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TRAUMA

Meta-analysis of the clinical efficacy and safety of single versus dual plate in the treatment of comminuted distal femur fractures

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- *Objective:* Through meta-analysis, this study aims to comprehensively evaluate the efficacy of single-plating and double-plating in the treatment of comminuted fractures of the distal femur.
- *Methods:* Computer searches of PubMed, Cochrane Library, Embase, China National Knowledge Infrastructure (CNKI), China Biology Medicine (CBM), VIP, and Wanfang digital journals were performed, and the timeframe for the searches was from the establishment of each database to July 2023 for each of the databases. Meta-analysis was performed using RevMan 5.4 software provided by the Cochrane Library, and the review process was registered in the PROSPERO database.
- *Results:* A total of ten studies were included for statistical analysis. One randomised controlled study and nine retrospective cohort studies with a total of 563 patients were included. The double-plate group was superior to the single-plate group in terms of knee mobility at 6 months postoperatively, overall postoperative complications, and the rate of healing of knee deformity. However, it increased the operation time and intraoperative bleeding, and the difference between the two groups was statistically significant ($P < 0.05$). There was no significant difference between the two groups in terms of excellent knee function rate, fracture healing time, plate fracture, postoperative infection, delayed fracture healing, and non-union ($P \geq 0.05$).
- *Conclusion:* Double plate fixation for comminuted fractures of the distal femur can improve knee mobility at 6 months postoperatively, reduce overall postoperative complications, and decrease the incidence of malunion healing. However, it increases operative time and bleeding. Randomised studies are needed to provide strong evidence in the future.

Keywords: distal femur fracture; double plate; lateral locking plate; medial plate; meta-analysis

Introduction

Fractures of the distal femur are relatively common, accounting for about 4–6% of all femur fractures and 0.4% of all adult fractures (1, 2). The incidence of distal femur fractures increases in proportion to ageing (3). Approximately 61% of these fractures are caused by falls from a standing height (4). The age of onset follows a bimodal distribution, with young males more commonly experiencing high-energy trauma such as traffic accidents, and elderly females more commonly experiencing low-energy injuries such as falls due to osteoporosis (5). These fractures are typically comminuted and intra-articular (6). It

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is worth noting that the mortality rate within 1 year after surgery for elderly patients with distal femur fractures is very high, similar to the mortality rate after hip fractures (7, 8). Currently, surgical treatment is commonly used for distal femur fractures, except for cases with obvious surgical contraindications, to promote early mobilisation, early weight-bearing, and to avoid long-term bed rest complications. Moreover, surgical treatment leads to better postoperative functional outcomes (9). Retrograde intramedullary nails and lateral locking plates are commonly used surgical methods for treating distal femur fractures. Intramedullary nail fixation offers advantages such as central fixation, minimal soft tissue damage, and high patient satisfaction. However, it is not recommended for use in complex articular surface fractures due to the degree of comminution of the articular surface (10). Many studies have shown that lateral locking plates are a good choice for treating distal femur fractures, especially for complex distal femur fractures (3, 11, 12). However, with the use of locking plates, research has found complications such as malunion, nonunion, and fixation failure after lateral locking plate application (13, 14). Liu *et al.* (15) reported that the rate of varus collapse after treatment with a single lateral locking plate for distal femur AO C3 fractures can be as high as 26.7%. Therefore, some scholars have used dual plates (DP) for fixation in the treatment of distal femur comminuted fractures. Existing biomechanical studies have shown that dual plate fixation is more reliable in terms of strength compared to single plate (SP) fixation (16). However, the use of dual plates increases the cost of implants and surgical trauma, and its clinical effectiveness and safety are still controversial (17, 18). This study primarily employs meta-analysis to compare the clinical efficacy and postoperative complications of two surgical methods for treating comminuted fractures of the distal femur.

Materials and methods

This meta-analysis was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (19). The study has been registered in the PROSPERO database (registration number: CRD 42023442954).

Search strategy

A computerised search of literature from the Cochrane Library, PubMed, Embase, CBM, CNKI, VIP, and Wanfang databases on DP and SP treatment of primary comminuted fractures of the distal femur from the date of creation of each database until July 2023. Retrieval languages were limited to Chinese and English. MeSH terms combined with free terms were used to search the treatment of distal femoral comminuted fractures using dual plates. The search terms were distal femur fracture, supracondylar femur fracture, intercondylar femur fracture, condylar femur fracture, lower middle femur fracture, double plate, dual plate, and medial plate. The detailed search strategy on PubMed is shown in Supplementary File 1 (see section on supplementary materials given at the end of this article).

Inclusion and exclusion criteria

The studies were included if they met the PICOS criteria as follows: (i) all patients were adults (>18 years old) diagnosed with a primary comminuted fracture of the distal femur; (ii) the intervention was a double-plate surgical treatment, one of which was a surgical treatment using a lateral locking plate. Surgical treatment with lateral locking plates only was considered as a control group; (iii) at least two indicators should be included: operation time, intraoperative blood loss, fracture healing time, range of motion (ROM) of the knee joint post-operation 6 months, overall excellent and good rates of Schatzker–Lambert functional score (20), and postoperative complications; (iv) randomised controlled trials and cohort studies; (v) the follow-up time was at least 6 months. The exclusion criteria were as follows: (i) case reports, conference papers, thesis papers, and review studies; (ii) research without access to the original text or extracted data; (iii) pathological fractures, old fractures, periprosthetic fractures, and cadaver studies.

Data extraction and quality assessment

The literature was initially screened by reading the title and abstract according to the inclusion and exclusion criteria. Further reading of the full text screened the literature for inclusion. Each step of study selection and data extraction was done independently by two investigators, and disagreements, if any, were resolved through discussion with a third investigator. Data extraction included the first author, year of publication, sample size, gender, age, study design, type of AO fracture, duration of follow-up, and relevant outcomes.

Randomised controlled trials were assessed for bias using the Cochrane bias risk tool. Cohort studies were evaluated for methodological quality using the Newcastle-Ottawa Scale (NOS), with a maximum score of 9. We assigned a score of ≥8 as high-quality literature, 7 as moderately high-quality literature, 6 as medium-quality literature, and ≤5 as low-quality literature.

Outcome measures

The clinical efficacy outcome measures included overall excellent and good rates of knee function based on the Schatzker–Lambert rating criteria, fracture healing time (in months), and ROM of the knee joint post-operation at 6 months (in degrees). The Schatzker–Lambert rating criteria included the following five aspects: degree of flexion loss, degree of loss of length, degree of varus or valgus, degree of pain, and whether or not the joint

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congruency was perfect. The safety evaluation outcome measures included operation time (in minutes), intraoperative blood loss (in millilitres), the overall complication rate, and some complications, which were analysed separately. The overall rate of complications was defined as incorporating all complications reported in the literature (18, 21, 22, 23, 24, 25, 26, 27, 28, 29), including plate fracture, malunion, delayed union, nonunion, incision infection, etc. The criteria for non-union is The Food and Drug Administration (FDA) system, at least 9 months after injury, the fracture site has shown no radiographical sign of healing progression, and there has been no change in the fracture callus for the final 3 months.

Statistical analysis

Meta-analysis was performed using RevMan 5.4 software (version 5.4.1 The Cochrane Collaboration). For dichotomous variables, relative risk (RR) and 95% CI were used as the efficacy statistics, and for continuous variables, weighted mean difference (WMD) and 95% CI were used as the efficacy statistics. If the value of $P < 0.05$, it is considered to be statistically significant. When the value of $I^2 \leq 50\%$ and $P > 0.1$, it is considered that there is little heterogeneity among the included studies, and a fixed-effects model is used to combine the results of each study. When the value of $I^2 > 50\%$ and $P \leq 0.1$, it is considered that there is significant heterogeneity among the included studies, and the source of heterogeneity should be analysed, and a random effects model should be used for analysis. A funnel plot of publication bias is created to qualitatively assess whether there is publication bias in the statistical data.

Results

Study search results

According to the retrieval plan mentioned above, a total of 915 articles were retrieved. After excluding duplicate articles (179 articles), a preliminary screening of titles and abstracts resulted in 51 articles. Finally, after reading the full text and excluding articles that did not meet the criteria, a total of 10 articles (18, 21, 22, 23, 24, 25, 26, 27, 28, 29) were included in the study. The literature retrieval and selection process is shown in Fig. 1.

Study characteristics

A total of 563 patients were included, with 282 in the double-plate group (DPG) and 281 in the single-plate group (SPG). One article was a randomised controlled trial, while the others were cohort studies. Most of the patients recruited in the study were middle-aged or older (≥18 years), and the studies that presented sex data included 299 men (53.1%). The overall follow-up ranged from 6 to 36 months. The baseline characteristics of the included studies are listed in Table 1. In addition, Supplementary Table 1 presents the detailed treatment and fracture characteristics of all included studies. The studies included 49 patients (8.70%) who sustained an AO fracture type A2; 221 (39.25%), type A3; 162 (28.77%), type C2; 61 (10.83%), type C3; and 70 (12.43%), unknown type. Three studies (21, 23, 29) excluded multiple associated fractures (>2), whereas other studies did not mention it (probably only distal femur fracture). The use of a tourniquet to reduce bleeding was reported in four studies (23, 25, 26, 27). However, Zhou *et al.* (22) and Li *et al.* (24) did not use it, and in four studies (18, 21, 28, 29), it was unclear.

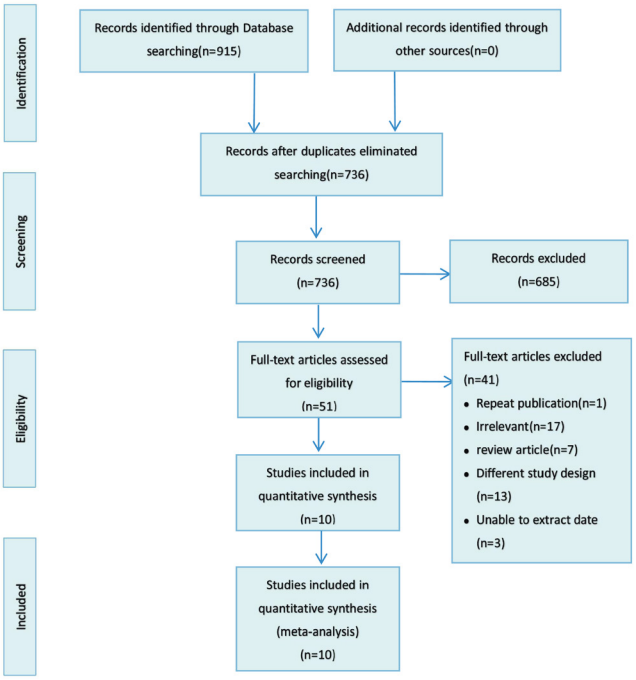

Figure 1

Flowchart for screening by inclusion and exclusion criteria.

Risk of bias in included studies

A total of one randomised controlled study was included. According to the Cochrane Risk of Bias Assessment Tool, the results are shown in Fig. 2. Nine non-randomised controlled studies were evaluated for quality according to the NOS scale, one had a score of 6, three had a score of 7, and five had a score of 8. The results of the NOS scores are shown in Supplementary Table 2.

Evaluation of clinical efficacy

Overall excellent and good rates of knee function

A total of five studies (22, 24, 25, 26, 27) reported the results of comparing the rate of excellent and good knee function based on the Schatzker–Lambert rating criteria,

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Table 1 Basic characteristics of the included studies.

Study	Year	Type of study	Sample size (*n*)		Gender (men/women)		Mean age (years)		Outcome assessment	Mean follow-up time (months)
			SPG	DPG	SPG	DPG	SPG	DPG		
Sun *et al.* (28)	2018	Retro-CS	21	11	13/8	6/5	44.0 ± 11.4	46.8 ± 10.5	①②③⑥⑨⑩⑪	12.3
Zhang *et al.* (18)	2018	RCT	15	14	5/10	5/9	57.93 ± 13.60	59.07 ± 14.58	①②④⑥⑪	NA (>12)
Zhou *et al.* (22)	2015	Retro-CS	29	24	19/10	15/9	46.3 ± 6.6	44.1 ± 7.6	④⑤⑥⑦	NA (>12)
Zhang *et al.* (26)	2017	Retro-CS	35	35	17/18	18/17	60.01 ± 8.74	59.17 ± 8.91	①②⑤	12
Zhang *et al.* (25)	2017	Retro-CS	32	40	12/20	15/25	57.8 ± 14.5	59.9 ± 13.7	①②⑤⑥⑨	19.8
Ma *et al.* (27)	2012	Retro-CS	20	13	11/9	8/5	46.8 ± 9.58	45.8 ± 11.2	①②⑤⑥	24
Lu *et al.* (21)	2022	Retro-CS	40	40	22/18	19/21	49.3 ± 6.2	48.7 ± 7.1	①②④⑥⑧⑨⑪	13.6
Li *et al.* (24)	2017	Retro-CS	40	40	25/15	27/13	46.1 ± 6.2	45.7 ± 6.8	③④⑤⑥⑦⑧	NA (>6)
Li *et al.* (23)	2017	Retro-CS	23	30	13/10	16/14	45.39 ± 10.93	42.70 ± 10.01	①②④⑥⑦⑧	15.11 ± 1.68
Gou *et al.* (29)	2019	Retro-CS	27	34	15/12	18/16	55.81 ± 11.46	54.28 ± 12.47	①②③⑥⑧⑩	13.72 ± 2.81

①, operation time (minutes); ②, intraoperative blood loss (mL); ③, fracture healing time (months); ④, ROM (°) of the knee joint post operation at 6 months; ⑤, overall excellent and good rates of knee function.; ⑥, overall complications; ⑦, plate fracture; ⑧, malunion; ⑨, delayed union; ⑩, nonunion; ⑪, incision infection.
RCT, randomised controlled trial; Retro-CS, retrospective cohort study.

and a total of 308 patients were included, including 156 in the SPG and 152 in the DPG. The results of the heterogeneity test showed that no heterogeneity was found between the studies ($I^2 = 0\%$, $P = 0.71$). Therefore, a fixed-effects model was selected for the analysis, and the results showed (Fig. 3) that there was no significant difference in postoperative knee function between the two groups (84.2% vs 78.2%; RR = 0.92; 95% CI: 0.83–1.03; $P = 0.14$).

Fracture healing time

A total of three studies (24, 28, 29) reported the results of the comparison of fracture healing times, including 173 patients, 88 in the SPG and 85 in the DPG. The results of the heterogeneity test showed high heterogeneity among the studies ($I^2 = 75\%$; $P = 0.02$), and the heterogeneity decreased significantly after excluding the study of Sun *et al*. (28). ($I^2 = 0\%$; $P = 0.57$), and the reason for the heterogeneity may be related to the combination of fractures at other sites. Therefore, a random-effects model was selected for the analysis, and the results showed that (Fig. 4) there was no significant difference in the time of fracture healing between the two groups (WMD = −0.06; 95% CI: −0.76–0.63; $P = 0.86$). Through the method of sequentially excluding literature for sensitivity analysis, the results did not show any significant changes, indicating that the results were robust. Gou *et al.* (29) found longer healing time, which may be due to the inclusion of type A2, and A3 medial comminuted fracture of the distal femur with poor medial cortical continuity or support after repositioning and internal fixation.

ROM of the knee joint postoperation at 6 months

A total of five studies (18, 21, 22, 23, 24) reported the 6-month postoperative knee mobility results, and a total of 295 patients were included, including 147 in the SPG and 148 in the DPG. The results of the heterogeneity test showed high heterogeneity among the studies ($I^2 = 87\%$; $P < 0.1$), and the reason for the heterogeneity was analysed as possibly related to the differences in fracture types and the degree of soft tissue injury. Therefore, a random-effects model was selected for the analysis, and the results showed (Fig. 5) that the

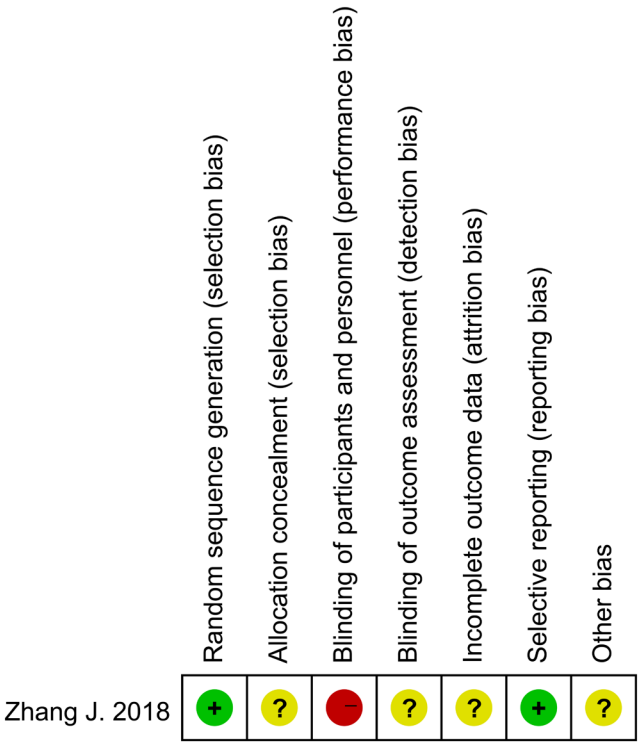

Figure 2

Quality assessment of RCTs according to the criteria of the Cochrane Collaboration Risk of bias tool (18).

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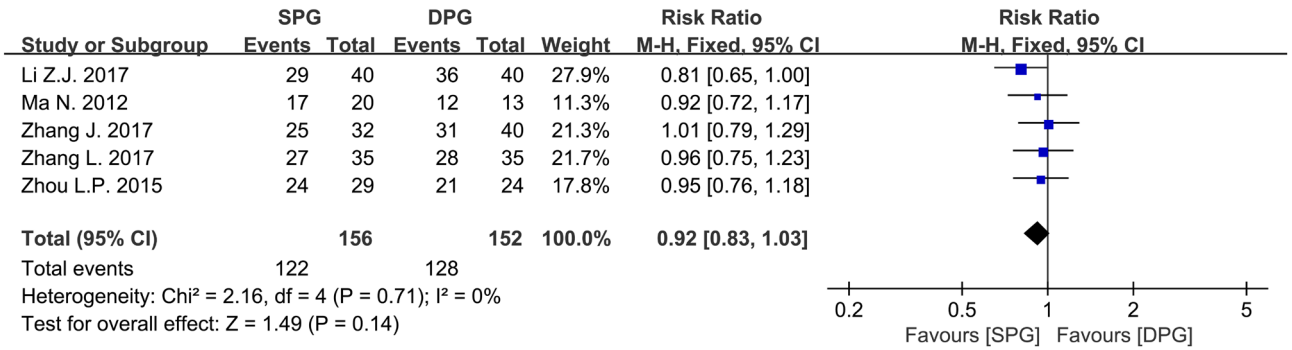

Figure 3

The overall excellent and good rates of knee function forest plot (22, 24, 25, 26, 27).

knee joint ROM at 6 months postoperatively in the DPG was better than that in the SPG (WMD = −14.42; 95% CI: −18.23–−10.61; $P < 0.05$). Through the method of sequentially excluding literature for sensitivity analysis, the results did not show any significant changes, indicating that the results were robust.

Safety evaluation

Operation time

A total of eight studies (18, 21, 23, 25, 26, 27, 28, 29) reported the results of the comparison of surgical time, and a total of 430 patients were included, including 213 in the SPG and 217 in the DPG. The results of the heterogeneity test showed high heterogeneity among the studies ($I^2 = 87\%$; $P < 0.1$), and the reason for the heterogeneity was analysed to possibly be related to the difference in the surgical experience of the operators. Therefore, a random-effects model was selected for the analysis, and the results showed (Fig. 6) that the operative time was longer in the DPG than in the SPG (WMD = −26.17; 95% CI: −33.24–−19.10; $P < 0.05$). Through the method of sequentially excluding literature for sensitivity analysis, the results did not show any significant changes, indicating that the results were robust.

Intraoperative blood loss

A total of eight studies (18, 21, 23, 25, 26, 27, 28, 29) reported the results of intraoperative blood loss comparisons, and a total of 430 patients were included, including 213 in the SPG and 217 in the DPG. The results of the heterogeneity test showed high heterogeneity among the studies ($I^2 = 90\%$; $P < 0.1$), and the analysis of the reason for the heterogeneity may be related to the fact that different surgical techniques were used to implant locking plates (open implantation, mini-open, or MIPO technique), and the use of a tourniquet or not intraoperatively. Therefore, a random-effects model was selected for analysis, and the results showed (Fig. 7) that intraoperative blood loss was significantly greater in the DPG than in the SPG (WMD = −43.10; 95% CI: −68.42–−17.78; $P < 0.05$). Through the method of sequentially excluding literature for sensitivity analysis, the results did not show any significant changes, indicating that the results were robust.

Overall complications

A total of nine studies (18, 21, 22, 23, 24, 25, 27, 28, 29) reported the overall postoperative complication outcomes, and a total of 493 patients were included, including 247 in the SPG and 246 in the DPG. The results of the heterogeneity test showed no heterogeneity among the studies ($I^2 = 0\%$; $P = 0.51$). Therefore, a fixed-effects model was selected for analysis, and the results showed (Fig. 8) that the overall postoperative complication rate was lower in the DPG than in the SPG (7.32% vs 17%; RR = 2.24; 95% CI: 1.35–3.72; $P < 0.05$).

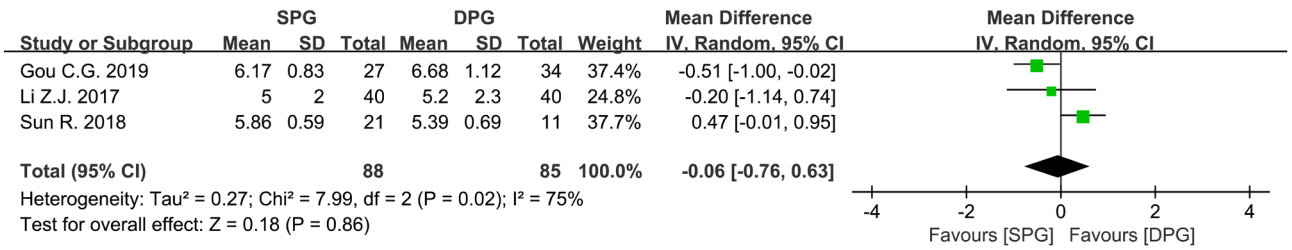

Figure 4

Fracture healing time forest plot (24, 28, 29).

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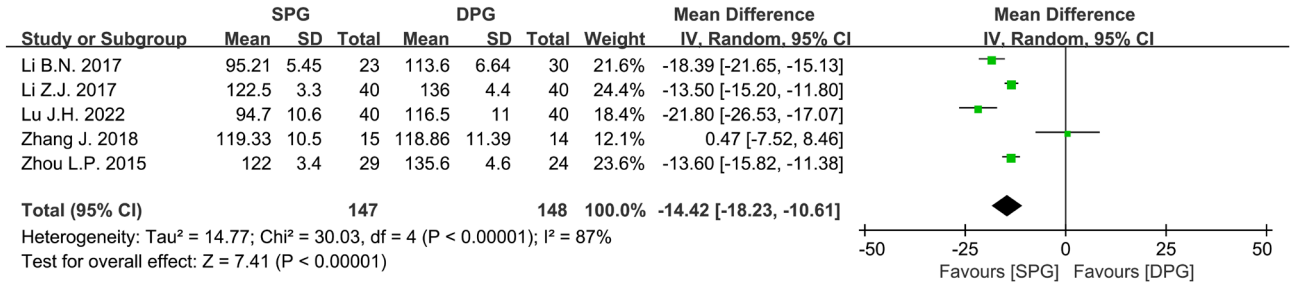

Figure 5

ROM of the knee joint postoperation at 6 months forest plot (18, 21, 22, 23, 24).

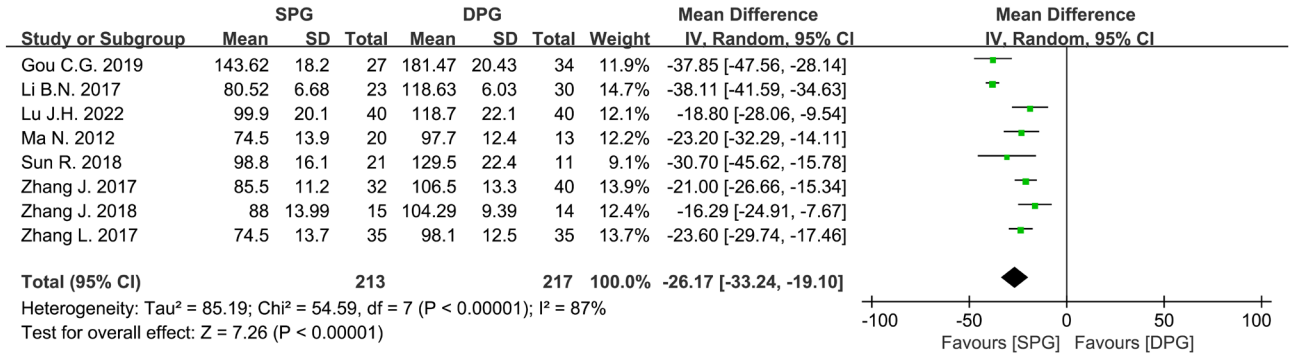

Figure 6

Operation time forest plot (18, 21, 23, 25, 26, 27, 28, 29).

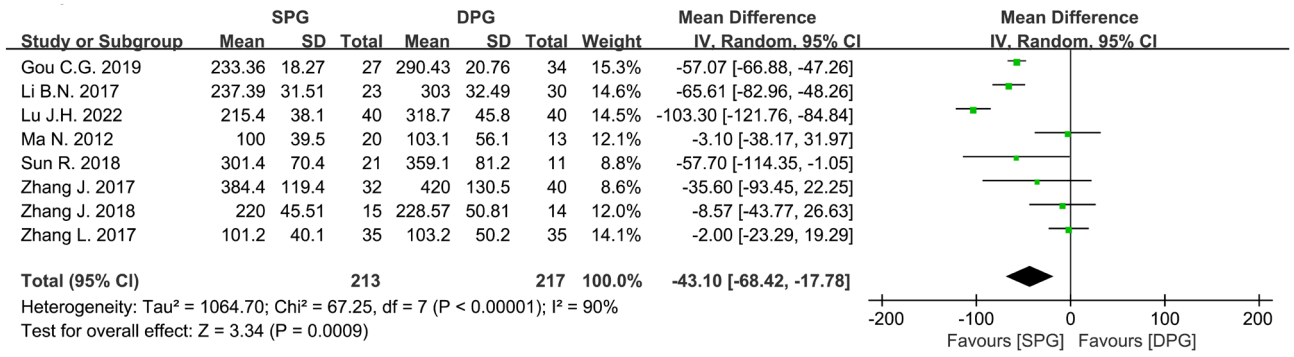

Figure 7

Intraoperative blood loss forest plot (18, 21, 23, 25, 26, 27, 28, 29).

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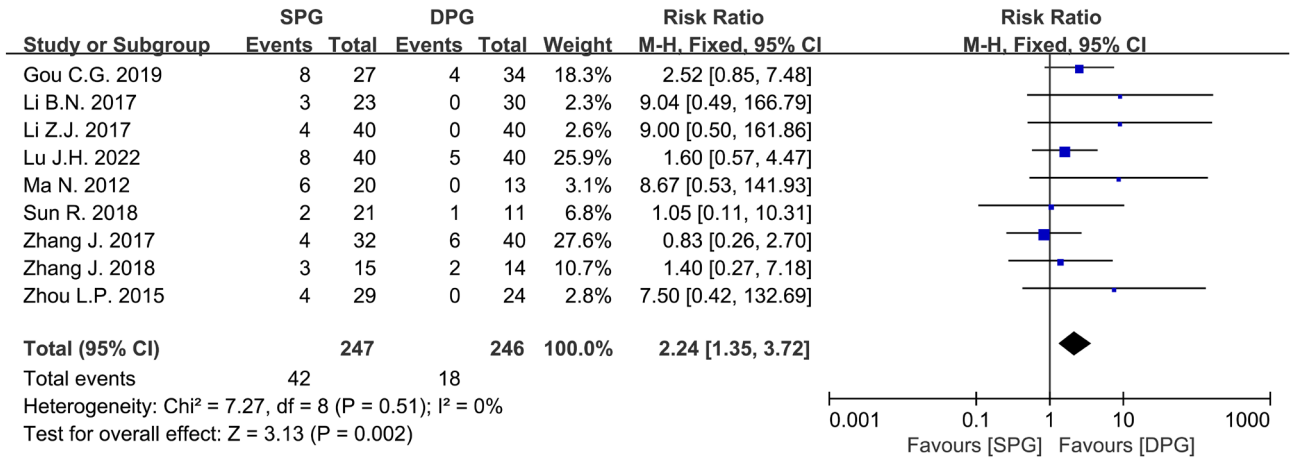

Figure 8

Overall complications forest plot (18, 21, 22, 23, 24, 25, 27, 28, 29).

Plate fracture

A total of three studies (22, 23, 24) reported the outcome of postoperative plate fracture, and a total of 186 patients were included, including 92 in the SPG and 94 in the DPG. The results of the heterogeneity test showed that there was no heterogeneity between the studies ($I^2 = 0\%$; $P = 0.98$). Therefore, a fixed-effects model was selected for the analysis, and the results showed (Fig. 9) that there was no significant difference between the two groups (RR = 3.07; 95% CI: 0.50–18.93; $P = 0.23$).

Malunion

A total of four studies (21, 23, 24, 29) reported the results of postoperative fracture deformity healing, and a total of 274 patients were included, including 130 in the SPG and 144 in the DPG. The results of the heterogeneity test showed that there was no heterogeneity among the studies ($I^2 = 0\%$; $P = 0.81$). Therefore, a fixed-effects model was selected for the analysis, and the results showed (Fig. 10) that the incidence of postoperative malunion in the DPG was lower than that in the SPG (RR = 2.94; 95% CI: 1.19–7.25; $P = 0.02$).

Delayed union

A total of three studies (21, 25, 28) reported the results of delayed postoperative fracture healing, and a total of 184 patients were included, including 93 in the SPG and 91 in the DPG. The results of the heterogeneity test showed that there was no heterogeneity between the studies ($I^2 = 0\%$; $P = 0.61$). Therefore, a fixed-effects model was selected for the analysis, and the results showed (Fig. 11) that there was no significant difference between the two groups (RR = 1.62; 95% CI: 0.49–5.31; $P = 0.43$).

Nonunion

A total of two studies (28, 29) reported the outcome of postoperative fracture nonunion, and a total of 93 patients were included, including 48 in the SPG group and 45 in the DPG group. The results of the heterogeneity test showed that there was no heterogeneity between the studies ($I^2 = 0\%$, $P = 0.89$). Therefore, a fixed-effects model was chosen for the analysis, and the results showed (Fig. 12) that there was no significant difference between the two groups (RR = 3.14; 95% CI: 0.36–27.08; $P = 0.30$).

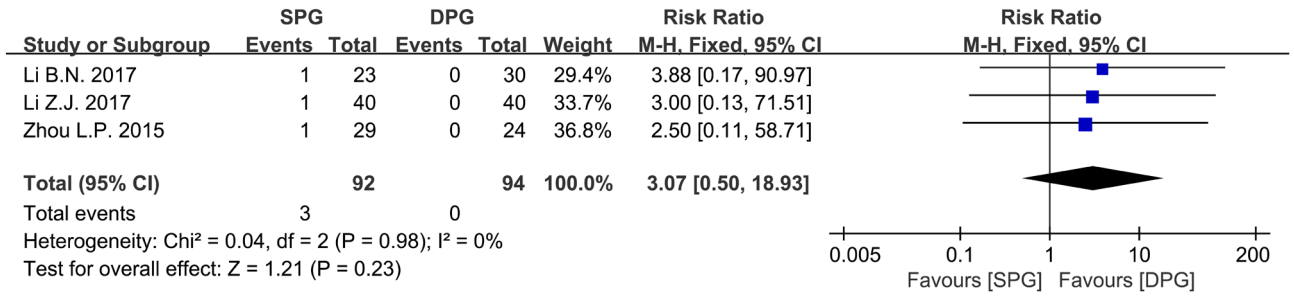

Figure 9

Plate fracture forest plot (22, 23, 24).

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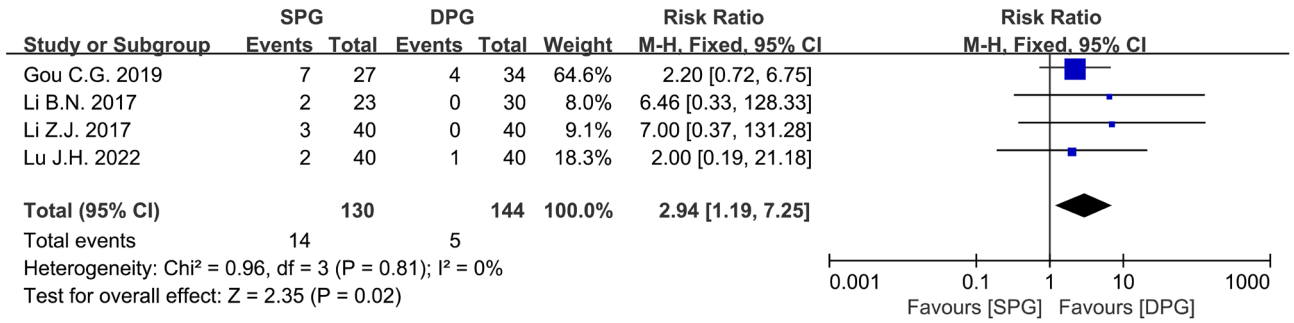

Figure 10

Malunion forest plot (21, 23, 24, 29).

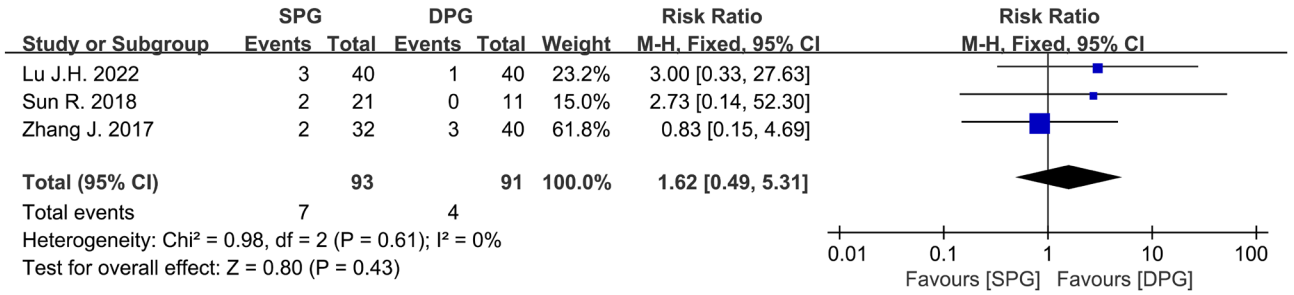

Figure 11

Delayed union forest plot (21, 25, 28).

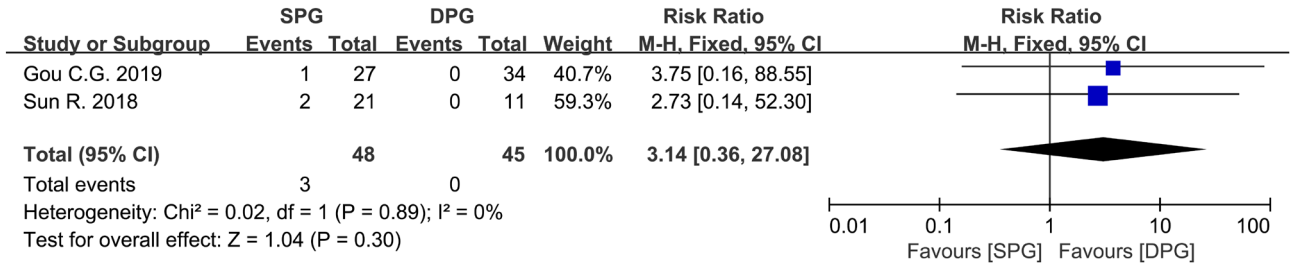

Figure 12

Nonunion forest plot (28, 29).

Incision infection

A total of three studies (18, 21, 28) reported the outcome of postoperative incision infection, and a total of 141 patients were included, including 76 in the SPG and 65 in the DPG. The results of the heterogeneity test showed that there was no heterogeneity between the studies ($I^2 = 0\%$; $P = 0.47$). Therefore, a fixed-effects model was selected for the analysis, and the results showed (Fig. 13) that there was no significant difference between the two groups (RR = 0.85; 95% CI: 0.23–3.13; $P = 0.81$).

Publication bias

Funnel plots were constructed to assess publication bias. The points in the funnel plot were distributed in a nearly symmetrical manner, indicating that there was no significant publication bias in our analysis (Supplementary Fig. 1). However, the distribution of results for overall excellent and good rates of knee function, malunion, delayed union, ROM of the knee joint post-operation at 6 months, operation time, and overall complications was asymmetrical, suggesting that publication bias is probable (Supplementary Fig. 2).

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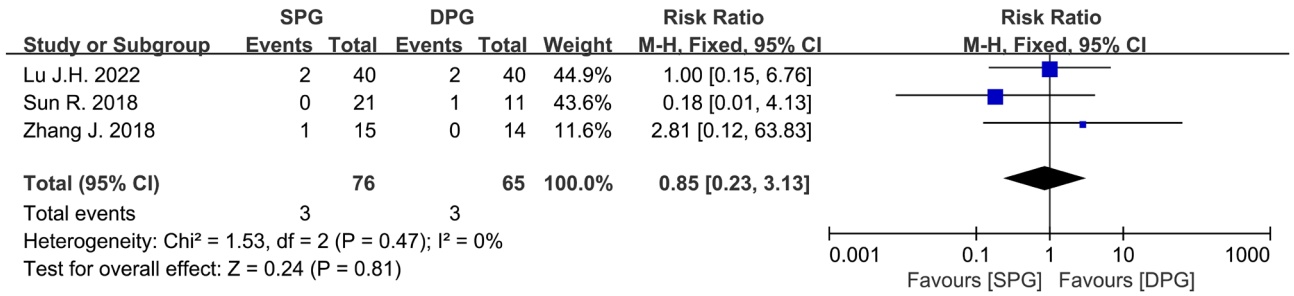

Figure 13

Incision infection forest plot (18, 21, 28).

Discussion

We conducted a meta-analysis of ten studies (18, 21, 22, 23, 24, 25, 26, 27, 28, 29), and in terms of knee function, the knee mobility of the DPG was better than that of the SPG at 6 months postoperatively. Although there was no significant difference in the rate of good knee function between the two groups, the overall rate of good knee function of the DPG was higher than that of the SPG (84.2% vs 78.2%), which was consistent with the results of previous studies (30, 31). Double plate fixation increases the stability of the internal implant (16, 18), allowing patients to engage in early functional exercises and early weight-bearing activities, effectively promoting their recovery. Figure 14 illustrates a 51-year-old woman who sustained a right-sided distal femoral fracture after falling down the stairs. The patient was treated with a lateral locking plate, but postoperatively developed limited knee joint mobility and nonunion of the fracture.

In terms of surgical safety, the operative time and intraoperative bleeding were significantly higher in the DPG than in the SPG. A systematic review of available vascular studies by DeKeyse *et al.* (16) showed that the femoral artery passes through the mid-femoral stem approximately 16.0–18.8 cm proximal to the adductor tubercle, and that medial plating of the distal femur is safe to apply. A retrospective analysis by Nam *et al.* (32) of 82 elderly cases of distal femur fracture showed that the average operative time and intraoperative bleeding were higher in the DPG than in the SPG, but there was no significant difference between the two groups. Double plate fixation required additional placement of medial plates, which increased operative time and bleeding. The increase in operating time and bleeding will lead to an increase in the risks associated with anaesthesia and postoperative infections, so the operator should have sufficient surgical experience, improve preoperative planning, operate carefully during the operation to reduce soft tissue injuries and take effective haemostatic measures to reduce the risks associated with the operation.

Figure 14

(A) X-rays of the injury. A 51-year-old woman who sustained a right-sided distal femoral fracture (AO/OTA 33C1.2, Gustilo-Anderson type I) after falling down the stairs. (B) Immediate postoperative X-rays. The patient was treated with lateral locking plate, and the fracture was well positioned. (C) At 16 months postoperatively, X-rays and CT revealed bone nonunion, fracture lines still visible, discontinuity of interosseous trabeculae, and sclerosis of the fracture ends, along with active knee flexion of 40°. (D) Immediate postoperative radiographs were taken at the time of the second surgery. After intraoperative knee release, a positive knee valgus stress test was found and artificial bone implantation and medial locking plate fixation were performed to enhance internal fixation stability. (E) Six-month postoperative X-rays after the second operation. The fracture line is blurred and the fracture is healing well.

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In terms of postoperative complications, the DPG can reduce the overall incidence of postoperative complications compared to the SPG (7.32% vs 17%), and reduce the occurrence of knee joint deformity healing. However, there was no statistical difference in complications such as nonunion and delayed healing of fractures reported after surgery in both groups. There was no significant difference in fracture healing time between the two groups. Liu *et al.* (31) believed that although the locked double plate structure has good fixation stability, the fully locked structure may lead to excessive rigidity, thereby hindering the secondary healing of fractures. Kiyono *et al.* (33) reported a higher rate of nonunion in comminuted distal femoral fractures with bone medial fracture distance exceeding 5 millimetres. Smoking and fracture translation are prognostic risk factors for nonunion in the treatment of distal femoral fractures using the LCP system (31, 33). Fracture healing is influenced by both mechanical and biological factors (34, 35). Double plate fixation increases the medial support of the fracture area, forming a central fixation similar to an intramedullary nail along with the lateral plate, improving the mechanical environment for fracture healing and preventing abnormal healing with knee joint varus or valgus. However, the inevitable placement of the medial plate increases the soft tissue injury on the medial side and disrupts the blood supply, which is detrimental to fracture healing. Overall, the study results show no significant difference in fracture healing time between the two groups.

The type of literature included in this study for analysis, only one was an RCT study (18) and the remaining nine were cohort studies (21, 22, 23, 24, 25, 26, 27, 28, 29), with a low grade of evidence for the quality of the literature and a small sample size, which led to certain flaws in this meta-analysis. In addition, the patients included in this study were all Chinese. There may be a selection bias, but the included studies were independently screened by two researchers according to the inclusion and exclusion criteria.

Conclusion

In terms of clinical efficacy, there was no significant difference between the DPG and SPG in terms of the rate of excellent knee function and the time to fracture healing, but the DPG was able to improve the knee mobility at 6 months postoperatively, which was a more favourable clinical outcome. In terms of surgical safety, there was no significant difference between the two groups in terms of plate breakage, postoperative infection, delayed fracture healing, and non-union, and DPG had fewer overall postoperative complications and less healing of knee deformity, but it would increase the surgical time and the amount of bleeding. The validity of the study is undermined by the limited sample size, significant risk of bias, and exceedingly low level of certainty, necessitating a cautious interpretation of these findings. Additional future randomised controlled trials with substantial sample sizes and rigorous methodologies are imperative to validate and reinforce this result.

Supplementary materials
This is linked to the online version of the paper at https://doi.org/10.1530/EOR-23-0160.

ICMJE Conflict of Interest Statement
The authors declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the study reported.

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HC, MZ, and KZ were responsible for study design and quality control; GZ, JL, and QX were responsible for data collection; and GZ and JL were responsible for data analysis and writing manuscript.

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