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Physical Therapy and Mobility 2 and 6 Months After Hip Fracture

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Abstract

OBJECTIVES— To examine the relationship between early physical therapy (PT), later therapy, and mobility 2 and 6 months after hip fracture.

DESIGN—Prospective, multisite observational study.

SETTING—Four hospitals in the New York City area.

PARTICIPANTS—Four hundred forty-three hospitalized older patients discharged after surgery for hip fracture in 1997–98.

MEASUREMENTS—Patient demographics, fracture type, comorbidities, dementia, number of new impairments at discharge, amount of PT between day of surgery and postoperative day (POD) 3, amount of therapy between POD4 and 8 weeks later, and prefracture, 2-, and 6-month mobility measured using the Functional Independence Measure.

RESULTS— More PT immediately after hip fracture surgery was associated with significantly better locomotion 2 months later. Each additional session from the day of surgery through POD3 was associated with an increase of 0.4 points ($P = .032$) on the 14-point locomotion scale, but the positive relationship between early PT and mobility was attenuated by 6 months postfracture. There was no association between later therapy and 2- or 6-month mobility.

CONCLUSION— PT immediately after hip fracture surgery is beneficial. The effects of later therapy on mobility were difficult to assess because of limitations of the data. Well-designed

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randomized, controlled trials of the effect of varying schedules and amounts of therapy on functional status after hip fracture would be informative.

Keywords

hip fractures; physical therapy; mobility; disability

Physical therapy (PT) after hip fracture is standard for most elderly patients, but there is a lack of consensus about the frequency and timing of therapy to maximize functional recovery after surgery. There may be deleterious effects from the prolonged period of immobility,[1] and early mobilization for PT may be beneficial. Alternatively, PT might be more effective if delayed until several weeks after surgery when patients are past the immediate postoperative complications[2] and have regained important cognitive abilities and resolution of short-term postfracture depression[3] and are perhaps better able to tolerate and benefit from physical rehabilitation. Additionally, given the increasingly compressed length of acute stay,[4,5] it may make sense to delay initiation of the therapy program until the patient moves to the postacute setting where it can be implemented and sustained.

Empirical findings from randomized trials to guide clinicians about when to start post-hip fracture PT are equivocal. An early, small study found no statistically significant differences in functional outcome at discharge and 3, 6, and 12 months after discharge between hip fracture patients randomized to usual care or a multi-component rehabilitation intervention.[6] The low power of the study raises questions about the null findings. A randomized, controlled trial of accelerated rehabilitation after hip fracture, including two sessions of PT daily in the hospital, found that patients with limited functional disability before the hip fracture randomized to the accelerated rehabilitation group regained more physical independence by discharge than those in the conventional care group,[7] but functional disability 4 months after the fracture did not differ between the two groups. Taken together, these two trials leave open the question of how much PT immediately after surgery is associated with better functional outcomes and how it affects the rate at which patients recover.

Findings from the few observational studies of the effect on functional outcomes of PT initiated immediately after hip fracture surgery demonstrated benefit, but many were based on short follow-up periods. In patients who received any PT in the hospital after hip fracture, more sessions increased the odds of ambulation with a walker during the early postoperative phase in the hospital.[8] Patients who received high-frequency PT (at least once, sometimes twice, a day) before hospital discharge achieved earlier ambulation in the hospital than those who received fewer sessions, even after adjusting for patient (e.g., age, comorbidity) and clinical care (type of surgical repair, medical complications) factors.[9] Patients who received PT in the hospital, in a skilled nursing facility, or in both locations were more likely to return to the community than those who did not receive any PT, even after adjusting for demographic characteristics and comorbid illness.[10]

In contrast to other observational studies with short follow-up periods, one investigator evaluated predictors of functional status up to 1 year after hospital discharge for hip fracture in a sample of community-residing older people.[11] After controlling for patient characteristics (e.g., prefracture dependency, age, sex, dementia), hospitalization experience (e.g., fracture type, length of stay, postoperative delirium), discharge situation (e.g., institution, rehospitalized, suffers major fall), and social supports (e.g., married, size of informal care network), more sessions of PT in the hospital did not significantly increase the odds of recovery of walking ability 1 year posthospital discharge for hip fracture.

In the current study, the relationship between the amount of PT patients received immediately after hip fracture surgery up through 8 weeks and functional status at 2 and 6 months postdischarge was examined. This study differs from previous studies in that more recent data, which reflects shorter lengths of stay for hip fracture patients and includes community-residing and nursing home residents with hip fractures, was used and follow-up was extended to 6 months.

METHODS

Participants

Patients hospitalized for hip fracture between August 1997 and August 1998 in four metropolitan New York hospitals were eligible for the study. The institutional review board at each participating institution approved the study. Details of the study design and cohort characteristics were described previously.[12]

Patients were excluded if they were younger than 50, sustained a fracture as an inpatient, transferred from another hospital postoperatively, or sustained concurrent major internal injuries. Patients with pathological fractures, fractures limited to the pelvis or acetabulum, fractures 2 cm or more below the trochanter, bilateral hip fractures, fractures in which there was prior surgery on the same hip, and previous ipsilateral hip fracture were also excluded. Six hundred fifty patients met the eligibility criteria. Of these, 571 consented to participate, or a surrogate provided consent if they were not able to provide it themselves because of cognitive limitations. Because this analysis focused on the relationship between PT after hip fracture surgery and mobility, patients who died in the hospital (n = 9) and those who did not receive surgery (n = 13) were excluded from the analyses. Finally, patients were not followed if they were discharged to nursing homes in which fewer than five study patients were discharged (n = 106). Results from a logistic regression indicated that patients who were not followed were similar at baseline to the 443 patients followed with one exception; the odds of being followed were slightly higher for patients with higher prefracture mobility scores (odds ratio (OR) = 1.08, 95% confidence interval (CI) = 1.01–1.16). Consequently, the sample at discharge included 443 patients alive at discharge and treated with surgery after hip fracture.

MEASURES

Patient information was collected from interviews with patients or surrogates, research coordinator assessments, and medical record review during the hospitalization and telephone interviews at 2 months and 6 months after hospital admission.

Independent Variables

The key independent variables were the number of hospital days in which the patient received PT from day of surgery to postoperative day (POD) 3 (early PT) and the number of PT and occupational therapy (OT) sessions the patient received and for how long from POD4 through 8 weeks postadmission (later therapy). Data on hospital PT were collected from the medical record. Data on the amount of postacute PT patients received were collected for patients at home by patient self-report or from a proxy at the 2-month interview and from the medical record of those who transferred to nursing homes and rehabilitation programs. Therapy sessions received at home and reported at the 2-month interview did not distinguish PT from OT. Because postacute Medicare skilled home care is more likely to include PT than OT, it was assumed that all sessions included at least PT.[13] Thus, we call therapy after the first three days ‘‘later therapy.’’ Later therapy was divided into two variables: (1) the total number of sessions between POD4 and 4 weeks and (2) the total number of sessions between Weeks 5 and 8.

Finally, duration of later therapy was measured as last day between POD4 and 8 weeks on which the patient had therapy (range 0 to Day 52).

Prefracture patient characteristics included sociodemographic characteristics (age, sex, race), living arrangements, mobility, and presence or absence of dementia. Prefracture mobility was measured using patient or proxy report in the hospital using the locomotion subscale of the Functional Independence Measure (FIM).[14,15] A modified Acute Physiology and Chronic Health Evaluation score was calculated as a measure of admission clinical condition.[16] In addition, a modified RAND comorbidity score was calculated from the medical record as a measure of chronic illness severity during the hospitalization.[17,18] The number of new impairments at discharge (not present prefracture) was defined as a count of the following in the 24 hours before discharge: inability to eat, bowel or bladder incontinence, bedbound status, and presence of a decubitus ulcer.[12] The type of fracture was categorized as femoral neck displaced, femoral neck nondisplaced, or intertrochanteric. Whether the patient had surgery within 24 hours of admission was collected from the medical record.

Dependent Variable

The outcome was mobility, measured at 2 and 6 months postadmission. Mobility was measured using the locomotion subscale of the FIM.[14,15] The patient's self- or surrogate-reported independence in walking 150 feet and going up and down 12 to 14 stairs was obtained by telephone at the 2- and 6-month interviews.[19] The walking and stair-climbing scales were scored from 1 to 7. A score of 1 indicated total assistance, scores of 2 to 4 indicated varying levels of human assistance, 5 indicated human supervision, 6 indicated modified independence (use of a device), and 7 indicated complete independence. The sum of the walking and stair-climbing scores produced a mobility score with a range of 2 to 14.

Alternative methods of formulating the dependent variable were examined to account for patients who died over the 6-month period. Methods suggested by a study for measures of general health status were followed,[20] and the FIM locomotion score (range 2–14) was transformed such that each score represented the probability in this sample of being able to walk 150 feet and climb stairs without human help 6 months postadmission for hip fracture. Patients who died over the 6-month period had zero probability of independence at 6 months post-hip fracture, and survivors had values that ranged from greater than 0 to 100. The results with this transformed variable were qualitatively similar to the findings obtained with the untransformed locomotion subscale, and results with the more widely used untransformed variable are therefore presented.

Analysis

Because the FIM locomotion scale is an interval level measure, ordinary least squares regression was used to examine the relationship between timing and duration of therapy and mobility at 2 and 6 months posthospital discharge after fracture. As noted above, analyses controlled for demographic and health status factors are likely to influence mobility.

RESULTS

Characteristics of the Sample

Thirty-three (6%) patients died between hospital discharge and the 2-month interview and 23 (4%) more by the 6-month interview. Results from a logistic regression indicated that the odds of dying were significantly greater for patients with lower prefracture mobility scores (OR = 0.860, 95% CI = 0.80–0.94) and more new impairments at discharge (OR = 1.56, 95% CI = 1.56–2.28), but they were otherwise not different at discharge from the survivor sample. Table 1 summarizes the characteristics of patients in the discharge sample (n = 443). Patients' average

age was 81, and they were predominately female. About 11% lived in a nursing home, and 35% used formal home care before admission. Patients were relatively independent in mobility before the hip fracture, with an average FIM locomotion score of mean ± standard deviation of 10.2 ± 3.8. At 2 and 6 months after the fracture, the average FIM locomotion scores of survivors were 6.8 ± 3.8 and 8.4 ± 4.0, respectively.

Most patients (78%) received some early PT. Results from a logistic regression of the receipt of early PT on baseline patient characteristics indicated that patients with higher mobility scores before the hip fracture (OR = 1.10, 95% CI = 1.03–1.18) and those who had surgery within the first 24 hours of admission (OR = 1.61, 95% CI = 1.61–5.00) were significantly more likely to have early PT.

As indicated in Table 1, the average number of PT sessions from the day of surgery through POD3 was 1.7 ± 1.1. Approximately 97% of patients had some PT sessions between POD4 and the 4-week interview; the mean number of sessions was 24.7 ± 14.7. Between Weeks 5 and 8, 81% of patients had therapy, averaging 11.6 ± 12.8 sessions. The median duration of therapy after POD3 through 8 weeks (52 days) was 49 ± 15.9 days.

Early PT, Later Therapy, and 2- and 6-Month Mobility

Table 2 summarizes the results of the regression analyses of the relationship between early and later therapy and subsequent mobility, controlling for patient demographics, mobility before the fracture, comorbidities, illness severity in the hospital, and rehospitalizations within 6 months of the hip fracture hospitalization. The 2- and 6-month models each account for 34% of the variance in mobility.

Early PT

More PT in the first days after hip fracture surgery was associated with significantly better locomotion at 2 months postadmission for fracture. In particular, each additional session from the day of surgery through POD3 was associated with an increase of about 0.4 points ($P = .032$) on the 14-point locomotion scale at 2 months. In contrast, by 6 months, the association between early PT and mobility was smaller and no longer significant.

Later Therapy

The number of therapy sessions between POD4 and 4 weeks and between 5 and 8 weeks was not significantly associated with 2- and 6-month mobility. This was also the case with the duration of therapy.

As noted above, the sample size was smaller when the postacute therapy variables were included in the analyses because those data were available for a subset of postacute sites. To assess whether the relationship between early PT and mobility persisted in the full sample, the 2- and 6-month mobility models were also estimated, leaving out the later therapy variables and thus including the full sample. The relationship between early PT and mobility remained significant and positive at about the same magnitude at 2 months, and no relationship was observed at 6 months in the full sample.

Finally, the sensitivity of the PT finding to exclusion of the 56 who died was tested by transforming FIM locomotion scores to the probability of independent mobility (walking 150 feet and climbing stairs without human help) at 6 months as a function of FIM before the hip fracture. Thus, the transformed mobility measure ranged from 0 to 100 and indicated the chances of independent mobility in the future. The 2- and 6-month mobility regressions were then reestimated but using the transformed mobility scores. All the results in both models were qualitatively the same with the transformed mobility scores and inclusion of patients who died.

The parameter estimate for early PT in the 2-month regression indicated that each additional early PT session increased the chances of future independent mobility at 2 months by 2%.

Other factors independently and significantly associated with mobility were, for the most part, similar at 2 and 6 months. As would be expected, mobility before the fracture positively influenced the older person's mobility at 2 and 6 months post-hip fracture. Older age was associated with significantly lower mobility at 2 months but not at 6 months. Patients who used formal care at home before the fracture had significantly lower mobility at 2 and 6 months postfracture.

DISCUSSION

Findings from this study indicated there was a mobility advantage at 2 months post-hip fracture for patients who received more PT between the day of hip fracture surgery and the first 3 PODs. But the association between early PT and mobility was attenuated at 6 months postfracture. Thus, even with the average 6-day length of stay for hip fracture in this sample, those who received a few days of hospital PT had better mobility, at least in the early postacute period.

These findings are consistent with those of other studies, which found that more PT sessions in the hospital were associated with better early mobility (at time of hospital discharge).[7–9] Moreover, they match other findings of no mobility differences at later time points.[7,11]

To evaluate the clinical significance of the finding that more early PT increased mobility at 2 months, the expected 2-month score was estimated for the average patient (i.e., the patient with mean scores for all the predictor variables except early PT sessions) who received one session compared with three sessions of early PT. The mobility scores were 6.5 versus 7.2, respectively, a difference of 0.7 on the 14-point mobility scale. Consider that a 1-point difference would be equivalent to the patient needing some hands-on human assistance with mobility versus needing only supervision.

The importance of the early PT finding was also evaluated by examining the parameter estimate from the 2-month regression using the FIM locomotion score transformed to the probability of independent mobility (walking 150 feet and climbing stairs without human help) at 6 months. The parameter estimate for early PT indicated that each additional early PT session increased the chances of future independent mobility 2%. Consequently, having three to four postoperative PT sessions increased patients' chances of independent mobility at 2 months 6% to 8%, all else being equal, over those of patients who did not receive early PT sessions.

The finding that later therapy was not associated with mobility at 2 or 6 months is noteworthy. Fifty-five percent of patients were still receiving therapy 7 weeks after the surgery, and most of it was in post-acute care facilities or at home under the Medicare skilled home health benefit. It is possible that, if skilled care providers saw weak or ambiguous evidence of functional improvement, they continued the therapy up to the maximum amount covered by insurance. If so, duration may be more sensitive to provider reimbursement than to patient outcomes, and this would tend to weaken the relationship between therapy and mobility at later time periods.

The possibility that later therapy moderated the relationship between early PT and mobility or vice versa was considered. In particular, was the early PT relationship weaker for patients who received none or a small amount of later therapy? Or conversely, was later therapy in the absence of early PT too little therapy, too late in the postoperative trajectory to influence 2- and 6-month mobility? The potential interaction of early PT and later therapy was modeled with a product term (early PT measured as 1 or 0 multiplied by the number of therapy sessions from POD4 to week 4) in the regressions of 2- and 6-month mobility on the variables included in Table 2, but the interaction term was not significantly different from zero in either model.

Thus, early PT mattered, but later therapy did not matter irrespective of whether the patient had early PT. However, the nonsignificant findings for posthospital therapy should also be considered in light of the less accurate and complete measurement of it compared with early PT.

This study has other limitations. It was observational and relied on information about the number and timing of therapy sessions as part of usual care after hip fracture. It is possible that patient receipt of early PT was associated with unmeasured factors related to mobility or rehabilitation prognosis. For example, patients who were expected to recover may have been more likely to receive early PT and conversely, those with a more limited rehabilitation prognosis may not have received early PT. The patients selected for early PT may have improved by 2 months with or without it. Thus, these results may overestimate the relationship between PT and mobility. However, the analysis tried to minimize bias by controlling for factors affecting prognosis, including measures of mobility before the fracture, comorbidity, severity of illness, and new impairments during the hospitalization.

Although this study controlled for patient characteristics at baseline and discharge, the progress patients made during the postacute rehabilitation process was not measured or controlled for. Thus, although there were good control variables for early PT and therapy effects in the first 4 weeks, this is less true for Weeks 4 to 8 because patient characteristics were not measured again at 4 weeks postfracture.

Another limitation arises from the use of the FIM. In particular, the FIM locomotion subscale measures independence in terms of the amount of assistance patients receive from a person or device to walk and climb stairs. If PT were to improve a patient's gait speed or reduce their fear of falling, these changes might not be directly reflected in the FIM score, but these changes and others, such as less perceived exertion, are aspects of mobility that are important to patients, families, and clinicians.

There is a complex interplay among pain, delirium, and PT in the first few PODs.[21–23] Patients with inadequately treated pain may be more likely to refuse or not be offered early PT. At the same time, patients may experience pain after early PT and be more likely to miss the next scheduled session. Moreover, undertreated perioperative pain significantly increases the risk for developing delirium,[23] which itself may interfere with early PT. However, these data do not allow us to disentangle these relationships. What seems clear is that the benefits of early PT are more likely to be realized if patients' pain is managed.

As is true of other longitudinal studies of clinically important conditions associated with high mortality (e.g., hip fracture, cancer, stroke), the analysis reported here was based on a sample of survivors who may have been healthier than the full sample at baseline (including patients who died between discharge and 6-month interview) but could not have been identified prospectively. However, as noted earlier, when the FIM locomotion score (range 2–14) was transformed such that each score represented the chances of future independent mobility (which was 0 for patients who died), the positive relationship between early PT and 2-month mobility and the lack of a relationship at 6 months remained despite including data for patients who died. Also, the lack of a relationship between later therapy and 2- and 6-month mobility persisted using the transformed variable and including patients who died.

As with all observational studies of PT, it was not possible to isolate the role of PT from that of other care received after hip fracture, and like other observational studies, this one lacks detailed information on the timing, intensity, and frequency of PT during hospitalization and postdischarge. Given that PT after hip fracture is standard practice for most patients, well-designed randomized, controlled trials of the effect of varying schedules and amounts of PT on functional status after hip fracture would be informative.

In conclusion, PT immediately after hip fracture surgery was associated with better mobility at 2 months, but the positive relationship was attenuated by 6 months postfracture. Later therapy, from POD4 through 8 weeks postfracture, was not related to 2- and 6-month mobility.

The number of therapy sessions is but one part of the rehabilitative and overall package of services received by patients with hip fracture. In the therapy, little is known about how the timing and intensity of therapy sessions might affect the outcomes. Moreover, reimbursement policy, rather than clinical judgment or evidence of effectiveness, may largely dictate prescription of timing and intensity. Additionally, apart from the therapy sessions, the timing of surgery,[9,24–26] management of pain,[27] and appropriate nutrition may also affect outcomes.[28] Other studies are needed to determine the magnitude and duration of the benefit from PT sessions if other aspects of care were optimized. In the meantime, early mobilization and PT sessions are prudent for patients undergoing surgical repair after fracture of a hip.

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Table 1

Characteristics of Hip Fracture Patients (N = 443)

Characteristic	Value
Male, %	18
Age, mean ± SD (range)	81.4 ± 8.7 (53.0–101.0)
Nursing home resident, %	11
Used formal home care prior to fracture, %	35
Prefracture Functional Independence Measure locomotion score, mean ± SD (range)	10.2 ± 3.8 (2.0–14.0)
Surgery within 24 hours of admission, %	28
RAND comorbidity score, mean ± SD (range)	2.3 ± 2.2 (0–10.0)
Acute Physiology and Chronic Health Evaluation severity score, mean ± SD (range)	2.7 ± 2.1 (2.1–11.0)
Dementia, %	21
Fracture type, %	
Femoral displaced	31
Femoral nondisplaced	17
Intertrochanteric	52
New impairments at discharge, mean ± SD (range)	0.48 ± 0.66 (0.66–3.00)
Physical therapy sessions between day of surgery and POD3, mean ± SD (range)	1.7 ± 1.1 (0.0–4.0)
Therapy sessions from POD4 to 4 weeks postadmission, mean ± SD (range)	24.7 ± 14.7 (0–71)
Therapy sessions from 4 weeks to 8 weeks postadmission, mean ± SD (range)	11.6 ± 12.8 (0–71)
Length of therapy program POD4 to 8 weeks, days, mean ± SD (range)	49.0 ± 15.9 (0–52)
Readmissions before 2 months, mean ± SD (range)	0.18 ± 0.40 (0–2)
Readmissions between 2 and 6 months, mean ± SD (range)	0.24 ± 0.55 (0–3)

SD = standard deviation;

POD = postoperative day.

Table 2

Relationship Between Therapy and Mobility at 2 and 6 Months After Hip Fracture

Predictor	Ordinary Least Squares Coefficient (Standard Error) *P*-value	
	2 Months (n = 375)*	**6 Months (n = 356)†**
Intercept	8.60 (1.9) *P*<.0001‡	7.54 (2.1) *P* = .0004‡
PT sessions between day of surgery and POD3	0.36 (0.16) *P* = .029‡	0.28 (0.17) *P* = .109
Therapy sessions from POD4 through Week 4	− 0.0006 (0.01) *P* = .96	0.003 (0.01) *P* = .833
Therapy sessions from Week 5 through Week 8	0.0009 (0.02) *P* = .95	− 0.02 (0.02) *P* = .236
Length of therapy program POD4 to Week 8 (0–52 days)	− 0.006 (0.01) *P* = .659	.001 (0.01) *P* = .937
Male	− 0.29 (0.44) *P* = .600	− 0.45 (0.47) *P* = .339
Age	− 0.06 (0.02) *P* = .002‡	− 0.04 (0.02) *P* = .089
Nursing home resident	− 1.04 (0.68) *P* = .126	− 0.97 (0.76) *P* = .20
Used formal home care prior to fracture	− 0.80 (0.41) *P* = .052	− 0.86 (0.44) *P* = .053
Prefracture Functional Independence Measure locomotion score	0.34 (0.05) *P*<.0001‡	0.45 (0.06) *P*<.0001‡
Surgery within 24 hours of admission	0.66 (0.37) *P* = .080	0.19 (0.40) *P* = .629
RAND comorbidity score	0.001 (0.08) *P* = .986	− 0.067 (0.09) *P* = .460
Acute Physiology and Chronic Health Evaluation severity score	0.04 (0.08) *P* = .649	− 0.09 (0.09) *P* = .322
Dementia	3 0.72 (0.48) *P* = .136	− 0.23 (0.54) *P* = .666
Fracture type§		
Femoral displaced	− 0.16 (0.37) *P* = .663	− 0.31 (0.41) *P* = .450
Femoral nondisplaced	0.88 (0.47) *P* = .062	− 0.30 (0.49) *P* = .547
New impairments at discharge	− 0.50 (0.29) *P* = .087	− 0.39 (0.33) *P* = .235
Rehospitalizations before 2 months	− 0.46 (0.44) P = .298	− 0.29 (0.52) *P* = .572
Rehospitalizations from 2 to 6 months	—	− 0.59 (0.34) *P* = .088
Adjusted coefficient of determination	0.34	0.34

Note: Both models were estimated including an indicator variable for hospital to examine site differences. The association between early physical therapy (PT) and 2-month mobility was attenuated ($\beta = 0.28$, standard deviation = 0.17, $P = .10$) by inclusion of site and unchanged in the 6-month analysis. Hospital C was associated with significantly lower mobility at 2 months and 6 months whether or not PT variables were included in the model. In addition, Hospital C provided fewer days of early PT than the other hospitals ($F = 10.87$, $P < .0001$). Because the mobility models control for important risk factors, (e.g., sex, age, comorbidity, severity), it is likely that the differences in the amount of early PT by hospital are the result of practice pattern variation. Thus, hospital and amount of early PT explain variation in 2-month mobility.

* Attrition due to death (n = 33), missing 2-month mobility data (n = 32), missing number of discharge impairments (n = 3).

† Attrition due to death (n = 23), missing 6-month mobility data (n = 28).

‡ Significant at $P \leq .05$.

§ Reference category is intertrochanteric.

POD = postoperative day.