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Research Paper

Evaluation of therapy in traumatic elderly falls to return autonomy and functional status☆

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ABSTRACT

Background: Traumatic falls among the elderly (≥65 years old) are the leading cause of injury, morbidity and mortality are increasing with rising medical costs.
Methods: This is a retrospective medical record review of elderly mechanical fall patients (288 patients) admitted to an American College of Surgeons level II trauma center from January 2016 to January 2021. Demographics and comorbidities were determined, and physical/occupational therapy used to predict subsequent fall readmissions.
Results: Out of 288 patients, 243 received therapy with 45 readmissions for subsequent falls. Age ($P = .016$), body mass index ($P = .035$), previous falls ($P = .003$), walker/cane use ($P = .039$), and dementia ($P = .038$) were predictive of readmission. Therapy was shown to benefit patients, but deferred therapy sessions were shown to be associated with prolonged hospitalization.
Conclusion: Directed therapy may improve functionality and return autonomy to elderly mechanical fall patients admitted to trauma services.

INTRODUCTION

Traumatic falls are a significant cause of injury and morbidity among elderly patients 65 years and older and are seen in every level of trauma system. It is the leading cause of injury among this population, and deaths from falls are reported to be increasing [1]. Florence et al reported that "approximately 10,000 Americans turn 65 each day," with the largest growth in population seen in the 85 years and older group having the highest risk of falls [2]. Estimates in 2015 totaled medical costs for falls over $50 billion [2,3]. Fatal falls were reported to be 59.64 per 100,000 in the 65 years and older population with associated medical costs of approximately $754 million. Approximately 99% of medical costs are therefore associated with nonfatal falls, incurring a huge burden on patients, families, trauma systems, and health care spending overall [2].

The causes of all falls are multifactorial [4–6], but in those of mechanical ground-level falls, they can be related to fear of future or additional falls [7–10], deconditioning with physiological weakening [11], poor mobility, or other possible limitations for which therapy may decrease the risk of future falls [9,12,13]. Falls frequently lead to increased morbidity and worsening health status, subsequent inpatient nursing facility/long-term care admission, and being taken away from independent community living [14,15]. The loss of personal autonomy and admission to a health care facility increase overall health care costs and likely recurrent hospitalization [1,16–19] as well as place a strain on family and patient quality of life. It has been demonstrated that readmission for subsequent falls typically occur within 4 weeks [18], with up to 6 months for return of independent function [16] after falls.

There is an abundance of literature promoting programs to reduce falls at home from multidisciplinary fields such as primary care, social work, public health research, physiotherapy, etc, discussing prefall and prevention after discharge. However, literature addressing fall reduction at the index hospitalization leaves treating clinicians with little to guide prevention or optimization while the patient is recovering as an inpatient. Several studies have provided evidence that early mobilization therapy has improved outcomes and recovery times and reduced inpatient weakness in various surgical and intensive care unit (ICU) patients [20–27]. Many of these study surgical patients with isolated orthopedic injuries, isolated abdominal surgeries, planned cardiac

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surgeries, and debilitated ICU patients. Patients frequently omitted from these studies are trauma patients being managed for complex, multiple, or nonoperative injuries that still require significant care and optimization before discharge. This study aims to determine the efficacy of inpatient therapy of trauma admissions while recovering from a mechanical fall to reduce the likelihood of future falls and observe the relationship of progression of therapy to discharge disposition to home or other facility.

MATERIALS AND METHODS

After obtaining Investigational Review Board (IRB) exemption from Western IRB, we performed a retrospective medical record review of patients admitted to the trauma service of our American College of Surgeons level II trauma center between January 1, 2016, and January 31, 2021, to allow a 6-month follow-up window for readmission and continuity purposes. All of our trauma patients are catalogued within the National Trauma Data Bank. These patients were screened for inclusion criteria of patients 65 years and older who were admitted for a mechanical ground-level fall; specifically, that the patients were ambulating under their own power whether or not they had use of an assistive device such as a cane or walker. We excluded those with admission notes or ongoing evaluation documenting likely etiology from nonmechanical causes such as syncope, stroke, or cardiac complications. We also excluded those falling out of bed or out of a chair/wheelchair, falling from >2–3 steps, as well as mortalities during index admission or known mortality within the 6-month window not related to falls. Subsequent readmission documentation of included study patients for all causes within the 6-month window was reviewed for any documentation of additional falls since index admission, regardless of readmission for fall.

Demographic data on all patients meeting inclusion criteria were collected for population analysis as a whole for fall statistics. Patients were dichotomized to whether they received therapy and analyzed for descriptive variables and potential predictive variables related to continued therapy after initial evaluation using adjusted odds from logistic regressions. Patients were then dichotomized into cohorts based on outcomes of readmission for subsequent fall within 6 months of index admission. Exposure of interest was participation in physical (PT) and/or occupational therapy (OT) with relation to duration of therapy during admission as an inpatient recovering after his or her mechanical fall. Variables were analyzed for independence or differences using Fisher exact test, Mann–Whitney *U* test, and Pearson χ^2 tests for statistical data analysis. Logistic and linear regressions were used to test relationships with continuous data as needed, indicated on data tables.

RESULTS

Fall Population Analysis. Between January 1, 2016, and January 31, 2021, there were 542 patients admitted for mechanical falls with 288 meeting full inclusion criteria. Of these, 243 patients received therapy from physical (PT) and/or occupational therapy (OT). Demographics and comorbidity comparisons of population for potential objective predictors were tabulated on Table 1. The average age of those who received therapy was 80.6 (standard deviation [SD]: 0.5) years old, and the average age of those who did not was 79.3 (1.2), $P = .358$. Average body mass index (BMI) as a potential objective measure of frailty between therapy and no therapy was 27.3 (0.4) vs 27.8 (0.9), $P = .640$, respectively. Male ($n = 165$, 57%) versus female ($n = 123$, 43%) patients were more common, but there was no significant sex prediction for receiving therapy ($P = .617$). Race/ethnicity and a priori living situation were not different for those receiving therapy ($P = .746$ and $P = .451$, respectively). With respect to comorbidities, previous falls, and preexisting disability, only prior walker/cane use was predictive of receiving therapy ($P < .001$). Neither Injury Severity Score (ISS), Abbreviated Injury Scale (AIS), common fall injury type of hip/skull/cervical fractures, nor surgical procedures for these or other injuries were significant predictors of receiving therapy (all P values > .05 on Table 1).

Readmission Analysis. Readmissions within 6 months of index falls were monitored, and 45 patients who had received therapy had subsequent falls requiring admission. Readmitted patients were older (Mean SD) than those not readmitted (mean SD), Table 1, odds ratio (OR) of 1.0, confidence interval. BMI was lower for readmitted participants (mean [SD]: 27.7 [5.0] vs 25.7 [5.7], $P = .314$) with OR 1.0 [95% CI: 0.9–1.0], $P = .314$. Other independent variable predictors of readmission between demographics, comorbidities, and injury patterns described in Table 2 were only significant for previous falls ($P = .003$), previous walker/cane use ($P = .039$), and dementia ($P = .038$). Of these, previous falls had greater statistically significant odds of readmission (OR 2.4 [95% CI: 1.1–5.0], $P = .022$), with previous walker/cane use odds (OR 1.7 [95% CI: 0.8–3.7], $P = .196$) and dementia odds (OR 1.8 [95% CI: 0.8–3.9], $P = .173$) greater but not statistically significant.

All-cause readmission for the therapy group was also compared to track outcomes as well as predict likelihood of readmission within 6 months of index fall and shown beside fall readmission data on Table 2. There were 96 readmissions with only previous walker/cane use with significant odds of readmission (OR 1.9 [95% CI: 1.1–3.4], $P = .023$).

Therapy Analysis. Physical and occupational therapies provided to the patients were then analyzed for potential trends and efficacy in relation to readmission. Of the 243 patients receiving therapy, 128 (52%) received only PT, 4 (2%) received only OT, and 111 (46%) received a combination of both therapies during the index fall admission (Table 3). The distribution of therapy data described in Table 3 was a non-normal, right-skewed distribution with few sessions in most due to short lengths of stay (LOSs) in overall admission duration. PT-only patients received a median of 2 (interquartile range [IQR]: 1–4) sessions, whereas OT-only patients received 0 [0–2] session, and combination 3 [2–6] sessions. Session deferrals were counted as well with PT only having 0 [0–1] session, OT only 0 [0–1] session, and combination 1 [0–2] session deferred. Time in therapy was counted with PT only receiving 50 [25–85] minutes, OT only 0 [0–30] minute, and combination 60 [30–105] minute of total therapy during admission.

Readmission data (Table 4) were then analyzed in relation to therapy data, with no difference ($P = .853$) in readmission between those who saw therapists on the first day (within 24 hours). No difference was seen in number of therapy sessions with PT (mean [SD]: 2.83 [2.4] vs 2.73 [2.4], $P = .763$) or OT (0.73 [1.2] vs 0.84 [1.4], $P = .521$), and in number of deferrals with PT (0.96 [1.8] vs 0.93 [1.5], $P = .905$) or OT (0.68 [1.9] vs 0.40 [1.1], $P = .166$). Total time in therapy sessions showed no difference in PT (55.41 [65.2] vs 54.22 [51.4], $P = .892$) or OT (16.17 [29.1] vs 15.0 [31.6], $P = .818$). Evaluating initial and final distance walked during the 6-minute walk test (6MWT), the initial distance (64.19 [93.1] vs 40.24 [66.1], $P = .041$) and final distance (114.14 [152.5] vs 67.6 [80.2], $P = .003$) were significant for predicting readmission with poorer measured distances walked. Improvement in distance walked was large between those not readmitted (49.94 [118.3] vs those readmitted 27.36 [59.7], $P = .056$) . No difference was seen in hospital or ICU length of stay (5.16 [3.91] vs 5.09 [3.24], $P = .738$ and 4.02 [3.03] vs 3.91 [2.66], $P = .775$, respectively). Discharge recommendation from therapists ($P = .068$) and actual discharge location ($P = .282$) were not statistically significant for predicting readmission. Discharge recommendation and actual discharge location were not significantly different ($P = .120$).

No significance was found for analysis of therapy (Table 5) for improvement due to age (OR 1.0 [95% CI: 1.0–1.1], $P = .630$), BMI (OR 1.0 [95% CI: 0.9–1.1], $P = .747$), previous falls (OR 1.6 [95% CI: 0.7–4.0], $P = .300$), walker/cane use (OR 1.1 [95% CI: 0.5–2.6], $P = .781$),

Table 1
Fall demographics

		NTx	Tx	P value	NRA	RA	P value
Age		79.3 (1.2)	80.6 (0.5)	.358†	79.8 (7.8)	83.3 (8.4)	.016†
BMI		27.8 (0.9)	27.3 (0.4)	.640†	27.7 (5.7)	25.7 (5.0)	.035†
Sex	M	23 (51%)	142 (58%)	.617*	142 (87%)	23 (14%)	.362‡
	F	22 (49%)	101 (42%)		101 (82%)	22 (18%)	
Race/ethnicity	AA	0 (0%)	1 (0%)	.746*	1 (100%)	0 (0%)	.660*
	White	12 (28%)	59 (24%)		62 (87.3%)	9 (12.7%)	
	Hisp	31 (72%)	148 (75%)		180 (83.3%)	36 (16.7%)	
Living situation	NH	1 (2%)	11 (5%)	.451*	10 (75%)	3 (25%)	.239‡
	HA	22 (51%)	98 (40%)		111 (88.3%)	14 (11.7%)	
	HWF	20 (47%)	135 (55%)		134 (82.1%)	28 (17.9%)	
Previous falls		8 (19%)	57 (23%)	.559*	195 (87.8%)	27 (12.2%)	.003‡
					48 (72.7%)	18 (27.3%)	
Walker/cane use		2 (5%)	142 (58%)	<.001*	127 (88.8%)	16 (11.2%)	.039‡
					116 (80.0%)	29 (20.0%)	
Dementia		6 (14%)	51 (21%)	.407*	200 (86.6%)	31 (13.4%)	.038‡
					43 (75.4%)	14 (24.6%)	
Previous CVA		6 (14%)	26 (11%)	.598*	214 (83.9%)	41 (16.1%)	.556‡
					29 (87.9%)	4 (12.1%)	
HTN		36 (84%)	208 (85%)	.817*	38 (88.4%)	5 (11.6%)	.434‡
					205 (83.7%)	40 (16.3%)	
Arrhythmia		5 (12%)	34 (14%)	.812*	213 85.9%)	35 (14.1%)	.078‡
					30 (75%)	10 (25.0%)	
COPD		2 (5%)	23 (9%)	.393*	222 (84.4%)	41 (15.6%)	.975‡
					21 (84.0%)	4 (16.0%)	
DM		23 (53%)	107 (44%)	.250*	135 (85.4%)	23 (14.6%)	.582‡
					108 (83.1%)	22 (16.9%)	
CKD		6 (14%)	24 (10%)	.419*	221 (81.5%)	37 (14.3%)	.078‡
					22 (73.7%)	8 (26.7%)	
AC/antiplatelet		19 (44%)	116 (48%)	.742*	125 (82.2%)	27 (17.8%)	.291‡
					118 (86.8%)	18 (13.2%)	
ISS		11.1 (0.9)	12 (0.4)	.324†	13.13 (6.9)	11.65 (5.61)	.284†
AIS head/neck		3 [0–3.5]	3 [1–3]	.623†	2.25 (1.56)	2.67 (1.55)	.161†
AIS face		0 [0–1]	0 [0–1]	.829†	0.48 (0.72)	0.4 (0.65)	.491†
AIS thorax		0 [0–0.5]	0 [0–0]	.643†	0.58 (1.09)	0.42 (0.81)	.344†
AIS abdomen		0 [0–0]	0 [0–0]	.821†	0.14 (0.55	0.22 (0.67)	.468†
AIS ext/hip		0 [0–0]	0 [0–10]	.271†	0.65 (1.08)	0.6 (1.04)	.724†
Hip fracture		1 (2%)	21 (9%)	.218*	224 (84.2%)	42 (15.8%)	.789‡
					19 (86.4%)	3 (13.6%)	
Hip surgery		0 (0%)	15 (6%)	.138*	230 (84.2%)	43 (15.8%)	.802*
					13 (86.7%)	2 (13.3%)	
Skull fracture		0 (0%)	10 (4%)	.368*	235 (84.2%)	43 (15.8%)	.698*
					8 (86.7%)	2 (20.0%)	
Cervical fracture		3 (7%)	14 (6%)	.727*	227 (83.8%)	44 (16.2%)	.254*
					16 (94.1%)	1 (5.9%)	
Neurosurgery/ICP		1 (2%)	19 (8%)	.328*	215 (84.0%)	41 (16.0%)	.606*
					28 (87.5%)	4 (12.5%)	
Other injury/surgery		1 (2%)	31 (13%)	.062*	227 (84.7%)	41 (15.3%)	.576*
					16 (80.0%)	4 (20.0%)	

The general demographics, known comorbidities, injury scores, and specific injury and surgery types for elderly fall patients. Groups dichotomized by whether or not they received therapy and whether or not they were readmitted for subsequent falls, with upper row showing treated and lower showing untreated (age/BMI/ISS: mean [standard deviation], sex/race/ethnicity/comorbidities/specific injury/surgery: count [%], AIS: median [interquartile range]).

AA, African-American; *AC*, anticoagulant; *CKD*, chronic kidney disease; *COPD*, chronic obstructive pulmonary disease; *CVA*, cerebrovascular accident; *DM*, diabetes mellitus; *Ext*, extremity; *F*, female; *Hisp*, Hispanic; *HTN*, hypertension; *ICP*, intracranial pressure; *M*, male; *NRA*, not readmitted; *NTx*, no therapy; *RA*, readmitted; *Tx*, therapy.

* Fisher exact test.
† Mann–Whitney *U* test.
‡ Pearson χ^2 test.

dementia (OR 0.5 [95% CI: 0.2–1.4], $P = .185$), living situation (OR 0.8 [95% CI: 0.4–1.6], $P = .542$), ISS (OR 1.1 [95% CI: 1.0–1.1], $P = .163$), number of therapy sessions (OR 1.2 [95% CI: 1.0–1.5], $P = .027$), or therapy deferrals (OR 0.7 [95% CI: 0.3–1.4], $P = .305$). Hospital LOS in relation to previous falls ($P = .956$), walker/cane use ($P = .386$), dementia ($P = .847$), and living situation ($P = .291$) all showed no significance, but ISS ($P = .004$), number of therapy sessions ($P < .001$), and number of deferrals ($P < .001$) were significant predictors of longer LOS. ICU LOS similarly demonstrated no significance in previous falls ($P = .676$), walker/cane use ($P = .718$), dementia ($P = .406$), or living situation ($P = .696$), but ISS ($P < .001$), number of therapy sessions ($P = .008$), and number of deferrals ($P < .001$) were statistically significant predictors of longer LOS.

DISCUSSION

Traumatic elderly falls are a significant patient population for admission to trauma services around the country as it is the leading cause of injury with increasing numbers of death and disability [1,2,17]. In a population that already has significant comorbidity due to the incidence of pathology associated with increasing age in the United States, additional falls effectively add insult to injury. The study data demonstrated the prevalence of a number of comorbidities and common diseases of older age with no real predictive value, shown by little statistical significance or independence between dichotomized groups for therapy and readmission (Table 1). Although age and BMI were statistically significant for independence in readmission, they were clinically insignificant.

Table 2
Readmission data

		Fall readmission (n = 45)				All-cause readmission (n = 96)			
		NRA	RA	OR (95% CI)	P value	NRA	RA	OR (95% CI)	P value
Age		79.8 (7.8)	83.3 (8.4)	1.0 (1.0–1.1)	.180‡	80.3 (7.9)	80.6 (8.1)	1.0 (1.0–1.0)	.468‡
BMI		27.7 (5.7)	25.7 (5.0)	1.0 (0.9–1.0)	.314‡	27.6 (5.5)	27.0 (5.9)	1.0 (0.9–1.0)	.577‡
Previous falls		47 (19%)	18 (40%)	2.4 (1.1–5.0)	.022*	36 (19%)	29 (30%)	1.6 (0.9–2.9)	.131*
Walker/cane use		115 (48%)	29 (64%)	1.7 (0.8–3.7)	.196*	83 (43%)	61 (64%)	1.9 (1.1–3.4)	.023*
Dementia		43 (18%)	14 (31%)	1.8 (0.8–3.9)	.173*	34 (18%)	23 (24%)	1.3 (0.7–2.6)	.392*
Living situation	NH	9 (4%)	3 (7%)	1.1 (0.6–2.0)	.847*	7 (4%)	5 (5%)	1.0 (0.6–1.6)	.990*
	HA	106 (44%)	14 (31%)			83 (43%)	37 (39%)		
	HWF	127 (52%)	28 (62%)			101 (53%)	54 (56%)		
ISS		11.7 (5.7)	13.1 (6.9)	1.0 (1.0–1.1)	.238‡	11.4 (5.4)	12.9 (6.7)	1.0 (1.0–1.1)	.085‡
Therapy sessions		3.6 (4)	3.5 (3.2)	1.0 (0.8–1.1)	.657‡	3.4 (3.4)	4.1 (4.7)	1.0 (0.9–1.1)	.862‡
Therapy deferrals	0	128 (53%)	23 (51%)	0.9 (0.4–1.8)	.708*	107 (56%)	44 (46%)	1.0 (0.6–1.7)	.910*
	1–3	78 (32%)	17 (38%)			59 (31%)	36 (38%)		
	>3	36 (15%)	5 (11%)			25 (13%)	16 (17%)		

Comparison of readmission variables between fall readmissions and all-cause readmissions based on basic demographics, comorbidity, and therapy sessions (age/BMI/ISS/therapy sessions: mean [standard deviation], comorbidity/therapy deferrals: count [%]). Odds ratios adjusted for age and BMI are reported with 95% confidence intervals and Wald chi-square-based p-values.
* Fisher exact test.
‡ Mann-Whitney test.

Previous falls ($P = .003$), walker/cane use ($P = .039$), and dementia ($P = .038$) were significant for independence, with previous falls and dementia well known to be associated with predicting future falls and functional decline [10,14,15]. Repeat falls, social isolation, older age, female, Hispanic, and Spanish language use have been associated with poorer functional outcomes in activities of daily living (ADLs), whereas maintaining social integration, family support, and confidence in abilities are associated with improved outcomes [7,10,14,18,28]. This study had a large Hispanic population and most were living at home, presenting an opportunity for intervention.

The average age of our fall population regardless of receiving therapy was approximately 80 years old (79.3 [1.2] vs 80.6 [0.5]), like a study by Choi et al wherein they showed that a large portion of patients with falls were aged >80 years, were widowed, had income severely below the poverty level, and were already showing difficulty ambulating without assistive devices [6]. Choi et al also reported in their study that 75% had falls that occurred in or around the home [6]. Our population demonstrated a large proportion of patients (Table 1) who were living home alone (HA) or home with family (HWF) with few in nursing homes (NH) prior to falling, demonstrating a likelihood of at least some community interaction and participation. This study included patients who were ambulatory at the time of falling (including 144 patients already using a walker/cane on admission) to evaluate those elderly fallers who were getting around and, presumably, actively participating in their lives and communities. Functional limitation, removal from daily routines, and prolonged inactivity can greatly impact long-term recovery and overall autonomy within a population taking part in the community surrounding our health care centers [8,11,14–16,28].

Not only do the elderly incur greater medical costs for their hospitalization, they require additional assistance after discharge due to limiting ability to perform ADLs [6]. The subsequent outpatient follow-up may require transportation services and could cause loss of income for themselves or family caregivers that may be taking them to clinic or rehabilitation services [1,2,17]. These direct and indirect costs continue to draw on limited resources on the part of both the patient and health care system. As the elderly population has been projected to continue growing [1,2,17], we as clinicians must seek methods to reduce the impact of elderly falls by trying to affect improvements in our care. While these patients are recovering from a fall on our service, we have the potential opportunity to mitigate the effect of deconditioning and inpatient weakness and hopefully limit fear of additional falling episodes by supporting and reinforcing good mechanics for long-term recovery.

Falling can limit income, mobility, and assistance, as well as growing concern over accruing additional bills or health care costs, the risk of falling brings with it the risk of pain, head injury, joint fractures, surgeries, and prolonged rehabilitation [6,8,15,16,19]. These also bring the fear of losing autonomy, being placed in nursing facilities, loss of property and privacy, as well as a decline in function resulting from both injury and detrimental effect on their confidence as independent members of the community [7,8,10,15,16,28]. The common concern for elderly falls is risk of hip fractures limiting mobility or severe head injury leading to prolonged nursing facilities [7,8,29–31]. Our study showed no significance between those receiving therapy and readmission based on these injuries and/or surgical need resulting from fall. Although those receiving surgery were more likely to receive therapy, there was no statistically significant difference in those injuries or need for surgery to predict readmission for subsequent falls (Table 1).

Traumatic elderly falls frequently have subsequent fall readmissions within 30 days [6,18,31], and demonstrated recovery of independent function is uncommon after 6 months [16], so we have window of opportunity for promoting recovery after a fall. We analyzed the readmission rates of mechanical traumatic falls within the 6-month time frame to determine if there were a trend in those receiving therapy to improve function and trends in the readmitted population overall for predictive factors. Previous falls were predictive of readmission for recurrent falls (OR 2.4 [95% CI: 1.1–5.0], $P = .022$), as is known from previous studies

Table 3
Therapy sessions

	PT only		OT only		Combined	
n	128 (52%)		4 (2%)		111 (46%)	
	Med [IQR]	(Min–max)	Med [IQR]	(Min–max)	Med [IQR]	(Min–max)
# Sessions	2 [1–4]	(0–26)	0 [0–2]	(0–11)	3 [2–6]	(1–37)
# Deferrals	0 [0–1]	0 (0–14)	0 [0–1]	(0–18)	1 [0–2]	(0–27)
Time in therapy (min)	50 [25–85]	(0–620)	0 [0–30]	(0–255)	60 [30–105]	(0–875)

Distribution of therapy types, number of sessions, number of deferrals, and duration of therapy based on nonparametric skewed data giving proportions with median and range (number [n]: count [%], sessions: median [interquartile range] and [minimum–maximum]).
Max, maximum; *Med*, median; *Min*, minimum.

Table 4
Therapy breakdown

			NRA	*RA*	P *value*
n			243	45	
Seen on first day		Yes	99 (83.9%)	19 (16.1%)	.853*
		No	144 (84.7%)	26 (15.3%)	
# PT sessions			2.83 ± 2.4	2.73 ± 2.4	.763†
# OT sessions			0.73 ± 1.2	0.84 ± 1.4	.521†
# PT deferrals			0.96 ± 1.8	0.93 ± 1.5	.905‡
	Med [IQR]		0 [0–1]	0 [0–2]	
# OT deferrals			0.68 ± 1.9	0.40 ± 1.1	.166‡
	Med [IQR]		0 [0–1]	0 [0–0]	
Time in PT (min)			55.41 ± 65.2	54.22 ± 51.4	.892‡
	Med [IQR]		40.0 [0–60]	45.0 [0–60]	
	(Min–max)		(0–620)	(0–245)	
Time in OT (min)			16.17 ± 29.1	15.00 ± 31.6	.818‡
	Med [IQR]		0 [0–30]	0 [0–28]	
	(Min–max)		(0–255)	(0–160)	
Initial distance (ft)			64.19 ± 93.1	40.24 ± 66.1	.041‡
Final distance (ft)			114.14 ± 152.5	67.60 ± 80.2	.003‡
Improvement (ft)			49.94 ± 118.3	27.36 ± 59.7	.056‡
Hospital LOS			5.16 ± 3.91	5.09 ± 3.24	.738†
ICU LOS			4.02 ± 3.03	3.91 ± 2.66	.775†
Discharge rec per therapy		Home	107 (87.7%)	15 (12.3%)	.068*
		H/HH	11 (61.1%)	7 (38.9%)	
		IRF	85 (83.3%)	17 (16.7%)	
		ORF	14 (87.5%)	2 (12.5%)	
		NF	26 (86.7%)	4 (13.3%)	
Discharge location (2 transferred out to other hospitals)		Home	146 (85.9%)	24 (14.1%)	.282*
		H/HH	51 (86.4%)	8 (13.6%)	
		IRF	32 (72.7%)	12 (27.3%)	
		ORF	8 (88.9%)	1 (11.1%)	
		NF	4 (100%)	0 (0%)	
Discharge same as rec		Yes	94 (88.7%)	12 (11.3%)	.120*
		No	148 (81.8%)	33 (18.2%)	

Breakdown of readmission date based therapy sessions, initiation of therapy, evaluation of initial and final distances walked, lengths of stay, and discharge data (first day/discharge data: count [%], sessions/deferrals/time in therapy/length of stay: mean ± standard deviation and median [interquartile range] and [minimum, maximum range]).
H/HH, home with home health; *IRF*, inpatient rehabilitation facility; *NF*, skilled nursing facility/long-term acute care facility; *NRA*, not readmitted; *ORF*, outpatient rehabilitation facility; *Rec*, recommendation.
* Pearson χ^2 test.
† Mann–Whitney *U* test.
‡ *t* test.

[1,2,10,14–16,18]. All-cause readmission within the study was predictive with walker/cane use (OR 1.9 [95% CI: 1.1–3.4], $P = .023$), potentially inferring poorer overall functional status but not necessarily falling (Table 2).

Analysis of therapy sessions with objective data is difficult because of the variable nature of functionality and methods used by therapists to address that functionality. We were able to use recorded time in minutes and the 6MWT during therapy sessions for objective

Table 5
Walk test improvement and lengths of stay

		6-min walk test (6MWT)				*Hospital LOS*				*ICU LOS*			
		NI	*IM*	*OR (95% CI)*	P *value*	*NTx*	*Tx*	*Mean (SD)*	P *value*	*NTx*	*Tx*	*Mean (SD)*	P *value*
Age		80.1 (7.7)	81.1 (8.2)	1.0 (1.0–1.1)	.630†								
BMI		27.6 (5.9)	27.0 (5.4)	1.0 (0.9–1.1)	.747†								
Previous falls		27 (20%)	30 (28%)	1.6 (0.7–4.0)	.300*	4.16 (1.87)	4.35 (1.77)		.956‡	3.17 (1.87)	3.27 (1.78)		.676*
Walker/cane use		76 (55%)	66 (62%)	1.1 (0.5–2.6)	.781*	3.71 (1.85)	4.76 (1.80)		.386‡	2.8 (1.87)	3.63 (1.8)		.718*
Dementia		34 (25%)	17 (16%)	0.5 (0.2–1.4)	.185*	4.16 (1.88)	4.38 (1.71)		.847‡	3.2 (1.87)	3.17 (1.77)		.406*
Living situation	NH	4 (3%)	36 (34%)	0.8 (0.4–1.6)	.542*			4.78 (1.48)	.291‡			3.63 (1.76)	.696*
	HA	56 (41%)	52 (49%)					4.34 (1.86				3.24 (1.86)	
	HWF	78 (57%)	18 (17%)					4.06 (1.87)				3.13 (1.83)	
ISS		11.2 (5.6)	13.1 (6.0)	1.1 (1.0–1.1)	.163†				.004*				<.001*
Therapy sessions		3.5 (4.3)	5.3 (2.9)	1.2 (1.0–1.5)	.027†	2.31 (1.6)	4.67 (1.78)		<.001*	2.24 (1.65)	3.97 (1.81)		.008*
Therapy deferrals	0	72 (52%)	36 (34%)	0.7 (0.3–1.4)	.305*			2.99 (1.61)	<.001*			1.75 (1.66)	<.001*
	1–3	43 (31%)	52 (49%)					5.17 (1.57)				3.52 (1.83)	
	>3	23 (17%)	18 (17%)					9.10 (1.60)				0.00 (1.00)	

Breakdown of therapy improvement and LOS by demographics, comorbidities, and therapy sessions (age/BMI/ISS/LOS comorbidities/therapy session numbers: mean [standard deviation], 6MWT comorbidities/therapy deferral: count [%]).
IM, improved; *NI*, not improved.
* Fisher exact test.
‡ Regression.
† Regression analysis.

measurements to define initial and final functional status. Clinically, ambulation of 150 ft. (45 m) is reported to be "functionally independent" with 1083 ft. (330 m) "capable of community ambulation" [9]. Because all included patients were ambulatory at the time of their fall, the 6MWT evaluated distance in feet walked for functionality. Time in therapy was assessed both as a measure of ability to participate and for efficacy of therapy sessions. Deconditioning, pain, and patient hesitancy can contribute to effort output from patient as total energy expenditure in the elderly as a matter of economics. The energy costs of ADLs, ambulation, socialization, and especially recovery are factors that elderly persons with limited functional reserves must now weigh to continue their overall daily activity [9]. It was not clear by documentation that the time spent in sessions was equivalent, so the total time spent in therapy was measured, assuming good faith effort on all parts of therapists and patients.

Patients received predominantly PT with most receiving 2–3 therapy sessions (Table 3). Time in therapy was between 50 and 60 minutes for most patients with a large rightward skew of data points. Harper et al reported that even after a single dedicated session of therapy focused on balance recovery, it was shown that learned responses could be maintained and reduce falls in community dwelling elderly [13]. Specific skills directed therapy to assess and correct gait abnormalities and simulate "slip training" provides direct cognitive training lasting up to a year in those who participated [13]. Gait training and focused therapy beyond sagittal plane (forward treadmill ambulation) can improve mechanics of ambulation as well as improve mental control and confidence in abilities in those already afraid of falling [9,12,13,32,33]. In those that received therapy in our study, there was no statistical difference in number of sessions (PT: $P = .763$, OT: $P = .521$), overall time in sessions (PT: $P = .892$, OT: $P = .818$), or deferrals (PT: $P = .905$, OT: $P = .166$) to predict readmission for subsequent falls. Initial distance and final distance walked ($P = .041$ and $P = .003$, respectively) during the 6MWT were significant predictors for readmission for recurrent falls, with quantitative improvement in distance clinically indicative of readmission ($P = .056$) (Table 4).

Interestingly, in analyzing hospital and ICU LOS, we found longer stays associated with more severe injuries (as calculated by ISS) and greater number of overall therapy sessions as expected, but longer LOS was also associated with increased number of therapy deferrals (Table 5). We grouped number of deferred therapy sessions and demonstrated that average LOS for each group was significantly longer when patients were deferred (hospital and ICU: $P \le .001$). Deferrals as a cause of decreased level of activity have a negative clinical effect as well as an opportunity cost for both the patient and health care system [9,11–13,32,34–36]. Deferrals are barriers to physical activity as patients will tend to stay in bed to minimize fall risk and time by dedicated caregivers and therapists watching them. Geelen et al described how inpatient admission leads to 87%–100% of a patient's time lying in bed due to a number of patient and health care barriers to activity [34].

Patient-related barriers can be due to clinical condition, fatigue level, lack of encouragement/motivation, fear of falling, and not wishing to bother staff [34], whereas health care–related barriers can be attachment to IV lines, tubes, lack of nursing availability, or therapist/nurse directed decline of therapy sessions [34]. Hemodynamic instability and generalized weakness early in recovery are cautious measures when deferring therapy, but in our study, there were many documented deferrals due to the session being close to a mealtime, the patient wishing to use the restroom, or the patient's nurse declining therapy with no reason given. These instances may be reason to delay therapy until finished, but many times, that deferral was the only opportunity to receive therapy that day and no attempt to return for therapy occurred until the following day. Early and regular therapy has been shown to be effective and crucial for improvement in functionality in these elderly fall patients [11,27,34–40].

Weakness a priori in traumatic elderly patients is compounded by persistent bed rest and "mechanical silencing" as inflammatory mechanisms associated with traumatic injury and illness set off metabolic pathways detrimental to the function of the patient through accelerated muscle breakdown, neuropathy, hyperglycemia and altered metabolism, altered calcium homeostasis in older potentially osteoporotic patients, and simple lack of muscle loading necessary to maintain a mechanical baseline for strength [11]. Perception of severity of illness and frailty of patient may lead compassionate health care providers to allow for recuperative rest but might do more harm than good if the patient can participate in activities. The term *ICU-associated weakness* (ICU-AW) has been coined to describe this deterioration of patient functionality due to prolonged bedrest either through sedation and mechanical ventilation restricting activity or by deferrals of even minimal activity [11,27,37–40]. Wernhart et al described initiating therapy while on mechanical ventilation as long as patients can actively participate and demonstrated both feasibility and safety of the therapy but also improved 6MWT in those participating [39].

Trauma patients are frequently left out of many postinjury, postoperative research studies on therapy because of the complexity of polytrauma and coordinated recovery. The milieu of inflammatory and biochemical processes, financial resource allocation, as well as increased difficulty of controlling for therapy due to a hip fracture with concomitant rib fractures with chest tubes, or upper extremity fractures requiring use of walker or cane for instance, makes controlling for data difficult. Growing data from many different surgical specialties, demonstrating overall clinical improvement from early mobilization and directed therapies, allow extrapolation for the elderly patients admitted to surgical specialties to improve outcomes [20–26,36,41]. Early mobilization has been shown to improve outcomes overall and reduce ICU-AW [21–27,36,37,39], as well as improve ventilation and increase ventilator-free days [23,26], improve gastrointestinal function in postoperative abdominal surgeries [24], decrease LOS [20,21,24], and increase the strength and number of patients able to stand and walk out of the hospital on discharge [20,22–26,41].

This is the first study to our knowledge to directly study physical and occupational therapy for timing of mobilization of elderly fall patients admitted to a trauma surgery service. Most studies found specifically excluded trauma patients and reported on isolated hip, knee, or elective joint orthopedic surgery patients or preoperatively planned cardiac, oncologic, or major abdominal surgery patients. Limitations are, of course, that this is a retrospective, single-institution study of traumatic elderly falls within our health care coverage area and may not generalize to all areas. We also have a larger population of Hispanic, Spanish-speaking patients with cultural, familial, and social patterns that would not be representative of all elderly fall patients in terms of social and economic support systems or access to certain resources within other trauma systems. Our patient numbers are limited but are large enough for statistical significance, but with a larger multicentered study, data may be more effective to determine predictive demographics. Ordering for PT/OT evaluation following a fall is common practice, but patient may not be seen by therapists for various reasons, such as being discharged from the ED before evaluation, therapies canceled by physicians, therapists unable to evaluate prior to discharge, etc. Therapies provided to patients are determined by individual therapists performing evaluations, and daily regimens vary based on clinical judgment of those therapists. Developed and directed therapies for elderly trauma patients may be helpful in focusing on prospective improvements in ambulation and functionality in future studies. Protocols ensuring dedicated therapists or accountability for daily therapy in recovering patients may also provide data for improvement in patient outcome studies.

In conclusion, elderly traumatic falls are projected to increase and opportunities to improve functionality to return patients to autonomy in their community can be achieved with directed therapy during their inpatient stay. Trauma services admitting these patients can improve care for elderly patients by reducing lengths of stay and potentially readmission rates by ensuring regular and early mobilization therapy.

Abbreviations

ADL	activities of daily living
AIS	abbreviated injury scale
BMI	body mass index
CI	confidence interval
HA	home alone
HWF	home with family
ICU	intensive care unit
IQR	interquartile range
IRB	investigational review board
ISS	injury severity score
LOS	length of stay
NH	nursing home
OR	odds ratio
OT	occupational therapy
PT	physical therapy
SD	standard deviation
6MWT	6-minute walk test

Ethics Approval and Consent to Participate

We obtained IRB approval from Western (WCG) IRB study #1318204.

Consent for Publication

Waiver of consent was obtained via Western (WCG) IRB.

Availability of Data and Material

The data sets generated and/or analyzed during the current study are not publicly available, as they were compiled from our own patient records, but are available from the corresponding author on reasonable request.

Disclosures

The authors have nothing to disclose.

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Author Contribution

CF completed data collection. CF and CHP wrote the manuscript. CF, CV, and CC performed statistical analysis. CHP was the senior mentor for this paper. The authors read and approved the final manuscript.

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Conflict of Interest

We know of no conflicts of interests associated with the publication, and there has been no financial support for this work that could influence its outcome.

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References

[1] Moreland B, Kakara R, Henry A. Trends in nonfatal falls and fall-related injuries among adults aged ≥65 years—United States, 2012-2018. MMWR Morb Mortal Wkly Rep. 2020;69(27):875–81. https://doi.org/10.15585/mmwr.mm6927a5. PMID: 32644982; PMCID: PMC7732363.

[2] Florence CS, Bergen G, Atherly A, Burns E, Stevens J, Drake C. Medical costs of fatal and nonfatal falls in older adults. J Am Geriatr Soc. 2018;66(4):693–8. https://doi.org/10.1111/jgs.15304. Epub 2018 Mar 7. PMID: 29512120; PMCID: PMC6089380.

[3] Facts About Falls. Centers for Disease Control and Prevention. https://www.cdc.gov/falls/facts.html. Published August 06, 2021. Last accessed February 24, 2021.

[4] Ungar A, Mussi C, Ceccofiglio A, et al. Etiology of syncope and unexplained falls in elderly adults with dementia: Syncope and Dementia (SYD) study. J Am Geriatr Soc. 2016;64(8):1567–73. https://doi.org/10.1111/jgs.14225. Epub 2016 Jun 28. PMID: 27351866.

[5] de Ruiter SC, Wold JFH, Germans T, et al. Multiple causes of syncope in the elderly: diagnostic outcomes of a Dutch multidisciplinary syncope pathway. Europace. 2018; 20(5):867–72. https://doi.org/10.1093/europace/eux099. [PMID: 28520944].

[6] Choi NG, Choi BY, DiNitto DM, et al. Fall-related emergency department visits and hospitalizations among community-dwelling older adults: examination of health problems and injury characteristics. BMC Geriatr. 2019;19(1):303. https://doi.org/10.1186/s12877-019-1329-2. PMID: 31711437; PMCID: PMC6849272.

[7] Salkeld G, Cameron ID, Cumming RG, et al. Quality of life related to fear of falling and hip fracture in older women: a time trade off study. BMJ. 2000;320(7231):341–6. https://doi.org/10.1136/bmj.320.7231.341. PMID: 10657327; PMCID: PMC27279.

[8] Hajek A, König HH. Falls are associated with decreased autonomy, and self-efficacy moderates this relation: results from a national study. Front Psych. 2019;10:447. https://doi.org/10.3389/fpsyt.2019.00447. PMID: 31281274; PMCID: PMC6597675.

[9] Julius LM, Brach JS, Wert DM, VanSwearingen JM. Perceived effort of walking: relationship with gait, physical function and activity, fear of falling, and confidence in walking in older adults with mobility limitations. Phys Ther. 2012;92(10): 1268–77. https://doi.org/10.2522/ptj.20110326. Epub 2012 Jun 21. PMID: 22723433; PMCID: PMC3461131.

[10] James EG, Conatser P, Karabulut M, et al. Mobility limitations and fear of falling in non-English speaking older Mexican-Americans. Ethn Health. 2017;22(5):480–9. https://doi.org/10.1080/13557858.2016.1244660. Epub 2016 Oct 14. PMID: 27741576; PMCID: PMC5392172.

[11] Friedrich O, Reid MB, Van den Berghe G, Vanhorebeek I, Hermans G, Rich MM, et al. The sick and the weak: neuropathies/myopathies in the critically ill. Physiol Rev. 2015;95(3):1025–109. https://doi.org/10.1152/physrev.00028.2014. PMID: 26133937; PMCID: PMC4491544.

[12] VanSwearingen JM, Perera S, Brach JS, et al. Impact of exercise to improve gait efficiency on activity and participation in older adults with mobility limitations: a randomized controlled trial. Phys Ther. 2011;91(12):1740–51. https://doi.org/10.2522/ptj.20100391. Epub 2011 Oct 14. PMID: 22003158; PMCID: PMC3229041.

[13] Harper SA, Beethe AZ, Dakin CJ, Bolton DAE. Promoting generalized learning in balance recovery interventions. Brain Sci. 2021;11(3):402. https://doi.org/10.3390/brainsci11030402. PMID: 33810159; PMCID: PMC8004641.

[14] Faulkner KA, Cauley JA, Zmuda JM, et al. Is social integration associated with the risk of falling in older community-dwelling women? J Gerontol A Biol Sci Med Sci. 2003; 58(10):M954–9. https://doi.org/10.1093/gerona/58.10.m954. [PMID: 14570865].

[15] Tinetti ME, Williams CS. The effect of falls and fall injuries on functioning in community-dwelling older persons. J Gerontol A Biol Sci Med Sci. 1998;53(2):M112–9. https://doi.org/10.1093/gerona/53a.2.m112. [PMID: 9520917].

[16] Gill TM, Murphy TE, Gahbauer EA, Allore HG. Association of injurious falls with disability outcomes and nursing home admissions in community-living older persons. Am J Epidemiol. 2013;178(3):418–25. https://doi.org/10.1093/aje/kws554. Epub 2013 Apr 1. PMID: 23548756; PMCID: PMC3816345.

[17] Burns ER, Stevens JA, Lee R. The direct costs of fatal and non-fatal falls among older adults—United States. J Safety Res. 2016;58:99–103. https://doi.org/10.1016/j.jsr.2016.05.001. Epub 2016 May 28. PMID: 27620939; PMCID: PMC6823838.

[18] Mojtaba M, Alinaghizadeh H, Rydwik E. Downton fall risk index during hospitalisation is associated with fall-related injuries after discharge: a longitudinal observational study. J Physiother. 2018;64(3):172–7. https://doi.org/10.1016/j.jphys.2018.05.005. Epub 2018 Jun 15. PMID: 29914804.

[19] Roger C, Debuyzer E, Dehl M, Bulaïd Y, Lamrani A, Havet E, et al. Factors associated with hospital stay length, discharge destination, and 30-day readmission rate after primary hip or knee arthroplasty: retrospective cohort study. Orthop Traumatol Surg Res. 2019;105(5):949–55. https://doi.org/10.1016/j.otsr.2019.04.012. Epub 2019 Jun 15. PMID: 31208932.

[20] Kulshrestha V, Sood M, Kumar S, Sharma P, Yadav YK. Outcomes of fast-track multidisciplinary care of hip fractures in veterans: a geriatric hip fracture program report.

Clin Orthop Surg. 2019;11(4):388–95. https://doi.org/10.4055/cios.2019.11.4.388. Epub 2019 Nov 12. PMID: 31788160; PMCID: PMC6867922.
[21] Haines KJ, Skinner EH, Berney S, Austin Health POST Study Investigators. Association of postoperative pulmonary complications with delayed mobilisation following major abdominal surgery: an observational cohort study. Physiotherapy. 2013;99 (2):119–25. https://doi.org/10.1016/j.physio.2012.05.013. Epub 2012 Sep 23. PMID: 23219632.
[22] van der Leeden M, Huijsmans R, Geleijn E, de Lange-de Klerk ES, Dekker J, Bonjer HJ, et al. Early enforced mobilisation following surgery for gastrointestinal cancer: feasibility and outcomes. Physiotherapy. 2016;102(1):103–10. https://doi.org/10.1016/j.physio.2015.03.3722. Epub 2015 May 7. PMID: 26059985.
[23] Ramos Dos Santos PM, Aquaroni Ricci N, Aparecida Bordignon Suster É, de Moraes Paisani D, Dias Chiavegato L. Effects of early mobilisation in patients after cardiac surgery: a systematic review. Physiotherapy. 2017;103(1):1–12. https://doi.org/10.1016/j.physio.2016.08.003. Epub 2016 Sep 14. PMID: 27931870.
[24] Okuno S, Yamashita T, Shirado K, Kawamitsu K, Yamabe K, Onishi Y, et al. Effects of early physical therapist-supervised walking on clinical outcomes after liver resection: propensity score matching analysis. Phys Ther Res. 2021;24(3):225–31. https://doi.org/10.1298/ptr.E10107. PMID: 35036256; PMCID: PMC8752846.
[25] Tipping CJ, Harrold M, Holland A, Romero L, Nisbet T, Hodgson CL. The effects of active mobilisation and rehabilitation in ICU on mortality and function: a systematic review. Intensive Care Med. 2017;43(2):171–83. https://doi.org/10.1007/s00134-016-4612-0. Epub 2016 Nov 18. PMID: 27864615.
[26] Zhang L, Hu W, Cai Z, Liu J, Wu J, Deng Y, et al. Early mobilization of critically ill patients in the intensive care unit: a systematic review and meta-analysis. PLoS One. 2019;14(10):e0223185. https://doi.org/10.1371/journal.pone.0223185. PMID: 31581205; PMCID: PMC6776357.
[27] Eggmann S, Luder G, Verra ML, Irincheeva I, Bastiaenen CHG, Jakob SM. Functional ability and quality of life in critical illness survivors with intensive care unit acquired weakness: a secondary analysis of a randomised controlled trial. PLoS One. 2020;15 (3):e0229725. https://doi.org/10.1371/journal.pone.0229725. PMID: 32131082; PMCID: PMC7056321.
[28] Tinetti ME, Williams CS. Falls, injuries due to falls, and the risk of admission to a nursing home. N Engl J Med. 1997;337(18):1279–84. https://doi.org/10.1056/NEJM199710303371806. [PMID: 9345078].
[29] McLynn RP, Ottesen TD, Ondeck NT, Cui JJ, Rubin LE, Grauer JN. The Rothman index is associated with postdischarge adverse events after hip fracture surgery in geriatric patients. Clin Orthop Relat Res. 2018;476(5):997–1006. https://doi.org/10.1007/s11999.0000000000000186. PMID: 29419631; PMCID: PMC5916609.
[30] Dubljanin-Raspopović E, Marković-Denić L, Marinković J, Nedeljković U, Bumbaširević M. Does early functional outcome predict 1-year mortality in elderly patients with hip fracture? Clin Orthop Relat Res. 2013;471(8):2703–10. https://doi.org/10.1007/s11999-013-2955-1. Epub 2013 Apr 2. PMID: 23546850; PMCID: PMC3705055.
[31] Arnold SM, Naessens JM, McVeigh K, White LJ, Atchison JW, Tompkins J. Can AM-PAC "6-clicks" inpatient functional assessment scores strengthen hospital 30-day readmission prevention strategies? Cureus. 2021;13(5):e14994. https://doi.org/10.7759/cureus.14994. PMID: 34131539; PMCID: PMC8195549.
[32] Barker A, Cameron P, Flicker L, Arendts G, Brand C, Etherton-Beer C, et al. Evaluation of RESPOND, a patient-centred program to prevent falls in older people presenting to the emergency department with a fall: a randomised controlled trial. PLoS Med. 2019;16(5):e1002807. https://doi.org/10.1371/journal.pmed.1002807. PMID: 31125354; PMCID: PMC6534288.
[33] Thelen DG, Schultz AB, Alexander NB, Ashton-Miller JA. Effects of age on rapid ankle torque development. J Gerontol A Biol Sci Med Sci. 1996;51(5):M226–32. https://doi.org/10.1093/gerona/51a.5.m226. [PMID: 8808994].
[34] Geelen SJG, van Dijk-Huisman HC, de Bie RA, Veenhof C, Engelbert R, van der Schaaf M, et al. Barriers and enablers to physical activity in patients during hospital stay: a scoping review. Syst Rev. 2021;10(1):293. https://doi.org/10.1186/s13643-021-01843-x. PMID: 34736531; PMCID: PMC8569983.
[35] Zadro J, O'Keeffe M, Maher C. Do physical therapists follow evidence-based guidelines when managing musculoskeletal conditions? Systematic review. BMJ Open. 2019;9(10):e032329. https://doi.org/10.1136/bmjopen-2019-032329. PMID: 31591090; PMCID: PMC6797428.
[36] Chua H, Brady B, Farrugia M, Pavlovic N, Ogul S, Hackett D, et al. Implementing early mobilisation after knee or hip arthroplasty to reduce length of stay: a quality improvement study with embedded qualitative component. BMC Musculoskelet Disord. 2020;21(1):765. https://doi.org/10.1186/s12891-020-03780-7. PMID: 33218326; PMCID: PMC7678277.
[37] Dos Santos Moraes TL, de Farias JMF, Rezende BS, de Carvalho FO, Santiago MS, Porto ES, et al. Limited mobility to the bed reduces the chances of discharge and increases the chances of death in the ICU. Clin Pract. 2021;12(1):8–16. https://doi.org/10.3390/clinpract12010002. PMID: 35076492; PMCID: PMC8788280.
[38] Jolley SE, Bunnell AE, Hough CL. ICU-acquired weakness. Chest. 2016;150(5): 1129–40. https://doi.org/10.1016/j.chest.2016.03.045. Epub 2016 Apr 7. PMID: 27063347; PMCID: PMC5103015.
[39] Wernhart S, Hedderich J, Wunderlich S, Schauerte K, Weihe E, Dellweg D, et al. The feasibility of high-intensity interval training in patients with intensive care unit-acquired weakness syndrome following long-term invasive ventilation. Sports Med Open. 2021;7(1):11. https://doi.org/10.1186/s40798-021-00299-6. PMID: 33527199; PMCID: PMC7849616.
[40] Vanhorebeek I, Latronico N, Van den Berghe G. ICU-acquired weakness. Intensive Care Med. 2020;46(4):637–53. https://doi.org/10.1007/s00134-020-05944-4. Epub 2020 Feb 19. PMID: 32076765; PMCID: PMC7224132.
[41] Cher EWL, Allen JC, Howe TS, Koh JSB. Comorbidity as the dominant predictor of mortality after hip fracture surgeries. Osteoporos Int. 2019;30(12):2477–83. https://doi.org/10.1007/s00198-019-05139-8. Epub 2019 Aug 26. PMID: 31451838.