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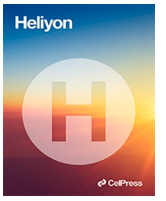

The effectiveness of fracture liaison services in patients with hip fractures: A systematic review and meta-analysis of randomized controlled trials

Chengli Yan [a], Yuyu Chen [a], Jia Cao [c,*], Kai Fang [b], Lifang Shao [a], Yaping Luo [a], Lili Yang [a,**]

[a] Department of Nursing, The Fourth Affiliated Hospital, Zhejiang University School of Medicine, Yiwu, Zhejiang, China
[b] Department of Information, The Fourth Affiliated Hospital, Zhejiang University School of Medicine, Yiwu, Zhejiang, China
[c] Nursing Department, Dazhou Central Hospital, Sichuan, China

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ABSTRACT

Background: In recent years, fracture liaison services (FLS) have been applied for hip fractures; however, their effectiveness remains uncertain.
Objective: To evaluate the effectiveness of FLS in patients with hip fractures.
Design: A systematic review and meta-analysis of randomized controlled trials.
Data sources: Embase, PubMed, Cochrane Library, Ebsco, Ovid, Web of Science, Medline, CNKI, Wangfang, and Vip were searched from their date of inception to March 2023. Two researchers screened the literature based on the inclusion and exclusion criteria, evaluated the quality, extracted data, and conducted a meta-analysis using ReviewManager 5.4.
Results: After screening, 12 randomised controlled trials (RCT) including 2136 patients were used in the meta-analysis. The primary outcomes were hip function rate of recurrent fracture, medication adherence, and degree of weakness. FLS improved hip function in patients with hip fractures [MD = 9.37, 95 % CI (7.69, 11.06), P < 0.0001], P < 0.0001], medication adherence [OR = 10.59, 95 % CI (1.64, 68.41), P < 0.0001], degree of weakness [MD = −1.45, 95%CI (−1.68 , -1.23), P < 0.0001], and reduced the rate of recurrent fractures [OR = 0.60, 95 % CI (0.44, 0.82).
Conclusion: Implementation of the FLS management model was beneficial for patients with hip fractures. It can positively impact the prognosis of patients with hip fractures by improving hip function, reducing the rate of recurrent fractures, and improving medication adherence and degree of weakness.

* Corresponding author. Nursing Department, Dazhou Central Hospital, 56th Nanyuemiao street, Tonchuan District, Dazhou City, Sichuan Province 635000, China
** Corresponding author. Nursing Department, The Fourth Affiliated Hospital Zhejiang University School of Medicine, 1st Shangcheng Avenue, Yiwu, Zhejiang Province 322000, China.
E-mail addresses: 281776259@qq.com (J. Cao), 3200006@zju.edu.cn (L. Yang).

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What is already known

- Hip fractures in the elderly cause significant morbidity and mortality, and are among the most fragile and costly fractures.
- Fracture liaison services can improve outcomes in patients with hip fractures.
- The management of fracture liaison services is not standardised, and the specific effects are controversial.

What this paper adds

- In patients with hip fractures, fracture liaison services can prevent secondary fractures, improve hip function, reduce the incidence of refractures, improve medication compliance, and improve vulnerability.
- The effectiveness of fracture liaison services may be impacted by medication and long-term follow-up.
- More high-quality trials are needed to explore drug therapy and long-term follow-up, develop more refined and cost-effective interventions, and focus on patient adherence.

1. Introduction

Hip fractures, the majority of which occur in patients over 65 years old, refer to transcervical and intertrochanteric fractures of the femur, with an increased risk associated with aging [1]. Approximately 6.3 million hip fractures are predicted to occur by 2050 [2]. Studies have shown that recurrent fractures occur in approximately one-third and three-quarters of patients in one and five years, respectively [3,4]. Hip fractures cause significant morbidity and mortality in older patients, and are among the most fragile and costly fractures. However, management of hip fractures is generally not standardised, although the key component, orthopaedic trauma is considered a difficult treatment focus [5,6]. The main components of conventional management mode includes routine preoperative preparation, surgical intervention, postoperative management, daily basic nursing, functional exercise, discharge education, and follow-up [7,8]. The Fracture Liaison Service (FLS), a management model for fragile fractures created by McLellan in the United Kingdom, has been helpful in many countries with established service points [3]. FLS is a multidisciplinary approach to reduce the subsequent fracture risk in patients with a recent fragility fracture due to compromised bone health by identifying them at or close to the time of admission and providing them with easy access to osteoporosis care [9]. Its core aim is appointment of a special coordinator to connect emergency, orthopaedics, endocrinology, geriatric departments, and other community family services to provide standardised recurrent fracture management services for patients [10]. Studies have found that FLS applied to hip fractures in older patients could reduce patient mortality and medical costs in addition to improve hip function, decrease the rate of recurrent fractures andthe degree of frailty, and increase medication adherence [10–14]. In recent years, FLS has been applied to hip fractures, but its effectiveness remains uncertain. This article searched all available databases for FLS literature, and performed a meta-analysis to evaluate its efficacy on hip fractures to provide evidence for clinical decision making.

2. Methods

2.1. Search strategy

This meta-analysis was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [15]. Embase, PubMed, Cochrane Library, EBSCO, Ovid, Web of Science, Medline, CNKI, Wangfang, and Vip were searched from their established date up to March 2023 without publication type and language restrictions. Theme words were used to explore the relevant literature. The snowball method was used to scan the reference lists of relevant articles to avoid missing relevant articles. Search terms included “Hip Fractures” or (Intertrochanteric Fractures) or (Trochanteric Fractures) or (Femur Trochlear Fractures) or (Femoral Trochlear Fractures) or (Subtrochanteric Fractures) or (Femoral Fractures) or (Proximal Femoral Fractures) or (or (Femur Trochlear Fractures) or (Femoral Trochlear Fractures) or (Subtrochanteric Fractures Hoffa Fracture) or (Femoral Neck Fractures) or (Femoral Fractures, Distal) or (Acetabulum Fracture) or (Femoral Head Fracture) or (Femur Intertrochanteric Facture) or (Femur Pertrochanteric Fracture) or (Femur Subtrochanteric Fracture) or (Femur Trochanteric Fracture) and ((Fracture Liaison Services) or (Fracture Liaison Service) or (Osteoporosis’ and ‘Fractures’ and ‘Liaison’ and ‘Service’)). An example of the search strategy is shown in Fig. 1, using Pubmed as an example.

2.2. Inclusion and exclusion criteria

Inclusion criteria: (1) the study design was an randomized controlled trials (RCT) ; (2) Subjects were patients with hip fracture; (3) FLS in the trial group, conventional management in the control group; (4) Primary outcomes included: Harris Hip Score, which included the four dimensions of daily function, pain, motion, and deformity; rate of recurrent fractures, assessed by imaging examination; medication adherence (Morisky Medication Adherence Scal-8items, MMAS-8), patients were divided into 8 items to investigate medication compliance, and the higher the score, the better the compliance; Elderly Frailty Assessment Scale, which includes five dimensions: physiological, psychological, social, cognitive and environmental and the higher the score, the more serious the frailness,(5) secondary outcomes included quality of life, osteoporosis rate, pain, and patient satisfaction. These four primary outcome indicators were included as they are extensively discussed in the relevant literature and have been shown to be significant prognostic indicators for hip fractures [11].

#1 Hip Fractures

#2 (Fractures, Hip) or (Intertrochanteric Fractures) or (Fractures, Intertrochanteric) or (Trochanteric Fractures) or (Fractures, Trochanteric) or (Trochlear Fractures, Femur) or (Femur Trochlear Fracture) or (Femur Trochlear Fractures) or (Fracture, Femur Trochlear) or (Fractures, Femur Trochlear) or (Trochlear Fracture, Femur) or (Femoral Trochlear Fractures) or (Femoral Trochlear Fracture) or (Fracture, Femoral Trochlear) or (Fractures, Femoral Trochlear) or (Trochlear Fracture, Femoral) or (Trochlear Fractures, Femoral) or (Subtrochanteric Fractures) or (Fractures,, Subtrochanteric) or (Femoral Fractures) or (Proximal Femoral Fractures) or (Hoffa Fracture) or (Femoral Neck Fractures) or (Femoral Fractures, Distal) or （acetabulum fracture） or (femoral head fracture) or(femoral neck fracture) or (femur intertrochanteric fracture) or (femur pertrochanteric fracture) or (femur subtrochanteric fracture) or (femur trochanteric fracture)

#3 #1 OR #2

#4 Fracture liaison service

#5 (Fracture liaison services) OR (osteoporosis' AND 'fractures' AND 'liaison' AND 'service'))

#6 #4 OR #5

#7 #3 AND #6

Fig. 1. Search strategy adopted throughout the databases, Pubmed is shown in this instance.

Exclusion criteria: (1) Repeated publications, (2) publications without available full text, (3) studies with un-extractable data, and (4) studies with no relevant outcome were all excluded from the analysis.

2.3. Study selection

Two independent researchers (CY and YC) screened for potentially relevant studies by reviewing the titles and abstracts. The full texts were then screened further according to the inclusion and exclusion criteria. Any uncertainty was solved by a third researcher (FK).

2.4. Data extraction

Two researchers (CY and YC) independently extracted and recorded the following information from the enrolled studies: author, country, intervention, outcome, and time of each study. Two investigators independently abstracted the data, and any discrepancies were resolved by joint discussion or by a third investigator's advice (FK).

2.5. Quality assessment

According to the tool for intervention studies from the Cochrane Collaboration, version 5.1.0, updated in 2011 [16]. The included studies were assessed by two independent researchers (CY and YC) for randomisation, allocation concealment, blinding, integrity of the research data, and reporting and other biases. Disagreements were resolved by a third researcher (FK).

2.6. Statistical analysis

The Cochrane Collaboration Review Manager Software Package version 5.4 (RevMan) was used for the meta-analysis. Heterogeneity was assessed with the χ^2 test. $P > 0.1$, $I^2 \geq 50$ % represented homogeneity, and a random effects mode was used for analysis. $P < 0.1$, $I^2 \geq 50$ % represented heterogeneity, and a fixed effects mode was used. Risk ratios with 95 % confidence intervals (CIs) were estimated for dichotomous variables, and mean differences with 95 % confidence intervals were estimated for quantitative variables. The standardised mean difference (SMD) was calculated using the same measurement tools used for continuous data, and the weighted mean difference (WMD) was calculated using different measurement tools. A 95%CI was calculated for each effect size.

3. Results

3.1. Flow and characteristics of included studies

A total of 12 articles [7,8,17–26] including 2136 patients were used in the analysis. The flow diagram of the included studies is shown in Fig. 2. The characteristics of the included studies are summarised in Table 1. Among them, the sources of intervention measures in Table 1 are as follows: after preliminary investigation, the original investigators consulted relevant literature on FLS intervention, combined with clinical characteristics of patients with hip fracture and group discussion, initially constructed an FLS intervention plan, and determined the final FLS intervention plan through expert consultation and pre-experiment.

3.2. Risk of bias in the included studies

Investigators used instruments for RCT to assess the risk of bias for appraisal of the included studies from seven aspects [16] (Fig. 3). A total of 12 studies were included in this review, six of which described the specific randomisation approach [8,18,21,22,24,25], and Zinger [18] reported an allocation concealment protocol. The studies by Liu and Li were blinded to the outcome assessors [8,22]. Liu,

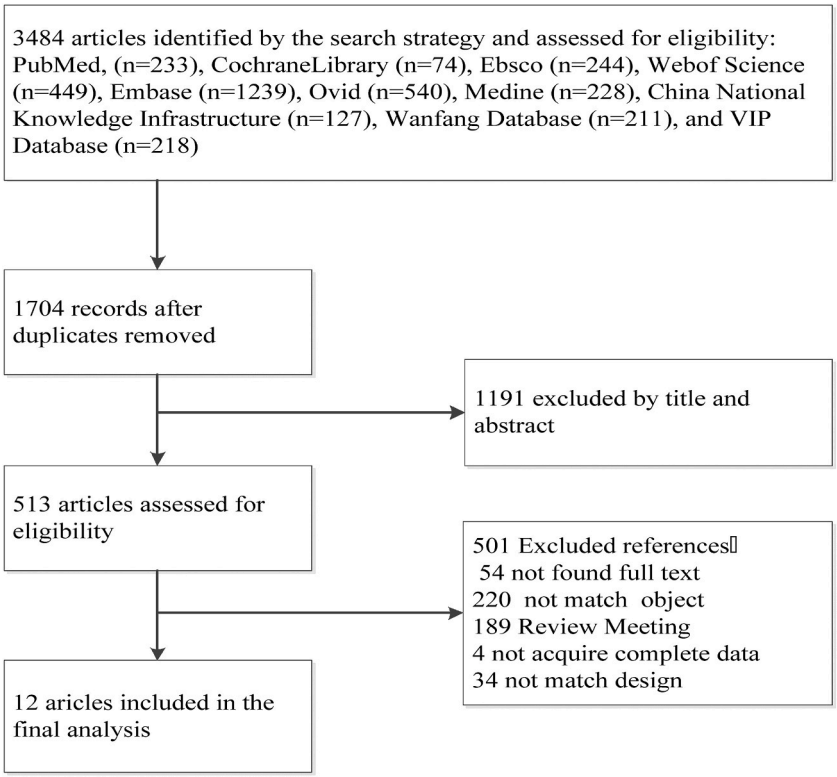

Fig. 2. Flow diagram of included studies.

Table 1
Characteristics of included studies.

Authors	Year	Country	Age		Sample size		Interventions		Subjects	Appraisal time	Outcomes
			Control group	Trial group	Control group	Trial group	Control group	Trial group			
Xiang et al. [7]	2021	China	78.82 ± 8.88	78.3 ± 10.28	65	43	Routine care	①FLS team (In-hospital and out-hospital) ②Personalized assessment and nursing ③Follow up ④Database for patient information	Patients with osteoporotic hip fracture	Before and 1 and 3 months after interventions	1 ②⑤⑧⑨
Liu et al. [8]	2019	China	74.60 ± 9.32	74.73 ± 8.42	53	53	Routine care	①FLS team (In-hospital and out-hospital) ②Identifying hip fracture ③Health consultation ④Interventions in risk factors ⑤Follow up	Patients hip fragile fracture	3 and 6 months after interventions	1 ④⑦
Huntjens et al. [17]	2014	Netherlands	68.3 ± 11.0	71.1± 11.8	303	280	Standard fracture care	①FLS team (In-hospital) ②Bone mineral density and medication appraised ③Follow up	Patients with hip fracture	Before and after intervention	1 ⑥⑦
Zinger et al. [18]	2021	Canada	–	–	97	83	Routine care	①FLS team (In-hospital and out-hospital) ②Health education ③Bone mineral density appraised ③Personalized therapy advice ④Follow up	Patients with hip fragile fracture	Before and 4 months after interventions	1 ⑤⑦
Qin. [19]	2022	China	68.98± 5.14	69.2 ± 5.08	42	40	Routine care	①FLS team (In-hospital) ②Health education ③Personalized nursing ④Rehabilitation training ④Follow up	Patients with transcervical fracture	Before and immediately after interventions	1 ③⑧⑨
Hu et al. [20]	2022	China	–	–	50	50	Routine care	①FLS team (In-hospital) ②Doctors and nurses' specialized management ③Anti-osteoporosis therapy ④Rehabilitation training ⑤Follow up	Patients with total hip replacement after transcervical fracture	Before and immediately after interventions	1 ⑦
Chen et al. [21]	2021	China	67.17 ± 3.68	66.17 ± 3.53	23	23	Routine care	①FLS team (In-hospital and out-hospital) 1 Bone mineral density appraised ③Personalized therapy advice ⑤Follow up	Patients with osteoporotic intertrochanteric fracture	Before and 6 months after interventions	1 ③
Li et al. [22]	2022	China	71.62 ± 8.01	73.09 ± 7.29	52	54	Routine care	①FLS team (In-hospital) ②Screening and identifying patients with hip fracture risks ③Health education ④Thrombosis risk management	Patients with hip fragile fracture	Before and 1 and 3 months after interventions	①②④

(*continued on next page*)

Table 1 (*continued*)

Authors	Year	Country	Age		Sample size		Interventions		Subjects	Appraisal time	Outcomes
			Control group	Trial group	Control group	Trial group	Control group	Trial group			
								⑤Nutritional support; ⑥Functional exercise; ⑦Follow up.			
Gan et al. [23]	2021	China	75.23 ± 7.07	76.23 ± 6.85	50	50	Routine care	①FLS team (In-hospital) ②Optimize patients screening flow and adjust rehabilitation plan ③Optimize content and methods of health education	Patients with hip fragile fracture	Before and 1 and 3 months after interventions	1 ③
Cong et al. [24]	2020	China	69.31 ± 4.97	69.24 ± 4.85	50	50	Routine care	①FLS team (In-hospital) ②Health education ③Interventions in fracture risks	Patients with hip fragile fracture	Before and 1, 2, and 3 months after interventions	1 ②③⑧⑨
Zhu et al. [25]	2020	China	69.32 ± 4.95	68.25 ± 5.36	49	49	Routine care	①FLS team (In-hospital and out-hospital) ②Identifying patients with fracture risks ③Health education	Patients with hip fragile fracture	Before and 6 months after interventions	1 ④⑤⑦
Li et al. [26]	2021	China	72.69 ± 4.57	72.19 ± 4.63	50	51	Routine care	①FLS team (In-hospital and out-hospital) ②Psychological intervention ③Medication guiding ④Rehabilitation exercise ⑤Nutrition guiding ⑥Follow up	Patients with hip fracture	Before and after interventions	1 ⑨

1 Rate of recurrent hip fracture; ② Hip function; ③ Quality of life; ④ Frailty; ⑤ Medication adherence; ⑥ Mortality; ⑦ Rate of osteoporosis; ⑧ Pain; ⑨ Satisfaction.

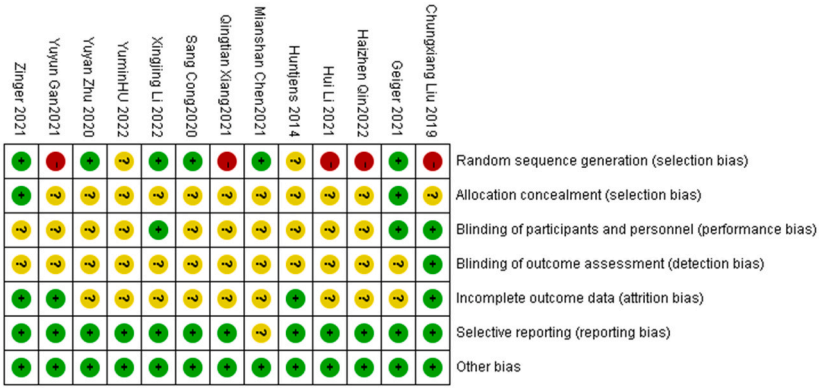

Fig. 3. Risk of bias in the included studies.

Huntjens, Zinger, Gan and Cong reported the loss to follow-up, and data from the included studies were complete [8,17,18,23,24]. Overall, 12 studies were RCTs; Liu's and Zinger's studies were rated A [8,18]; other studies were rated B; and the overall quality of the included literature was generally good. The results of the combined data have specific reference values; however, relevant, high-quality studies still need to be conducted in the future.

3.3. Outcomes

3.3.1. Impact of FLS on hip function in patients with hip fracture

Qin [19], Chen [21], Li [22], Cong [24], and Li [26] reported the effectiveness of FLS on hip function in patients with hip fractures, with heterogeneity ($P = 0.07$, $I^2 = 53$ %). FLS improved hip function in patients with hip fractures with statistically significant differences (MD = 9.37, 95 % CI (7.69, 11.06), $P < 0.00001$) (Fig. 4).

3.3.1.1. Subgroup analysis by follow-up duration on hip function. Subgroup analyses of Qin [19], Chen [21], Li [22], Cong [24], and Li [26] could be combined. Qin [19] and Li [26] assessed hip function ≤1-month post-intervention and Chen [21], Li [22], Cong [24], used follow-up periods > one month after the intervention. Subgroup analysis showed that the follow-up time≤1 month group [MD = 9.70, 95%CI (6.13,13.27), $P < 0.00001$, $I^2 = 84$ %] and the follow-up time >1 month (MD = 9.29,95%CI (7.40,11.18, $P < 0.00001$, $I^2 = 0$ %), There was no significant difference between the two subgroups ($P = 0.84$) (Fig. 5).

3.3.1.2. Subgroup analysis of the impact of different forms of intervention on hip function. Subgroup analyses by Qin [19], Chen [21], Li [22], Cong [24], and Li [26] could be combined, of which three [19,22,24] looked at in-hospital interventions and two [21,26] used in-hospital and out-hospital interventions to follow hip function. Subgroup analysis showed that the differences between the in-hospital (MD = 10.69, 95%CI (9.03,12.34), $P < 0.0001$, $I^2 = 5$ %] and the in-hospital and out-hospital [MD = 7.98, 95%CI (6.69, 9.27, $P < 0.0001$, $I^2 = 0$ %], and the two subgroups were statistically significant ($P = 0.01$) (Fig. 6).

3.3.2. Impact of FLS on the rate of recurrent fractures in patients with hip fracture

Huntjens [17], Liu [8], Li [22], Gan [23], Cong [24], Zhu [25] reported the impact of FLS on the rate of recurrent fractures in patients with hip fractures. Because the heterogeneity test yielded $P = 0.52$ and $I^2 = 0$ %, indicating less heterogeneity among the included studies, a fixed effects model was chosen for the pooled analysis of the included literature. The final results showed that the rate of recurrent fracture in the FLS group was 60 % of that in the control group, which was statistically significant (OR = 0.60, 95 % CI [0.44, 0.82], $P = 0.001$). The results are detailed in Fig. 7.

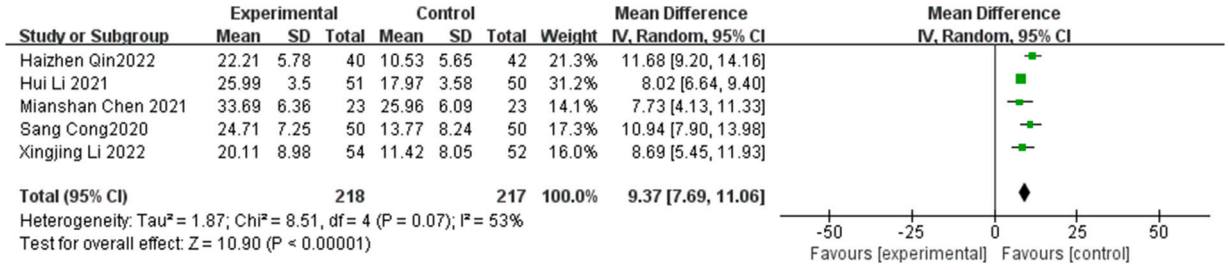

Fig. 4. Impact of FLS on hip function in patients with hip fracture.

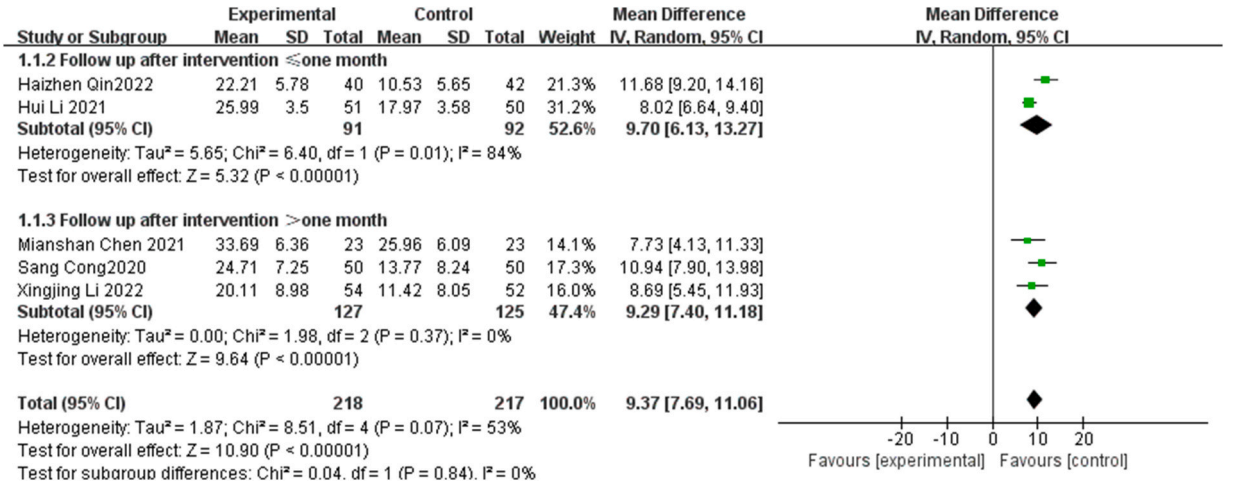

Fig. 5. Subgroup analysis of the effect of different follow-up times on hip function in patients with hip fracture.

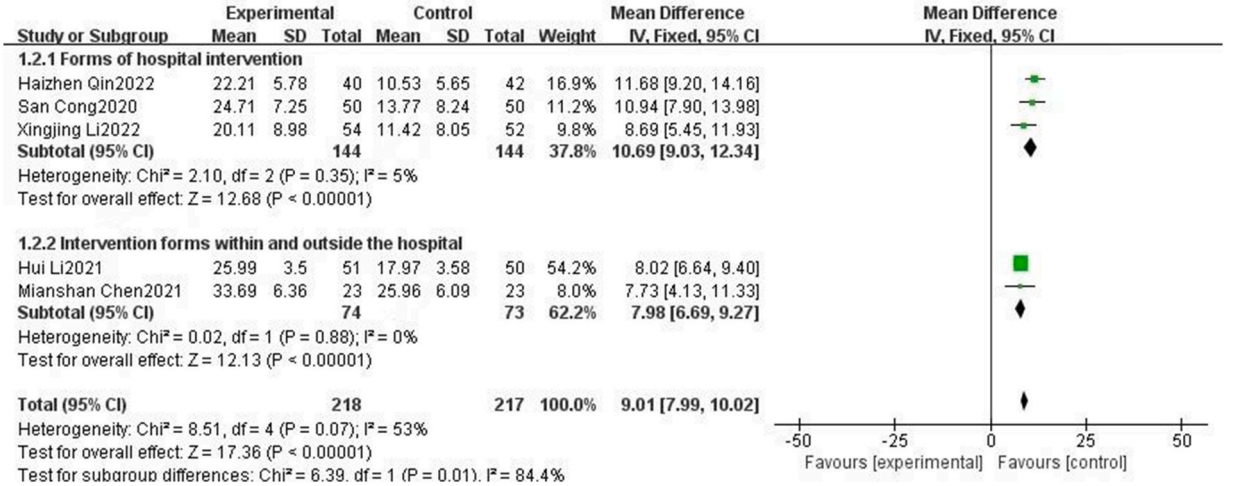

Fig. 6. Results of subgroup analysis of the effects of different intervention forms on hip function in patients with hip fracture.

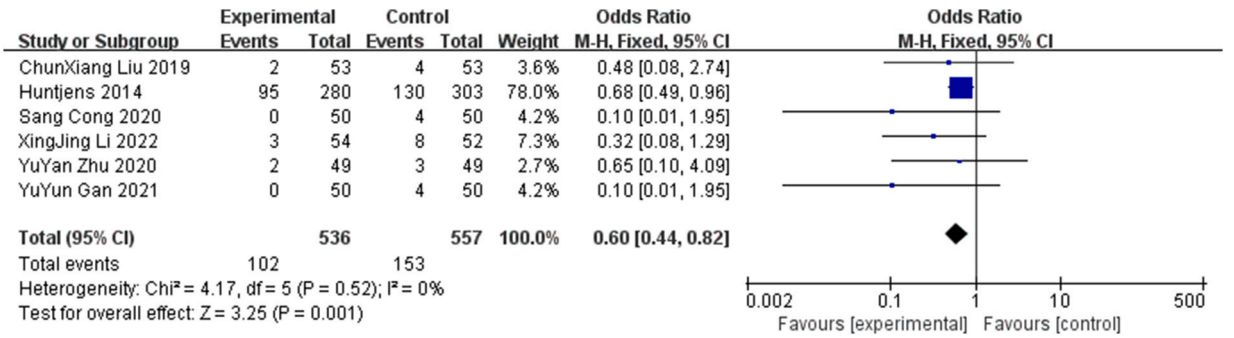

Fig. 7. Influence of FLS on the rate of recurrent hip fracture.

3.3.3. Effect of FLS on medication adherence in patients with hip fracture

Zinger [18], Xiang [7], and Zhu [25] reported the effectiveness of FLS on medication adherence in hip fracture patients, and a random effects model was selected for pooled analysis of the included literature because P = 0.0001 for the heterogeneity test and I^2 = 89 % indicated significant heterogeneity between the included studies. The results showed that FLS improved medication adherence in

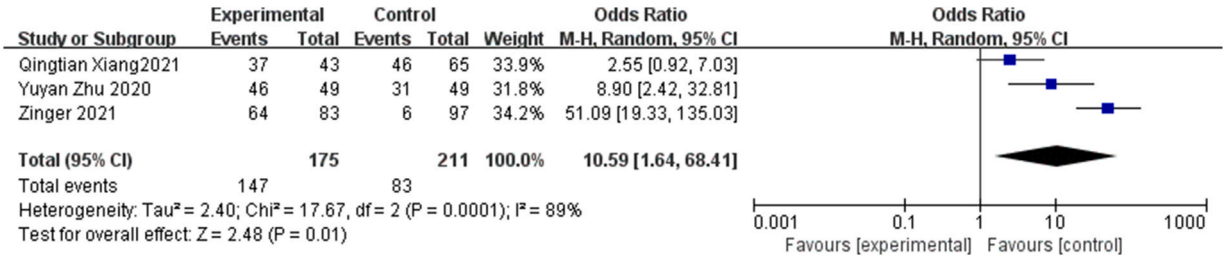

Fig. 8. Impact of FLS on medication adherence in patients with hip fracture.

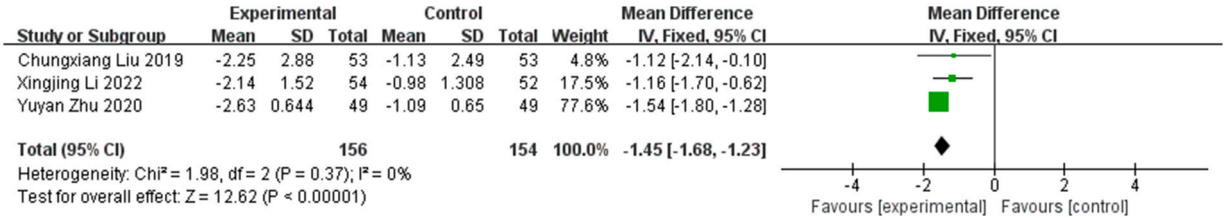

Fig. 9. Effects of FLS on frailty in hip fracture patients.

hip fractures with statistically significant differences (OR = 10.59, 95 % CI (1.64, 68.41), P < 0.0001) (Fig. 8). After excluding the study by Zinger (2021), I^2 changed from 89 % to 49 %, suggesting that the study may be a source of heterogeneity, and the reasons for the analysis may be related to the underlying diseases, educational level, race of the included study subjects, different countries, and regions.

3.3.4. Impact of FLS on frailty in patients with hip fracture

Liu [8], Li [22], and Zhu [25] reported the effect of the FLS on frailty in patients with hip fracture because the heterogeneous test results of P = 0.37 and I^2 = 0 % showed no heterogeneity between the included studies, and a fixed effect model was chosen for the pooled analysis of the included literature. The results showed that the FLS improved frailty in patients with hip fracture compared to conventional management, with statistically significant differences (MD = -1.45, 95 % CI(-1.68,-1.23), P < 0.0001) (Fig. 9).

4. Discussion

4.1. FLS could improve hip function in patients with hip fracture

The FLS is a management model for the prevention of recurrent fractures with three key elements: identification of patients with fracture risk, assessment of fall risk, and initiation of treatment [27,28] to prevent recurrent fractures. In a previous study [20], we found that the postoperative hip function score of patients in the FLS model was higher than that of the control group, and the excellent hip function rate of patients in the experimental group was 86 % and 72 % higher than that of the control group, respectively. This was due to the early treatment of patients, functional exercise guidance of the postoperative system, scientific follow-up time formulated by the full-time liaison administrator, and individualised rehabilitation guidance of specialists, which had multilevel and all-round advantages compared with standard management [29]. In the main contents of the conventional management mode, patients simply followed the doctor's advice for functional training, follow-up consisted of patients simply following physician advice for functional training without supervision and management. In FLS model, group members participate in supervised functional training and have liaisons available to guide patients to functional training appointments, thus improving follow-up and overall hip function. In this study, different follow-up time and subgroups were analysed, and there was no significant difference in hip function based on a follow-up time ≤1 month and a follow-up time >1 month. In addition, subgroup analysis of different intervention forms showed that both inpatient and outpatient interventions s could improve hip function. The overall research on the FLS model focused on using the FLS liaison, often a clinical nurse, acting as a link between patients and multiple disciplines such as, orthopaedic teams, primary care physicians, and fall prevention services. The liaison role was relatively single, uniform access standards for liaison nurses had not been established, and the heavy workload of clinical nurses could not guarantee sufficient time to serve this project. Follow-up studies could develop liaisons of multiple roles to explore the effects of different roles on the outcomes of patients with hip fractures and compare their clinical effects. Follow-up is very important in FLS planning. Therefore, future research should focus on establishing a diverse, complete and easily manageable follow-up system. Therefore, after discharge, hip fracture patients could communicate with the liaison in a timely and effective manner, with easily adaptable dynamic rehabilitation exercise programs.

4.2. FLS could reduce the incidence of recurrent fractures in patients with hip fracture

Lee reported that elderly patients with hip fractures had a significantly increased risk of a second fracture within six years [30]. Six articles in this study reported on the incidence of recurrent fractures, and the meta-results showed that the FLS could reduce the incidence of recurrent fractures in patients with hip fractures. A Japanese hospital implemented the FLS model for hip fracture patients, which involved pharmacists asking about the patient's medication history, orthopedic doctors administering medication for osteoporosis, nurses assessing the risk of falls, physical therapists performing rehabilitation and patients continuing to treat osteoporosis after discharge. Compared with conventional management mode, the treatment rate of hip fracture is higher and the recurrence rate is lower [31]. An Australian FLS study conducted a 6-month intervention and a 3-year follow-up and found that the incidence of recurrent fractures was lower in the intervention group than in the control group [13]. However, Axelsson found that the refracture rate after FLS had no statistical difference [32]. This may be because recurrent fractures are affected by many factors including age, underlying disease, surgical method, and compliance. In follow-up studies, we should focus on the characteristics of patients with primary fracture, evaluate the risk factors of refracture, and conduct a personalized intervention for the evaluation results, mainly focusing on drug treatment and long-term follow-up to ensure compliance with treatment and minimise the risk of recurrence of fracture.

4.3. FLS may improve medication compliance in patients with hip fractures

Studies have shown that drug compliance in patients with hip fractures is only 20 %, and improving drug compliance is essential for the treatment and care of fragility fractures [33]. Naranjo conducted an observational study of the FLS in two hospitals from refracture identification, investigation, preventive treatment, and integration into longitudinal and systematic follow-up, resulting in 1-and 2-year compliance rates of 66.4 % and 55.6 %, respectively [27]. This study demonstrated that compliance improved in more than half of the patients after receiving high levels of the FLS. This finding is consistent with the results of this meta-analysis. In Zinger's study, which analysed 200 patients with hip fractures, the 4-month follow-up results showed that medication compliance in the intervention group was 77.1 % [18]. Only 6.2 % was found in the control group, and the difference was statistically significant. Thus, the FLS program is effective in improving patient compliance with medium-and long-term treatments. The FLS enabled more than half of the patients to be treated. The reason might be that FLS management mode pays more attention to the duration of follow-up and the variety of contents than the conventional management mode,and the liaison officer carries out regular health education for the patients, which can enable them to fully master the relevant knowledge of the disease and improve their cognition of the role of regular treatment. However, most studies were single-centre experiments with small sample sizes, and should be carried out with large multicentre samples. Patient compliance with medical treatment is closely related to the best treatment outcomes and a reduced risk of refracture [34]. Therefore, it is necessary to improve patient compliance with treatment in future studies on the FLS. Improving bone health literacy and strengthening awareness of disease prevention and treatment are directions for future research. Future interventions should be more economical and operable, and should reduce the burden on patients with hip fractures. Bias should be avoided during the implementation of the intervention to more effectively ensure the authenticity.

4.4. FLS may improve frailty in patients with hip fracture

The inflammatory state induced by fracture trauma enhances the catabolic response, particularly the breakdown of skeletal muscle proteins, resulting in decreased skeletal muscle mass and increased risk of developing frailty [35]. Some studies have shown that more than one-third of older patients with hip fracture had frailty. These patients were significantly more likely to have postoperative complications and hospitalisation mortality than those in the non-debilitating group, and the hospitalisation time in the debilitating group was significantly prolonged in 106 patients with hip fragility fractures [8]. These results were consistent at three and 6 months following intervention [36]. Using an FSL, Liu discussed the application of the intervention, and the physiological, psychological, and cognitive dimensions and the total score of the test group were significantly lower than those of the control group. The reason might be that in the implementation of FLS, more attention should be paid to nutritional rehabilitation treatment, supervision of liaison staff, psychological counseling and other aspects. Orthopaedics, geriatricians, therapists, nutritionists, and others can increase food intake and improve the nutritional status of patients with hip fractures. At the same time, the liaison officers can give patients health guidance to enhance their awareness of the disease and reduce the degree of weakness. Multidisciplinary and multiteam interventions can effectively improve patient frailty and body function [37]. However, the intervention time of the overall study was short, and the intervention measures for all frailty dimensions were not sufficiently refined. It is suggested that follow-up studies should extend the intervention time of the FLS, conduct a refined intervention for different dimensions of frailty, and carry out a longitudinal study of frailty by a fracture liaison service to improve the implementation and application of the FLS in patients with fragility fractures.

4.5. Limitations and Recommendations

The overall quality of the literature included in this study was generally good; two articles were grade A and all others were grade B, and the number of included studies was small, there might be publication bias. Because the FLS was challenging to achieve blinding, there might be implementation bias; FLS in the included articles were compared with conventional management, the results might be biased owing to differences in underlying diseases, education level, race, country, and region of the included subjects. Owing to the limited literature included in this study, the results need to be verified by more researchers in future high-quality original studies.

5. Conclusions

Compared to the conventional management model, the FLS model is a novel protocol for preventing secondary fractures. It can improve hip function, reduce secondary fracture rates, improve medication compliance, and reduce frailty in patients with hip fractures. Future studies should focus on drug treatment and long-term follow-ups, build more refined and economical intervention programs, and focus on patient compliance to achieve improved intervention effectiveness.

Registered

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Data availability statement

Data will be made available on request.

CRediT authorship contribution statement

Chengli Yan: Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **Yuyu Chen:** Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **Jia Cao:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Kai Fang:** Software, Formal analysis, Data curation. **Lifang Shao:** Writing – original draft. **Yaping Luo:** Writing – original draft, Funding acquisition. **Lili Yang:** Writing – review & editing, Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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