Barriers and Facilitators of weight Bearing after Hip Fracture Surgery among Older Adults. A Scoping review

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ABSTRACT

Purpose

This scoping review aimed to synthesise the available evidence on barriers and facilitators of weight bearing after hip fracture surgery in older adults.

Methods

Published (Cochrane Central, MEDLINE, EMBASE, CINAHL, and PEDro) and unpublished (Global Health, EThOS, WorldCat dissertation and thesis, ClinicalTrials.gov, OpenAIRE, DART-Europe) evidence was electronically searched from database inception to 29th March 2022. Barriers and facilitators of weight bearing were extracted and synthesised into patient, process (non-surgical), process (surgical), and structure related barriers/facilitators using a narrative review approach.

Results

In total, 5594 were identified from the primary search strategy, 1314 duplicates were removed, 3769 were excluded on title and abstract screening, and 442 were excluded on full-text screening. In total, 69 studies (all from published literature sources) detailing 47 barriers and/or facilitators of weight bearing were included. Of barriers/facilitators identified, 27 were patient-, 8 non-surgical process-, 8 surgical process-, and 4 structure-related. Patient facilitators included anticoagulant, home-discharge, and aid at discharge. Barriers included preoperative dementia and delirium, postoperative delirium, pressure sores, indoor falls, ventilator dependence, haematocrit<36%, systemic sepsis, and acute renal failure. Non-surgical process facilitators included early surgery, early mobilisation, complete medical co-management, in-hospital rehabilitation, and patient-recorded nurses' notes. Barriers included increased operative time and standardised hip fracture care. Surgical process facilitators favoured intramedullary fixations and arthroplasty over extramedullary fixation. Structure facilitators favoured more recent years and different healthcare systems. Barriers included pre-holiday surgery and admissions in the first quarter of the year.

Conclusions

Most patient/surgery-related barriers/facilitators may inform future risk stratification. Future research should examine additional process/structure barriers and facilitators amenable to intervention. Furthermore, patient barriers/facilitators need to be investigated by replicating the studies identified and augmenting them with more specific details on weight bearing outcomes.

INTRODUCTION

Hip fractures are among the most prevalent fractures in older adults worldwide [1]. Older adults constitute more than 90% of hip fracture cases, and despite a prompt surgical repair, the mortality rate remains high [2-6]. Among survivors, many studies report poor outcomes, including reduced functional outcomes, mobility, transfer, living status, and quality of life [7, 8].

Most evidence-based guidelines recommend full weight bearing from the first 48 hours after hip fracture surgery [9-13]. The British Orthopaedic Association proposed an even earlier timeframe of within 36 hours of admission [14]. Indeed, it is widely accepted that mobilising from bed early is essential for older adults to prevent complications of prolonged immobility, such as blood clots and pressure sores [15-17]. Restricted weight bearing may inhibit this early mobility as older adults with frailty may struggle to mobilise under partial- or non-weight bearing orders [18]. This, in turn, may negatively influence hospital stay, the likelihood of discharge to home, and morbidity and mortality [19-22].

Although early full weight bearing is recommended by guidelines [9-13], globally, it is not consistently prescribed or achieved postoperatively [15, 23, 24]. Several patient, process, and system factors may influence the prescription and/or achievement of full weight bearing after hip fracture surgery. For example, partial weight bearing is sometimes prescribed with a justification based on poor bone quality [15, 25], perceived risk of implant failure [15], and healthcare systems in different sites [23]. To date, no effort has been made to synthesise the evidence on barriers and facilitators of full weight bearing after hip fracture surgery. Therefore, we aimed to synthesise the available evidence on the presence/absence of barriers and facilitators of weight bearing among older adults after hip fracture surgery within a scoping review framework.

METHODS

We reported this review according to the Scoping Review extension of the Preferred Reporting Items for Systematic Review and Meta-Analysis statement (PRISMA-ScR) [26]. The protocol is available upon request. **(Supplementary file 1)**.

Eligibility Criteria

We included observational and intervention studies reporting on associations between barriers and/or facilitators and weight bearing among patients aged 50 years and older who underwent surgery for non-pathological isolated hip fractures. The comparator/control groups of both intervention studies and observational studies presented with hip fractures and underwent surgery. For intervention studies, which compared different surgical procedures, the post-intervention outcomes related to weight bearing were extracted and the interventions themselves were included as potential barriers and facilitators.

We excluded systematic and non-systematic reviews, conference proceedings, editorials, commentaries, qualitative studies, and case studies. We also excluded studies with populations under 50 years old, treated conservatively, with pathologic fractures, multiple fractures, treated for periprosthetic fracture, with a comparator group without hip fracture, and/or if studies were published in a language other than English.

Information sources

We searched for published evidence in the following electronic databases from inception to 29th March 2022: the Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE (via Ovid), EMBASE (via Ovid), Cumulative Index to Nursing and Allied Health Literature (CINAHL), and the Physiotherapy Evidence Database (PEDro). We searched the grey literature in the following electronic databases from inception to 29th March 2022: Global Health, EThOS, WorldCat dissertation and thesis, ClinicalTrials.gov, OpenAIRE and the DART-Europe E-theses Portal.

Search

We used terms for hip fracture (population), weight bearing (outcome), and study design (intervention studies) from previously published Cochrane Systematic Reviews [27, 28] and recommended search terms for study design (observational studies) [29] (Supplementary File 2). We did not include terms for our exposure (barriers and facilitators) or comparator group (where applicable) in our search strategy to prevent the loss of any relevant studies. No limits on date, country, or language were applied during the searches.

Selection of evidence

We imported search results into Covidence, a web-based program designed for de-duplication and study selection for systematic reviews [30]. We completed title and abstract screening (RT, SG) and full-text screening of potentially eligible studies (RT, SG, KS, TK) in duplicate. We resolved conflicts by consensus at each stage.

Data charting process

A data-charting sheet was developed prior to extraction to include all studies. The sheet was piloted on two studies and refined thereafter. Studies were first arranged based on the number of reported barriers/facilitators (studies reporting multiple barriers/facilitators and studies reporting one barrier/facilitator). Separate excel sheets were then created for each category of the Donabedian Framework [31] (patient, process (non-surgical), process (surgical), structure) to be summarized in tables (columns). This framework implies that, to provide the care, it is necessary for the care providers to have the physical resources (including staff and equipment), human resources (with experience and qualifications) and organisational characteristics (including systems and the provided services). The delivery of care within the established structures is comprised of organizational activities (such as transfer, scheduling, discharge planning) and medical operations (diagnostic, treatment, rehabilitation). In order to quantify the effects of the structure and process elements on the outcomes of care, Shroyer et al. reasoned that patient factors (such as demographics, comorbidity, and socioeconomic status) should be taken into account [32]. Studies were distributed in the tables based on the presence/absence of each barrier/facilitator. Data charting was completed by a single reviewer (RT)."

Data items

We extracted data on article characteristics (year of publication, author's name, study title, study type (design), country, setting), population characteristics (age, gender, pre-fracture residence, type of fracture, type of surgery, sample size) sampling methods, data collection, data analysis, barriers and facilitators (patient, process, and structure) and outcome (weight bearing prescribed or achieved and/or time to full weight bearing). We extracted associations between barriers and/or facilitators and weight bearing outcome from multivariable analysis (where available) and from univariable analysis to avoid the misclassification of covariates in the multivariable analysis as primary variables [33].

Synthesis

We summarised the evidence on barriers and facilitators of weight bearing in text and tables using a narrative review approach [34]. Barriers and facilitators of weight bearing were mapped to categories of the Donabedian Framework for evaluating healthcare quality [31] (patient, process (non-surgical), process (surgical), structure). Counts of barriers/facilitators which demonstrated a positive, negative, or no association were then generated and presented in text and tables. We defined the presence of an association by a p-value ≤ 0.05. We interpreted a positive association as a facilitator, a negative association as a barrier, and also report the absence of an association.

RESULTS

Study selection

We identified 4,280 studies from electronic databases after duplicates were removed. We excluded 3,769 on title and abstract screening. We excluded a further 442 on full-text screening for the following reasons: patient population (n = 156), outcome (n = 109), language (n = 96), study design (n = 64), no barrier or facilitator assessed (n = 17). In total, 69 studies (all from published literature sources) detailing 47 barriers and/or facilitators of weight bearing were included **(Figure 1).**

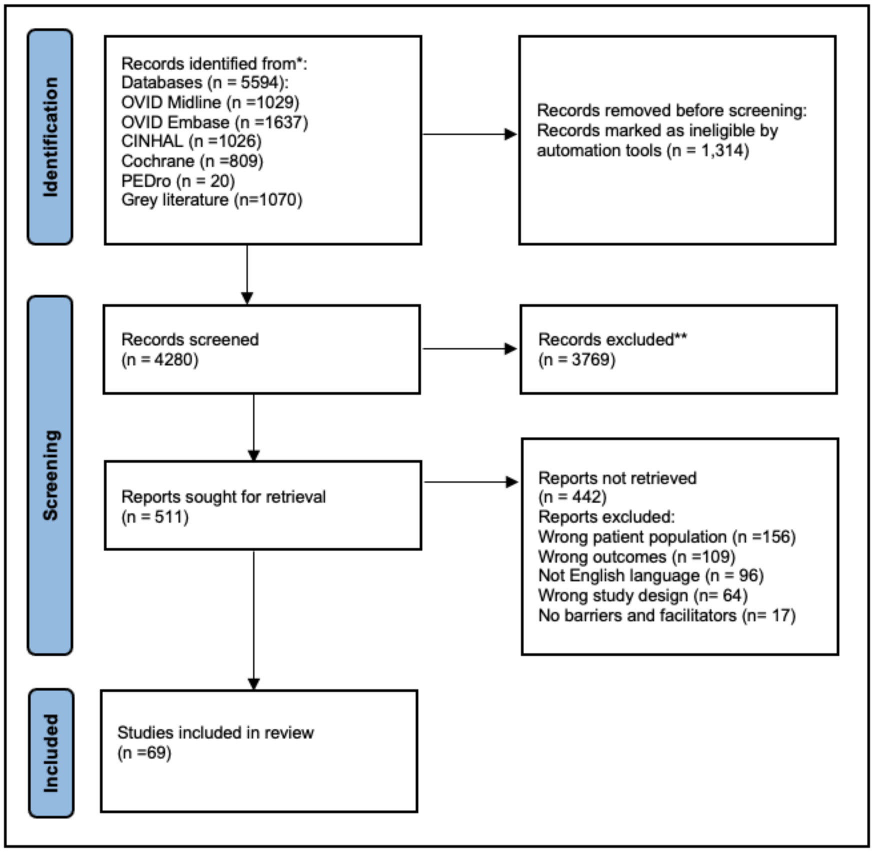

Fig. 1 PRISMA chart for study selection

Study characteristics

We included 69 studies reflecting a total of 48,978 patients with sample sizes ranging from 28 [35] to 13,939 [36]. Fifty-one studies were observational and 18 studies were randomised clinical trials, which compared different surgical procedures. Studies were conducted in China (n = 19), India (n =11), Turkey (n = 9), United States of America (USA) (n = 5), Israel (n = 3), Italy (n = 3), Spain (n = 3), Japan (n = 2), Sudan (n = 2), Japan and USA (n = 1), Australia (n = 1), France (n = 1), Germany (n = 1), Iran (n = 1), Kosovo (n = 1), Lebanon (n = 1), Nepal (n = 1), Netherlands (n = 1), Norway (n = 1), Portugal (n = 1) and Sweden (n = 1). Six studies reported on associations between multiple patient, process and structure barriers and facilitators and weight bearing [37-42]. Six studies reported on the association between a single patient barrier/facilitator and weight bearing [36, 43-46]. Three studies reported on the association between a single non-surgical process barrier/facilitator and weight bearing [47-49]. Fifty-one studies reported on the association between a single surgical process barrier/facilitator and weight bearing [50-87]. Three studies reported on the association between a single structure and weight bearing [88, 89]. Additional details related to the studies included in this review may be found in Supplementary file 3-4.

Barriers and facilitators of weight bearing

Tables 1-3 synthesise the evidence for barriers and facilitators of weight bearing after hip fracture surgery.

Patient (Table 1)

Twelve studies identified twenty-seven patient-related barriers/facilitators associated with weight bearing (Table1). Facilitators included anticoagulant use [40], target discharge destination (to home) [37, 38], and mobility aid at discharge (walker or crutches) [37]. Barriers included preoperative dementia [39], preoperative delirium [39], postoperative delirium [43], preoperative pressure sore [39], place of fall (indoor) [37], dyspnea [39], ventilator dependency [39], haematocrit (<36%) [39], history of severe chronic obstructive pulmonary disease [39], ascites [39], preoperative dialysis [39], open or infected wound [39], systemic sepsis [39], subtrochanteric fracture (compared with pertrochanteric fracture) [36], Type 31.A3 intertrochanteric fracture (compared to 31.A2) [90], pertrochanteric fracture (compared with femoral neck fracture)[18], and acute renal failure [39].

There was inconsistent evidence_for an association between several patient-related barriers/facilitators and weight bearing across studies. American Society of Anaesthesiologists (ASA) was both positively [39, 41] and not [37, 38, 42] associated with weight bearing. Pre-fracture functional level was positively [38, 39, 41] and not [42] associated with weight bearing. Pre-fracture residence of home was positively [37, 39] and not [38, 42] associated with weight bearing. Age was both negatively [38-42] and not [37] associated with weight bearing. Cognitive impairment was negatively [38, 44] and not [37, 42] associated with weight bearing. Hypertension and diabetes were negatively [40] and not [39] associated with weight bearing. BMI > 30 kg/m^2 was positively [41], negatively [40], and not associated [37, 39] with weight bearing. Preoperative use of mobility aid was negatively [39] and not [42] associated with weight bearing.

No association was reported between gender [37-42], race [39], emergency case [39], pre-fracture bone protection medication use [39], serum albumin [38], smoking [39, 41], hyponatremia [39], congestive heart failure[39], disseminated cancer [39], chronic steroid use [39], bleeding disorders [39], cerebrovascular accident [40], pulmonary embolism [40], pertrochanteric fractures [46], and assistance at discharge [37], and weight bearing.

Process (non-surgical) (Table 2)

Six studies identified eight process-related barriers/facilitators associated with weight bearing after hip fracture surgery (Table2). Facilitators included early mobilisation [49], complete medical co-management during hospital stay [39], rehabilitation sessions-in-hospital [37], and patient-recorded nurses notes [48]. Barriers included increased operative time (>90 minutes) [39], transfusion of one unit of packed red blood cells in less than 72 hours [39], and standardised hip fracture care [39]. No association was reported between type of anaesthesia and weight bearing [39]. There was inconsistent evidence for an association between time to surgery and weight bearing with two studies reporting a positive [39, 47] and one study no [38] association.

Process (surgical) (Table 3)

Fifty-one studies identified eight surgical-related process barriers/facilitators of weight bearing after hip fracture surgery (Table 3). Thirty studies compared different internal fixation procedures [35, 52, 54, 56-58, 62, 63, 65, 68, 71-73, 76-85, 91-97], 17 studies compared internal fixation to arthroplasty [50, 51, 53, 55, 59-61, 64, 67, 74, 75, 86, 87, 98-100], and four studies compared different arthroplasties [66, 69, 70, 101].

For comparisons of different internal fixation procedures, intramedullary implant facilitators included the intramedullary nail with auxiliary locking plate (compared with intramedullary nail with steel wire) [93], Proximal femoral nail antirotating (PFNA) with cerclage cables (compared with PFNA alone) [63], intramedullary nail with cerclage cable (compared with intramedullary nail alone) [91], and PFNA-II (compared with interTan and profn nails) [57]. The interTan and PFNA [35, 83], and pertrochanteric nails and PFNA [79] were not associated with weight bearing. Extramedullary implant facilitators included dynamic compression locking system (DCLS) (compared with multiple cannulated compression screw (MCCS)) [84], percutaneous compression plate (PCCP) (compared with Dynamic hip screw (DHS))[80], DHS with scaffold enriched with the autologous bone marrow stem cells concentrate (compared with DHS alone) [92], and Medoff sliding plate (MSP) (compared with Dynamic condylar screw, DHS and DHS with trochanteric stabilizing plate) [73]. No association was reported between extramedullary DHS and derotation screw alone or with trochanteric wiring [81], Minimally invasive DHS and conventional DHS [62], and weight bearing. The studies that compare different types of extramedullary and intramedullary implants report facilitators of weight bearing favouring PFNA-II (compared with dynamic hip locking plates (DHLP)) [95], PFNA (compared with DHS) [52, 65, 72, 94, 96], PFN (compared with DHS) [68, 76, 77], short PFN (compared with DHS) [78], Mini-invasive static nail (compared with conventional DHS) [56], and gamma nail (compared with DHS) [71]. No difference between extramedullary and intramedullary implants was reported in two studies [54, 85].

For comparison of internal fixation and arthroplasty, most studies reported arthroplasty (hemiarthroplasty) [50, 51, 53, 55, 59-61, 64, 67, 86, 99, 100], femoral head replacement [98], and total hip replacement [75]) as a facilitator of weight bearing compared with internal fixation. In contrast, one study reported PFN as a facilitator of weight bearing when compared with hemiarthroplasty [74]. Mansukhani and colleagues reported DHS as a barrier of weight bearing when compared with PFN and arthroplasty [102]. One study reported no association between surgery type (arthroplasty or internal fixation) and weight bearing [87].

For comparisons of different arthroplasties, facilitators included hemiarthroplasty with a minimally invasive superpath approach (compared to hemiarthroplasty with traditional posterior approach) [66], hemiarthroplasty with minimally invasive mini-incision (compared to minimally invasive hemiarthroplasty with ordinary-incision) [69], and diaphyseal fixed-stem hemiarthroplasty (compared to metaphyseal fixed-stem hemiarthroplasty) [70]. No difference in weight bearing was noted for those who underwent hemiarthroplasty compared to dual mobility acetabular cup [101].

Structure (Table 2)

Four studies identified four structure-related barriers/facilitators associated with weight bearing after hip fracture surgery (Table 2). Facilitators included the healthcare system at admission (USA compared with Japan) [88] and the year of admission (2015 compared with 2000) [89]. Barriers included pre-holiday surgery (surgery conducted on Friday or the day before public holidays) [38] and admissions in the first quarter of the year (January to March) [39]. No associations were reported between length of hospital stay [37], outpatient rehabilitation within three months [37], and hospital type (community centre compared to medical centre) [103], and weight bearing.

DISCUSSION

Main findings

We identified 47 barriers and facilitators which were synthesised into three groups: patient, process (non-surgical, surgical), and structure. We found the majority of reported barriers and facilitators related to the patient or the surgery. Indeed, 74% of the included studies reported on the association between surgery type and weight bearing. These studies suggest arthroplasty as a facilitator of weight bearing compared with internal fixation, and intramedullary nails as a facilitator of weight bearing when compared with extramedullary fixations. However, most of the reported associations were investigated by a single study with a need for replication in future research. Further, our findings indicate a paucity of research focusing specifically on non-surgical processes and/or structure related barriers/facilitators of weight bearing after hip fracture surgery.

Comparison to previous literature

Most studies focused on surgical barriers/facilitators of weight bearing after hip fracture. We found most studies favoured intramedullary compared to extramedullary implants for weight bearing following surgery for extracapsular hip fracture. A recent Cochrane systematic review concluded intramedullary and extramedullary implants yielded similar mobility outcomes following extracapsular hip fractures [104]. In the current review, 14 studies compared internal fixation to arthroplasty for extracapsular (intertrochanteric only) fractures with 13 reporting an association with weight bearing favouring arthroplasty. Indeed, Due to the low and very low certainty of the current evidence , a recent systematic review concluded there was insufficient evidence to make a clinical recommendation for internal fixation or arthroplasty for extracapsular hip fracture among older adults [105].

One patient factor investigated by several studies was cognitive impairment. Most reported impaired cognitive status, preoperative dementia, preoperative delirium, or postoperative delirium as barriers of weight bearing after hip fracture surgery. In contrast, one study reported no association between cognitive function and weight bearing, suggesting the decline of cognitive skills was associated with decreased peripheral nerve sensory input, which may in fact lead to increased weight bearing [106]. Indeed, the presence of cognitive impairment should not influence weight bearing orders given previous evidence for no association between cognitive impairment and adherence of weight bearing among older adults after hip fracture [38, 42].

Few studies focused on non-surgical processes or structure barriers/facilitators of weight bearing after hip fracture. One study reported an association between pre-holiday surgery and weight bearing with patients undergoing surgery on the days before a weekend or a public holiday less likely of weight bear within 48 hours compared to those undergoing surgery on other days [38]. Delays may relate to available resources inclusive of staffing during the holidays [38]. Indeed, patient activity levels after hip fracture surgery were previously reported as decreased on weekends compared with the weekdays due to reduced physiotherapy staffing [107]. This may be mitigated through better engagement of the broader multidisciplinary team to support weight bearing postoperatively. For example, engagement of nursing staff with weight bearing on weekends where physiotherapy staff is absent [48, 108].

Future research

Most factors were reported by a single study where weight bearing was not the primary outcome and poorly defined (not clearly specified whether weight bearing ordered or weight bearing achieved). Moreover, reasons for failed weight bearing were not specified in any study. There is a need to replicate studies identified and to augment them with more specific details on weight bearing outcomes. These future studies have the potential to inform clinical practice, particularly in low-middle-income countries where the rates of weight bearing after hip fracture remain well below care guidelines [109].

Most patient-related barriers identified are non-modifiable between admission and the target time for weight bearing. However, insights into the association of these factors with weight bearing may allow for early identification of those at risk of failed weight bearing for targeted intervention such as clinical co-management. Indeed, pathways along specific care programmes which facilitate e.g., increased geriatrician input, may enhance the likelihood of weight bearing by mitigating modifiable risk factors such as delirium which may be more prevalent among those with non-modifiable risk factors (e.g., those who are older and present with poor cognitive and functional status) [110]. Previous studies revealed that adopting these programmes leads to a considerable gain in walking capacity [111].

Future research may wish to focus more on non-surgical process and structure related barriers and facilitators of weight bearing as these are more likely to be amenable to intervention. Such factors may include time to surgery, anaesthetic type, postoperative pain management, staffing levels, and access to physiotherapy/exercise gyms. The complexity of these factors should be viewed at macro and micro levels.

Strengths and limitations of the review

This is the first scoping review to report and synthesise the barriers and facilitators of weight bearing after hip fracture surgery in older adults, reported in line with the recommendation of the PRISMA-ScR statement [26], which follow the same rigours and transparent methodology used in systematic reviews. We searched multiple databases, including the grey literature, for relevant evidence on barriers and facilitators of weight bearing, with study selection completed in duplicate.

This review had some limitations. First, the studies identified through electronic databases were published in English which may have led to publication bias [112]. Second, the bibliography of included studies was not screened, which may have led to an underestimation of relevant evidence. Third: data extraction was completed by one reviewer which may have led to extraction bias. Finally, in keeping with the scoping review framework [26] (which aims to identify and map the scope of available evidence rather than the quality of evidence identified), we did not assess the quality of the included studies. Therefore, it is not possible to determine whether the uncertainty identified for some barriers/facilitators reflects varying methodological qualities among the studies. It will now be possible to complete systematic reviews with more focused questions related to association/ intervention effectiveness for the barriers/facilitators identified with uncertainty by the current review.

CONCLUSION

We synthesised the evidence to identify 47 barriers and facilitators of weight bearing after hip fracture surgery in a scoping review. Most barriers and facilitators related to the patient or the surgery and were reported by a single study limiting the inferences that may be drawn. Identifying barriers and facilitators of weight bearing is important as it will enable healthcare providers to improve weight bearing for patients after hip fracture surgery through quality improvement and intervention studies. Further studies should seek to replicate the findings from the current review which suggest arthroplasty as a facilitator of weight bearing compared with internal fixation, and intramedullary nails as a facilitator of weight bearing when compared with extramedullary fixation.

ETHICS DECLARATIONS

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors

Conflict of interest: Katie Sheehan receives funding from UK Research & Innovation, the National Institutes of Health Research (NIHR) and Chartered Society of Physiotherapy Charitable Trust for hip fracture health services research not related to the current manuscript. KS is the Chair of the Scientific and Publications Committee of the Falls and Fragility Fracture Audit Programme which manages the National Hip Fracture Database audit at the Royal College of Physicians. David Wyatt has received NIHR funding that is unrelated to the current work. Matthew O'Connell has received NIHR funding that is unrelated to the current work. Ruqayyah Turabi, Stefanny Guerra, Toslima Khatun, Saibin Ahmad Sageer, and Adel Alhazmi declare that they have no conflict of interest.

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Additional information:
Supplementary file 1 includes PRISMA-ScR checklist
Supplementary file 2 includes search strategy
Supplementary file 3 includes the details of the included studies
Supplementary file 4 distributed studies based on barriers and facilitators numbers

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	Age	BMI (<18) kg/m2	ASA (<II)	Cognitive impairment	Preoperative dementia	Preoperative delirium	postoperative delirium	Preoperative use of mobility aid (yes)	Prefracture functional level (Independent)	Preoperative Pressure Sore	Haematocrit (<36)	Diabetes	Dyspnea (Moderate exertion)	Ventilator dependent	History of severe COPD	Ascites	Hypertension	Preoperative dialysis	Open wound/wound infection	Systemic sepsis	Acute Renal failure (ARF)
Malik 2019 [39]	X	_	✓		X	X		X	✓	X	X	_	X	X	X	X	_	X	X	X	X
Barone2009 [38]	X		_	X					✓												
Ariza-Vega 2014[37]	_	_	_	_					_												
Ottesen 2018 [41]	X	X	✓						✓												
Atzmon 2022 [40]	X	X										X					X				
Tarrant 2022 [42]	X		_	_				_													
Arshi 2018[43]							X														
Aguado 2022 [36]																					
Ariza-Vega 2017 [44]				X																	
Pfeifer 2019 [45]																					
Onta 2021 [46]																					
Schipper and van der Werken 2004 [90]																					
Association																					
Yes	5	2	2	2	1	1	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1
No	1	2	3	2	0	0	0	1	1	0	0	1	0	0	0	0	1	0	0	0	0

	anticoagulant use	Prefracture Residence (home)	aid at discharge (walker or crutches)	discharge destination (Home)	place of fall (Indoor)	Type and location of the fracture	Gender	Race	Emergency case	Prefracture bone protection medication	serum albumin	Hyponatremia	Smoker	Congestive heart failure	Disseminated cancer	Chronic steroid use	Bleeding disorders	Cerebrovascular accident	Pulmonary embolism	Assistance at discharge
Malik 2019 [39]		✓					_	_	_	_		_	_	_	_	_	_			
Barone2009 [38]		_		✓			_				_									
Ariza-Vega 2014[37]		✓	✓	✓	X		_													_
Ottesen 2018 [41]							_						_							
Atzmon 2022 [40]	✓						_											_	_	
Tarrant 2022 [42]		_					_													
Arshi 2018[43]																				
Aguado 2022 [36]						X a														
Ariza-Vega 2017 [44]																				
Pfeifer 2019 [45]						X b														
Onta 2021 [46]						_														
Schipper and van der Werken 2004 [90]						X c														
Association																				
Yes	1	2	1	2	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
No	0	2	0	0	0	1	6	1	1	1	1	1	2	1	1	1	1	1	1	1

Table 1. Counts of reported patient-related barriers and facilitators with a positive association (√), negative association (X), or absence of an association (-), with weight bearing after hip fracture surgery. (a) Subtrochanteric fracture is a barrier to weight bearing compared to pertrochanteric fracture. (b) Pertrochanteric fracture is a barrier to weight bearing compared to femoral neck fracture. (c) 31.A3 intertrochanteric fracture is a barrier to weight bearing compared to 31.A2

	Process related factors									Structure related factors						
	Time to surgery (early)	Transfusion (one unit of packed RBCs <72 hours)	Total operative time (>90 minutes)	Medical co-management during stay (complete)	Standardized Hip Fracture Care (yes)	mobilization time (Early)	Patient recorded Nurses notes	Rehabilitation sessions - in-hospital	Type of anaesthesia	healthcare system - different countries (USA vs Japan)	healthcare system - different years (2015)	Quarter of admission (January - March)	preholiday surgery	different types of hospitals - community vs medical center	Length of hospital stay	outpatient rehabilitation within 3 months
Malik 2019 [39]	✓	X	X	✓	X				–			X				
Ariza-Vega 2014 [37]								✓							–	–
Barone 2009 [38]	–												X			
Doruk 2004 [47]	✓															
Kondo 2012 [48]							✓									
Xiang 2021 [49]						✓										
Myers 1996 [103]														–		
Trevisan 2019 [89]											✓					
Kondo 2010 [88]										✓						
Association																
YES	2	1	1	1	1	1	1	1	0	1	1	1	1	0	0	0
NO	1	0	0	0	0	0	0	0	1	0	0	0	0	1	1	1

Table 2. Counts of reported structural- and process-related barriers and facilitators with a positive association (√), negative association (X), or absence of an association (-), with weight bearing after hip fracture surgery.

Author/year	I	II	III	IV	V	VI	VII	VIII	IX	X
Wang 2020 [93]	✓ (B)									
Huang and Wu 2021 [63]	✓ A)									
Imerci 2019 [91]	✓ (A)									
ÜLkÜ 2019 [35]	–									
Seyhan 2015 [83]	–									
Duramaz and İlter 2019 [57]	✓ (B)									
Okkaoğlu 2020 [79]	–									
Tao 2013 [97]	✓ (B)									
Shu 2020 [84]		✓ (A)								
Peyser 2007 [80]			✓ (B)							
Torres 2014 [92]			✓ (B)							
Lunsjo 1999 [73]				✓ (D)						
Xie, 2017 [95]					✓ (B)					
Leung 1992 [71]					✓ (B)					
Duymus 2019 [58]					✓ (B)					
Kamboj 2019 [68]					✓ (B)					
Mayi 2016 [76]					✓ (B)					
Meesala 2018 [77]					✓ (B)					
Huang 2017 [65]					✓ (B)					
Chen 2018 [52]					✓ (B)					
Li 2018 [72]					✓ (B)					
Wang 2019 [94]					✓ (B)					
Xu 2018 [96]					✓ (B)					
Nargesh 2013 [78]					✓ (B)					
Singh 2021 [85]					–					
Darbandi 2022 [54]					–					
Dujardin 2001 [56]					✓ (B)					
Sandhu 2019 [82]					✓ (B)					
Jianbo 2019 [66]						✓ (A)				
Kaneko 2004 [69]						✓ (A)				
Karaali and Ciloglu 2021 [70]							✓ (B)			
Ekinci 2020 [59]								✓ (A)		
Dubin 2022 [55]								✓ (A)		
Zandi 2020 [100]								✓ (A)		
Huang 2020 [64]								✓ (A)		
Chengkui 2021 [53]								✓ (A)		
Bansal 2019b [51]								✓ (A)		
Ma and Wu 2021 [74]								✓ (B)		
Sun 2021 [98]								✓ (A)		
Xie 2019 [99]								✓ (A)		
Gashi 2018 [61]								✓ (A)		

Elhadi and Gashi 2018 [60]								✓ (A)		
Sinno 2010 [86]								✓ (A)		
Bansal 2019a [50]								✓ (A)		
Jin 2021 [67]								✓ (A)		
Soreide 1979 [87]								-		
Magu 2008 [75]								✓ (A)		
Mansukhani 2017 [102]								✕ (B)		
Puram 2017 [81]									-	
Ho 2009 [62]									-	
Ukaj 2019 [101]										-
Association										
Yes	5	1	2	1	14	2	1	16	0	0
No	3	0	0	0	2	0	0	1	2	1

Table 3. Counts of reported surgical-related barriers and facilitators with a positive association (√), negative association (X), or absence of an association (-), with weight bearing after hip fracture surgery.

I - intramedullary implants versus intramedullary implants - Intramedullary Nail with Steel Wire/ cables PTN/InterTan/ reverse LISS-DF /Profn (A) - Intramedullary Nail with Auxiliary Locking Plate (B) - Intramedullary Nail PFN/ PFNA/ PFNA-II (B)

II- Extramedullary implants versus Extramedullary implants - Dynamic compression locking system (DCLS)(A) - multiple cannulated compression screw (MCCS) (B)

III- Extramedullary implants versus Extramedullary implants - Conventional Dynamic Hip screw (DHS) (A) - percutaneous compression plate (PCCP) (B) - DHS with scaffold enriched with the autologous bone marrow stem cells concentrate (ABMC) (B)

IV- Extramedullary implants versus Extramedullary implants - Conventional Dynamic Hip screw (DHS) (A) - Dynamic Condylar Screw (DCS) (B) - DHS with or without trochanteric stabilizing plate (TSP)DHS/TSP (C) - Medoff sliding plate (MSP) (D)

V-Extramedullary fixation (A) versus Intramedullary fixation (B)

VI-Arthroplasty versus Arthroplasty - hemiarthroplasty - Minimally invasive SuperPath approach, mini-incision(A) - hemiarthroplasty - traditional posterior approach, ordinary-incision (B)

VII-Arthroplasty versus Arthroplasty - Metaphyseal fixed-stem hemiarthroplasty (A) - Diaphyseal fixed-stem hemiarthroplasty (B)

VIII- Arthroplasty (A) versus Internal fixations (B)

IX- Extramedullary implants versus Extramedullary implants - Conventional Dynamic Hip screw (DHS) (A) - Minimally invasive DHS (B) - DHS with trochanteric wiring (B)

X-Arthroplasty versus Arthroplasty - Hemiarthroplasty (A) - Dual mobility acetabular cup (B)