistent with those of previous studies. Beaupre LA et al. reported a dose–response relationship between the intensity and duration of a rehabilitation program and the degree of functional recovery.[13]

Different protocols of rehabilitation programs have different outcomes. A protocol that focused on ambulation showed improvement in the 6-minute walking test score.[14] In our study, the goal of our rehabilitation services was to improve the patients' ADL. The exercise programs were individualized according to each patient's surgical type, comorbidity, previous condition, and

recovery pattern. The patients showed more improvement in mobility and transfer, which are relatively important for ADL independence, than in the other items (Figure 3). Gialanella B showed a similar outcome in basic ADL improvement; the highest efficiency and effectiveness in the motor-Functional Independence Measure scale was walking after an in-hospital rehabilitation program in elderly patients.[15]

In our subgroup analysis in the PAC group, males,less than 80 years old or who had received hemi-arthroplasty showed more functional improvement than that of the females, ≥80 years old or who had received ORIF (Table 2). Some studies have found no statistical difference in functional outcomes between males and females, and some have reported a higher mortality rate in males.[16-17] In our study, the functional outcome was better for males than for females in the PAC group, but the difference was not statistically significant. This finding was probably because the effect of the in-patient rehabilitation program decreased the difference in outcomes between the sexes in our study. Other studies did not include the effect of the rehabilitation program. Vergara I et al. reported that older patients, had a higher degree of comorbidity, and less educated were more likely to show deterioration in basal ADL and instrumental ADL performance.[18] Our study also showed that patients ≥80 years old had less functional improvement than that of those less than 80 years old. One meta-analysis[19] showed that patients who had undergone arthroplasty had a lower rate of subsequent reoperation at mid- and long-term follow-up and better mid-term functional recovery than that of those who had undergone internal fixation. In Taiwan, arthroplasty is not commonly used in patients with hip fracture, and therefore, patients who had received that treatment were not included in our study. We found that functional recovery was better for the patients who had undergone hemiarthroplasty than for those who had undergone ORIF. This result was consistent with that in the meta-analysis described above.

### Limitations

There were several limitations to the present study. First, the BI of premorbid status of the patients was not available. Second, this was not a double-blind study. The BI score of the control group was significantly higher than that of the PAC group at the initial time point (35.3 *vs.* 19.9 points) (p=0.037). However, the PAC group showed greater improvement despite the initial low BI value (Figure 2). Third, the demographic characteristics of participants could be better to include information of the participants' body height, body weight, BMI, length of stay before PAC treatment and co-morbidity (such as DM, hypertension, heart disease) of two groups.

## CONCLUSION

This study showed that the functional recovery in patients with hip fracture was significantly increased at 2 weeks after comprehensive rehabilitation relative to that of the control group. Furthermore, the improvement in patients with hip fracture was better in the PAC group than in the control group at the 2-weeks, 3-months, and 6-months follow-ups. The BI scores significantly decreased in the control group at the 6-months follow-up. Males, aged less than 80 years old or who had received hemiarthroplasty showed greater functional improvement than that of females, aged ≥80 years old or who had received ORIF. The moderate functional status subgroup measured at the initial evaluation showed the highest improvement among the 3 subgroups at 6 months after rehabilitation. The greatest improvement was observed in the BI items of transfers and mobility.

Further studies that include information regarding health status and cognition function before hip fracture are mandatory because these premorbid conditions could affect rehabilitation outcomes.[20-21] Home-based rehabilitation programs also have been shown to have positive effects on patients after hip surgery.[22]These additional studies can focus on comparisons between in-hospital rehabilitation and home-based rehabilitation programs.

## ABBREVIATIONS

PAC = Post-acute care; BI = Barthel index; FI = functional index; GEE = generalized estimating equation; aOR = adjusted odds ratio; ORIF= open reduction and internal fixation; ANOVA = analysis of variance; ADL = activities of daily living.

## DISCLOSURES

The author reports no conflicts of interest in this work. This manuscript was edited by Enago Academic Editing.

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# 急性後期復健對於髖關節骨折術後功能恢復的功效

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目的：本篇主要研究老年人的髖關節骨折經過兩週的急性後期復健訓練後的功能恢復。

研究設計：我們將 129 位病人分成兩組: 一組爲急性後期照護組(90 位)，將接受兩週的住院復健訓練；另一組爲控制組(39 位)爲立即出院，利用巴氏量表分數來評估結果。

結果：研究發現在第二週，第三個月與第六個月追蹤的巴氏量表分數，急性後期照護組比起控制組的分數較高，特別是在轉位與平地行走的部分。此外，男性、年紀小於 80 歲或接受半人工髖關節置換術(hemiarthroplasty)的病人有更多的進步。起始是中等的功能狀態的病人，在接受急性後期復健訓練後有最大的功能進步。所有控制組的病人在追蹤過程的巴氏量表分數都變差。

結論：接受急性後期復健訓練的髖關節骨折病人，比起控制組有顯著的功能恢復，特別是在轉位與行走的表現。（台灣復健醫誌 2019；47(1)：11 - 20）

**關鍵詞：**巴氏量表分數(BartheI index)，髖關節骨折(hip fracture)，結果(outcome)，急性後期照護(post-acute care)，復健(rehabilitation)

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