

Supplementary Data 3. Evidence table

KQ1. Does hospital-based multidisciplinary rehabilitation have more clinical effects than usual postoperative treatment in patients with hip fracture surgery?

Included articles

Authors	Study No.	Description
Nordstrom et al. (2018)	SR1	Nordstrom P, Thorngren KG, Hommel A, Ziden L, Anttila S. Effects of geriatric team rehabilitation after hip fracture: meta-analysis of randomized controlled trials. J Am Med Dir Assoc 2018;19:840-5.
Bachmann et al. (2010).	SR2	Bachmann S, Finger C, Huss A, Egger M, Stuck AE, Clough-Gorr KM. Inpatient rehabilitation specifically designed for geriatric patients: systematic review and meta-analysis of randomised controlled trials. BMJ 2010;340:c1718.
Handoll et al. (2009).	SR3	Handoll HH, Cameron ID, Mak JC, Finnegan TP. Multidisciplinary rehabilitation for older people with hip fractures. Cochrane Database Syst Rev 2009;(4):CD007125.
Halbert et al. (2007)	SR4	Halbert J, Crotty M, Whitehead C, Cameron I, Kurrle S, Graham S, et al. Multi-disciplinary rehabilitation after hip fracture is associated with improved outcome: a systematic review. J Rehabil Med 2007;39:507-12.

SR, systemic review.

Methodological quality of the included SRs

Ref No.	Quality item															
	1	2 ^{a)}	3	4 ^{a)}	5	6	7 ^{a)}	8	9 ^{a)}	10	11 ^{a)}	12	13 ^{a)}	14	15 ^{a)}	16
SR1	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	N	Y	Y	N
SR2	Y	PY	Y	Y	Y	Y	N	Y	N	N	Y	N	N	Y	Y	Y
SR3	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SR4	Y	PY	Y	N	Y	Y	Y	PY	N	N	Y	Y	Y	N	N	Y

SR, systemic review.

^{a)}Critical domain using AMSTAR 2.0.

Literature summary

1 st author	Title	Journal	Design	Year	Sample size	Intervention	Comparison	Outcomes	Study duration	Results
Halbert J	Multi-disciplinary rehabilitation after hip fracture is associated with improved outcome A systematic review	J Rehabil Med	MA	2007	11 studies, n=2177	coordinated multi-disciplinary rehabilitation	Usual orthopaedic care	1. Good outcome : return home 2. Poor outcome : mortality or admission to a nursing home	At discharge– 12 months	Lower risk (RR 0.84, 95% CI 0.73–0.96) of a “poor outcome”(mortality or admission to a nursing home at discharge), Trend towards higher levels of return home (RR 1.07, 95% CI 1.00–1.15).
Handoll HH	Multidisciplinary rehabilitation for older people with hip fractures	Cochrane Database Syst Rev	MA	2009	13 studies, n=2498	Multidisciplinary rehabilitation	Usual care	Poor outcome : a composite of mortality & decline in residential status at long-term	12 months	Tendency to a better overall result in patients receiving multidisciplinary inpatient rehabilitation
Bachmann S	Inpatient rehabilitation specifically designed for geriatric patients: systematic review and meta-analysis of randomised controlled trials	BMJ	MA	2010	9 studies, n=1853	Orthopaedic geriatric rehabilitation	Usual care	Katz index/Barthel index, nursing home admission, mortality	3–12months	Overall better outcomes in orthopaedic geriatric rehabilitation group
Nordström P	Effects of Geriatric Team Rehabilitation After Hip Fracture Meta-Analysis of Randomized Controlled Trials	J Am Med Dir Assoc	MA	2018	7 studies, n=1763	Systematic rehabilitation by geriatric interdisciplinary teams	Conventional care	ADLs, physical function, mobility, depression, cognitive function, discharge to home, QoL, influence on relatives, complications, and survival	12 months	Increased physical function and mobility by systematic rehabilitation without differences for being discharged to home discharge and survival

MA: meta-analysis

Level of evidence

No.	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Level of evidence
SR1	0	-1	0	0	0	Moderate
SR2	0	-1	0	0	0	Moderate
SR3	0	-1	0	0	0	Moderate
SR4	0	-1	0	0	0	Moderate

SR, systemic review.

Grade of recommendation

	YES	NO
Confidence in the estimates	o	
Balancing benefits and harms	o	
Resource use		o
Values and preference	o	
Acceptability/feasibility	o	
Recommendation	Yes	
Grade	Strong	

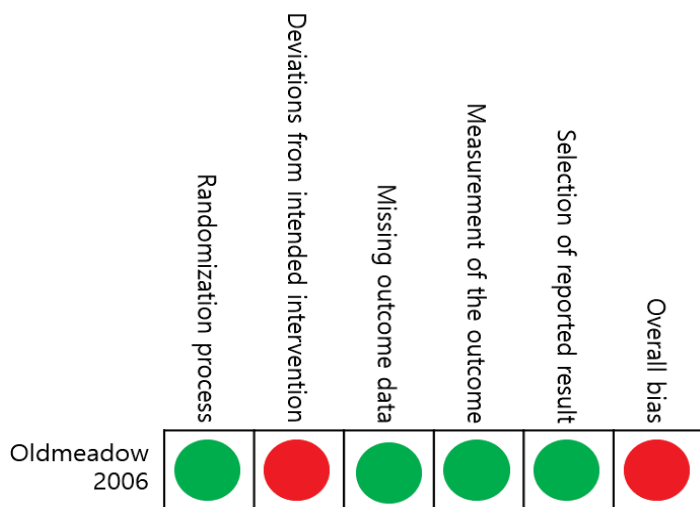
KQ2. Is it functionally effective to start rehabilitation early (within 48 h after surgery) after hip fracture surgery?

Included articles

Authors	Study No.	Description
Oldmeadow et al. (2006)	RCT	Oldmeadow LB, Edwards ER, Kimmel LA, Kipen E, Robertson VJ, Bailey MJ. No rest for the wounded: early ambulation after hip surgery accelerates recovery. <i>ANZ J Surg</i> 2006;76:607-11.
Kuru and Olcar (2020)	OS1	Kuru T, Olcar HA. Effects of early mobilization and weight bearing on postoperative walking ability and pain in geriatric patients operated due to hip fracture: a retrospective analysis. <i>Turk J Med Sci</i> 2020;50:117-25.
Su et al. (2018)	OS2	Su B, Newson R, Soljak H, Soljak M. Associations between post-operative rehabilitation of hip fracture and outcomes: national database analysis (90 characters). <i>BMC Musculoskelet Disord</i> 2018;19:211.
Frenkel Rutenberg et al. (2018)	OS3	Frenkel Rutenberg T, Vitenberg M, Haviv B, Velkes S. Timing of physiotherapy following fragility hip fracture: delays cost lives. <i>Arch Orthop Trauma Surg</i> 2018;138:1519-24.
Pioli et al. (2012)	OS4	Pioli G, Frondini C, Lauretani F, Davoli ML, Pellicciotti F, Martini E, et al. Time to surgery and rehabilitation resources affect outcomes in orthogeriatric units. <i>Arch Gerontol Geriatr</i> 2012;55:316-22.
Kamel et al. (2003).	OS5	Kamel HK, Iqbal MA, Mogallapu R, Maas D, Hoffmann RG. Time to ambulation after hip fracture surgery: relation to hospitalization outcomes. <i>J Gerontol A Biol Sci Med Sci</i> 2003;58:1042-5.

OS, observational study; RCT, randomized-controlled trial.

Risk of biases for the included articles (using ROB 2.0)



No.	Comparability	Selection bias	Confounding variables	Exposure measurement	Blinding of assessment	Detection bias	Attrition bias	Reporting bias
OS1	Unclear	Low	Low	Low	High	Low	Low	Unclear
OS2	Unclear	Low	Low	Low	High	Low	Low	High
OS3	Low	Low	Low	Low	High	Low	Low	Unclear
OS4	High	High	Low	Low	High	Low	Low	High
OS5	Unclear	Low	Unclear	Low	High	High	High	Unclear

OS, observational study.

Literature summary

1 st author	Title	Journal	Year	Design	Inclusion	Sample size	Intervention	Comparison	Outcomes	Duration	Results
Su	Associations between post-operative rehabilitation of hip fracture and outcomes: national database analysis	BMC Musculoskeletal Disord	2018	Cross-sectional study (2013–2015) (national database analysis)	All patients aged 60 and over with a hip fracture	1. Mobility outcome: 17,708 2. Discharge destination outcome : 34,142	Early mobilization by PT (mobilization on the day or the day following surgery)	No early mobilization Propensity-weighted analysis	1. 30-day mobility score 2. Discharge destination from acute orthopaedic ward	30 days post-surgery	1. mobilisation on the day or the day following surgery is associated with a lower mobility score i.e. better mobility function 30 days after discharge. 2. The discharge destination outcome is also better in mobilised than unmobilised patients
Oldmeadow	No rest for the wounded: early ambulation after hip surgery accelerates recovery	ANZ J Surg	2006	RCT	Surgical fixation of an acute neck of femur fracture The mean age of the total group was 79.4 years (range, 53–95 years)	Total: 60 1. Early ambulation (EA): 29 1) True EA: 19 2) Failed EA: 10 2. Delayed ambulation (DA): 31	EA on postoperative day 1 or 2.	DA group did not commence walking until postoperative day 3 or 4.	1. Distance they walked 2. Level of assistance required to transfer from supine to sit, sit to stand 3. To negotiate one step	7 days post-surgery	1. Mean walking metres (range) 82.55 (0.5–400) in TEA, 34.70 (5–103) in FEA, 29.71 (0–150) in DA 2. Independent transfer: 57.9% in TEA, 50% in FEA, 4% in DA

RCT, randomized-controlled trial.

1 st author	Title	Journal	Year	Design	Inclusion	Sample size	Intervention	Comparison	Outcomes	Duration	Results
Rutenberg	Timing of physiotherapy following fragility hip fracture: delays cost lives	Arch Orthop Trauma Surg	2018	Retrospective	Patients 65 years and older who underwent surgery for proximal femoral fractures Only patients who were operated within 48 h from admission were included.	Total: 747 PT early at POD 1: 525 PT delayed ≥POD 2: 222	PT designed to encourage mobilization and muscle strengthening at POD 1	PT ≥ POD 2	Primary outcomes: mortality either within hospital or in the post-operative year. Secondary outcomes: In-hospital complications, LOS, recurrent hospitalizations, and orthopedic complications within 3 months	3 month, 1 year post-surgery	Delayed PT group higher in-hospital mortality 6.8 vs. 3.2% (OR 2.2, 95% CI 1.06–4.42, p value = 0.034)
Kuru	Effects of early mobilization and weight bearing on postoperative walking ability and pain in geriatric patients operated due to hip fracture: a retrospective analysis	Turk J Med Sci	2019	Retrospective	A total of 52 patients aged over 65 years who underwent partial prosthesis surgery due to hip fracture	Total: 52 Early mobilization: 23 Late mobilization: 29	Early mobilization was defined as first mobilization of the patient within 24 h after surgery.	Late mobilization after 24 h	Length of stay 2. Walking ability (higher scores, better function) 3. Harris hip score (higher scores, better function)	1 month post-surgery	1. LOS: mobilization (early: 5.4 ± 1.8 days, late: 6.9 ± 2.9 days; P= 0.026). 2. Walking ability (percentage of walking ability 3, 4, 5, 6 categories): early 78.3% vs late 10.3% (P<0.001) 3. Harris score: 1 month post surgery: early 84.0 vs late 71.1 (P<0.001) 4. Harris pain subscore: early 36.8 vs late 24.4 (P<0.001)

1 st author	Title	Journal	Year	Design	Inclusion	Sample size	Intervention	Comparison	Outcomes	Duration	Results
Pioli	Time to surgery and rehabilitation resources affect outcomes in orthogeriatric units	Archives of Gerontology and Geriatrics	2012	Prospective cohort	consecutive patients, aged 75 years or older, admitted with a fragility HF between March 2008 and February 2009 in 3 Hospitals	Total: 806	Early ambulation within POD 3 (Yes/No)+ Post-acute rehabilitation (Yes/No) Yes/Yes: early rehab and post acute rehab No/Yes: late rehab and post acute rehab Yes/No: early rehab and not acute rehab	Late ambulation, No post-acute rehabilitation	1 year mortality 2. Loss of 1 or more functional abilities in activities of daily living (ADLs) 3. Recovery/maintenance of independent ambulation at 6 months from the fracture	6 moth, 1 year post-surgery	Odds ratio 1 year mortality: Yes/no 0.370, No/yes 0.506, Yes/yes 0.321 6 month ADL loss: Yes/yes 0.438 6 month independent walk: Yes/yes 2.579
Kamel	Time to ambulation after hip fracture surgery; relation to hospitalization outcomes	J Gerontol A Biol Sci Med Sci	2003	Retrospective		Total: 131	The time an order was written to ambulate (walk) patients after surgery		Frequency of postoperative complications Length of hospital stay		Time to ambulation after surgery was an independent predictor for the development of pneumonia (1.5 OR [odds ratio]/day, p , .001), new onset delirium (1.7 OR/day, p , .001), and to prolonged length of hospital stay (B [slope coefficient] = 1.36, p , .0001).

Level of evidence

Study design	No. of studies	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Level of evidence	Importance
RCT	1	-1	0	0	-1	0	Low	6
Non-RCT	5	-1	0	0	-1	0	Very low	4

RCT, randomized controlled trial.

Grade of recommendation

	YES	NO
Confidence in the estimates		o
Balancing benefits and harms	o	
Resource use	o	
Values and preference	o	
Acceptability/feasibility	o	
Recommendation		Yes
Grade		Weak

KQ3. Is supervised progressive resistance exercise more effective than self-directed exercise in patients with hip fracture surgery?**Included articles**

Authors	Study No.	Description
Lee et al. (2017)	SR	Lee SY, Yoon BH, Beom J, Ha YC, Lim JY. Effect of lower-limb progressive resistance exercise after hip fracture surgery: a systematic review and meta-analysis of randomized controlled studies. <i>J Am Med Dir Assoc</i> 2017;18:1096.e19-1096.e26.
Stasi et al. (2019)	RCT1	Stasi S, Papathanasiou G, Chronopoulos E, Dontas IA, Baltopoulos IP, Papaioannou NA. The effect of intensive abductor strengthening on postoperative muscle efficiency and functional ability of hip-fractured patients: a randomized controlled trial. <i>Indian J Orthop</i> 2019;53:407-19.
Kronborg et al. (2017)	RCT2	Kronborg L, Bandholm T, Palm H, Kehlet H, Kristensen MT. Effectiveness of acute in-hospital physiotherapy with knee-extension strength training in reducing strength deficits in patients with a hip fracture: a randomised controlled trial. <i>PLoS One</i> 2017;12:e0179867.

SR: systemic review; RCT, randomized controlled trial.

Methodological quality of the included SR

Ref No	Quality item															
	1	2 ^{a)}	3	4 ^{a)}	5	6	7 ^{a)}	8	9 ^{a)}	10	11 ^{a)}	12	13 ^{a)}	14	15 ^{a)}	16
SR	Y	PY	Y	Y	Y	Y	PY	Y	Y	Y	Y	Y	PY	Y	Y	Y

SR, systemic review.

^{a)}Critical domain using AMSTAR 2.0.

Risk of biases for the included articles (using ROB 2.0)

	Randomization process	Deviations from intended intervention	Missing outcome data	Measurement of the outcome	Selection of reported result	Overall bias
Stasi 2019	●	●	●	●	●	●
Kronborg 2017	●	●	●	●	●	●

Literature summary

1 st author	Title	Journal	Year	Design	Inclusion	Sample size	Intervention	Comparison	Outcomes	Duration	Results
Lee	Effect of Lower-Limb Progressive Resistance Exercise After Hip Fracture Surgery: A Systematic Review and Meta-Analysis of Randomized Controlled Studies	J Am Med Dir Assoc	2017	MA	(1) RCT and (2) articles that described the use of lower-limb PRE.	8 studies, n=587	Resistance OR Strengthening OR Weight lifting OR Endurance exercise	Usual care	Primary outcome: overall mobility Secondary outcome: (1) ADLs (2) balance (3) lower-limb strength, torque, and power (4) performance tasks (5) self-reported physical function	immediate postop ~ 84 months	1. Physical function: SMD= 0.408; 95% CI: 0.238-0.578; P < .001) 2. Overall mobility (SMD = 0.501; 95% CI 0.297-0.705; P < .001) 3. ADLs (SMD = 0.238; 95% CI 0.040-0.437; P = .019), 4. Balance (SMD = 0.554; 95% CI 0.310-0.797; P < .001) 5. Lower-limb strength or power (SMD = 0.421; 95% CI 0.101-0.741; P = .010) 6. Performance tasks (SMD = 0.841; 95% CI 0.197-1.484; P = .010) 7. Self-reported physical function did not differ significantly (pooled SMD = 0.449; 95% CI 0.061 to 0.958; P = .084)

MA: meta-analysis

1 st author	Title	Journal	Year	Design	Inclusion	Sample size	Intervention	Comparison	Outcomes	Duration	Results
Stasi	The Effect of Intensive Abductor Strengthening on Postoperative Muscle Efficiency and Functional Ability of Hip-Fractured Patients: A Randomized Controlled Trial	Indian J Orthop	2019	RCT	Displaced femoral neck fracture Age between 70 and 84 years	Total: 96 I-PT (intensive physiotherapy): 48 S-PT (standard physiotherapy): 48	Intensive abductor-strengthening exercise program + usual PT	Usual PT	1. Measurement of HA (hip abductor)'s isometric strength 2. Timed up and go test 3. LEFS (Lower extremity functional scale)	Outcome measures were obtained at three different time points: before surgery (baseline), at the end of the 3rd month (postintervention), and at follow-up at the end of the 6th month.	Postintervention: 1. isometric strength was 35.7% greater (P < 0.0005) in I-PT 2. 29.1% faster during TUG test and 26.7% higher LEFS total score (P < 0.0005). At follow-up, 1. isometric strength: 37.0% greater (P < 0.0005) 2. 45.9% faster during TUG test (P < 0.0005) and 11.2% higher LEFS total score, (P = 0.013).
Kronborg	Effectiveness of acute in-hospital physiotherapy with knee-extension strength training in reducing strength deficits in patients with a hip fracture: A randomised controlled trial	PLoS One	2017	RCT	home-dwelling patients with a primary HF surgery, aged 65 years or older	Total: 90 I-PT (intensive physiotherapy): 45 S-PT (standard physiotherapy): 45	Progressive knee-extension strength training (10RM), 3 x 10 repetitions, of the fractured limb using ankle weight cuffs + routine PT	Routine PT	1. Change in maximal isometric knee-extension strength in the fractured limb 2. Timed up and go test	Data was collected at baseline 1±3 days after surgery and at discharge or postoperative day 10 (follow-up).	8.1% (95% CI -2.3; 18.4) by additional strength training from baseline to follow-up

Level of evidence

No.	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Level of evidence
SR1	0	-1	0	0	0	Moderate

SR, systemic review.

Study design	No. of studies	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Level of evidence	Importance
RCT	2	0	-1	0	-1	0	Moderate	6

RCT, randomized controlled trial.

Grade of recommendation

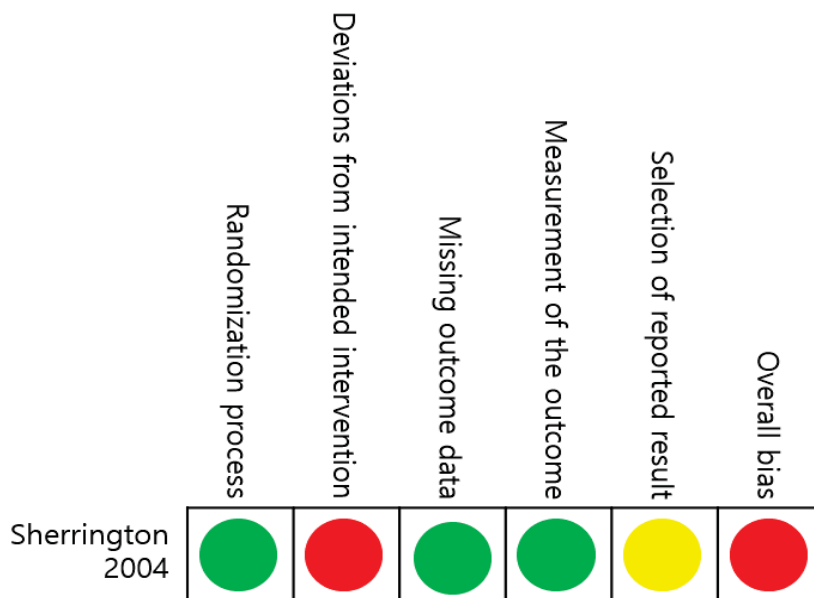
	YES	NO
Confidence in the estimates	o	
Balancing benefits and harms	o	
Resource use		o
Values and preference	o	
Acceptability/feasibility	o	
Recommendation	Yes	
Grade	Strong	

KQ4. Does weight-bearing exercise affect functional recovery after hip fracture surgery?**Included articles**

Authors	Study No.	Description
Sherrington et al. (2004)	RCT	Sherrington C, Lord SR, Herbert RD. A randomized controlled trial of weight-bearing versus non-weight-bearing exercise for improving physical ability after usual care for hip fracture. <i>Arch Phys Med Rehabil</i> 2004;85:710-6.
Warren et al. (2019)	OS1	Warren J, Sundaram K, Anis H, McLaughlin J, Patterson B, Higuera CA, et al. The association between weight-bearing status and early complications in hip fractures. <i>Eur J Orthop Surg Traumatol</i> 2019;29:1419-27.
Pfeufer et al. (2019)	OS2	Pfeufer D, Zeller A, Mehaffey S, Bocker W, Kammerlander C, Neuerburg C. Weight-bearing restrictions reduce postoperative mobility in elderly hip fracture patients. <i>Arch Orthop Trauma Surg</i> 2019;139:1253-9.
Kuru and Olcar (2020)	OS3	Kuru T, Olcar HA. Effects of early mobilization and weight bearing on postoperative walking ability and pain in geriatric patients operated due to hip fracture: a retrospective analysis. <i>Turk J Med Sci</i> 2020;50:117-25.
Baer et al. (2019).	OS4	Baer M, Neuhaus V, Pape HC, Ciritsis B. Influence of mobilization and weight bearing on in-hospital outcome in geriatric patients with hip fractures. <i>SICOT J</i> 2019;5:4.
Ottesen et al. (2018)	OS5	Ottesen TD, McLynn RP, Galivanche AR, Bagi PS, Zogg CK, Rubin LE, et al. Increased complications in geriatric patients with a fracture of the hip whose postoperative weight-bearing is restricted: an analysis of 4918 patients. <i>Bone Joint J</i> 2018;100-B:1377-84.
Ariza-Vega et al. (2014)	OS6	Ariza-Vega P, Jimenez-Moleon JJ, Kristensen MT. Non-weight-bearing status compromises the functional level up to 1 yr after hip fracture surgery. <i>Am J Phys Med Rehabil</i> 2014;93:641-8.
Siebens et al. (2012)	OS7	Siebens HC, Sharkey P, Aronow HU, Horn SD, Munin MC, DeJong G, et al. Outcomes and weight-bearing status during rehabilitation after arthroplasty for hip fractures. <i>PM R</i> 2012;4:548-55.
Wu et al. (2009)	OS8	Wu J, Kurrle S, Cameron ID. Restricted weight bearing after hip fracture surgery in the elderly: economic costs and health outcomes. <i>J Eval Clin Pract</i> 2009;15:217-9.
Raivio et al. (2005)	OS9	Raivio M, Korkala O, Pitkala K, Tilvis R. Rehabilitation outcome in hip-fracture: impact of weight-bearing restriction: a preliminary investigation. <i>Phys Occup Ther Geriatr</i> 2005;22:1-9.
Adunsky et al. (2001)	OS10	Adunsky A, Levenkrohn S, Fleissig Y, Arad M, Heruti RJ. Rehabilitation outcomes in patients with full weight-bearing hip fractures. <i>Arch Gerontol Geriatr</i> 2001;33:123-31.

OS, observational study; RCT, randomized-controlled trial.

Risk of biases for the included articles (using ROB 2.0)



No.	Comparability	Selection bias	Confounding variables	Exposure measurement	Blinding of assessment	Detection bias	Attrition bias	Reporting bias
OS1	High	Low	Unclear	Low	High	Low	Low	Unclear
OS2	Low	Low	Low	Low	High	Low	Low	Unclear
OS3	Unclear	Low	Low	Low	High	Low	Low	Unclear
OS4	Unclear	Low	Low	Low	High	Low	Low	Unclear
OS5	High	Low	Low	Low	High	Low	Low	Unclear
OS6	Low	Low	Low	Low	High	Low	High	Unclear
OS7	Low	Low	Low	Low	High	Low	Low	Low
OS8	Low	Low	Low	Low	High	Low	Low	Low
OS9	Low	Low	Unclear	Low	High	Low	High	High
OS10	Unclear	Unclear	Unclear	Low	High	Low	High	Unclear

OS, observational study.

Literature summary

1 st author	Title	Journal	Year	Design	Inclusion	Sample size	Intervention	Comparison	Outcomes	Duration	Results
Warren	The association between weight-bearing status and early complications in hip fractures	Eur J Orthop Surg Traumatol	2019	National database survey	The hip fracture subsection of the NSQIP database was queried,	Total: 7,947 WBAT: 5,845 non-WBAT: 2,102 (1182 + 315 + 605)	Weight-bearing as tolerated (WBAT) on postoperative day one (POD1)	non-WBAT	(1) 30-day mortality (2) 30-day postoperative major and minor complications (3) length of stay (LOS) (4) discharge disposition after hip fracture management	30 days	WBAT on POD1 : risk of 30-day ↓ mortality (OR 0.532; 95% CI 0.383–0.738; p < 0.001) for the cephalomedullary nail cohort.
Pfeuffer	Weight-bearing restrictions reduce postoperative mobility in elderly hip fracture patients	Arch Orthop Trauma Surg	2019	Prospective cohort study	Inclusion criteria were asked to participate: age > 75 years with pertrochanteric fractures, treated with intramedullary nailing	Total: 41 Partial weight bearing: 19 Full weight bearing: 22	PWB (<20 kg)	FWB	1. Gait analysis using an insole force sensor 2. Parker Mobility Score 3. Gait speed	POD 5 days	1. Parker Mobility Score: significantly reduced (3.21 vs. 4.73, p < 0.001) 2. a significantly lower gait speed in the PWB group of 0.16 m/s vs. 0.28 m/s was seen (p = 0.003).
Ottesen	Increased complications in geriatric patients with a fracture of the hip whose postoperative weight-bearing is restricted: an analysis of 4918 patients	Bone Joint J	2018	National database survey	Patient aged > 60 years undergoing surgery for a hip fracture	Total: 4,918 WBAT: 3,668 (74.58%) non-WBAT: 1,250 (25.42%)	Weight-bearing as tolerated (WBAT) on postoperative day one (POD1)	Restricted weight-bearing	(1) 30-day mortality (2) 30-day postoperative major and minor complications (3) length of stay (LOS) (4) discharge disposition after hip fracture management	30 days	Odds of any adverse event, major adverse event, delirium, infection, transfusion, length of stay ≥ 75th percentile (six days) and mortality within 30 days were all higher in patients with weight-bearing restrictions

1 st author	Title	Journal	Year	Design	Inclusion	Sample size	Intervention	Comparison	Outcomes	Duration	Results
Kuru	Effects of early mobilization and weight bearing on postoperative walking ability and pain in geriatric patients operated due to hip fracture: a retrospective analysis	Turk J Med Sci	2019	Retrospective study	Aged over 65 years Intertrochanteric and femoral neck fractures Partial prosthesis surgery	Total: 52 1. Weight bearing, degree Partial: 10 (19.2%) Full: 42 (80.8%) 2. Weight bearing, timing Early (≤24h): 23 (44.2%) Late (>24h): 29 (55.8%)	Early, full weight bearing	Late, partial weight bearing	30-day Walking ability 30-day Harris hip score (higher scores mean better function.) (3) length of stay	1 month	The mean and median Harris scores were higher in the group with full weight bearing.
Baer	Influence of mobilization and weight bearing on in-hospital outcome in geriatric patients with hip fractures	Sicot j	2019	Retrospective study	Patients aged 70 years or older who were treated with surgery after a hip fracture treated with intramedullary nail, total or partial hip prosthesis	Total: 219 Full weight bearing: 153 Partial weight bearing: 66	Full weight bearing	Parital weight bearing	Mortality Complications Length of stay Merle d'Aubigné score which evaluates pain, mobility of the hip, and ability to walk	at discharge	Mortality: 8(5.2%) vs. 8(12.12%) Complication: 58(37.9%) vs. 29(43.9%) Length of stay: 9.4 vs. 10.3 in Weight bearing: full vs. partial

1 st author	Title	Journal	Year	Design	Inclusion	Sample size	Intervention	Comparison	Outcomes	Duration	Results
Ariza-Vega	Non-weight-bearing status compromises the functional level up to 1 yr after hip fracture surgery	Am J Phys Med Rehabil	2014	Prospective cohort study	(1) 65 yrs or older (2) Type of fracture was classified as cervical or trochanteric and trochanteric	Total: 194 Full WB: 119 NBW: 75	Full WB (practiced as WBAT) 48 hrs after surgery	Not allowed any WB for the first 2Y4 wks after surgery	Functional Independence Measure (18-126 points)	1 year	Non-WB status, age, health status, and cognitive impairment of the patient were associated negatively with the 1-yr functional outcome (P ≤ 0.03). Pre-fracture functional level and non-WB status were the strongest determinant of functional level (A: 0.599 and -0.204, respectively; P < 0.001)
Siebens	Outcomes and weight-bearing status during rehabilitation after arthroplasty for hip fractures	PM R	2012	Prospective cohort study	18 sites multi-center Hip fractures treated with hip arthroplasty	Total: 224 WBAT or full WB: 179 RWB (restricted WB): 45 (27 partial WB, 13 toe touch, 5 non-WB)	WBAT or full WB	restricted weight-bearing	1. Comprehensive Severity Index (CSI) score (lower, better) 2. Living location at discharge and follow-up	at discharge 8 month follow up	Less osteoarthritis and lower admission CSI, that is, lower medical severity, were associated with WBAT (P .021 and P .014, respectively).
Wu	Restricted weight bearing after hip fracture surgery in the elderly: economic costs and health outcomes	Journal of evaluation in clinical practice	2009	Retrospective study	Of the 343 patients audited, 331 (96.4%) of all minimal trauma hip fractures occurred in those aged 65 years and over. It is this group that was selected for analysis.	Total: 331 WBAT: 255 (77%) RWB: 76 (23%)	WBAT	RWB	1. LOS 2. Cognitive impairment 3. Independent mobility on discharge 4. Return to pre-fracture living status 5. Re operation	at discharge	Shorter LOS in WBAT (26 days) than RWB (32 days) (P=0.04)

1 st author	Title	Journal	Year	Design	Inclusion	Sample size	Intervention	Comparison	Outcomes	Duration	Results
Sherrington	A randomized controlled trial of weight-bearing versus non-weight-bearing exercise for improving physical ability after usual care for hip fracture	Arch Phys Med Rehabil	2004	Randomized controlled trial	Older people who had completed usual care after a fall-related hip fracture (medium to long-term rehabilitation)	Total: 120 Weight-bearing exercise: 40 Non-weight-bearing exercise: 40 Control: 40	1. WBE: sit-to-stand, lateral step-up, forward step-up-and-over, forward foot taps, stepping grid (5 階)	2. NWBE: (supine position exercise) hip abduction, hip flexion, hip and knee flexion and extension, end of range knee extension, ankle Df and PF (5 階) 3. Control: no exercise	1. Strength: spring gauge, hand-held dynamometer 2. Balance: functional task 3. Gait: 6 meter gait 4. Functional performance: Physical Performance and Mobility Examination 5. Self-report: ADL	4 months	The weight-bearing exercise group showed the greatest improvements in measures of balance and functional performance (between-group differences of 30%-40% of initial values)
Raivio	Rehabilitation outcome in hip-fracture: Impact of weight-bearing restriction - A preliminary investigation	Physical and Occupational Therapy in Geriatrics	2004	Retrospective study	Hip fracture	Total: 98 Mobility restriction: 37 No restriction: 61	Mobility restriction	No restriction	1. Independent walking ability with or without aids in the rehabilitation ward within six weeks	6 weeks	Whereas 84% of patients whose surgery required no restrictions learned to walk independently with or without aids inside the rehabilitation ward within 6 weeks, the comparable figure was only 41% in the group with restrictions (P < 0.001).
Adunsky	Rehabilitation outcomes in patients with full weight-bearing hip fractures	Arch Gerontol Geriatr	2001	Retrospective study	Patients who are able to fully weight bearing following surgical repair of femoral neck fracture	217	Rehabilitation		FIM		in absolute total and daily FIM gains (19.32 and 0.8 respectively).

Level of evidence

Study design	No. of studies	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Level of evidence	Importance
RCT	1	-1	0	0	0	0	Moderate	6
Non-RCT	10	-1	-1	-1	0	0	Very low	3

RCT, randomized controlled trial.

Grade of recommendation

	YES	NO
Confidence in the estimates		o
Balancing benefits and harms	o	
Resource use	o	
Values and preference	o	
Acceptability/feasibility	o	
Recommendation		Yes
Grade		Weak

KQ5. After hip fracture surgery, is rehabilitation treatment, including balance exercise, more effective than usual exercise?

Included articles

Authors	Study No.	Description
Wu et al. (2019)	SR1	Wu JQ, Mao LB, Wu J. Efficacy of balance training for hip fracture patients: a meta-analysis of randomized controlled trials. J Orthop Surg Res 2019;14:83.
Lee et al. (2018)	SR2	Lee SY, Jung SH, Lee SU, Ha YC, Lim JY. Effect of balance training after hip fracture surgery: a systematic review and meta-analysis of randomized controlled studies. J Gerontol A Biol Sci Med Sci 2019;74:1679-85.

SR, systemic review.

Methodological quality of the included SRs

Ref No	Quality item															
	1	2 ^{a)}	3	4 ^{a)}	5	6	7 ^{a)}	8	9 ^{a)}	10	11 ^{a)}	12	13 ^{a)}	14	15 ^{a)}	16
SR1	Y	PY	Y	Y	Y	Y	PY	Y	Y	Y	Y	Y	PY	Y	Y	Y
SR2	Y	PY	Y	Y	Y	Y	PY	Y	Y	Y	Y	Y	PY	Y	Y	Y

SR, systemic review.

^{a)}Critical domain using AMSTAR 2.0.

Literature summary

1 st author	Title	Journal	Year	Design	Inclusion	Sample size	Intervention	Comparison	Outcomes	Duration	Results
Lee	Effect of Balance Training After Hip Fracture Surgery: A Systematic Review and Meta-analysis of Randomized Controlled Studies	J Gerontol A Biol Sci Med Sci	2018	MA	(i) an RCT and (ii) evaluation of the utility of BT after HFS. BT	8 studies, n=752	balance exercise OR balance training OR balance OR standing on one leg OR balance equipment OR tai chi OR stepping OR fall prevention exercise OR foot taps OR step up	Usual care	1. Primary outcome: balance function, assessed in any manner 2. Secondary outcome: (i) gait (ii) lower limb strength (iii) the activities of daily (iv) performance tasks (v) health-related quality of life	1 month ~ 12 months	1. Physical function: SMD= 0.390; 95% CI, 0.114-0.667; p = .006 2. Secondary outcomes 1) gait (SMD = 0.195; 95% CI = 0.043-0.347; p = .012) 2) lower limb strength (SMD = 0.276; 95% CI = 0.122-0.429; p < .001), 3) ADLs (SMD = 0.484; 95% CI = 0.043-0.926; p = .032), 4) performance task scores (SMD = 0.660; 95% CI = 0.127-1.193; p = .015) 5) HRQoL scores (SMD = 0.602; 95% CI = 0.023-1.181; p = .042)
Wu	Efficacy of balance training for hip fracture patients: a meta-analysis of randomized controlled trials	J Orthop Surg Res	2019	MA	RCTs or prospective clinical controlled studies comparing the balance training with control in the management of hip fracture	9 studies, n=872	(((((Training, Circuit) OR Circuit Training) OR Exercises, Circuit-Based) OR Exercise, Circuit-Based) OR balance training	placebo	overall function gait speed lower limb strength ADL performance task scores HRQoL;	1 month ~ 12 months	1) Overall function (SMD = 0.59, 95% CI [0.25, 0.93], P = 0.001), 2) gait speed (SMD = 0.63, 95% CI [0.19, 1.07], P = 0.005) 3) lower limb strength (SMD = 0.73, 95% CI [0.50, 0.95], P = 0.000), 4) activities of daily living (ADLs) (SMD = 0.97, 95% CI [0.61, 1.34], P = 0.000), 5) performance task scores (SMD = 0.41, 95% CI [0.21, 0.61], P = 0.000) 6) health-related quality of life (HRQoL) scores (SMD = 0.32, 95% CI [0.16, 0.47], P = 0.000)

MA: meta-analysis

Level of evidence

No.	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Level of evidence
SR1	0	-1	0	0	-1	Moderate
SR2	0	-1	0	0	-1	Moderate

SR, systemic review.

Grade of recommendation

	YES	NO
Confidence in the estimates	o	
Balancing benefits and harms	o	
Resource use		o
Values and preference	o	
Acceptability/feasibility	o	
Recommendation	Yes	
Grade	Strong	

KQ6. Should activities of daily living training be included in rehabilitation treatment after hip fracture surgery?

Included articles

Authors	Study No.	Description
Lee et al. (2019)	SR	Lee SY, Jung SH, Lee SU, Ha YC, Lim JY. Is occupational therapy after hip fracture surgery effective in improving function? A systematic review and meta-analysis of randomized controlled studies. <i>Am J Phys Med Rehabil</i> 2019;98:292-8.
Uruma et al. (2019)	OS	Uruma M, Momosaki R, Chono M, Fukumoto M, Watanabe T, Nakamura M, et al. Effectiveness of acute in-hospital occupational therapy for older patients with hip fracture. <i>Geriatr Gerontol Int</i> 2019;19:611-5.

SR, systemic review; OS, observational study.

Methodological quality of the included SR

Ref No	Quality item															
	1	2 ^{a)}	3	4 ^{a)}	5	6	7 ^{a)}	8	9 ^{a)}	10	11 ^{a)}	12	13 ^{a)}	14	15 ^{a)}	16
SR	Y	PY	Y	Y	Y	Y	PY	Y	Y	Y	Y	Y	PY	Y	Y	Y

SR, systemic review.

^{a)}Critical domain using AMSTAR 2.0.

Risk of biases for the included article

No.	Comparability	Selection bias	Confounding variables	Exposure measurement	Blinding of assessment	Detection bias	Attrition bias	Reporting bias
OS	High	Low	Low	Low	High	Low	Low	Unclear

OS, observational study.

Literature summary

1 st author	Title	Journal	Year	Design	Inclusion	Sample size	Intervention	Comparison	Outcomes	Duration	Results
Lee	Is Occupational Therapy After Hip Fracture Surgery Effective in Improving Function?: A Systematic Review and Meta-Analysis of Randomized Controlled Studies	Am J Phys Med Rehabil	2019	MA	(1) an RCT and (2) evaluation of the utility of only OT after HFS	5 studies, n=524	occupational therapy OR occupational training OR activity of daily living OR activities of daily living OR ADL training OR skilled treatment OR independent living	Comprehensive postoperative care (without occupational therapy)	1. Primary outcome: performance of ADL assessed in any manner 2. Secondary outcome: (1) physical function (Harris hip score and mobility measures) (2) health perception and emotion (3) fall occurrence	2 months ~ 6 months	1. ADL function: not statistically significant (pooled SMD= 0.761, 95% CI = -0.306 to 1.829, P = 0.162) 2. Secondary outcomes (1) physical function (3) fall occurrence not significant. However, health perception and emotion improved significantly (SMD = 0.391, 95% CI = 0.104 to 0.678, P = 0.008) in the OT group
Uruma	Effectiveness of acute in-hospital occupational therapy for older patients with hip fracture	Geriatr Gerontol Int	2019	Retrospective observational study	patients with hip fracture admitted to acute hospitals within 1 day after injury	Total: 1,266 from 21 acute hospitals Patients who received OT (OT group): 644 (50.9%) Patients who did not receive OT (non-OT group): 622	OT + PT	PT	Primary outcome: motor FIM efficiency Secondary outcome: motor FIM effectiveness	at discharge	OT + PT group: significantly higher scores in motor FIM efficiency (mean 0.79 vs 0.70; P = 0.02) and FIM effectiveness (mean 0.49 vs 0.41; P < 0.01) than non-OT. From multivariate linear regression analysis, OT was identified as a significant factor in motor FIM efficiency (coefficient 1.29, 95% confidence interval 1.14-1.47; P < 0.01) and FIM effectiveness (coefficient 1.07, 95% confidence interval 1.02-1.12; P < 0.01).

MA: meta-analysis
RCT: randomized controlled trial

Level of evidence

No.	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Level of evidence
SR1	0	-1	0	0	0	Moderate

SR, systemic review.

Study design	No. of studies	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Level of evidence	Importance
Non-RCT	1	-1	0	0	-1	0	Very low	3

RCT, randomized controlled trial.

Grade of recommendation		
	YES	NO
Confidence in the estimates		o
Balancing benefits and harms	o	
Resource use		o
Values and preference	o	
Acceptability/feasibility	o	
Recommendation		Yes
Grade		Weak

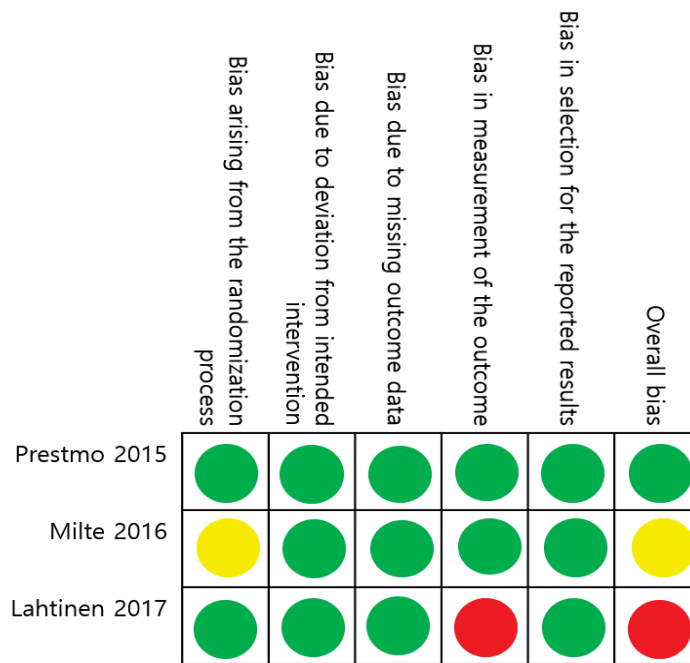
KQ7. Is multidisciplinary rehabilitation treatment after hip fracture surgery cost-effective?

Included articles

Authors	Study No.	Description
Lahtinen et al. (2017)	RCT1	Lahtinen A, Leppilahti J, Vahanikkila H, Harmainen S, Koistinen P, Rissanen P, et al. Costs after hip fracture in independently living patients: a randomised comparison of three rehabilitation modalities. Clin Rehabil 2017;31:672-85.
Milte et al. (2016)	RCT2	Milte R, Miller MD, Crotty M, Mackintosh S, Thomas S, Cameron ID, et al. Cost-effectiveness of individualized nutrition and exercise therapy for rehabilitation following hip fracture. J Rehabil Med 2016;48:378-85.
Prestmo et al. (2015)	RCT3	Prestmo A, Hagen G, Sletvold O, Helbostad JL, Thingstad P, Taraldsen K, et al. Comprehensive geriatric care for patients with hip fractures: a prospective, randomised, controlled trial. Lancet 2015;385:1623-33.

RCT, randomized controlled trial.

Risk of biases for the included articles (using ROB 2.0)



Literature summary

1st author	Title	Journal	Design	Year	Sample size	Intervention	Comparison	Outcomes	Duration	Results
Prestmo A	Comprehensive geriatric care for patients with hip fractures a prospective, randomised, controlled trial	Lancet	RCT	2015	198 vs. 199	Comprehensive geriatric care	Orthopaedic care	cost-effectiveness	12 months	Comprehensive geriatric care: 99% probability of being cost-effective compared with orthopaedic care, with the assumption of a threshold of € 62,500 per QALY
Milte R	Cost-effectiveness of individualized nutrition and exercise therapy for rehabilitation following hip fracture	J Rehabil Med	RCT	2016	86 vs. 89	alternate weekly visits from a physical therapist and dietitian	social visits	incremental cost-effectiveness ratio (ICER)	6 months	Mean ICER: \$AUD 28,350 per QALY, A probability that the ICER falls under the threshold: approximately 50%
Lahtinen A	Costs after hip fracture in independently living patients: a randomised comparison of three rehabilitation modalities	Clin Rehabil	RCT	2017	187, 171, 180	Physical rehabilitation (neurologist, physiatrist, PT, OT for as long as 3 weeks)	geriatric rehabilitation (geriatrician, PT), healthcare centre hospital (control)	Total hip fracture treatment costs, 15D-instrument of health-related QoL	12 months	Total hip fracture treatment costs: lower with physical (36,356€, 51,018€) than control rehabilitation (38,018€, 57,031€) at 50% and 100% of salary. --> physical rehabilitation: significantly more cost-effective than routine treatment

RCT: randomized controlled trial

Level of evidence

Study design	No. of studies	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Level of evidence	Importance
RCT	3	-1	0	-1	0	0	Low	6

RCT, randomized controlled trial.

KQ8. Is home-based hip fracture rehabilitation effective during the recovery period after hip fracture surgery?

Included articles

Authors	Study No.	Description
Donohue et al. (2013)	SR1	Donohue K, Hoevenaars R, McEachern J, Zeman E, Mehta S. Home-based multidisciplinary rehabilitation following hip fracture surgery: what is the evidence? <i>Rehabil Res Pract</i> 2013;2013:875968.
Mehta and Roy (2011)	SR2	Mehta SP, Roy JS. Systematic review of home physiotherapy after hip fracture surgery. <i>J Rehabil Med</i> 2011;43:477-80.
Turunen et al. (2017)	RCT1	Turunen K, Salpakoski A, Edgren J, Tormakangas T, Arkela M, Kallinen M, et al. Physical activity after a hip fracture: effect of a multicomponent home-based rehabilitation program: a secondary analysis of a randomized controlled trial. <i>Arch Phys Med Rehabil</i> 2017;98:981-8.
Tseng et al. (2016)	RCT2	Tseng MY, Liang J, Shyu YI, Wu CC, Cheng HS, Chen CY, et al. Effects of interventions on trajectories of health-related quality of life among older patients with hip fracture: a prospective randomized controlled trial. <i>BMC Musculoskelet Disord</i> 2016;17:114.
Milte et al. (2016)	RCT3	Milte R, Miller MD, Crotty M, Mackintosh S, Thomas S, Cameron ID, et al. Cost-effectiveness of individualized nutrition and exercise therapy for rehabilitation following hip fracture. <i>J Rehabil Med</i> 2016;48:378-85.
Karlsson et al. (2016)	RCT4	Karlsson A, Berggren M, Gustafson Y, Olofsson B, Lindelof N, Stenvall M. Effects of geriatric interdisciplinary home rehabilitation on walking ability and length of hospital stay after hip fracture: a randomized controlled trial. <i>J Am Med Dir Assoc</i> 2016;17:464.e9-464.e15.
Salpakoski et al. (2014)	RCT5	Salpakoski A, Tormakangas T, Edgren J, Kallinen M, Sihvonen SE, Pesola M, et al. Effects of a multicomponent home-based physical rehabilitation program on mobility recovery after hip fracture: a randomized controlled trial. <i>J Am Med Dir Assoc</i> 2014;15:361-8.
Orwig et al. (2011)	RCT6	Orwig DL, Hochberg M, Yu-Yahiro J, Resnick B, Hawkes WG, Shardell M, et al. Delivery and outcomes of a yearlong home exercise program after hip fracture: a randomized controlled trial. <i>Arch Intern Med</i> 2011;171:323-31.
Tinetti et al. (1999)	RCT7	Tinetti ME, Baker DI, Gottschalk M, Williams CS, Pollack D, Garrett P, et al. Home-based multicomponent rehabilitation program for older persons after hip fracture: a randomized trial. <i>Arch Phys Med Rehabil</i> 1999;80:916-22.

RCT, randomized controlled trial; SR, systemic review.

Methodological quality of the included SRs

Ref No	Quality item															
	1	2 ^{a)}	3	4 ^{a)}	5	6	7 ^{a)}	8	9 ^{a)}	10	11 ^{a)}	12	13 ^{a)}	14	15 ^{a)}	16
SR1	Y	PY	Y	N	Y	Y	Y	Y	Y	N	N	N	Y	Y	N	Y
SR2	Y	PY	Y	N	Y	Y	Y	PY	Y	N	N	N	Y	Y	N	Y

SR, systemic review.

^{a)}Critical domain using AMSTAR 2.0.

Risk of biases for the included articles (using ROB 2.0)

	Bias arising from the randomization process	Bias due to deviation from intended intervention	Bias due to missing outcome data	Bias in measurement of the outcome	Bias in selection for the reported results	Overall bias
Turunen K 2017	Yellow	Yellow	Green	Yellow	Green	Yellow
Milte R 2016	Yellow	Yellow	Yellow	Green	Green	Yellow
Tseng MY 2016	Yellow	Yellow	Green	Red	Green	Red
Karlsson A 2016	Green	Green	Green	Green	Green	Green
Salpakoski A 2014	Green	Yellow	Green	Green	Green	Yellow
Orwig DL 2011	Green	Yellow	Green	Green	Green	Yellow
Tinetti ME 1999	Yellow	Yellow	Green	Yellow	Yellow	Yellow

Literature summary

1 st author	Title	Journal	Year	Design	Inclusion	Sample size	Intervention	Comparison	Outcomes	Duration	Results
Donohue	Home-Based Multidisciplinary Rehabilitation following Hip Fracture Surgery: What Is the Evidence?	Rehabil Res Pract	2013	SR		Five studies	Multidisciplinary home rehabilitation (MHR) following acute care	-Inpatient group received multidisciplinary rehabilitation in inpatient setting (1) -No treatment group (4)	-Patient reported outcome (functional status, HRQOL, balance confidence) -Performance-based outcome (physical mobility, functional status, lower limb strength, ambulation ability, balance)	-Short-term (the first four months) -Long-term (12 months)	-Over the short-term, functional status and lower extremity strength were better in the MHR group compared to the no treatment group -Over the long-term, the MHR group showed greater improvements in balance confidence, functional status, and lower extremity muscle strength compared to NT group
Mehta	Systematic Review of Home Physiotherapy after Hip Fracture SURGERY	J Rehabil Med	2011	SR		Five studies	Home physiotherapy (PT)	-Inpatient PT (1) -Outpatient PT(2) -No PT (2)	-Patient-reported health-related quality of life (HRQOL) -Performance-based outcomes	3 and 6 months after surgery	-Home physiotherapy was better than no physiotherapy and similar to outpatient physiotherapy in improving patient-reported HRQOL -Performance-based outcomes were marginally better following outpatient physiotherapy compared with home physiotherapy 3 and 6 months after surgery
Turunen	Physical Activity After a Hip Fracture: Effect of a Multicomponent Home-Based Rehabilitation Programme: A Secondary Analysis of a Randomized Controlled Trial	Arch Phys Med Rehabil	2017	RCT		-Total: 81 -Intervention: 40 -Control: 41	-A yearlong multicomponent home-based rehabilitation -Modification of environmental hazards, guidance for safe walking, progressive home exercise program(5-6 home visits), counselling	Standard care (written information on home exercises)	The level of physical activity (PA) with the questionnaire (a modified Grimby scale)	Baseline, and 3, 6, 12, and 24 months after baseline	-The 12-month individualized multicomponent rehabilitation program increased PA among older patients with hip fracture -The increase was found to be maintained at the 1-year follow-up

SR: systematic review, RCT: randomized controlled trial

1 st author	Title	Journal	Year	Design	Inclusion	Sample size	Intervention	Comparison	Outcomes	Duration	Results
Milte	Cost-effectiveness of individualized nutrition and exercise therapy for rehabilitation following hip fracture	J Rehabil Med	2016	RCT		-Total: 175 -Intervention: 86 -Control: 89	-A multidisciplinary nutrition and exercise programme for 6 months -Alternate weekly visits from a physical therapist and dietitian	Attention control (social visits for 6 months)	Costs for utilization of hospitals, health and community services	6 months	-There were minimal differences in mean healthcare costs between the intervention and the control group -A comprehensive 6-month programme of therapy from dietitians and physical therapists could be provided at a relatively low additional cost in the intervention group
Tseng	Effects of interventions on trajectories of health-related quality of life among older patients with hip fracture: a prospective	BMC Musculoskeletal Disord	2016	RCT		-Total: 281 -Interdisciplinary care: 97 -Comprehensive care: 91 -Usual care: 93	-Interdisciplinary care (geriatric assessment, supported discharge planning, 4 months of home rehabilitation) -Comprehensive care (interdisciplinary care plus management of nutrition and	-Usual care (only in-hospital rehabilitation, occasional discharge planning)	Physical component summary scale (PCS) and Mental component summary scale (MCS) of the Medical Outcomes Study Short Form 36	1, 3, 6, and 12 months after discharge	The interdisciplinary and comprehensive care models improved recovery from hip fracture by increasing subjects' odds for following a trajectory of good physical functioning after

	randomized controlled trial										depression, fall prevention, 12 months of home rehabilitation)			hospitalization
Karlsson	Effects of Geriatric Interdisciplinary Home Rehabilitation on Walking Ability and Length of Hospital Stay After Hip Fracture: A Randomized Controlled Trial	J Am Med Dir Assoc	2016	RCT		-Total: 205 -Intervention: 107 -Control: 98 -Including patients with cognitive impairment and living in residential care facilities	-Geriatric interdisciplinary home rehabilitation (GIHR) -Comprehensive geriatric assessment, management of postoperative complications, early discharge, 10 weeks of home rehabilitation (OT, PT, nurse visits & social worker, dietician when necessary)	-Usual care (only in-hospital rehabilitation-comprehensive geriatric assessment, management of postoperative complications)	-Walking ability and the use of walking device -Gait speed -Length of the hospital stay (LOS)	3, 12 months after discharge	The GIHR group regained walking ability similar to the usual care group The GIHR group had a significantly shorter postoperative LOS in the hospital			

SR: systematic review, RCT: randomized controlled trial

1 st author	Title	Journal	Year	Design	Inclusion	Sample size	Intervention	Comparison	Outcomes	Duration	Results
Salpakoski	Effects of a Multicomponent Home-Based Physical Rehabilitation Program on Mobility Recovery After Hip Fracture: A Randomized Controlled Trial	J Am Med Dir Assoc	2014	RCT		-Total: 81 -Intervention: 40 -Control: 41	-A yearlong multicomponent home-based rehabilitation -Modification of environmental hazards, guidance for safe walking, progressive home exercise program(5-6 home visits), counselling	Standard care (written information on home exercises)	-Main outcome: perceived ability to negotiate stairs -Leg extension power deficit (LEP), -Berg Balance Scale -Short Physical Performance Battery	Baseline, and 3, 6, 12 months after baseline	The individualized home-based rehabilitation program improved mobility recovery after hip fracture over standard care
Orwig	Delivery and Outcomes of a Yearlong Home Exercise Program After Hip Fracture: A Randomized Controlled Trial	Arch Intern Med	2011	RCT		-Total: 180 -Intervention: 91 -Control: 89	-A yearlong home exercise program -Exercise component and a self-efficacy based motivational component -Exercise program by exercise trainer	Usual care	-Main outcome: bone mineral density -Time spent and kilocalories expended in physical activity using the Yale Physical Activity Scale, muscle mass and strength, fat mass, activities of daily living, and physical and psychosocial functioning	2, 6, and 12 months after fracture	The intervention group reported more time spent in exercise activity during follow-up, however, no significant changes in other targeted outcomes were detected.
Tinetti	Home-Based Multicomponent Rehabilitation Program for Older Persons After Hip Fracture: A Randomized Trial	Arch Phys Med Rehabil	1999	RCT		-Total: 304 -Intervention: 148 -Control: 156	-Home based multicomponent rehabilitation program for 6 months -Physical therapy and functional therapy by study PT + ADL training by OT -Provided through one of 27 Medicare-certified home care agencies -All other home care services, including home care nursing and home health aides, were provided by the home care agencies without regard to treatment group.	-Usual care -Physical therapy through staff employed by home care agencies	A battery of self-report and performance-based measures of physical and social function	3 months (by telephone) and 6 months (during the home interview)	-Compared with participants who received usual care, those in the multicomponent rehabilitation program showed slightly greater upper extremity strength at 6 months (p = .04) and a marginally better gait performance (p = .08) - Compared with previous cohorts, participants randomized to usual care received more rehabilitative and home care services and experienced a higher rate of recovery.

SR: systematic review, RCT: randomized controlled trial

Level of evidence

No.	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Level of evidence
SR1	-1	0	-1	-1	0	Very low
SR2	-1	0	-1	-1	0	Very low

Study design	No. of studies	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Level of evidence	Importance
RCT	7	-1	0	0	-1	0	Low	6

Grade of recommendation

	YES	NO
Confidence in the estimates		o
Balancing benefits and harms	o	
Resource use		o
Values and preference	o	
Acceptability/feasibility	o	
Recommendation	Yes	
Grade	Weak	

KQ9. Is home-based hip fracture rehabilitation effective during the maintenance period after hip fracture surgery?

Included articles

Authors	Study No.	Description
Latham et al. (2014)	RCT1	Latham NK, Harris BA, Bean JF, Heeren T, Goodyear C, Zawacki S, et al. Effect of a home-based exercise program on functional recovery following rehabilitation after hip fracture: a randomized clinical trial. JAMA 2014;311:700-8.
Mangione et al. (2010)	RCT2	Mangione KK, Craik RL, Palombaro KM, Tomlinson SS, Hofmann MT. Home-based leg-strengthening exercise improves function 1 year after hip fracture: a randomized controlled study. J Am Geriatr Soc 2010;58:1911-7.
Sherrington et al. (2004)	RCT3	Sherrington C, Lord SR, Herbert RD. A randomized controlled trial of weight-bearing versus non-weight-bearing exercise for improving physical ability after usual care for hip fracture. Arch Phys Med Rehabil 2004;85:710-6.
Sherrington and Lord (1997)	RCT4	Sherrington C, Lord SR. Home exercise to improve strength and walking velocity after hip fracture: a randomized controlled trial. Arch Phys Med Rehabil 1997;78:208-12.

RCT, randomized controlled trial.

Risk of biases for the included articles (using ROB 2.0)

	Bias arising from the randomization process	Bias due to deviation from intended intervention	Bias due to missing outcome data	Bias in measurement of the outcome	Bias in selection for the reported results	Overall bias
Latham NK 2014	●	●	●	●	●	●
Mangione KK 2010	●	●	●	●	●	●
Sherrington C 2004	●	●	●	●	●	●
Sherrington C 1997	●	●	●	●	●	●

Literature summary

1 st author	Title	Journal	Year	Design	Inclusion	Sample size	Intervention	Comparison	Outcomes	Duration	Results
Latham	Effect of a Home-Based Exercise Program on Functional Recovery Following Rehabilitation After Hip Fracture A Randomized Clinical Trial	JAMA	2014	RCT		-Total: 232 -Intervention: 120 -Control: 112	-Home exercise program with minimal contact with a PT -Functionally oriented exercises (such as standing from a chair, climbing a step) -Max 4 visits & 3 session/wk for 6months	-Attention control group -In-home and telephone-based cardiovascular nutrition education	-Primary outcome: Short Physical Performance battery (SPPB), Activity Measure for Post-acute Care(AM-PAC) -Other outcomes: lower extremity strength, balance, self-efficacy, adverse events, exercise adherence	Baseline, post-intervention (6 months), and follow-up (9 months)	Among patients who had completed standard rehabilitation after hip fracture, the use of a home-based functionally oriented exercise program resulted in modest improvement in physical function at 6 months
Mangione	Home-Based Leg Strengthening Exercise Improves Function One Year After Hip Fracture: A Randomized Controlled Study	J Am Geriatr Soc	2010	RCT		-Total: 26 -Intervention: 14 -Control: 12	-Home based leg strengthening exercise program -Lower extremity PRE (hip Ex, knee Ex, hip Ab, ankle PF, BRM & 3 sets)by PT twice a week for 10 weeks	-Attention control group -TENS & mental imagery	-Isometric force production of lower extremity muscles -Usual and fast gait speed -6MWT -Modified physical performance test (mPPT) -SF-36	Baseline, post intervention, 1year post fracture	A 10 week program of twice weekly progressive resistance training for the leg muscles beginning six months after hip fracture was effective in improving force production, gait speed and endurance, and physical performance one year after hip fracture.
Sherrington	A Randomized Controlled Trial of Weight-Bearing Versus Non-Weight-Bearing Exercise for Improving Physical Ability After Usual Care for Hip Fracture	Arch Phys Med Rehabil	2004	RCT		-Total: 120 -WBE: 40 -NWBE: 40 -Control: 40	-Home exercise by PT for 4 months (2 visits) -WBE: sit to stand, step up, foot taps, stepping grid -NWBE: hip Ab, hip Fl, knee Fl, Knee Ex, ankle DF/PF in supine position	Usual care (No intervention)	-Strength of knee Ext -Balance -Gait -Functional performance(physical performance mobility examination, PPME)	-Before the intervention, and 1 month and 4 months after the initial assessment	A weight-bearing home exercise program can improve balance and functional ability to a greater extent than a non-weight-bearing program or no intervention.
Sherrington	Home Exercise to Improve Strength and Walking Velocity After Hip Fracture: A Randomized Controlled Trial	Arch Phys Med Rehabil	1997	RCT		Total: 42 -Intervention: 21 -Control: 21	-Home exercise by PT or 1month (2 visits) -weight bearing exercise using telephone books (increase the number of repetition and height of the book as necessary)	Usual care (No intervention)	-Quadriceps strength -Postural sway, functional reach -Gait speed & 6MWT -Self-rated fall risk	-Before the intervention, and 1 month after the intervention	This exercise program improved strength and mobility following hip fracture.

RCT: randomized controlled trial, WBE: weight bearing exercise, NWBE: non-weight bearing exercise, PRE: progressive resistive exercise, Ex: extensor, PF: plantarflexor, ab: abductor, Fl: flexor, DF: dorsiflexor, RM: repetition maximum, PT: physical therapy

Level of evidence

Study design	No. of studies	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Level of evidence	Importance
RCT	4	-1	0	0	-1	0	Low	6

RCT, randomized controlled trial.

Grade of recommendation		
	YES	NO
Confidence in the estimates		o
Balancing benefits and harms	o	
Resource use		o
Values and preference	o	
Acceptability/feasibility	o	
Recommendation		Yes
Grade		Weak

KQ10. After hip fracture surgery, can nerve block reduce postoperative pain?**Included articles**

Authors	Study No.	Description
Rowlands et al. (2018)	RCT1	Rowlands M, Walt GV, Bradley J, Mannings A, Armstrong S, Bedforth N, et al. Femoral Nerve Block Intervention in Neck of Femur Fracture (FINOF): a randomised controlled trial. <i>BMJ Open</i> 2018;8:e019650.
Morrison et al. (2016)	RCT2	Morrison RS, Dickman E, Hwang U, Akhtar S, Ferguson T, Huang J, et al. Regional nerve blocks improve pain and functional outcomes in hip fracture: a randomized controlled trial. <i>J Am Geriatr Soc</i> 2016;64:2433-9.
Bang et al. (2016)	RCT3	Bang S, Chung J, Jeong J, Bak H, Kim D. Efficacy of ultrasound-guided fascia iliaca compartment block after hip hemiarthroplasty: a prospective, randomized trial. <i>Medicine (Baltimore)</i> 2016;95:e5018.
Kang et al. (2013)	RCT4	Kang H, Ha YC, Kim JY, Woo YC, Lee JS, Jang EC. Effectiveness of multimodal pain management after bipolar hemiarthroplasty for hip fracture: a randomized, controlled study. <i>J Bone Joint Surg Am</i> 2013;95:291-6.
Mouzopoulos et al. (2009)	RCT5	Mouzopoulos G, Vasiliadis G, Lasanianos N, Nikolaras G, Morakis E, Kaminaris M. Fascia iliaca block prophylaxis for hip fracture patients at risk for delirium: a randomized placebo-controlled study. <i>J Orthop Traumatol</i> 2009;10:127-33.
Foss et al. (2007)	RCT6	Foss NB, Kristensen BB, Bundgaard M, Bak M, Heiring C, Virkelyst C, et al. Fascia iliaca compartment blockade for acute pain control in hip fracture patients: a randomized, placebo-controlled trial. <i>Anesthesiology</i> 2007;106:773-8.

RCT, randomized controlled trial.

Risk of biases for the included articles (using ROB 2.0)

	Bias arising from the randomization process	Bias due to deviation from intended intervention	Bias due to missing outcome data	Bias in measurement of the outcome	Bias in selection for the reported results	Overall bias
Rowlands 2018						
Morrison 2016						
Bang 2016						
Kang 2013						
Mouzopoulos 2009						
Foss 2007						

Literature summary

1 st author	Title	Journal	Year	Design	Sample size	Intervention	Comparison	Outcomes	Duration	Results
Rowlands	Femoral Nerve Block Intervention in Neck of Femur Fracture (FINOF): A randomised controlled trial	BMJ Open	2018	RCT	71, 70	Continuous femoral nerve block	IV morphine	Cumulative Dynamic Pain score and Cumulated Ambulation Score at day 3. Resting pain score, Side effects QOL (EuroQOL 5D score) at 3 and 30 days, Rehabilitation outcome (mobility score at discharge)	3 days, 30days	Less resting pain, but no difference in ambulation, quality of life, and dynamic pain score
Morrison	Regional Nerve Blocks Improve Pain and Functional Outcomes in Hip Fracture: a Randomized Controlled Trial	Journal of the American Geriatrics Society	2016	RCT	79, 82	Ultrasound-guided femoral nerve block & continuous fascia iliaca block	conventional analgesia	Pain score at 1-2 hours after admission, Pain score at rest, at transfer, and with walking on postoperative 3 days (POD 3), distance walked in 2 minutes on POD 3, FIM locomotion score at 6 weeks after discharge, number of missed physical therapy sessions, opioid requirement, opioid side effects.	3 days, 6 weeks	Intervention group: significant better outcomes in all pain score, walking ability at POD 3 and FIM locomotion scores at 6 weeks after discharge. Intervention group showed lesser missed physical therapy sessions, less opioid requirement, and less opioid related side effects.
Bang	Efficacy of ultrasound-guided fascia iliaca compartment block after hip hemiarthroplasty: A prospective, randomized trial	Medicine (Baltimore)	2016	RCT	11, 11	Fascia-iliac blocks + PCA	PCA only	VAS, fentanyl requirement and side effects,	4, 8, 12, 24, and 48 hours	The VAS was similar in both groups. The fentanyl requirement at 4, 8, and 12 hours was low in the FICB group. The total amount of fentanyl required in the first 24 hours was 246.3 µg in the FICB group and 351.4 µg in the Non-FICB group. Patients in the Non-FICB group had nausea (n = 2), and pruritus (n = 1), and 1 patient had nausea in the FICB group during postoperative 2 days.

RCT: randomized controlled trial, IV: intravenous, PCA: patient-controlled anesthesia, QOL: quality of life, FICB: fascia iliaca compartment block, VAS: visual analogue scale, POD: postoperative day

1 st author	Title	Journal	Year	Design	Sample size	Intervention	Comparison	Outcomes	Duration	Results
Mouzopoulos	Fascia iliaca block prophylaxis for hip fracture patients at risk for delirium: a randomized placebo-controlled study	J Orthop Traumatol	2009	RCT	102, 105	fascia iliaca compartment block with bupivacaine	fascia iliaca compartment block with saline (placebo)	Delirium; DSM-IV and Confusion Assessment Method (CAM) criteria. Delirium severity : MMSE, DRS-R-98, Digit Span test Delirium duration, and VAS	until delirium occurrence or discharge	Intervention group significantly reduced delirium incidence than control group. Intervention showed significantly lower incidence of delirium in intermediate risk group but no significant difference in high risk group in comparison with control group. Less delirium severity and duration was found in intervention group. No difference in VAS between two groups.
Foss	Fascia iliaca compartment blockade for acute pain control in hip fracture patients: a randomized, placebo-controlled trial	Anesthesiology	2007	RCT	24, 24	fascia iliaca compartment block with mepivacaine & intramuscular saline injection	intramuscular morphine injection & fascia iliaca compartment block with saline	pain at rest and movement, morphine consumption, morphine related side effects	30, 60 and 180 minutes	intervention group showed more pain relief, less morphine consumption, and less sedation.
Kang	Effectiveness of multimodal pain management after bipolar hemiarthroplasty for hip fracture: a randomized, controlled study	J Bone Joint Surg Am	2013	RCT	43, 39	Preemptive pain medication(oxycodone SR (10 mg), celecoxib (200 mg) and intraoperative periarticular injections	No preemptive medication and injections	pain level on POD 1,4,7 and at discharge, frequency of use of patient controlled analgesia and total fentanyl use at 12, 12-24, 24-36, 36-48, and 48-60 hours after surgery, patient satisfaction at discharge, delirium, wound complications, drug-related side effects, functional recovery (Walking ability at hospital discharge, time to starting walking and standing exercises)	1,4,7 POD and at discharge	Intervention group obtained lower pain level on postoperative 1 and 4 days but no difference on 7 days. The total amount of fentanyl used and the frequency of use of patient-controlled analgesia were also lower in this group. Patient satisfaction at discharge was higher in this group. No significant intergroup differences were found in Walking ability at hospital discharge, time to starting walking and standing exercises or in the complications.

RCT: randomized controlled trial, DSM: diagnostic and statistical manual of mental disorders, MMSE: mini-mental status exam, DRS: delirium rating scale, VAS: visual analogue scale, POD: postoperative day

Level of evidence

Study design	No. of studies	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Level of evidence	Importance
RCT	6	-1	-1	0	0	0	Low	6

Grade of recommendation

	YES	NO
Confidence in the estimates		o
Balancing benefits and harms	o	
Resource use	o	
Values and preference	o	
Acceptability/feasibility	o	
Recommendation		Yes
Grade		Weak

KQ11. After hip fracture surgery, is VTE prevention using compression therapy/drug treatment required?

Included articles

Authors	Study No.	Description
Bang et al. (2014)	CPG1	Bang SM, Jang MJ, Kim KH, Yhim HY, Kim YK, Nam SH, et al. Prevention of venous thromboembolism, 2nd edition: Korean Society of Thrombosis and Hemostasis Evidence-based Clinical Practice Guidelines. J Korean Med Sci 2014;29:164-71.
Falck-Ytter et al. (2012)	CPG2	Falck-Ytter Y, Francis CW, Johanson NA, Curley C, Dahl OE, Schulman S, et al. Prevention of VTE in orthopedic surgery patients: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed. American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. Chest 2012;141(2 Suppl):e278S-325S.
Balk et al. (2017)	SR	Balk E, Ellis AG, Di M, Adam GP, Trikalinos TA. Venous thromboembolism prophylaxis in major orthopedic surgery: systematic review update. Rockville, MD: Agency for Healthcare Research and Quality; 2017.
Li et al. (2017)	RCT1	Li Q, Dai B, Xu J, Yao Y, Song K, Zhang H, et al. Can patients with femoral neck fracture benefit from preoperative thromboprophylaxis? A prospective randomized controlled trial. Medicine (Baltimore) 2017;96:e7604.
Tang et al. (2017)	RCT2	Tang Y, Wang K, Shi Z, Yang P, Dang X. A RCT study of rivaroxaban, low- molecular-weight heparin, and sequential medication regimens for the prevention of venous thrombosis after internal fixation of hip fracture. Biomed Pharmacother 2017;92:982-8.

CPG, clinical practice guideline; SR, systemic review; RCT, randomized controlled trial.













Methodological quality of the included SR

Ref No	Quality item															
	1	2 ^{a)}	3	4 ^{a)}	5	6	7 ^{a)}	8	9 ^{a)}	10	11 ^{a)}	12	13 ^{a)}	14	15 ^{a)}	16
SR	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

SR, systemic review.

^{a)}Critical domain using AMSTAR 2.0.

Risk of biases for the included articles

	Bias arising from the randomization process	Bias due to deviation from intended intervention	Bias due to missing outcome data	Bias in measurement of the outcome	Bias in selection for the reported results	Overall bias
Tang Y 2017						
Li Q 2017						

Literature summary

1 st author	Title	Journal	Year	Design	Inclusion	Sample size	Intervention	Comparison	Outcomes	Duration	Results
Li	Can patients with femoral neck fracture benefit from preoperative thromboprophylaxis?: A prospective randomized controlled trial	Medicine (Baltimore)	2017	RCT	femoral neck fracture were at least 60 years	Total: 80 Rivaroxaban group: 39 Control group: 41	Oral rivaroxaban, 10mg once daily scheduled for 7 to 11 days. + Pressure pump	no rivaroxaban + Pressure pump	The primary efficacy outcomes were VTE defined as DVT detected by color Doppler ultrasound or pulmonary embolism (PE) recorded before discharge. Secondary efficacy outcomes: total, proximal, distal DVT, and symptomatic VTE.	at discharge	Compared with conservative treatment, rivaroxaban could significantly reduce the incidence of DVT from 19.5% (8/41) to 2.6% (1/39) (P=0.016).
Tang	A RCT study of Rivaroxaban, low-molecular-weight heparin, and sequential medication regimens for the prevention of venous thrombosis after internal fixation of hip fracture	Biomed Pharmacother	2017	RCT	patients with hip fractures who were admitted to the hospital within 24 h following injury, the patients who were diagnosed by X-ray and/or CT, and all patients who received internal fixation	Total: 287 1) Rivaroxaban alone (n=96), 2) Enoxaprin alone (n=95), 3) Enoxaprin+rivaroxaban (n=96)	1) Rivaroxaban alone (xarelto, 6 h following operation) for 28 days, 2) Enoxaprin alone (LMWH) (4000 IU, 12 h following the operation) for 28 days, 3) Enoxaprin (LMWH 1 week) (12 h following the surgery for 1 week) + rivaroxaban For 28 days	3 group comparison	Primary endpoint: the incidence of postoperative VTE, Secondary endpoints: Compliance and treatment costs. Adverse reactions included bleeding and wound complications.	The follow-up lasted 30 d following the surgery.	Incidences of VTE: 5.21%, 14.74%, and 10.42% in the Rivaroxaban, low-molecular-weight heparin, and sequential therapy groups, respectively (P>0.05). VTE-related mortality rates: 0%, 1.05%, and 1.04%. (P>0.05) Average hospital stay: 12±8, 15±7, and 11±5d Compliance rates of the three groups: 82.3%, 71.6%, and 88.5%, respectively. (P = 0.011) The incidences of adverse incisions: 14.6%, 4.2%, and 6.3% for the three groups examined.

RCT: randomized controlled trial, VTE: venous thromboembolism

Level of evidence

No.	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Level of evidence
SR1	0	0	0	0	0	High

SR, systemic review.

Study design	No. of studies	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Level of evidence	Importance
RCT	2	-1	0	0	-1	0	Low	8

RCT, randomized controlled trial.

Grade of recommendation

	YES	NO
Confidence in the estimates	o	
Balancing benefits and harms	o	
Resource use		o
Values and preference	o	
Acceptability/feasibility	o	
Recommendation		Yes
Grade		Weak

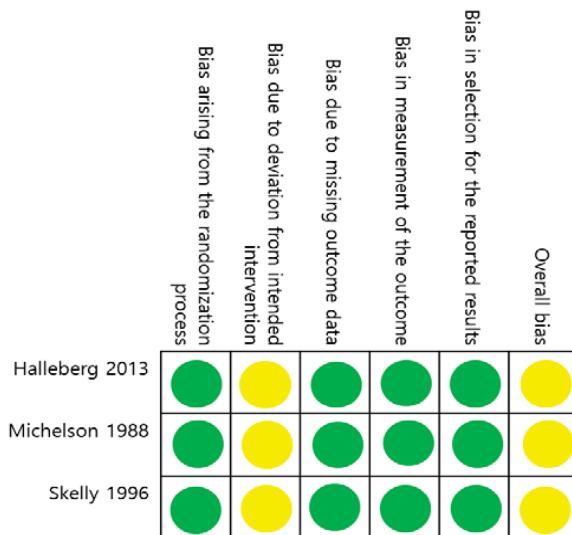
KQ12. Should the indwelling catheter be removed early after hip fracture surgery to reduce urinary tract infection?

Included articles

Authors	Study No.	Description
SIGN (2009)	CPG	Scottish Intercollegiate Guidelines Network. Management of hip fracture in older people: a national clinical guideline. Edinburgh, Scotland: Scottish Intercollegiate Guidelines Network; 2009.
Halleberg Nyman et al. (2013)	RCT1	Halleberg Nyman M, Gustafsson M, Langius-Eklof A, Johansson JE, Norlin R, Hagberg L. Intermittent versus indwelling urinary catheterisation in hip surgery patients: a randomised controlled trial with cost-effectiveness analysis. <i>Int J Nurs Stud</i> 2013;50:1589-98.
Skelly et al. (1992)	RCT2	Skelly JM, Guyatt GH, Kalbfleisch R, Singer J, Winter L. Management of urinary retention after surgical repair of hip fracture. <i>CMAJ</i> 1992;146:1185-9.
Michelson et al. (1988)	RCT3	Michelson JD, Lotke PA, Steinberg ME. Urinary-bladder management after total joint-replacement surgery. <i>N Engl J Med</i> 1988;319:321-6.

CPG, clinical practice guideline; RCT, randomized controlled trial.

Risk of biases for the included articles (using ROB 2.0)



Literature summary

1 st author	Title	Journal	Year	Design	Inclusion	Sample size	Intervention	Comparison	Outcomes	Duration	Results
Halleberg	Intermittent versus indwelling urinary catheterisation in hip surgery patients: a randomised controlled trial with cost-effectiveness analysis	International journal of nursing studies	2013	RCT	patients undergoing hip fracture surgery or hip replacement surgery	Total 170: CIC just after op: 85 Foley for POD 2 days: 85	urinated in a toilet, a bedpan or a diaper when needed. If the patient was unable to urinate and the bladder scan indicated 400 ml urine in the bladder, intermittent catheterisation was introduced	the catheter was removed in the morning on post-operative day 2.	UTI events (1st), bladder function, catheterization number, bladder scan number	4 months	Faster recovery of bladder function in IC group No difference of UTI
Michelson	Urinary-bladder management after total joint-replacement surgery	N Engl J Med	1988	RCT	96 patients undergoing 100 hip or knee replacements.	Total 96: Group 1: 41 Group 2: 55	short term use of indwelling catheter	CIC	Urinary retention UTI	POD 5 days	lower incidence of urinary retention in group 1 (27 vs. 52%, P<0.01) no difference of UTI between 2 groups (11 vs. 15%)
Skelly	Management of urinary retention after surgical repair of hip fracture	Cmaj	1992	RCT	Patients 60 years or more admitted to hospital for surgical repair of a hip fracture	Total: 67 Group 1 (indwelling catheter): 35 Group 2 (CIC): 32	Catheterization (removed 48 hours after surgery)	CIC	Pattern of return to satisfactory voiding within 5 postoperative days.	POD 5 days	Satisfactory voiding resumes earlier with the use of intermittent catheterization (group 2), if begun at the onset of urinary retention and repeated at regular intervals, than with the use of an indwelling catheter in elderly patients who have undergone surgical repair of hip fractures.

RCT: randomized controlled trial, CIC: clean intermittent catheterization, UTI: urinary tract infection, POD: postoperative day

Level of evidence

Study design	No. of studies	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Level of evidence	Importance
RCT	3	-1	-1	0	-1	0	Very low	6

RCT, randomized controlled trial.

Grade of recommendation

	YES	NO
Confidence in the estimates		o
Balancing benefits and harms	o	
Resource use	o	
Values and preference	o	
Acceptability/feasibility	o	
Recommendation		Yes
Grade		Weak

KQ13. Can bisphosphonate administration reduce refracture and mortality after hip fracture surgery?

Included articles

Authors	Study No.	Description
Lee et al. (2018)	SR1	Lee SY, Jung SH, Lee SU, Ha YC, Lim JY. Can bisphosphonates prevent recurrent fragility fractures? A systematic review and meta-analysis of randomized controlled trials. J Am Med Dir Assoc 2018;19:384-90.
Peng et al. (2016)	SR2	Peng J, Liu Y, Chen L, Peng K, Xu Z, Zhang D, et al. Bisphosphonates can prevent recurrent hip fracture and reduce the mortality in osteoporotic patient with hip fracture: a meta-analysis. Pak J Med Sci 2016;32:499-504.

SR, systemic review.

Methodological quality of the included SRs

Ref No	Quality item															
	1	2 ^{a)}	3	4 ^{a)}	5	6	7 ^{a)}	8	9 ^{a)}	10	11 ^{a)}	12	13 ^{a)}	14	15 ^{a)}	16
SR1	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y
SR2	Y	Y	Y	PY	Y	Y	N	Y	N	N	Y	Y	Y	Y	Y	N

SR, systemic review.

^{a)}Critical domain using AMSTAR 2.0.

Literature summary

1 st author	Title	Journal	Year	Design	Inclusion	Sample size	Intervention	Comparison	Outcomes	Duration	Results
Lee	Can bisphosphonates prevent recurrent fragility fracture? A systematic review and meta-analysis of randomized controlled trials	J Am Med Dir Assoc	2018	MA		12 RCT, 5670 participants	Bisphosphonates, oral or IV	All controls received placebos	subsequent fracture and mortality after FFs	Over 1 year	BPs significantly prevented secondary FFs [overall Hedges g-pooled SMD = 0.766; 95% confidence interval (CI) 0.493-1.038; P <.001]. The risks of subsequent fracture (OR = 0.499; 95% CI 0.418-0.596; P < .001) and mortality (OR = .662; 95% CI 0.511-0.858; P =.002) after FF were reduced in the BP group.
Peng	Bisphosphonates can prevent recurrent hip fracture and reduce the mortality in osteoporotic patient with hip fracture: A meta-analysis	Pak J Med Sci	2016	MA		Four studies including 3088 patients	Bisphosphonates (only oral medication)	placebo or blank control	New fracture and mortality	1-3 years	Decreased refracture and mortality

MA: meta-analysis

Level of evidence

No.	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Level of evidence
SR1	0	0	-1	0	-1	Low
SR2	-1	0	0	0	-1	Low

SR, systemic review.

Grade of recommendation

	YES	NO
Confidence in the estimates		o
Balancing benefits and harms	o	
Resource use	o	
Values and preference	o	
Acceptability/feasibility	o	
Recommendation		Yes
Grade		Weak

KQ14. After hip fracture surgery, does nutritional evaluation and planning help functional recovery?

Included articles

Authors	Study No.	Description
Malafarina et al. (2018)	SR	Malafarina V, Reginster JY, Cabrerizo S, Bruyere O, Kanis JA, Martinez JA, et al. Nutritional status and nutritional treatment are related to outcomes and mortality in older adults with hip fracture. <i>Nutrients</i> 2018;10:555.
Torbergsen et al. (2019)	RCT1	Torbergsen AC, Watne LO, Frihagen F, Wyller TB, Mowe M. Effects of nutritional intervention upon bone turnover in elderly hip fracture patients. Randomized controlled trial. <i>Clin Nutr ESPEN</i> 2019;29:52-8.
Wyers et al. (2018)	RCT2	Wyers CE, Reijnen PL, Breedveld-Peters JJ, Denissen KF, Schotanus MG, van Dongen MC, et al. Efficacy of nutritional intervention in elderly after hip fracture: a multicenter randomized controlled trial. <i>J Gerontol A Biol Sci Med Sci</i> 2018;73:1429-37.
Mahran et al. (2019)	OS	Mahran DG, Farouk O, Ismail MA, Alaa MM, Eisa A, Ragab II. Effectiveness of home based intervention program in reducing mortality of hip fracture patients: a non-randomized controlled trial. <i>Arch Gerontol Geriatr</i> 2019;81:8-17.

SR, systemic review; RCT, randomized controlled trial; OS, observational study.

Methodological quality of the included SR

Ref No	Quality item															
	1	2 ^{a)}	3	4 ^{a)}	5	6	7 ^{a)}	8	9 ^{a)}	10	11 ^{a)}	12	13 ^{a)}	14	15 ^{a)}	16
SR	Y	PY	Y	N	N	Y	N	PY	N	PY	No MA	No MA	N	N	No MA	Y

SR, systemic review.

^{a)}Critical domain using AMSTAR 2.0.

Risk of biases for the included articles (using ROB 2.0)

	Randomization process	Deviations from intended intervention	Missing outcome data	Measurement of the outcome	Selection of reported result	Overall bias
Torbergson 2019	Yellow	Yellow	Green	Green	Yellow	Yellow
Wyers 2018	Red	Green	Green	Green	Red	Red

Literature summary

1 st author	Title	Journal	Year	Design	Inclusion	Sample size	Intervention	Comparison	Outcomes	Duration	Results
Malafarina	Nutritional Status and Nutritional Treatment Are Related to Outcomes and Mortality in Older Adults with Hip Fracture	Nutrients	2018	SR		44 studies, n=26,281	To describe how both nutritional status (MNA, BMI, albumin concentration, weight loss) influences the clinical evolution and mortality in older people with hip fracture and the impact of nutritional intervention Hip fracture		Functional recovery Complications Mortality	3 years	<ul style="list-style-type: none"> - Malnutrition was associated with increased mortality. - Nutritional intervention such as ONS was cost effective and was associated with in improvement in nutritional status and functional recovery. - Multidisciplinary nutritional intervention including dieticians and nurses decreased the incidence of malnutrition after discharge and was associated with better performances in the ADL better recovery of the ability to walk.
Mahran	Effectiveness of home based intervention program in reducing mortality of hip fracture patients: A non-randomized controlled trial	Arch Gerontol Geriatr	2019	Non-RCT		Total: 124 Intervention: 64 Control: 60	Postoperative care program: Education session with an leaflet on discharge for nutrition and physical exercise program at home (improving food habits for foods with calcium and vitamin D, exposure to sunlight, factors decreasing the calcium absorption	Usual care	- WOMAC (Western Ontario And McMaster Universities Osteoarthritis Index) score - Mortality	12 month	<ul style="list-style-type: none"> - Milk daily intake: intervention group (42.2%) vs. control group (26.7%), p=0.03 - Cheese, yogurt, egg intake: no difference - Daily sun exposure: intervention group (37.5%) vs. control group (10.0%), p<0.001. - lower WOMAC score in intervention group - decreased mortality at 1 month and 1 year post surgery in intervention group

SR: systematic review, RCT: randomized controlled trial, MNA: mini-nutritional assessment, BMI: body mass index, ONS: oral nutritional supplement, ADL: activities of daily living

1 st author	Title	Journal	Year	Design	Inclusion	Sample size	Intervention	Comparison	Outcomes	Duration	Results
Torbergesen	Effects of nutritional intervention upon bone turnover in elderly hip fracture patients. Randomized controlled trial	Clinical nutrition ESPEN	2019	RCT		Total: 71 intervention group (n=31) control group (n=40)	1. Nutrition advice: individual plan made by a clinical nutritionist on how to improve food intake 2. Nutritional supplement for 4 months usage on discharge	Usual care	- Vitamin K1, 25(OH)D, vitamin B1, B6, C, E and A - Blood bone turnover markers	4 months	- Blood vitamin K1: intervention group (1.0ng/mL) vs, control group(0.6ng/mL), p=0.09 - Blood 25(OH)D: intervention group(60nmol/L) vs. control group(43 nmol/L), p=0.01 - Bone turnover markers: no difference
Wyers	Efficacy of Nutritional Intervention in Elderly After Hip Fracture: A Multicenter Randomized Controlled Trial	J Gerontol A Biol Sci Med Sci	2018	RCT		Total: 152 - intervention group (n=73) - control group (n=79)	Intensive 3 month nutritional intervention post-surgery (weekly dietetic consultation: energy and protein requirement, recommendations on choice, quantity, and timing of foods) + ONS (400mL/d; 500kcal, protein 40g)	Usual nutritional care	1. Primary: length of stay (LOS) in hospital and rehabilitation clinic 2. Secondary - nutritional and functional status - postoperative complications for 6 months post-surgery - subsequent fractures - all-cause mortality (1 and 5 years)	5 years	-Total LOS: intervention group (34.0 days) vs. control (35.5 days) P=0.8 - Hospital LOS: intervention group(12 days) vs. control(11 days) P=0.19 - Rehabilitation LOS: intervention(19.5 days) vs. control(18.5 days) P=0.82 - Improved nutritional intake/status at 3, but not at 6 months by intervention

RCT: randomized controlled trial, ONS: oral nutritional supplement, LOS: length of stay

Level of evidence

No.	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Level of evidence
SR1	0	-1	-1	0	0	Low

SR, systemic review.

Study design	No. of studies	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Level of evidence	Importance
RCT	2	-1	0	0	-1	0	Low	5
Non-RCT	1	0	0	0	-1	0	Very low	5

RCT, randomized controlled trial.

Grade of recommendation

	YES	NO
Confidence in the estimates		o
Balancing benefits and harms	o	
Resource use	o	
Values and preference	o	
Acceptability/feasibility	o	
Recommendation	Yes	
Grade	Weak	

KQ15. After hip fracture surgery, does high protein supplementation help restore function?**Included articles**

Authors	Study No.	Description
Avenell et al. (2016)	SR	Avenell A, Smith TO, Curtain JP, Mak JC, Myint PK. Nutritional supplementation for hip fracture aftercare in older people. <i>Cochrane Database Syst Rev</i> 2016;11:CD001880.
Invernizzi et al. (2019)	RCT1	Invernizzi M, de Sire A, D'Andrea F, Carrera D, Reno F, Migliaccio S, et al. Effects of essential amino acid supplementation and rehabilitation on functioning in hip fracture patients: a pilot randomized controlled trial. <i>Aging Clin Exp Res</i> 2019;31:1517-24.
Aquilani et al. (2019)	RCT2	Aquilani R, Zuccarelli Ginetto C, Rutili C, Pisano P, Pasini E, Baldissarro E, et al. Supplemented amino acids may enhance the walking recovery of elderly subjects after hip fracture surgery. <i>Aging Clin Exp Res</i> 2019;31:157-60.
Wyers et al. (2018)	RCT3	Wyers CE, Reijven PL, Breedveld-Peters JJ, Denissen KF, Schotanus MG, van Dongen MC, et al. Efficacy of nutritional intervention in elderly after hip fracture: a multicenter randomized controlled trial. <i>J Gerontol A Biol Sci Med Sci</i> 2018;73:1429-37.
Niitsu et al. (2016)	RCT4	Niitsu M, Ichinose D, Hirooka T, Mitsutomi K, Morimoto Y, Sarukawa J, et al. Effects of combination of whey protein intake and rehabilitation on muscle strength and daily movements in patients with hip fracture in the early postoperative period. <i>Clin Nutr</i> 2016;35:943-9.
Ekinci et al. (2016)	RCT5	Ekinci O, Yanik S, Terzioglu Bebitoglu B, Yilmaz Akyuz E, Dokuyucu A, Erdem S. Effect of Calcium β -Hydroxy- β -Methylbutyrate (CaHMB), vitamin D, and protein supplementation on postoperative immobilization in malnourished older adult patients with hip fracture: a randomized controlled study. <i>Nutr Clin Pract</i> 2016;31:829-35.

SR, systemic review; RCT, randomized controlled trial.

Methodological quality of the included SR

Ref No	Quality item															
	1	2 ^{a)}	3	4 ^{a)}	5	6	7 ^{a)}	8	9 ^{a)}	10	11 ^{a)}	12	13 ^{a)}	14	15 ^{a)}	16
SR	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

SR, systemic review.

^{a)}Critical domain using AMSTAR 2.0.

Risk of biases for the included articles (using ROB 2.0)

	Randomization process	Deviations from intended intervention	Missing outcome data	Measurement of the outcome	Selection of reported result	Overall bias
Invernizzi 2019	Red	Red	Green	Yellow	Yellow	Red
Aquilani 2019	Red	Green	Green	Green	Yellow	Red
Wyers 2018	Red	Yellow	Green	Green	Yellow	Red
Niitsu 2016	Red	Green	Green	Green	Yellow	Red
Ekinci 2016	Red	Green	Green	Green	Yellow	Red

Literature summary

1st author	Title	Journal	Year	Design	Inclusion	Sample size	Intervention	Comparison	Outcomes	Duration	Results
Avenell	Nutritional supplementation for hip fracture aftercare in older people	The Cochrane database of systematic reviews	2016	SR	People aged over 65 years with hip fracture	4 trials related to high protein intake involving 361 participants (total 41 trials of this SR, 3881 participants)	Protein-containing supplement vs. non-protein-containing supplement High protein-containing supplement vs. low protein-containing supplement Protein (15–20 g/day)	Protein-containing supplement vs. non-protein-containing supplement High protein-containing supplement vs. low protein-containing supplement	1) Mortality 2) Morbidity and complications: delirium, bed sore, urinary tract infection 3) Length of stay: acute hospital ward 4) Postoperative functional status: Barthel Index, Mobility Index, days from surgery to walking Level of care and extent of support required after discharge: discharge home or geriatric rehabilitation unit, use of walking aids at 6 months	3—12months	1) No clear effect of increased protein intake on mortality (30/181 versus 21/180; RR 1.42, 95% CI 0.85 to 2.37; 4 trials) or number of participants with complications 2) Very low-quality and contradictory evidence of a reduction in unfavourable outcomes (66/113 versus 82/110; RR 0.78, 95% CI 0.65 to 0.95; 2 trials).
Invernizzi	Effects of essential amino acid supplementation and rehabilitation on functioning in hip fracture patients: a pilot randomized controlled trial	Aging clinical and experimental research	2019	RCT	Patients aged more than 65 years, at 3 months after hip fracture having undergone THR.	Total: 32 Group A: 16 Group B: 16	Physical exercise + Dietetic counseling + 4g/day of essential aminoacid (Aminotrofic®)	Physical exercise + Dietetic counseling +	Hand grip strength Timed Up and Go Iowa Level of Assistance scale (ILOA)	2 month	Sarcopenic patients in group A (n = 10) : significant differences in all the primary outcomes at T1 (p < 0.017) Sarcopenic patients in group B (n = 13) : a significant reduction of ILOA only In non-sarcopenic patients : no differences at T1 in all outcome measures.

SR: systematic review, RCT: randomized controlled trial, THR: total hip replacement

1 st author	Title	Journal	Year	Design	Inclusion	Sample size	Intervention	Comparison	Outcomes	Duration	Results
Aquilani	Supplemented amino acids may enhance the walking recovery of elderly subjects after hip fracture surgery	Aging clinical and experimental research	2019	RCT	Subjects with HFS, consecutively admitted to our Rehab Institute, 20 ± 11 days after acute trauma	Total: 83 Rehab only (Rehab; n = 27), Rehab + placebo (RP; n = 28) or Rehab + EAAs (RE 8 g/day; n = 28)	Rehab + EAAs (RE 8 g/day)	Rehab only (Rehab), Rehab + placebo (RP; n = 28)	6-min walking distance (6MWD)	baseline At discharge (median 66 days)	RE: rehab + amino acid (protein) the improvement rate in RE was higher than in the other two groups (p value = 0.04; pairwise comparison: RE vs RP: p value = 0.024; RE vs Rehab: p value = 0.034 RP: rehab + placebo RP showed no significant differences with Rehab ; RP vs Rehab: p value = 0.9).
Wyers	Efficacy of Nutritional Intervention in Elderly After Hip Fracture: A Multicenter Randomized Controlled Trial	The journals of gerontology. Series A, Biological sciences and medical sciences	2018	RCT	Elderly patients admitted for surgical treatment of hip fracture	Total: 152 Intervention: 73 Control: 79	weekly dietetic consultation, energyprotein-enriched diet, and ONS (400 mL per day) (40 g protein per day) for 3 months + physical and exercise therapy daily during hospitalization and after discharge	usual nutritional care + physical and exercise therapy daily during hospitalization and after discharge	Primary outcome: length of stay (LOS) Secondary outcomes: nutritional and functional status, cognition, quality of life, postoperative complications (6 months); subsequent fractures and all-cause mortality (1 and 5 years).	5 years	No difference of LOS : median total LOS was 34.0 days in the intervention group versus control 35.5 days Hospital LOS: 12.0 days versus 11.0 days LOS in rehabilitation clinics: 19.5 days versus 18.5 days. The intervention improved nutritional intake/status at 3, but not at 6 months, and did not affect any other outcome.

RCT: randomized controlled trial

1 st author	Title	Journal	Year	Design	Inclusion	Sample size	Intervention	Comparison	Outcomes	Duration	Results
Niitsu	Effects of combination of whey protein intake and rehabilitation on muscle strength and daily movements in patients with hip fracture in the early postoperative period	Clinical nutrition (Edinburgh, Scotland)	2016	RCT	patients with hip fracture aged 60 years or older who underwent an operation and received rehabilitation after surgery in Iwata City Hospital	Total: 38 Intervention: 20 Control: 18	Whey protein (POD 1 ~ 2 weeks, 32.2 g protein) + Rehab	Rehab	Main outcome parameters: knee extension strength BI (Barthel Index) CRP rest pain and motion pain	Early postoperative period for two weeks	Protein group: 1) greater improvement in knee extension strength in the operated limb compared with the control group (P = 0.02). 2) The abilities of transfer, walking and toilet use: greater improvements by BI (P < 0.05)
Ekinci	Effect of Calcium β-Hydroxy-β-Methylbutyrate (CaHMB), Vitamin D, and Protein Supplementation on Postoperative Immobilization in Malnourished Older Adult Patients With Hip Fracture: A Randomized Controlled Study	Nutrition in clinical practice : official publication of the American Society for Parenteral and Enteral Nutrition	2016	RCT	75 older female patients with a hip fracture	Total: 75 Intervention: 38 Control: 37	Enteral product containing 3 g CaHMB, 1000 IU vitamin D, and 36 g protein, in addition to standard postoperative nutrition for 30days	Standard postoperative nutrition for 30days	Anthropometric measurements, Muscle strength, Mobilization, Wound healing, Laboratory assessments, Hospitalization	Postoperative days 15 and 30	1) Wound-healing period: significantly shorter in the CaHMB/vitamin D/protein group than in the control group (P < .05). 2) The number of patients who were mobile on days 15 and 30 : CaHMB/vitamin D/protein group (81.3%) significantly higher than control group (26.7%) (P = .001) 3) Muscle strength on day 30 significantly higher in the CaHMB/vitamin D/protein group vs the control group.

RCT: randomized controlled trial

Level of evidence

No.	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Level of evidence
SR1	0	-1	-1	-1	-1	Very low

SR, systemic review.

Study design	No. of studies	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Level of evidence	Importance
RCT	5	-1	0	-1	-1	0	Very low	8

RCT, randomized controlled trial.

Grade of recommendation

	YES	NO
Confidence in the estimates		o
Balancing benefits and harms	o	
Resource use	o	
Values and preference	o	
Acceptability/feasibility	o	
Recommendation	Yes	
Grade	Weak	

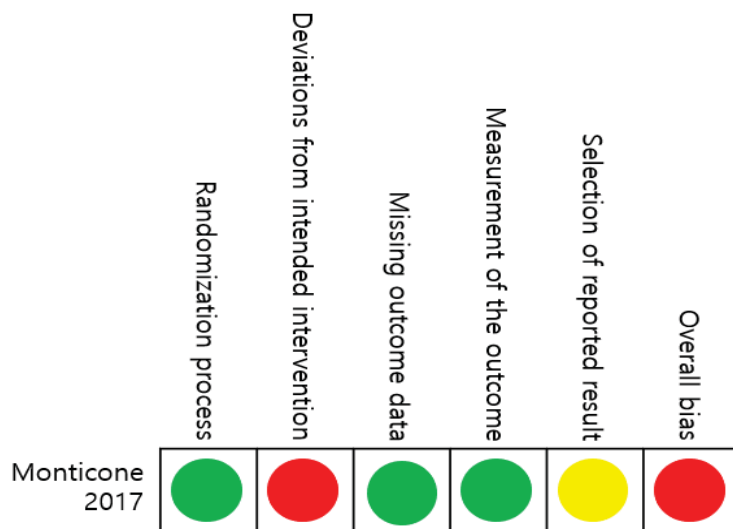
KQ (deleted after Delphi survey due to lack of agreement). After hip fracture surgery, is rehabilitation mainly focused on balance training more effective than usual or self-exercise?

Included articles

Authors	Study No.	Description
Monticone et al. (2017)	RCT	Monticone M, Ambrosini E, Brunati R, Capone A, Pagliari G, Secci C, et al. How balance task-specific training contributes to improving physical function in older subjects undergoing rehabilitation following hip fracture: a randomized controlled trial. Clin Rehabil 2018;32:340-51.

RCT, randomized controlled trial.

Risk of biases for the included articles



Literature summary

1 st author	Title	Journal	Year	Design	Inclusion	Sample size	Intervention	Comparison	Outcomes	Duration	Results
Monticone	How balance task-specific training contributes to improving physical function in older subjects undergoing rehabilitation following hip fracture: a randomized controlled trial	Clin Rehabil	2017	RCT	patients who had an internal fixation due to extra-capsular hip fractures, 7–10 days before admission to our Rehabilitation Unit, a good understanding of Italian, and an age of >70 years.	Total: 52 Experimental group: 26 Control group: 26	balance task-specific training.	general physiotherapy, including open kinetic chain exercises and walking training	1. Primary: physical function (WOMAC) (lower scores mean better function) 2. Secondary: pain (WOMAC), BBS, FIM, SF-36	12 months	primary outcome (WOMAC function mean (SD) before treatment, after treatment and at follow-up, 84.8 (3.7), 39.8 (4.9) and 35.7 (6.2) for the experimental group 80.9 (5.7), 65.2 (7.1) and 61.0 (11.1) for the control group.

RCT: randomized controlled trial

Level of evidence

Study design	No. of studies	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Level of evidence	Importance
RCT	1	-2	0	-1	-1	0	Low	7

RCT, randomized controlled trial.

Grade of recommendation

	YES	NO
Confidence in the estimates		o
Balancing benefits and harms	o	
Resource use	o	
Values and preference	o	
Acceptability/feasibility	o	
Recommendation	Yes	
Grade	Weak	