

ARTICLES

Effect of Rehabilitation Site on Functional Recovery After Hip Fracture

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Objective: To evaluate whether FIM instrument motor outcomes differ between hip fracture survivors undergoing rehabilitation in inpatient rehabilitation facilities (IRFs) and skilled nursing facilities (SNFs).

Design: Inception cohort with follow-up to 12 weeks after hospital discharge.

Setting: University-affiliated tertiary care hospital, IRFs, and SNFs.

Participants: All hip fracture patients prospectively admitted between March 1, 2002, and June 30, 2003, were eligible if they were 60 years or older and had surgical stabilization of the fracture.

Interventions: Posthip fracture rehabilitation delivered at either IRFs or SNFs.

Main Outcome Measure: FIM motor score obtained postoperatively and at 2 and 12 weeks posthospital discharge.

Results: IRF patients stayed an average of 12.8 days, whereas SNF patients averaged 36.2 days. Rehabilitation participation scores were obtained during therapy sessions and did not differ between groups. A repeated-measures analysis of covariance found a significant group by time interaction ($F_{2,68} = 23.75, P < .001$), which indicates that patients in an IRF had significantly higher FIM motor scores than those in an SNF across time. Logistic regression showed that IRF subjects were more likely to reach 95% of their prefracture FIM motor by week 12 than were SNF patients. A significantly higher percentage of IRF patients were discharged home after rehabilitation compared with SNF patients.

Conclusions: IRF patients had superior 12-week functional outcomes, as measured by the FIM motor score, compared with those treated in an SNF. The improved outcomes occurred during a significantly shorter rehabilitation length of stay and remained even when statistically controlling for baseline differences between groups. These data suggest that hip fracture survivors should not be excluded from receiving inpatient rehabilitation services. Randomized clinical trials are needed to

understand more fully differences between rehabilitation treatment settings.

Key Words: Hip fractures; Nursing homes; Rehabilitation. © 2005 by American Congress of Rehabilitation Medicine and the American Academy of Physical Medicine and Rehabilitation

A PROXIMAL FEMUR FRACTURE (hip fracture) is a common and increasing problem that is a major source of disability in the elderly.¹ Rehabilitation after surgical stabilization of the hip fracture is crucial to regain prefracture function and to avoid long-term institutionalization that can be as high as 25% 1 year postfracture.^{1,2} The intensity and setting of rehabilitation are modifiable variables that may influence functional outcomes, including return to the community. Many patients after a hip fracture cannot go directly home because of disability from the hip fracture combined with coexisting medical and psychiatric illness. Inpatient rehabilitation facilities (IRFs) and skilled nursing facilities (SNFs) provide postacute care services once the hip fracture and medical comorbidities have been stabilized. There are no clear guidelines to determine how best to treat hip fracture survivors in a rehabilitation setting.³

IRFs must provide a minimum of 3 hours of combined physical therapy (PT) and occupational therapy (OT) per day. These centers also have rehabilitation nurses and physicians working in a multidisciplinary fashion to provide daily care. In contrast, SNFs are not mandated to provide a specific intensity or type of therapy program. Weekend therapy services are not usually included, nursing staffing ratios are lower, and patients have less contact with physicians.

Large-scale randomized controlled trials (RCTs) have not been performed to determine the setting and level of rehabilitation intensity that produces the best outcomes due to the perceived difficulty of enrolling elderly subjects immediately after surgery.³ Studies by Kramer⁴ and Kane⁵ and colleagues have examined differences in functional outcomes attributable to postacute care settings.

Kramer⁴ performed a prospective cohort study on hip fracture and stroke survivors. Patients were not followed from the acute care hospital, but instead were enrolled only when they began rehabilitation. Functional outcomes were measured using a telephone interview to patients or proxies with the 5-point basic activities of daily living (ADL) score from the Longitudinal Study on Aging. This functional scale has significant limitations in that ambulation is reported only to a distance of 20ft (6.1m) and bowel and bladder functions are not assessed. The results showed that hip fracture patients admitted to IRFs did not differ from patients admitted to SNFs in returning home to the community or in the number of ADLs recovered to pre-morbid levels.

More recently, Kane⁵ estimated the differences in functional outcomes attributable to postacute care discharge location for 5 major conditions that included hip fracture. Function was measured using a research instrument that assessed 7 domains

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of ADLs, including bowel and bladder continence via personal interviews with patients or their proxies. Multivariate-adjusted mean functional dependency scores by discharge setting showed less ADL dependency at 6 months in patients who were treated in an IRF and in those who went directly home from acute care with home services. More ADL dependency was documented in hip fracture survivors who were treated in an SNF.

Prospective cohort studies published to date have not measured how well subjects participated during therapy sessions and did not include sensitive measures of cognition or behavioral domains like depression and social support that affect rehabilitation outcomes after hip fracture.^{6,7} Our group has developed the Pittsburgh Rehabilitation Participation Score (PRPS), a validated instrument that quantifies patient participation at each therapy session.⁸ We have previously examined cognitive function after hip fracture and have related these measures to the FIM instrument motor score, a validated rehabilitation outcome measurement considered to be an industry benchmark.^{8,9}

The purpose of our current hip fracture study is to evaluate whether FIM motor outcomes differ between rehabilitation settings when controlling for important cognitive and patient characteristics; we hypothesized that the rate of improvement and overall FIM motor scores at 12 weeks from hospital discharge would be higher in the IRF patients than in those treated in an SNF. We also compared patient participation within an IRF and an SNF setting to determine the effect, if any, on FIM motor outcome.

METHODS

Subject Recruitment

This study was approved by the university's institutional review board. All hip fracture patients prospectively admitted to our university-affiliated tertiary care hospital between March 1, 2002, and June 20, 2003, were eligible if they were 60 years or older, had surgical stabilization of the fracture, and were living in the community at the time of the fracture.

To be included, subjects had to demonstrate to the research staff an understanding of the authorizations and informed consent documents required under the Health Insurance Portability and Accountability Act of 1996. We did not measure dementia, a diagnosis that would require a clinical evaluation taking into account the longitudinal course, risk factors, and additional tests. Our determination for consent was that subjects with a preexisting diagnosis of dementia who were admitted to skilled nursing homes for that reason would be expected to have at least moderate to severe dementia and to be unable to understand the informed consent process. We did not use proxy consents; thus, if after 3 attempts eligible subjects were too confused to understand the informed consent process, they were also excluded. We also excluded subjects with metastatic cancer.

Subjects were discharged from the acute care hospital when deemed appropriate by the primary clinical service (family medicine, internal medicine, or orthopedic surgery). Disposition to SNF or IRF was based primarily on orthopedic surgeon preference, which is idiosyncratic, and patient/family preference, also idiosyncratic but typically based on geographic location being close to home. Referrals for postacute rehabilitation services were not based on insurance status. No patient received a psychiatric consultation as part of the decision-making process. Additionally, the research team had no influence on clinical decision making.

In our study, 12 different SNFs treated subjects, and 7 of the 12 facilities were classified as for-profit institutions. For IRFs, 8 facilities were used, and 2 of the 8 were classified as for-profit institutions.

Assessments

Once consent was obtained, key demographic data, including age, sex, insurance, and race, were abstracted from the clinical record. Surgical data included fracture pattern, location, and type of anesthesia and stabilization technique. Medical complexity for each patient was assessed by chart review with the Cumulative Illness Rating Scale¹⁰ (CIRS). The CIRS is completed by a physician who extrapolates data from the history, physical, and laboratory sections of the patient record. This instrument not only captures the number of comorbid conditions but also rates the severity of each diagnosis.

The Mini-Mental Status Examination¹¹ (MMSE) and Delirium Rating Scale were used to measure cognition. No patient was excluded based on data from these instruments. The MMSE has been used in other hip fracture studies.^{12,13} The Delirium Rating Scale is a validated measure that indicates that delirium is present, with scores of 10 or greater.¹⁴ The Hamilton Depression Rating Scale¹⁵ (HAMD), used extensively in research as a baseline and outcome measure in depression, was also obtained. Higher scores indicate greater depressive symptoms. The extent of each subject's social support network was determined by the Social Network Index.¹⁶ A higher score indicates greater social support. Living status was also noted on admission to the acute care hospital and at discharge from the IRF or SNF.

Length of stay (LOS) was recorded at the acute care hospital and postacute care institution. The type of postacute care facility was classified as a freestanding or hospital-based IRF or a freestanding SNF. One patient was treated at a hospital-based SNF (transitional care unit) and another subject was in an SNF for 8 days but then went to an IRF. These 2 people were excluded from the analysis.

Patient participation was measured in IRFs and SNFs after each PT and OT session using the PRPS. This scale uses a Likert rating from 1 (refusing therapy) to 6 (tolerated entire session, excellent motivation, completed all tasks and exercises without prompting) to quantify the interaction between patient and therapist. Scores were recorded throughout the IRF or SNF admissions, and a mean score was calculated for each patient combining all available PT and OT ratings. This scale has demonstrated good psychometric properties and is predictive of LOS and FIM motor change.⁸ We did not record data concerning the actual amount of therapy sessions attended by each subject.

Function was measured throughout the rehabilitation continuum using the FIM motor scale. The FIM motor scale is a 13-item instrument that uses a 7-point grading scale per item. The maximum score is 91 points, with 42 points measuring self-care, 21 points measuring mobility, 14 points for sphincter control, and 14 points for locomotion. A member of the research team, who is an occupational therapist with 7 years of orthopedic rehabilitation experience and Uniform Data System certification, obtained all FIM motor data via phone contacts. The FIM motor scale administered to hip fracture patients or proxy caregivers via phone call has previously demonstrated excellent psychometric properties in terms of validity and sensitivity to change 8 weeks after rehabilitation discharge.¹⁷

Prefracture FIM motor score was obtained from the study participant or, on occasion when the participant was an unreliable historian, a family member (usually adult child). Function was ascertained in the last 4 weeks before fracture using a structured interview. The FIM motor score was then obtained

Table 1: Baseline Demographics and Clinical Measures Comparing IRF and SNF Subjects

Variable	IRF				SNF				Test Statistic		
	n	Mean \pm SD	Min	Max	n	Mean \pm SD	Min	Max	t	df	P
Demographics											
Age (y)	42	80.2 \pm 8.4	61	94	34	83.9 \pm 9.4	63	105	-1.78	74	.079
Female (%)	35	83.3			27	79.4					.769*
White (%)	40	95.2			30	88.2					.398*
Social support	41	18.5 \pm 9.9	2	37	32	13.5 \pm 6.9	1	31	2.58	70.3	.012
Cognitive measures											
MMSE	41	25.2 \pm 3.8	16	30	34	23.0 \pm 5.3	9	30	2.03	58.5	.046
HAMD	41	9.5 \pm 5.2	2	24	33	11.6 \pm 5.9	4	26	-1.75 [†]	72	.085
Delirium Rating Scale	41	5.8 \pm 5.7	2	24	33	8.3 \pm 6.6	2	26	1.85 [†]	72	.068
Clinical measures											
CIRS	38	9.2 \pm 3.1	3	18	31	10.2 \pm 2.9	5	16	-1.41 [†]	67	.164
Rehabilitation participation	37	4.6 \pm 0.8	2.1	6	22	4.3 \pm 1.1	2.4	6	1.25	57	.215
Hospital LOS	40	5.0 \pm 1.9	2	12	31	6.4 \pm 3.7	3	21	2.34 [†]	69	.022
Rehabilitation LOS	36	12.8 \pm 6.9	4	38	24	36.2 \pm 20.5	15	90	-8.18 [‡]	58	<.001

Abbreviations: Max, maximum; Min, minimum; SD, standard deviation.

*Fisher exact test;

[†]1/X transformation used in the analysis;

[‡] \sqrt{X} transformation used in the analysis;

[§]Ln(X) transformation used in the analysis.

before hospital discharge and at 2 and 12 weeks after acute hospital discharge. These data were obtained from phone interviews by the treating therapists at each institution using a standard interview method. Twelve-week FIM motor data were completed by phone from structured patient interviews. If cognitive status was deemed unreliable or if information was inconsistent, the research occupational therapist contacted the proxy caregiver (usually adult child or occasionally a therapist in long-term care environments).

Statistical Analysis

We compared the IRF group with the SNF group in terms of baseline clinical and sociodemographic characteristics. Before analyses, distributions of all variables were examined, and appropriate transformations were used to normalize the distributions and to stabilize the variance. We used *t* tests for continuous measures and Fisher exact tests for categorical data. Motor FIM improvement was analyzed using a mixed model with time as a repeated measure. This technique allows the use of all available data without having to impute specific values for missing data, because approximately 30% of the subjects did not reach the 12-week time point. It also allows the user to define the covariance structure, taking into account the correlation of the repeated measures. For this set of analyses, SAS Proc Mixed^a was used with the unstructured covariance matrix. In the mixed model, baseline demographic and clinical measures, as well as rehabilitation participation, were examined as possible covariates. We examined the effect of each covariate individually in the mixed model and subsequently fit a model containing all significant covariates. The mixed model was used to do a post hoc test of group differences at week 12. Logistic regression was used to look at predictors of response where response was defined as a subject attaining 95% or more of the prefracture FIM motor score by 12 weeks. If at any time point (0, 2, 12wk) subjects had an FIM motor score of 95% or more of their prefracture value, they were coded as responders; otherwise, they were coded as nonresponders. Rehabilitation group (IRF, SNF), age, sex, CIRS, prefracture FIM motor score, and rehabilitation participation were examined as predictors. *P* values less than .05 were considered statistically significant.

RESULTS

Baseline Demographics and Clinical Measures

In this analysis, 42 hip fracture subjects were treated at an IRF and 34 subjects were treated at an SNF. The data set contains variability in the number of observations collected for each measure. Reasons for missing data were categorized and compared between groups using the Fisher exact test; no significant differences in missing data were noted, including deaths during the study period (1 patient in the IRF group, 2 patients in the SNF group).

Baseline demographics and clinical measures in the rehabilitation treatment groups are listed in table 1. Both groups consisted primarily of white, female subjects typical of this condition. People treated at an SNF had significantly lower mean MMSE scores than IRF subjects and less social support, as measured by the Social Network Index (table 1).

Before the fracture, 95% of the IRF group and 87.5% of the SNF group had been living at home, whereas 5% of the IRF group and 12.5% of the SNF group were residing in personal care facilities. These differences were not significant (Fisher exact test, *P* = .396). Traditional Medicare and Medicare health maintenance organizations were the most common insurers for both IRF and SNF subjects, and insurance status did not differ statistically between groups (Fisher exact test, *P* = .572). Fracture pattern and surgical data are listed in table 2. There were no statistically significant differences between rehabilitation groups.

LOS differed statistically between groups during both the acute care hospitalization and the rehabilitation admission (table 1). Patients treated in an IRF stayed an average of 12.8 days, whereas SNF patients' stays averaged 36.2 days. Despite differences in LOS and perceived intensity of therapy between settings, participation scores were good at both SNFs and IRFs without significant differences (table 1).

Outcome Measures

Prefracture mean FIM motor score was 85.0 \pm 10.5 for IRF subjects (*n* = 42) and 85.2 \pm 8.0 for SNF subjects (*n* = 32). These data indicate that both groups started from a similar prefracture

Table 2: Fracture Pattern and Surgical Data

Variable	IRF % (n)	SNF % (n)	P (Fisher exact test)
Fracture type			
Intertrochanteric	57.5 (23)	71.9 (23)	.169
Femoral neck	42.5 (17)	25.0 (8)	
Periprosthetic femur fracture	0	3.1 (1)	
Fracture on left side	65.0 (26)	59.4 (19)	.634
Surgery type			
Compression hip screw, cannulated screws, or nail	55.0 (22)	68.8 (22)	.330
Hemiarthroplasty	45.0 (18)	31.3 (10)	
Anesthesia type			
General	59.0 (23)	62.5 (20)	.810
Spinal	41.0 (16)	37.5 (12)	

level of mild disability, which is not unexpected given the age and frailty of the study population. As expected, FIM motor scores dropped precipitously after fracture, then improved over time in both groups (fig 1).

Figure 1 displays FIM motor data over 12 weeks for IRF and SNF patients, listing raw means and predicted means based on the mixed model. There is a significant group by time interaction ($F_2=23.33$, $P<.001$), which indicates that patients in an IRF had significantly higher FIM motor scores than those in an SNF across time. Contrast testing showed that the difference in FIM motor means remained statistically significant between IRF and SNF subjects at 12 weeks postfracture ($F_1=4.67$, $P=.034$).

Mixed models were calculated controlling for baseline covariates that included age, HAMD, MMSE, CIRS, delirium

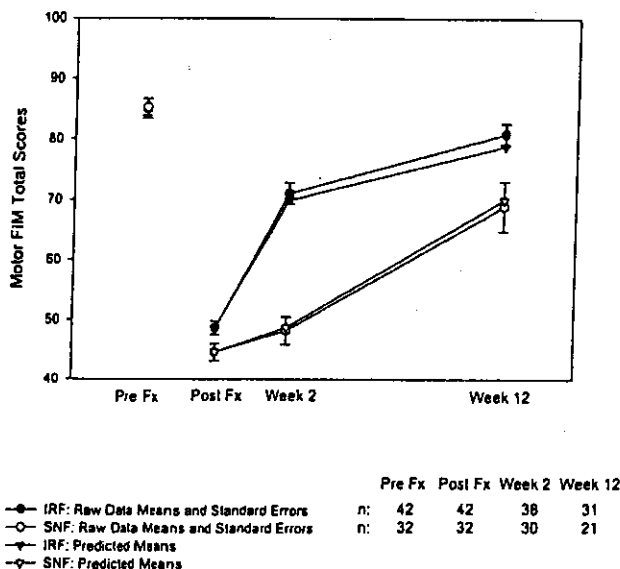


Fig 1. Repeated-measures analysis of variance displaying raw data and predicted FIM motor means between IRF and SNF subjects. IRF subjects demonstrated significantly higher FIM motor scores than those in an SNF across time. The number of subjects with FIM motor data at each time point is listed. Abbreviations: Post Fx, postsurgery FIM motor rating; Pre Fx, prefracture baseline; Week 2, FIM motor rating 2 weeks after hospital discharge; Week 12, FIM motor rating 12 weeks after hospital discharge.

Table 3: Logistic Regressions to Predict the Percentage of Subjects Who Attained 95% of Their Prefracture FIM Motor Scores at 12 Weeks

Variable	OR	95% CI	P
Rehab type (0=SNF, 1=IRF)	8.31	1.43-48.19	.018
Age	1.02	0.94-1.12	.617
Sex (0=female, 1=male)	0.73	0.12-4.53	.737
CIRS	1.22	0.93-1.59	.145
Prefracture motor FIM score	0.97	0.89-1.07	.577
Rehab participation	3.38	1.11-10.32	.032

Abbreviations: CI, confidence interval; OR, odds ratio; Rehab, rehabilitation.

scores, and social network index. Because only age, MMSE, and delirium scores were statistically significant, a mixed model was performed controlling for these specific covariates. This analysis continued to show a significant group by time interaction ($F_2=23.75$, $P<.001$), which indicates that IRF subjects had higher FIM motor scores over time. Contrast testing in this model was not significant at 12 weeks postfracture.

Participation during rehabilitation (not a baseline measure) was also examined in a mixed model, with FIM motor score as the primary outcome. It was a significant predictor of FIM motor scores, meaning that those subjects with better participation in therapy displayed higher FIM motor scores. When controlling for participation, there continued to be a significant group by time interaction, which indicates that IRF subjects attained higher FIM motor scores than SNF subjects over time ($F_2=15.28$, $P<.001$).

Logistic regressions showed that rehabilitation type and participation were significant predictors of who responded by 12 weeks. IRF subjects were more likely to attain 95% or more of their prefracture FIM motor score than SNF subjects. Subjects with higher participation were also more likely to respond. Age, sex, CIRS, and prefracture FIM motor score were not significant predictors (table 3). Discharge disposition showed that 81.1% of the IRF group and 45.5% of the SNF group were discharged to home. Personal care facility discharges were seen in 10.8% of IRF and in 13.6% of SNF subjects. IRF subjects had 8.1% discharged to extended care nursing homes, whereas 36.4% of SNF subjects were placed in nursing homes. In addition, 4.6% of SNF subjects were discharged to other non-home settings. Discharge disposition differed significantly using the Fisher exact test ($P<.009$).

Last, acute care hospital readmissions were tracked up to the 12-week end point. In the IRF group, 4 subjects were readmitted with medical diagnoses and 4 with orthopedic diagnoses. In this latter sample, 1 patient refractured the repaired hip, 1 patient had a fixation failure, 1 patient was admitted with pain, and 1 patient fell without fracture. In the SNF group, 5 were readmitted with medical diagnoses, and 1 patient had another hip fracture. There were no significant differences between groups.

DISCUSSION

This prospective cohort study of elderly rehabilitating hip fracture survivors found that patients treated in an IRF had greater improvement in FIM motor scores over 12 weeks than those treated in an SNF. IRF patients were more likely than SNF patients to attain 95% of their prefracture functional estimate by 12 weeks after hospital discharge. In addition, a higher percentage of IRF subjects were discharged home rather than to an extended care facility compared with SNF subjects. The improvement seen in the IRF cohort occurred during a much shorter total rehabilitation LOS compared with patients

treated in an SNF. The participation data indicate that IRF subjects participated as well as the SNF subjects did, which suggests that hip fracture subjects tolerated the higher-intensity therapy provided in an IRF. The superiority of IRFs over SNFs for hip fracture subjects remained significant over time when controlling for important cognitive and patient characteristics.

Differences in methodology may explain why our findings are similar to some^{5,18,19} prospective studies but not to others.^{4,20,21}

The study population included patients who had a reasonable potential of regaining prefracture function during rehabilitation because of adequate baseline cognitive and physical status. The groups had remarkably similar baseline function, as measured by prefracture motor FIM estimates. Those living in the community before the fracture were deemed unable to return directly home, even with home care services, by the primary care team. Our data indicate that an IRF setting improved outcomes more rapidly for these individuals. Healthier hip fracture patients have elsewhere demonstrated the greatest improvement in an IRF setting and the least improvement in an SNF.²² In contrast, sicker hip fracture patients did not show differences in functional improvement among postacute care sites.²²

Our study used sensitive measures to evaluate cognition and behavioral domains such as depression. This study was also the first to measure the patient-therapist interaction during the rehabilitation process. We believe that because IRF patients appeared to have good participation with the increased physical and occupational therapy protocols, they recovered better and faster by week 12. We are continuing to follow this cohort to examine outcomes at longer time intervals. This dose response or intensity effect from rehabilitation has also been observed after elective hip and knee arthroplasty.²³ IRFs typically provide more frequent nursing and physician contacts, which may improve pain management and reduce known complications such as urinary tract infections and obstipation.

The higher FIM motor scores for IRF subjects between the week 2 and week 12 intervals may explain why a larger percentage returned home. The FIM motor is the largest subscale of the 18-item FIM instrument. This instrument describes level of disability, because lower scores have been shown to translate directly into higher daily caregiver burden.²⁴ Thus, if function is poor and care burden high, patients will have a difficult time returning home to the community. It is also possible that by attaining functional goals more rapidly in the IRFs, elderly patients avoided cognitive and physical impairments from longer hospitalizations that may impact their ability to return home. The study did not examine or measure costs associated with in-hospital or postdischarge care. However, given the significantly longer SNF LOS, decreased functional outcomes, and higher extended care placement, any potential cost savings from the less expensive SNF settings may be mitigated.

Our study is directly relevant to the current debate in the United States regarding payment for inpatient rehabilitation services. Specifically, several Medicare fiscal intermediaries have proposed local medical review policies that would deny multidisciplinary inpatient rehabilitation for most hip fracture patients. These proposed medical policies are not consistent with the data obtained from our study. Given the epidemiology and potential devastating consequences from hip fracture, it seems unjustified to eliminate inpatient rehabilitation services to most hip fracture survivors, especially those with the greatest potential to regain premorbid functional status, including return to the community.

Some potential limitations require explanation. Subjects were recruited from 1 acute care facility and this could limit generalizability. Yet, this facility admits approximately 200

patients with hip fractures per year, and the surrounding county has among the oldest populations in the United States, making it an ideal environment to study hip fracture rehabilitation. Not all subjects had complete follow-up data, yet we attempted to control for this deficiency with statistical methods. In addition, the amount of missing data did not differ significantly between groups. Possible bias by the research occupational therapist could influence FIM motor data. However, as the data were collected, the focus was to examine cognition and depression after hip fracture; thus the research therapist would have been unaware of our hypothesis. Most important, like all other earlier studies conducted in the United States, group selection was based on clinical decision making rather than on random group assignment. More than any earlier study, we measured and controlled for a number of clinically relevant variables, but could not guarantee that unmeasured differences did not account for the some of the variance between IRF and SNF groups. An RCT to determine how services can be best delivered within the available rehabilitation settings across the United States is necessary and should be attempted to better understand the effect of rehabilitation after hip fracture.³

CONCLUSIONS

This prospective inception cohort study of hip fracture survivors demonstrated that people treated in IRFs had superior functional outcomes as measured by the FIM motor score compared with those treated in SNFs. The improved outcomes with inpatient rehabilitation occurred during a significantly shorter rehabilitation LOS and remained constant even when statistically controlling for baseline differences between groups. These data suggest that hip fracture survivors should not be excluded from receiving inpatient rehabilitation services. RCTs are needed to understand more fully differences between rehabilitation treatment settings.

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Supplier

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