

Thirty-Day Functional Ambulation After Hip Fracture Surgery in Older Adults: A Single-Centre Retrospective Cohort Study

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ABSTRACT

Background: Regaining walking ability is a central patient-relevant outcome after hip fracture, but early recovery estimates are difficult to interpret when death and missing functional assessments are not reported separately. Objective: To describe 30-day functional ambulation, survival, and completeness of follow-up in older adults treated surgically for hip fracture at a single trauma centre.

Methods: This retrospective cohort included 96 patients aged 65 years or older who underwent surgery for an intracapsular or extracapsular proximal femoral fracture between 1 January and 30 April 2024. Functional Ambulation Category (FAC) ≥ 3 at approximately 30 days was the prespecified operational outcome. Death and missing assessment were reported separately. An exploratory extreme-case analysis classified all missing survivor assessments as either FAC < 3 or FAC ≥ 3 .

Results: The mean age was 85.3 years and 69/96 patients (71.9%) were women. Eight patients (8.3%; 95% CI 4.3–15.6%) died before day 30. Six of 88 survivors (6.8%) lacked a valid functional assessment, leaving 82 evaluable patients. FAC ≥ 3 was documented in 46/82 patients (56.1%; 95% CI 45.3–66.3%). Under the two extreme assumptions for missing assessments, the proportion with FAC ≥ 3 among survivors ranged from 52.3% to 59.1%.

Conclusions: Just over half of evaluable patients attained level-surface ambulation without hands-on assistance by approximately 30 days. Outcome-specific denominators and explicit handling of mortality and missing assessments are essential when reporting early functional recovery after hip fracture.

KEYWORDS: hip fracture; functional ambulation; Functional Ambulation Category; older adults; retrospective cohort; 30-day outcome.

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I. INTRODUCTION

Hip fracture is one of the most consequential fragility injuries in older adults. Beyond the immediate need for surgery and medical stabilisation, it frequently initiates a sustained decline in mobility, independence, and health-related quality of life [1,2]. Mortality remains important, but walking recovery is often the outcome most readily understood by patients and families because it directly affects the ability to return home, perform activities of daily living, and avoid institutional care.

Contemporary hip-fracture pathways combine timely surgery with coordinated orthogeriatric management, pain control, delirium prevention, and mobilisation as soon as clinically feasible. Large database and multicentre cohort studies have linked earlier mobilisation with better short-term survival and walking outcomes, although definitions of early mobilisation and functional recovery differ across studies [3,4]. A systematic review and meta-analysis likewise reported lower mortality and complication rates among patients mobilised earlier, while emphasising residual confounding and the inability of observational evidence to establish a direct causal effect [5].

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Recovery nevertheless varies widely. Pre-fracture mobility, age, cognitive impairment, comorbidity, nutritional vulnerability, postoperative delirium, and the clinical opportunity to begin gait practice have all been associated with postoperative function [6-11]. These factors are interrelated: patients with greater physiological reserve are more likely to mobilise early, while those who are medically unstable may both mobilise later and experience poorer outcomes.

Descriptive cohort data should therefore avoid implying causation when predictor-level analyses are unavailable.

The Functional Ambulation Category (FAC) is an ordinal scale based on the physical assistance required for walking [12]. A threshold of $FAC \geq 3$ represents walking on level ground with supervision or less physical assistance, with or without a walking aid. This outcome is clinically meaningful but is not synonymous with full independence, community ambulation, or recovery of the pre-fracture level. Careful definition is necessary when comparing studies that use different mobility scales or endpoints.

Published studies have used several definitions of functional recovery, including return to the pre-fracture walking level, independence with or without a walking aid, change in activities of daily living, and discharge destination. These outcomes describe related but non-equivalent aspects of recovery. A critical review found that only 40-60% of patients recovered their pre-fracture mobility or instrumental activities of daily living, with most improvement in walking and basic activities occurring during the first six months after fracture [2]. Consequently, a 30-day walking measure should be interpreted as an early milestone in a longer recovery trajectory rather than as the completion of rehabilitation.

Short-term studies also face a denominator problem. Patients who die before functional follow-up have experienced a competing event and cannot simply be assigned a measured walking score. Conversely, excluding deaths and survivors without an assessment may make the observed recovery proportion appear more favourable. This issue is particularly relevant at 30 days, when patients may have moved between acute care, rehabilitation facilities, residential care, and home. Reporting survival, completeness of assessment, and functional status as separate components is therefore necessary for a clinically meaningful estimate.

The present study aimed to describe functional ambulation at approximately 30 days after hip fracture surgery in a consecutive single-centre cohort. The primary objective was to estimate the proportion of patients with a documented assessment who achieved the prespecified FAC threshold. Secondary descriptive objectives were to report 30-day survival, the completeness of functional follow-up among survivors, and the range of recovery estimates produced by extreme assumptions about the six missing assessments.

II. MATERIALS AND METHODS

A. Study design, setting, and participants

This single-centre retrospective cohort study was conducted at the Orthopaedics and Traumatology Clinic of Poleo “Santa Maria della Misericordia University Hospital”, Perugia, Italy. The study period ran from 1 January to 30 April 2024, and all patients who met the eligibility criteria during this period were included. Reporting was guided by the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement [13]. Mutua patients were eligible if they

were aged 65 years or older, had an intracapsular or extracapsular proximal femoral fracture, and underwent operative treatment. Pathological and periprosthetic fractures, polytrauma, and non-operative management were excluded. Each patient contributed one observation to the cohort.

B. Data source and functional outcome

Routinely recorded clinical information was reviewed. The dataset available for this analysis comprised age, sex, 30-day vital status, availability of a functional assessment at approximately 30 days, and classification of the day-30 Functional Ambulation Category (FAC) in relation to the study threshold. Age was available as a cohort mean only; a measure of dispersion was not available. FAC ranges from 0 (non-functional ambulation) to 5 (independent ambulation) and records the degree of human support required for walking [12]. For this study, $FAC \geq 3$ was prespecified as an operational threshold indicating level-surface ambulation without hands-on physical assistance, although supervision could still be required. The threshold does not imply recovery of community ambulation or of the pre-fracture walking level.

The available records did not permit confirmation of the exact assessment date, assessor, setting, or assessment modality. The endpoint is therefore described consistently as occurring at approximately 30 days. The full ordinal distribution of FAC scores was not available for analysis, so the outcome was reported according to the prespecified threshold rather than as a change across all six FAC levels.

C. Participant flow and missing data

Death before day 30 and loss to functional follow-up among survivors were handled as separate participant-flow states. No FAC score was imputed for patients who died or for survivors without a valid assessment. Mortality used the full cohort as the denominator; loss to follow-up used the number alive at day 30; and the primary functional estimate used only patients with a documented FAC classification. The proportion of the original cohort with a documented $FAC \geq 3$ was also reported descriptively, but it was not interpreted as the primary functional estimate because its denominator includes deaths and missing assessments.

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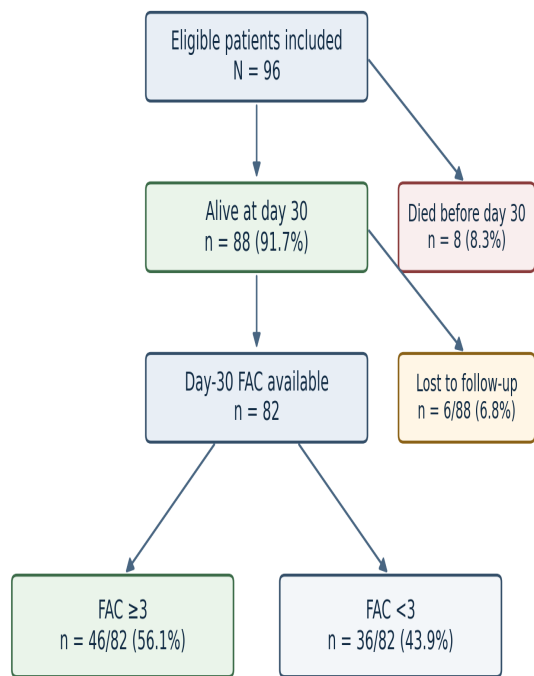
D. Statistical analysis

The analysis was descriptive. Categorical variables are reported as n/N (%) and age as the available cohort mean. Percentages were rounded to one decimal place using the clinically relevant denominator. Wilson score 95% confidence intervals (CIs) were calculated for key binomial outcomes from the observed counts. To show how the six missing functional assessments could influence the survivor-level estimate, an exploratory extreme-case analysis was performed: the lower bound classified all six missing assessments as FAC <3, whereas the upper bound classified all six as FAC ≥3. These calculations provide descriptive bounds and were not treated as imputations. Because patient-level covariates were not available, no hypothesis testing, subgroup comparisons, or multivariable modelling was undertaken.

III. RESULTS

A. Cohort, follow-up, and 30-day functional ambulation

Ninety-six patients met the eligibility criteria during the study period. The mean age was 85.3 years, and 69 patients were women (71.9%). Eight patients died before day 30, corresponding to a 30-day mortality of 8.3% (95% CI 4.3–15.6%). Among the 88 survivors, six patients (6.8%; 95% CI 3.2–14.1%) lacked a valid functional assessment. Day-30 FAC was therefore available for 82 patients, representing 85.4% of the full cohort and 93.2% of survivors (Figure 1).



FAC = Functional Ambulation Category. Death and missing follow-up were not assigned a FAC score.

Among the 82 evaluable patients, 46 attained FAC ≥3 (56.1%; 95% CI 45.3–66.3%), while 36 had FAC <3 (43.9%; 95% CI 33.7–54.7%). Thus, slightly more than one half of assessed patients could walk on a level surface without hands-on physical assistance at approximately 30 days. When the original cohort was used only as a descriptive reference, 46/96 patients (47.9%) had a documented FAC ≥3, 36/96 (37.5%) had a documented FAC <3, 8/96 (8.3%) had died, and 6/96 (6.3%) were alive without a valid assessment.

In the extreme-case analysis among all 88 survivors, the FAC ≥3 proportion was 46/88 (52.3%) when every missing assessment was classified below the threshold and 52/88 (59.1%) when every missing assessment was classified at or above the threshold. The observed estimate of 56.1% therefore lay within a relatively narrow 6.8-percentage-point range defined by the two extreme assumptions.

Table 1. Cohort characteristics and 30-day outcomes.

Variable	Value
Total cohort	96
Mean age, years	85.3
Female sex, n/N (%)	69/96 (71.9%)
Alive at day 30, n/N (%)	88/96 (91.7%)
Death before day 30, n/N (%)	8/96 (8.3%; 95% CI 4.3–15.6%)
Lost to functional follow-up among survivors, n/N (%)	6/88 (6.8%; 95% CI 3.2–14.1%)
Valid day-30 FAC assessment, n/N (%)	82/96 (85.4%)
Valid day-30 FAC assessment among survivors, n/N (%)	82/88 (93.2%)
Day-30 FAC ≥3 among assessed patients, n/N (%)	46/82 (56.1%; 95% CI 45.3–66.3%)
Day-30 FAC <3 among assessed patients, n/N (%)	36/82 (43.9%; 95% CI 33.7–54.7%)

Note. Percentages use the denominator displayed. Where shown, 95% CIs are Wilson score intervals. FAC, Functional Ambulation Category. No functional score was imputed for death or missing follow-up.

Figure 1. Participant flow and ascertainment of 30-day functional ambulation.

IV. DISCUSSION

A. Interpretation and clinical implications

The principal finding is that 46 of 82 evaluable patients (56.1%; 95% CI 45.3–66.3%) reached FAC ≥ 3 at approximately 30 days. The result remained clinically similar when the six missing assessments were handled under extreme assumptions: among the 88 survivors, the proportion ranged from 52.3% if all missing patients were below the threshold to 59.1% if all were at or above it. This bounded analysis does not remove the possibility of missing-outcome bias, but it shows that the missing assessments alone could not shift the survivor-level estimate outside a range of 6.8 percentage points.

Sampling precision remains an important consideration. The 95% confidence interval around the primary estimate extended from 45.3% to 66.3%, a range considerably wider than the shift produced by the extreme-case assumptions for the six missing assessments. The dominant uncertainty is therefore the modest cohort size rather than missing follow-up alone. This distinction matters when the result is used for benchmarking: a difference between two small single-centre cohorts may reflect sampling variation, case mix, or measurement practice rather than a genuine difference in quality of care. Multicentre data collected with a common protocol would provide a more stable estimate.

Direct numerical comparison with other cohorts is difficult because studies use different baseline requirements, follow-up intervals, and definitions of walking recovery. Some evaluate return to pre-fracture mobility, whereas others assess walking independence, use of an aid, activities of daily living, or discharge destination. Across this heterogeneous literature, long-term disability remains substantial: only 40–60% of patients recover their pre-fracture mobility or instrumental activities of daily living, and most gains in walking and basic activities occur within the first six months [2]. The present 30-day estimate is therefore best viewed as an early description of assistance requirements rather than a measure of complete functional restitution.

FAC offers a practical advantage because it distinguishes the degree of human support required for walking. Nevertheless, dichotomising an ordinal scale has limitations. A patient who improves from non-functional ambulation to walking with continuous physical support may experience an important clinical gain while remaining below FAC 3. Conversely, reaching FAC 3 does not establish safe outdoor mobility, stair negotiation, return to the pre-fracture level, or independent community living. Future studies should retain the full FAC distribution and, where possible, compare postoperative status with a documented pre-fracture measure.

The importance of early mobilisation is well established in contemporary hip-fracture care, although published studies assess different exposures and outcomes. In a UK database analysis of 126,897 surgically treated patients, mobilisation on the day of or the day after surgery was associated with 30-day survival and recovery of pre-fracture walking ability [3]. A prospective Japanese multicentre cohort subsequently found that ambulation initiated on postoperative day 1 or 2 was associated with independent walking at postoperative week 1 and at discharge [4]. A meta-analysis of 13 studies involving 297,435 patients likewise reported lower 30-day mortality and fewer complications among patients mobilised earlier, while emphasising that observational evidence cannot establish a direct causal effect [5]. A hospital cohort also associated early mobilisation with lower in-hospital mortality, supporting its use as a care-process indicator while leaving residual confounding unresolved [15].

Functional recovery is also shaped by the patient's reserve before injury and by complications arising during acute care. Pre-fracture mobility and age [6–9], cognitive impairment [7,8], postoperative delirium [10], and preoperative hypoalbuminaemia [11] have each been associated with subsequent function. A recent scoping review identified a wide range of candidate prognostic factors but found that only a subset was supported by studies at low risk of bias [17].

These factors are interrelated, and the present aggregate dataset cannot determine their independent contribution.

The current findings should therefore not be interpreted as evidence for or against any specific predictor or component of treatment.

The cohort profile also deserves attention. A mean age of 85.3 years and a female proportion of 71.9% place the study within a very old fragility-fracture population, but the absence of an age distribution prevents assessment of heterogeneity within that average. Patients in their late sixties and patients in their nineties may have markedly different physiological reserve, baseline mobility, living arrangements, and rehabilitation potential. Likewise, the predominance of women should not be interpreted as evidence of sex-specific recovery because the study was not designed or powered for subgroup comparisons. Patient-level age and sex data would be required to explore effect modification responsibly.

From a clinical perspective, a 30-day walking assessment can complement mortality and readmission metrics by describing an outcome that is directly meaningful to patients and families. Patients who remain below FAC 3 may require more intensive gait training, transfer practice, falls-prevention strategies, review of pain control, optimisation of nutrition, and coordination of community or residential support. Patients who reach the threshold may still require assistance in other domains. FAC should consequently be considered alongside cognition, activities of daily living, living situation, pain, confidence, and the availability of caregivers rather than used as a stand-alone discharge criterion.

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For service evaluation, reproducibility is as important as the choice of scale. A useful pathway should specify the acceptable assessment window, whether evaluation is performed face to face or remotely, who assigns the FAC score, how walking aids are handled, and what evidence is required when information comes from a caregiver or rehabilitation facility. A short standard operating procedure and a structured electronic field could reduce measurement variability and make follow-up less dependent on individual documentation habits. The same system should record why an assessment is missing, because death, medical instability, transfer, refusal, and inability to contact the patient have different clinical meanings.

Early functional recovery is also a potential prognostic milestone. Most recovery continues beyond 30 days [2], and prospective evidence indicates that the relationship between pre-fracture status and 30-day recovery is associated with longer-term survival [14]. This makes a standardised early assessment useful for both clinical follow-up and service evaluation, provided that the timing and method of measurement are clearly defined. Repeated assessment at discharge, 30 days, three months, and six months would better distinguish delayed recovery from persistent disability and would describe trajectories that a single threshold cannot capture.

The observed 30-day mortality of 8.3% was close to the 7.8% reported among 29,695 patients aged 75 years or older in the Spanish National Hip Fracture Registry [16].

This comparison provides context rather than evidence of equivalence, because case mix, eligibility criteria, perioperative pathways, and completeness of follow-up differ between settings. In the present study, keeping death separate from functional missingness is clinically important: death is a competing event, whereas a surviving patient without an assessment has an unknown functional outcome.

Completeness of functional ascertainment was high among survivors (93.2%), but the reasons for the six missing assessments were not available. Patients with greater disability, cognitive impairment, institutional care needs, or rehospitalisation may be more difficult to assess; alternatively, some patients may decline follow-up after recovering. Either mechanism can bias a complete-case estimate. Reporting the full participant flow and the extreme-case bounds makes the uncertainty visible without assigning unobserved scores.

B. Strengths, limitations, and future directions

The study has several strengths. It includes all eligible patients treated during a defined four-month period, reports the clinically relevant denominators for survival and functional assessment, uses a recognised scale of walking assistance, and avoids assigning a functional score to patients who died. The addition of extreme-case bounds provides a simple assessment of the possible influence of the six missing outcomes without relying on model-based assumptions. The cohort also reflects routine care in a university hospital, which makes the findings relevant to local quality improvement and hypothesis generation.

The limitations are substantial and should frame interpretation. The study is retrospective, single-centre, and modest in size.

Age was available only as a mean, without standard deviation or range. The dataset did not contain the full FAC distribution, pre-fracture mobility, comorbidity, cognitive status, delirium, albumin, fracture pattern, surgical procedure, time to surgery, time to first mobilisation, length of stay, discharge destination, or rehabilitation intensity. These omissions precluded adjusted analyses and prevented examination of factors associated with recovery. The exact date, assessor, setting, and modality of the approximately 30-day assessment could not be confirmed, introducing possible measurement and temporal misclassification. Generalisability is also limited by the short enrolment period and the characteristics of a single orthopaedic service. Seasonal variation, referral patterns, availability of inpatient rehabilitation, and local discharge pathways may influence which patients are assessed and the speed of recovery.

The confidence intervals quantify sampling precision for the observed proportions but do not account for selection bias, measurement error, or unmeasured differences between assessed and unassessed survivors. The sensitivity bounds address only the six missing outcomes and not these broader sources of uncertainty.

A prospective study should define an assessment window in advance, document the setting and assessor, retain the complete FAC score, and collect a standardised pre-fracture mobility

Recording cognition, delirium, comorbidity, nutritional status, fracture and procedure type, operative delay, first mobilisation, weight-bearing instructions, rehabilitation exposure, and discharge destination would support clinically meaningful multivariable analyses. Follow-up beyond 30 days should include residence, activities of daily living, falls, readmission, and patient-reported recovery. These additions would allow the early FAC trajectory to be evaluated as both a patient-centred outcome and a potential predictor of longer-term independence.

V. CONCLUSIONS

In this single-centre retrospective cohort, slightly more than half of evaluable patients reached FAC ≥ 3 at approximately 30 days after hip fracture surgery. The result remained within a narrow range under extreme assumptions for the six missing survivor assessments. A standardised 30-day walking measure can provide clinically useful information, but it should be interpreted alongside survival, completeness of follow-up, and the broader dimensions of functional independence. Prospective collection of baseline, perioperative, and rehabilitation variables is required to identify determinants of recovery and to establish the longer-term significance of early FAC status.

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