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FRAIL Questionnaire Screening Tool and Short-Term Outcomes in Geriatric Fracture Patients

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Abstract

Objectives: There are limited screening tools to predict adverse post-operative outcomes for the geriatric surgical fracture population. Frailty is increasingly recognized as a risk assessment to capture complexity. The goal of this study was to utilize a short screening tool, the FRAIL scale, to categorize the level of frailty of older adults admitted with a fracture to determine the association of each frailty category with post-operative and 30-day outcomes.

Design: Retrospective cohort study

Setting: Level 1 Trauma Center

Participants: 175 consecutive patients over age 70 admitted to co-managed orthopaedic trauma and geriatrics service

Measurements: The FRAIL scale (short five-questions assessment of fatigue, resistance, aerobic capacity, illnesses and loss of weight) classified the patients into three categories: robust (score=0), prefrail (score=1–2), and frail (score=3–5). Postoperative outcome variables collected were: postoperative complications, unplanned ICU admission, length of stay (LOS), discharge disposition, and orthopedic follow-up after surgery. 30-day outcomes measured were 30-day readmission and 30-day mortality. Analysis of variance (one-way ANOVA) and Kruskal-Wallis tests were used to compare continuous variables across the three FRAIL categories. Fisher exact tests were used to compare categorical variables. Multiple regression analysis, adjusted by age,

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gender and Charlson index, was conducted to study the association between frailty category and outcomes.

Results: FRAIL scale categorized the patients into three groups: robust (n=29), prefrail (n=73), and frail (n=73). There were statistically significant differences between groups in terms of age, comorbidity, dementia, functional dependency, polypharmacy and rate of institutionalization, being higher in the frailest patients. Hip fracture was the most frequent fracture, and it was more frequent as the frailty of the patient increased (48%, 61% and 75% in robust, prefrail and frail groups, respectively). The American Society of Anesthesiologists (ASA) preoperative risk significantly correlated with the frailty of the patient (ASA score 3–4: 41%, 82% and 86%, in robust, prefrail and frail groups, $p<0.001$). After adjustment by age, gender and comorbidity, there was a statistically significant association between frailty and both, length of stay and the development of any complication after surgery (length of stay: 4.2, 5.0, and 7.1 days, $p=0.002$; any complication: 3.4, 26 and 39.7%, $p=0.03$; in robust, prefrail and frail groups). There were also significant differences in discharge disposition (31% of robust and 4.1% of frail patients were discharged home ($p 0.001$)) and follow-up completion (97% of robust versus 69% of the frail ones). Differences in time to surgery, unplanned ICU admission, and 30-day readmission and mortality, although showing a trend, didn't reach statistical significance.

Conclusion: Frailty, measured by the FRAIL scale, was associated with increase length of stay, complications after surgery, and discharge to rehabilitation facility in geriatric fracture patients. The FRAIL scale is a promising short screen to stratify and help operationalize the perioperative care of older surgical patients.

Keywords

frailty; fracture; fall; delirium; older adult

Introduction

With the population aging, there is a larger impact on the healthcare system of older patients admitted to the hospital with fractures. Understanding who is at risk for adverse outcomes in the aging surgical fracture population is essential to allow for informed conversations and targeted programs to assist this vulnerable population.

To date, there are limited screening tools for predicting adverse post-operative outcomes for the geriatric surgical fracture population. Preoperative risk assessments are traditionally carried out using the American Society of Anesthesiology (ASA) level and a cardiac evaluation such as a Revised Cardiac Risk Index^{1,2}, and Gupta Index.³ However, these screening tools are limited for the older adult population because they fail to capture the complexity of the elderly population, in other words, they do not assess for frailty. The presence of frailty in elderly patients is becoming increasingly recognized as a contributing element in the outcome of treatment.^{4–8} Frailty, defined as a state of increased vulnerability to stress, has been one way for clinicians to characterize the physiological reserve of geriatric patients. Assessment of frailty of geriatric patients prior to surgery can aid in prognosis and optimize care plans. The two most commonly used concepts of frailty include the Fried criteria and the Rockwood frailty index.^{9,10} One disadvantage to screening for

frailty using these diagnostic tools is they are both time consuming and labor intensive. Due to these limitations, simplified screening tools are needed to operationalize frailty management in this vulnerable population.

Given that there is currently a lack of consensus regarding the appropriate assessment of frailty in older adults admitted for surgical repair of fracture¹¹, our goal was to utilize a screening frail questionnaire the FRAIL scale to categorize the level of frailty of elderly patients admitted with a fractures and determine the association of frailty category with post-operative and 30-day outcomes.

Methods

This retrospective cohort study included all consecutive patients over age 70 admitted to a geriatric fracture co-management service at a Level 1 Trauma center, between August 2015 and May 2016. Patients were evaluated by one of three board certified geriatricians and seen daily by orthopedic surgeons. The FRAIL scale was completed as part of the routine comprehensive geriatric assessment performed on admission as part of a new initiative.

During the study period, our geriatricians assessed 369 patients. Patients were excluded if they did not have an orthopedic fracture diagnosis (i.e., no fracture or only rib, nasal, or facial fractures) or if their injury did not require surgery. 175 geriatric fracture patients met the inclusion criteria (Figure 1). They were categorized using FRAIL scale into 3 groups: robust (N=29), pre-frail (N=73) and frail (N=73). The study was approved by the hospital Institutional Review Board.

Assessment of Frailty

The FRAIL scale is a short five-question assessment that can screen for frailty (Figure 2).¹²⁻¹⁴ The scale contains 4 questions directed at components of the Cardiovascular Health Study Frailty Index and one (number of illnesses) at the Rockwood Scale.¹⁵ Individuals are considered robust (score=0), prefrail (score=1-2), and frail (score=3-5). The questionnaire has been shown to be an optimal screening test for clinicians to identify frail persons at risk of decline in health and mortality.¹⁶⁻¹⁸

Preoperative Variables

Preoperative variables that were obtained from the medical records included the following: demographics, marital status, living situation, Charlson index¹⁹, activities of daily living (BADL)²⁰ and instrumental activities of daily living (IADL)²¹, Mini-Cog score²², number of medications on admission, self-reported history of falls, basic code status, albumin level, ASA score, and fracture type. All preoperative variables were obtained from the initial geriatric consult note with the exception of ASA score and comorbidities, which were collected from the anesthesiology and orthopedic surgery notes.

Postoperative and 30-day Outcome Variables

Postoperative outcome variables included postoperative complications (pulmonary, cardiac, delirium, deep vein thrombosis or pulmonary embolism, renal insufficiency [twice more

than baseline creatinine] and unplanned intensive care unit (ICU) admission [new admission to ICU after surgery], LOS, discharge disposition location, and orthopedic follow-up at any point after surgery. Thirty-day outcomes included readmission, and mortality. All postoperative variables were recorded from the geriatric and discharge notes found in patients' electronic medical records (EMR). Follow-up appointment and 30-day readmission data were ascertained by reviewing patients' longitudinal data in the EMR, as was the 30-day mortality.

Statistical analysis

Analysis of variance (one-way ANOVA) and Kruskal Wallis tests were used to compare continuous variables across the three FRAIL categories: robust, prefrail and frail. Chi-square and Fisher exact tests were used to compare categorical variables. Multiple regression analysis, adjusted by age, gender and Charlson index, was conducted to study the association between frailty category and outcomes. All the analyses were performed using IBM SPSS Statistics for Macintosh, Version 20 (Armonk, NY: IBM Corp.)

Results

The baseline characteristics of the study population are shown in Table 1. The mean (SD) age of the cohort was 82.3 (7.4) years, and the majority of the patients were female (74.9%). Several variables demonstrated a statistically significant difference according to frailty categories. Age increased in parallel to the frailty of the patients (mean age in robust patients: 77.8 years, versus 84 years in the frail group). While 83% of robust patients were living at home before the admission, only 49% of frail patients could do the same. Robust patients had less number of comorbidities compared to prefrail and frail patients (Charlson index mean: 1, 2.2, and 2.4, respectively), and they were on fewer medications at the time of admission (6.6, 10.5, and 10.5, respectively).

Regarding the Comprehensive Geriatric Assessment, robust patients were more independent for BADL and IADL than pre-frail or frail patients (independent for BADL: 100%, 68.5%, and 30.1%, respectively; IADL: 79.3%, 35.6%, and 6.8%, respectively). There were no patients with the diagnosis of baseline dementia in the robust group compared to 15.1% in the prefrail group, and 21.9% in the frail group. However, 10.7% of robust patients had an abnormal Mini-Cog test during admission, compared to 43.1% and 77.8% in the pre-frail and frail groups, respectively. The *Do-not-resuscitate* code (DNR code) was in place for 10.3% of the robust patients, compared to 17.8% and 37% in prefrail and frail patients. Only 10.3% of robust patients were incontinent, while that percent increased to 53% in the frail group.

Preoperative risk as defined by ASA score also correlated with the frailty of the patients, as 41% of robust patients had high pre-surgical risk (ASA score 3 or 4) compared to 86% of the patients in the frail group. The majority of the fracture patients presented with proximal femoral fracture (65.5%), and its prevalence increased as the frailty of the patient increased (48.1%, 62% and 75.3% in robust, prefrail and frail patients). The total prevalence of upper extremity fractures was 8.2%. They constituted 25.9% of all fractures in robust patients while only a 2.7% of all in frail patients.

Table 2 show frail patients had a slightly longer time to surgery than prefrail and robust ones; however, the difference was not statistically significant (mean time to surgery in the frail group: 1.96 versus 1.34 and 1.38 in the prefrail and robust groups, respectively). While the average number of complications experienced by patients was less than one, there does appear to be an increasing number of complications with frailty. The overall incidence of post-operative delirium was 20%. More specifically, post-operative delirium is significantly greatest in the frail group, in which it was present in almost 29% of the patients. Ninety percent of the entire cohort patients were discharged to a rehabilitation facility, while 31% of robust patients were discharged home; frail and pre-frail patients had a greater percentage of rehabilitation facility discharges. In our sample, all robust patients (100%) attended some form of follow-up compared to pre-frail patients (91.7%) and frail patients (71.8%).

The association between frailty and postoperative and 30-days outcomes is shown in Table 3. The unadjusted analysis evidenced a statistically significant difference between robust, prefrail and frail groups in terms of length of stay (mean LOS: 4.2, 5 and 7.1 days, respectively), and the development of any complication during admission (3.4, 26 and 39.7%, respectively). While 90.4% of frail patients were likely to stay 6 or more days only 51.7% of robust patients required that extended length of stay. There were also significant differences when comparing the percent of patients discharged to home (31, 4.2 and 4.1%, in robust, prefrail and frail patients), and the percentage of patients completing a follow-up appointment (100, 91.8, and 71.8%, respectively). Finally, non-significant differences between groups were found in unplanned ICU admission, 30-day readmissions and mortality with a trend toward worse outcomes in the pre-frail and frail groups.

Discussion

This study demonstrated that frailty is common among fracture patients as well as investigated the relationship between a physiological frailty screening tool, FRAIL scale, and postoperative and 30-day outcomes. It is unique in that we found that this brief screening tool identifies vulnerable patients with a relationship between level of frailty and outcomes independent of age, gender and comorbidity in fracture patients. The results of this study are consistent with the small body of literature on frailty and hip fracture outcomes in older adults. Specifically, alternative frailty indices have shown a significant association between frailty and outcomes after hip fracture including increased LOS²³, postoperative complications^{24,25}, and mortality at 1 and 2 years post-fracture.²⁶ The advantage of the FRAIL scale compared to other scales is that it is a brief, easy to use tool¹⁸ that assesses physiological reserve in geriatric surgical fracture patients to stratify risk.

Overall, there is a general lack of consensus on how to best categorize frailty; nonetheless, it is increasingly being used for clinical risk assessments.^{6,27} The outcomes associated with frail and prefrail patients on the FRAIL scale have implications for where resources should be employed within the growing number of geriatric orthopedic co-management services.²⁸⁻³¹ We discovered significant findings that non-robust patients (prefrail, frail) have greater needs than robust ones. Delirium was occurred in a greater percentage of non-robust patients. Delirium has been shown to be associated with worse postoperative outcomes in the postsurgical setting.^{32,33} Almost a third of frail patients (28.2%) did not make it to their

outpatient surgical follow up. This has implications for outpatient follow up resources designated for these patients and may be better served with house visit or community outreach services for these targeted patients. Early surgery is optimal for fracture patients³⁴, and from our internal quality metrics in our co-management group, on average, even frail patients can be assessed and stabilized for surgery within 2 days, but require more time postoperatively (on average 2 more days LOS) before discharge. This has implications when designing surgical bundles where robust and non-robust patients will require different number of postoperative days. Additionally, a third of robust patients were able to go home from hospital, not something normally associated with acute fractures in older adults. This is an important finding for those designing transitions of care. Frail patients had a trend, although non-significant, toward greater of 30-day readmission and 30-day mortality than robust patients, which agrees with the findings of other similar studies.^{35,36} All of these findings increase the value of implementing a simple FRAIL scale screening.

As expected, proximal femoral fractures, intertrochanteric and femoral neck fractures, were the most prevalent in frail patients. Frail patients likely have less associated capacity to avoid falling onto their pelvis. Additionally, we found that in the robust group upper extremity fractures more frequent (25.9% vs 2.7%). This suggests that the robust patients likely had greater bone density, were more active and that they may have greater strength and reflex to catch themselves upon falling; therefore, resulting in an upper extremity fracture rather than a lower extremity fracture.^{37,38}

The use of Mini-Cog, measure of cognitive frailty, has previously been demonstrated to identify vulnerable geriatric ortho-patients pre-operatively.³⁹ There is a significant relationship between cognitive impairment, represented by an abnormal Mini-Cog, and frailty. Mini-Cog is a complimentary assessment to the FRAIL scale in that it assesses cognitive reserve instead of physiological reserve. FRAIL scale does not replace the Mini-Cog, rather it should be viewed as an explicit cognitive assessment directly identifying delirium risk and the capacity for the patient providing consent around hip fractures. This argument is supported by our current data that demonstrates that 10.7% of robust patients had abnormal Mini-Cog. Among this group of robust patients, 3.4% developed delirium, the dominant complication in robust patients. This unlikely combination of robust physiological reserve combined with vulnerable cognitive state justifies the benefit of an explicit assessment for delirium risk even in robust patients. Finally, it is also important to point out that the overall delirium incidence was only 20%, compared with 41% in usual care, and is consistent with previous studies demonstrating the benefits of geriatric orthopedic co-management.²⁹

There are several noteworthy strengths to this study. First, the same three geriatricians performed the comprehensive geriatric assessment at time of admission, including the FRAIL scale, thereby maintaining consistency throughout the duration of the study. Second the study was performed in a geriatric orthopedic co-management service where care pathways are standardized and interdisciplinary care is optimized for the acute care of the elderly. Third, medical records of consecutive patients were analyzed, which reduced any type of bias. Lastly, this study used a novel approach to screening geriatric fracture patients with a simple FRAIL scale, in order to predict their risk of post-operative complications.

Our study was limited in that it was a retrospective study utilizing one institution's electronic medical record. We were also unable to obtain information on if a patient was admitted to a different institution within the 30-day discharge period. Additionally, our sample size might have limited the study power to detect significant associations between frailty and other postoperative outcomes.

Future studies should compare the frail screen to a full frailty assessment such as a calculated frailty index from the comprehensive geriatric assessment in a larger sample to further validate this screen in the fracture population.

Conclusion

Frailty screening, measured by the FRAIL scale, can help predict postoperative outcomes in fracture patients. The FRAIL scale is a promising short screen to stratify patients by frailty and help operationalize the perioperative care of older surgical fracture patients.

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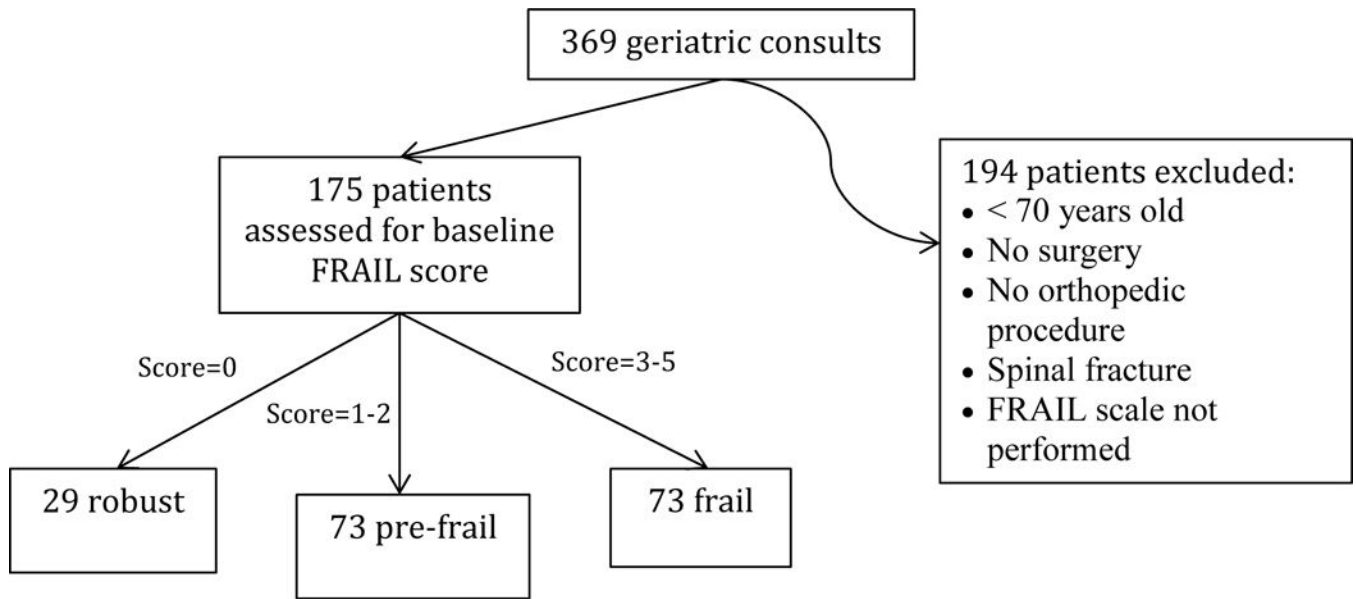


Figure 1.
Patient inclusion algorithm

Fatigue: Are you fatigued?

Resistance: Cannot walk up 1 flight of stairs?

Aerobic: Cannot walk 1 block?

Illnesses: Do you have more than 5 illnesses?

Loss of weight: Have you lost more than 5% of your weight in the past 6 months?

Scoring:

Robust (score=0), Prefrail (score=1-2), and Frail (score=3-5)

Figure 2.
FRAIL Scale

Table 1.

Preoperative Characteristics by Frailty Category

| Characteristics | Total N=175 | Robust N= 29 | Prefrail N=73 | Frail N=73 | P- Value |
|--|----------------|-----------------|------------------|---------------|-------------|
| Demographics | | | | | |
| Age, mean (SD) | 82.3 (7.4) | 77.8 (5.7) | 82.3 (7.2) | 84 (7.5) | 0.01 |
| Female, n (%) | 131(74.9) | 23 (79.3) | 54 (74) | 54 (74) | 0.83 |
| Married, n (%) | 72 (42.4) | 17 (58.6) | 27 (38) | 28 (40) | 0.57 |
| Living at home prior to admission, n (%) | 116(66.3) | 24 (83) | 56 (77) | 36 (49) | 0.001 |
| Charlson index, mean (SD) | 2.1 (1.9) | 1.0 (1.0) | 2.2 (1.9) | 2.4 (2.0) | 0.001 |
| Dementia, n (%) | 27(15.4) | 0 | 11 (15.1) | 16 (21.9) | 0.02 |
| Comprehensive Geriatric Assessment (CGA) | | | | | |
| Independent for all ADL, n (%) | 101(57.7) | 29 (100) | 50 (68.5) | 22 (30.1) | <0.001 |
| Independent for all IADL, n (%) | 54 (30.9) | 23 (79.3) | 26 (35.6) | 5 (6.8) | <0.001 |
| Mini-cog abnormal, n (%) | 80 (51.3) | 3 (10.7) | 28 (43.1) | 49 (77.8) | <0.001 |
| No. medications, mean (SD) | 9.8 (5.6) | 6.6 (5.6) | 10.5 (5.7) | 10.5 (5.0) | 0.03 |
| History of falls in past year, n (%) | 96 (55.8) | 15 (51.5) | 36 (49.3) | 45 (64.3) | 0.17 |
| Incontinence, n (%) | 66 (38) | 3 (10.3) | 25 (34.2) | 38 (53) | 0.002 |
| DNR code, n (%) | 43 (24.6) | 3 (10.3) | 13 (17.8) | 27 (37) | 0.02 |
| Albumin level, mean (SD) | 3.6 (0.5) | 3.8 (0.4) | 3.7 (0.5) | 3.5 (0.5) | 0.10 |
| ASA score 3–4, n (%) | 135(77.1) | 12 (41.4) | 60 (82.2) | 63 (86.3) | <0.001 |
| Fracture type, n (%) | | | | | |
| Proximal femoral intertrochanteric | 51 (29.8) | 6 (22.2) | 21 (29.6) | 24(32.9) | |
| Proximal femoral subtrochanteric | 12 (7) | 3 (11.1) | 4 (5.6) | 5 (6.8) | |
| Proximal femoral neck | 49 (28.7) | 4 (14.8) | 19 (26.8) | 26 (35.6) | |
| Proximal femoral periprosthetic | 11 (6.4) | 1 (3.7) | 5 (7) | 5 (6.8) | |
| Distal femur | 10 (5.8) | 1 (3.7) | 4 (5.6) | 5 (6.8) | |
| Distal femoral periprosthetic | 7 (4.1) | 2 (7.4) | 3 (4.2) | 2 (2.7) | |
| Ankle | 10 (5.8) | 1 (3.7) | 6 (8.5) | 3 (4.1) | |
| Tibia/Fibula | 7 (4.1) | 2 (7.4) | 4 (5.6) | 1 (1.4) | |
| Upper extremity | 14 (8.2) | 7 (25.9) | 5 (7.0) | 2 (2.7) | |

IADL: Instrumental Activities of daily living

DNR: *Do-not-resuscitate* code

Table 2.

Time to surgery, complications and discharge disposition by Frailty Category

| Characteristic | Total N=175 | Robust N=29 | Prefrail N=73 | Frail N=73 | P- Value |
|----------------------------------|----------------|----------------|------------------|---------------|-------------|
| Time to surgery, mean(SD) (days) | 1.6 (2.0) | 1.4 (0.9) | 1.3 (1.0) | 2.0 (2.9) | 0.42 |
| No. Complications, mean (SD) | 0.4 (0.8) | 0 (0.2) | 0.4 (1.0) | 0.6 (0.9) | 0.01 |
| Complications, n (%) | | | | | |
| Respiratory | 7 (4) | 0 | 2 (2.8) | 5 (6.8) | 0.22 |
| Cardiac | 10 (5.7) | 0 | 4 (5.5) | 6 (8.2) | 0.27 |
| Delirium | 35 (20) | 1 (3.4) | 13 (17.8) | 21 (28.8) | 0.01 |
| DVT/PE | 2 (1.1) | 0 | 2 (2.7) | 0 | 0.25 |
| Acute renal failure | 7 (4) | 0 | 4 (5.5) | 3 (4.1) | 0.44 |
| Discharge disposition, n (%) | | | | | |
| Home | 15 (8.6) | 9 (31) | 3 (4.2) | 3 (4.1) | <0.001 |
| Rehab ^a | 157 (90.2) | 20 (69) | 68 (94.4) | 69 (94.5) | |
| Other ^b | 2 (1.2) | 0 | 1 (1.4) | 1 (1.4) | |
| Orthopedic follow-up, n (%) | | | | | |
| Yes | 142 (82.1) | 28 (96.6) | 65 (89) | 49 (69) | 0.008 |
| No | 9 (5.2) | 0 | 2 (2.7) | 7 (9.9) | |
| Off-site | 5 (2.9) | 1 (3.4) | 2 (2.7) | 2 (2.8) | |
| No show ^c | 17 (9.8) | 0 | 4 (5.5) | 13 (18.3) | |

^aRehabilitation hospital or Skilled Nursing Facility^bHospice or Cognitive rehab facility^cPatients who did not follow up with an orthopedic surgeon while their medical records remained active with other appointments

Table 3.

Association between Frailty and Postoperative and 30-day Outcomes

| Outcomes Variable | Total N=175 | Robust N= 29 | Prefrail N=73 | Frail N=73 | P-Value | |
|----------------------------------|----------------|-----------------|------------------|---------------|------------|-----------------------|
| | | | | | Unadjusted | Adjusted ^a |
| Length of stay, mean (SD) (days) | 5.5 (3.4) | 4.2 (1.7) | 5.0 (3.0) | 7.1 (5.7) | <0.001 | 0.002 |
| Length of stay ≥ 6 days, n (%) | 127 (72.6) | 15 (51.7) | 46 (63) | 66 (90.4) | <0.001 | <0.001 |
| Any complication, n (%) | 49 (28) | 1 (3.4) | 19 (26) | 29 (39.7) | 0.001 | 0.03 |
| Unplanned ICU admission, n (%) | 13 (7.4) | 0 | 6 (8.2) | 7 (9.6) | 0.24 | 0.98 |
| Discharged home, n (%) | 15 (8.6) | 9 (31) | 3 (4.2) | 3 (4.1) | <0.0011 | 0.01 |
| Orthopedic follow-up, n (%) | 147 (84) | 29 (100) | 67 (91.8) | 51 (71.8) | <0.001 | 0.02 |
| 30-day readmission, n (%) | 20 (11.4) | 2 (6.9) | 9 (12.5) | 9 (12.5) | 0.69 | 0.96 |
| 30-day mortality, n (%) | 5 (2.9) | 0 | 1 (1.4) | 4 (5.5) | 0.20 | 0.43 |

^a Adjusted by age, gender and Charlson index