

A Meta-analysis Comparing Lateral Decubitus with Supine Position for Surgery for Intertrochanteric Fractures

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Abstract

Purpose: There are few studies compares surgery with proximal femoral nail antirotation (PFNA) in lateral decubitus with that in supine position about their advantages and disadvantages for patients with intertrochanteric femoral fractures. Previous studies reported conflicting findings. This meta-analysis was to compare the efficacy and safety of surgery with PFNA in different surgical positions.

Methods: Relevant randomized controlled trials comparing surgery with PFNA in lateral decubitus with surgery in supine position for intertrochanteric fractures patients were included into this meta-analysis. Inclusion criteria of this meta-analysis were: randomized controlled trials comparing lateral decubitus with supine position for surgery for intertrochanteric fractures and reporting at least one of the main outcomes, including blood loss, operating time, hospital stay, and length of incision, Harris values and union time.

Results: Six randomized controlled trials were finally included into this meta-analysis. Pooled results showed that there were less blood loss, less operation time, smaller incision and higher Harris values score in lateral decubitus group. Sensitivity analysis by sequential omission of individual studies showed the significance of weighted mean difference was robust, which suggested this outcome was credible.

Conclusions: Surgery with PFNA in lateral decubitus can benefit intertrochanteric fractures patients with less blood loss, less operation time, shorter incision and high Harris values scores compared with surgery in supine position according to our research.

Keywords: Intertrochanteric femoral fracture; Proximal femoral nail antirotation; Lateral decubitus; Supine position; Meta-analysis

Introduction

Intertrochanteric femoral fracture has become increasingly common especially in elderly patients [1,2]. Treatment of intertrochanteric femoral fracture depends on medical condition, bone quality and biomechanics of the fracture configuration of the patient [2,3]. In the past few decades, Intertrochanteric Femoral Fractures could be treated by using several effective internal fixation such as dynamic hip screw (DHS), dynamic condylar screws (DCS), proximal femoral nail (PFN) and proximal femoral nail antirotation (PFNA). Among these internal fixations, proximal femoral nail antirotation shows its advantages compared with other internal fixations [4-6]. Surgery with PFNA can benefit patients with intertrochanteric femoral fracture with less blood loss, less operation time, fewer complications. In result, PFNA is used globally.

Proximal femoral nail antirotation is generally used in surgery with supine position. This surgery has a high require of operating bed and equipment of fluoroscopy, which limits it being used in more primary hospitals. Recently, more and more surgeons perform surgery with PFNA in lateral decubitus. Surgery with PFNA in lateral decubitus doesn't need an extension table, so it can be performed in primary hospitals. Additionally, some surgeons observe that surgery in lateral decubitus has some advantages, such as less blood less, less operation time, comparing with surgery in supine position. However, there are not so many studies compares surgery in lateral decubitus with that in supine position about their advantages and disadvantages. Thus, to provide the most comprehensive assessment of the lateral decubitus and supine position for surgery for intertrochanteric fractures, we performed this meta-analysis based on all relevant randomized controlled trials comparing lateral decubitus with supine position for surgery for intertrochanteric fractures.

Methods

Search strategy and eligibility criteria

We searched Pubmed, Embase, and China Knowledge Infrastructure (CNKI) databases for randomized controlled trials comparing lateral decubitus with supine position for surgery for intertrochanteric fractures. We used the following search items: ("PFNA" or "proximal femoral nail antirotation") and (("surgical position") or ("lateral decubitus") and ("supine position")) and ("intertrochanteric fractures" or "peritrochanteric fractures" or "subtrochanteric fractures" or "perthrochanteric fractures" or "extracapsular hip fractures"). The references of the retrieved articles were also confirmed and language restriction wasn't imposed in our search.

Inclusion criteria of this meta-analysis were: randomized controlled trials comparing lateral decubitus with supine position for surgery for intertrochanteric fractures and reporting at least one of the main outcomes, including blood loss, operating time, hospital stay, and length of incision, Harris values and union time. Exclusion criteria were: cases series that investigated either lateral decubitus or supine position for surgery for intertrochanteric fractures, data were

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duplicated, demographic background of the patients and preoperative conditions were not similar, usable data were not reported and inconsistencies were resolved by reaching a consensus between all authors after discussion.

Data extraction and quality assessment

We extracted following information from every study: Year of publication, study design, number of patients, fracture classification, average follow-up time, blood loss, operating time, hospital stay, length of incision, Harris values and union time. Quality of randomized controlled trials included in this meta-analysis was assessed by the Jadad score [7], which was as follows: was the study described as randomized, was the study described as double blind, was there a description of withdrawals and dropouts [7]. Randomized controlled trials with scores no less than three points were defined as high quality, while with scores less than three points were defined as lesser quality randomized controlled trails [7].

Statistical analysis

In each study the pooled odds ratio (OR) with a 95% confidence interval (CI) was calculated for dichotomous outcomes, and weighted mean difference (WMD) with a 95% confidence interval (CI) was calculated for continuous outcomes. To assess the between-study heterogeneity more precisely, both the Chi² based Q statistic test (Cochran's Q statistic [8]) to test for heterogeneity and the I² statistic to quantify the proportion of the total variation attributable to heterogeneity were calculated [9]. A significance level of less than 0.10 for the Chi² test was interpreted as evidence of heterogeneity. When there was no statistical evidence of heterogeneity, a fixed effect model was adopted [10]; otherwise, a random effect model was chosen [11]. Besides, to validate the credibility of outcomes in this meta-analysis, a sensitivity analysis was performed by sequential omission of individual studies [12]. Publication bias was investigated by funnel plot and an asymmetric plot suggested possible publication bias [13]. Statistical analyses were performed with the software program RevMan (Version 5.0, Copenhagen: The Nordic Cochrane Centre, the Cochrane Collaboration). All P-values were two-sided and a P-value of less than 0.05 was deemed statistically significant.

Results

Study characteristics

There were 67 initial record identified. A total of 57 of these records were excluded, leaving 10 potentially relevant studies. Then we excluded 2 non-random studies and 2 studies for no available data. Six randomized controlled trials were included into this meta-analysis [14-19]. Table 1 summarized the main characteristics of the included studies. Table 2 showed the methodological quality of included studies in this meta-analysis. The quality of randomized controlled trials included was assessed using the Jadad scoring system, and three trials were high quality randomized controlled trials with scores no less than three points (Figure 1).

Blood loss and operation time

Data for blood loss were reported in 6 trials (Table 3 and Figure 2). There was significant heterogeneity among these trials (I²=95%, P<0.00001). The random effects model was used to pool the results. It was showed in this meta-analysis that surgery in lateral decubitus was marginally associated with less blood loss compared with surgery in supine position (WMD_{Blood loss} = -52.12 ml, 95%CI -87.61 to -16.63, P=0.004) (Figure 2). Besides, sensitivity analysis by sequential omission of individual studies showed the significance of WMD_{Blood loss} was robust, which suggested this outcome was credible.

Data for operation time were reported in 5 trials (Table 3 and Figure 2). There was no significant heterogeneity among these trials (I²=0%, P=0.66). The fixed effects model was used to pool the results. It was showed in this meta-analysis that surgery in lateral decubitus was marginally associated with less operation time compared with surgery in supine position (WMD_{Operation time} = -14.77 min, 95%CI -16.55 to -12.99, P<0.00001) (Figure 2). Besides, sensitivity analysis by sequential omission of individual studies showed the significance of WMD_{Operation time} was robust, which suggested this outcome was credible.

Length of incision

Data for length of incision were reported in 3 trials (Table 3 and Figure 3). There was no significant heterogeneity among these trials (I²=24%, P=0.27). The fixed effects model was used to pool the results.

Study	Study design ^a	Indication	lateral decubitus group	Supine position group
Li Xue et al. [14]	RCT	intertrochanteric fractures (31A1-3)	60 patients (77.3 years,26 males)	60 patients (75.7 years,29 males)
Zhu Weiguo et al. [15]	RCT	intertrochanteric fractures (31A1-3)	40 patients (76.5 years,17 males)	40 patients (78.3 years,19 males)
Liu Jianmin et al. [16]	RCT	intertrochanteric fractures (31A1-3)	22 patients (70.3 years,13 males)	21 patients (71.1 years,12 males)
Fu Yuping et al. [17]	RCT	intertrochanteric fractures (Evans II-IV)	22 patients	20 patients
Huang Jin et al. [18]	RCT	intertrochanteric fractures	48 patients	31 patients
Yang bo et al. [19]	RCT	intertrochanteric fractures (Evans I-IV)	17 patients	14 patients

^a RCT was for randomized controlled trial.

Table 1: Main characteristics of the studies included into the meta-analysis.

Study	Randomization	Allocation concealment	Blinding	Loss to follow-up	Jadad score	Baseline		
						Age	Gender	Fracture type
Li Xue et al. [14]	Adequate	Unclear	Unclear	Yes	4	Comparable	Comparable	Comparable
Zhu Weiguo et al. [15]	Adequate	Unclear	Unclear	Yes	4	Comparable	Comparable	Comparable
Liu Jianmin et al. [16]	Adequate	Unclear	Unclear	Yes	4	Comparable	Comparable	Comparable
Fu Yuping et al. [17]	Inadequate	Unclear	Unclear	Yes	2	Comparable	Comparable	Comparable
Huang Jin et al. [18]	Inadequate	Unclear	Unclear	Yes	3	Comparable	Comparable	Comparable
Yang bo et al. [19]	Adequate	Unclear	Unclear	Yes	3	Comparable	Comparable	Comparable

Table 2: Methodological quality of included studies in this meta-analysis.

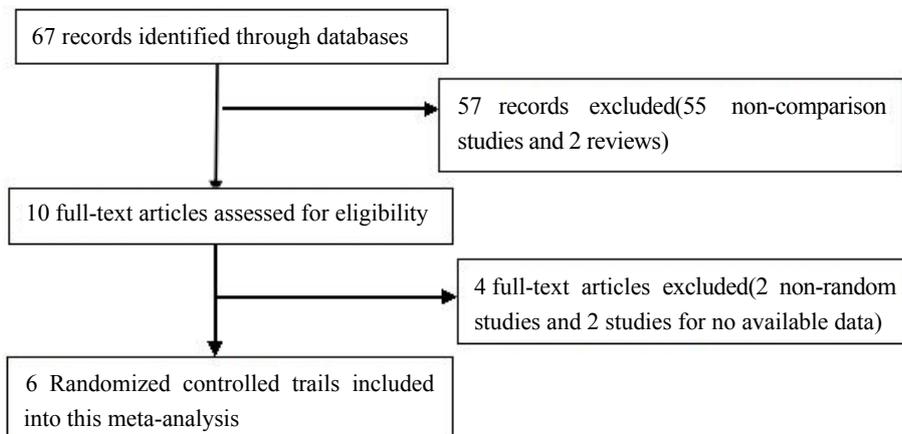


Figure 1: Flow chart demonstrating selection of studies for inclusion in the meta-analysis.

Comparison items	Number of included studies	WMD or odds ratio		Heterogeneity		Model
		WMD/OR(95%CI)	P-value	I ² (%)	P _H	
Blood loss	6	-52.12 (-87.61 to -16.63)	0.004	95	<0.00001	Random
Operation time	5	-14.77 (-16.55 to -12.99)	<0.00001	0	0.66	Fixed
Hospital stay	3	-0.89 (-2.34 to -0.55)	0.23	79	0.009	Random
Length of incision	3	-2.47 (-2.64 to -2.30)	<0.00001	24	0.27	Fixed
Harris values	3	1.36 (0.01 to 2.70)	0.05	0	0.83	Fixed
Union time	4	-1.00 (-3.20 to -1.19)	0.37	94	<0.00001	Random

Table 3: Summary of meta-analysis of comparing lateral decubitus with supine position for surgery for intertrochanteric fractures.

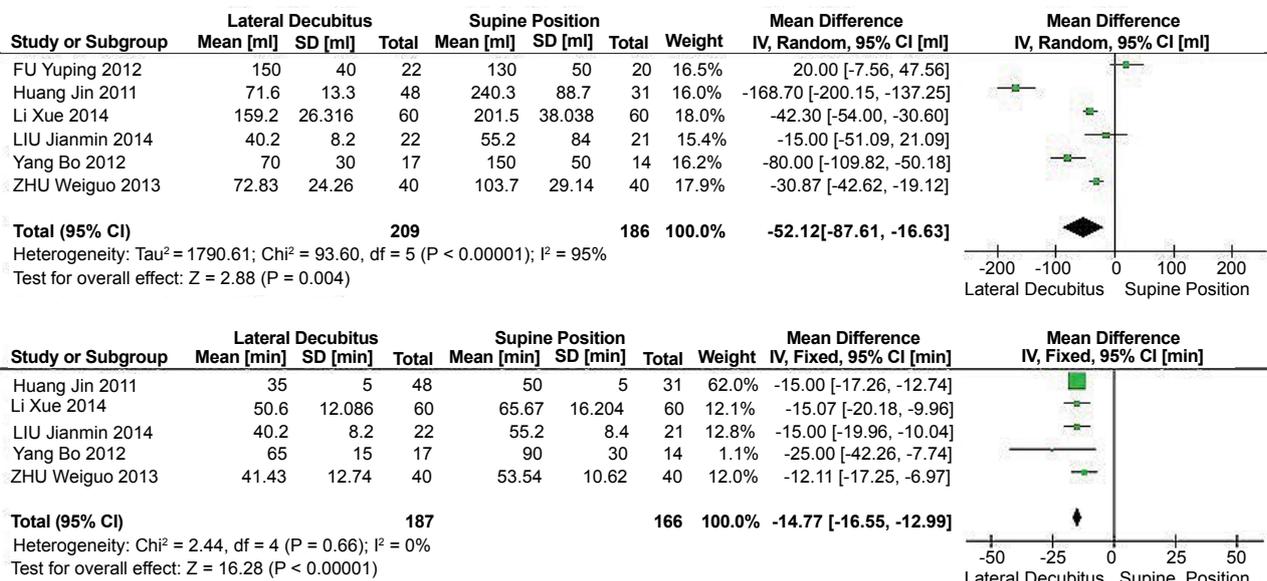


Figure 2: Forest plot of pooled WMD with 95% CI for comparing lateral decubitus with supine position for surgery for intertrochanteric fractures on the assessment of blood loss and operation time (The size of the data marker corresponds to the weight of the study. The diamond and vertical broken line represent the summary estimate).

It was showed in this meta-analysis that surgery in lateral decubitus was marginally associated with smaller incision compared with surgery in supine position (WMD_{Length of incision} = -2.47 cm, 95%CI -2.64 to -2.30, P<0.00001) (Figure 3). Besides, sensitivity analysis by sequential omission of individual studies showed the significance of WMD_{Length of incision} was robust, which suggested this outcome was credible.

Harris values

Data for Harris values were reported in 3 trials (Table 3 and Figure 4). There was no significant heterogeneity among these trials (I²=0%, P=0.83). The fixed effects model was used to pool the results. It was showed in this meta-analysis that surgery in lateral decubitus was marginally associated with higher score compared with surgery

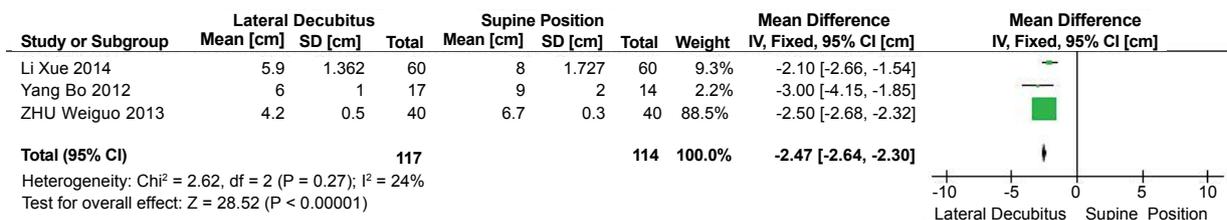


Figure 3: Forest plot of pooled WMD with 95% CI for comparing lateral decubitus with supine position for surgery for intertrochanteric fractures on the assessment of length of incision (The size of the data marker corresponds to the weight of the study. The diamond and vertical broken line represent the summary estimate).

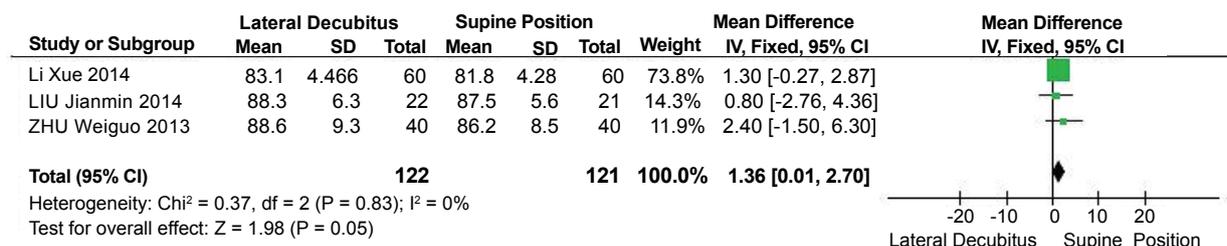


Figure 4: Forest plot of pooled WMD with 95% CI for comparing lateral decubitus with supine position for surgery for intertrochanteric fractures on the assessment of Harris values (The size of the data marker corresponds to the weight of the study. The diamond and vertical broken line represent the summary estimate).

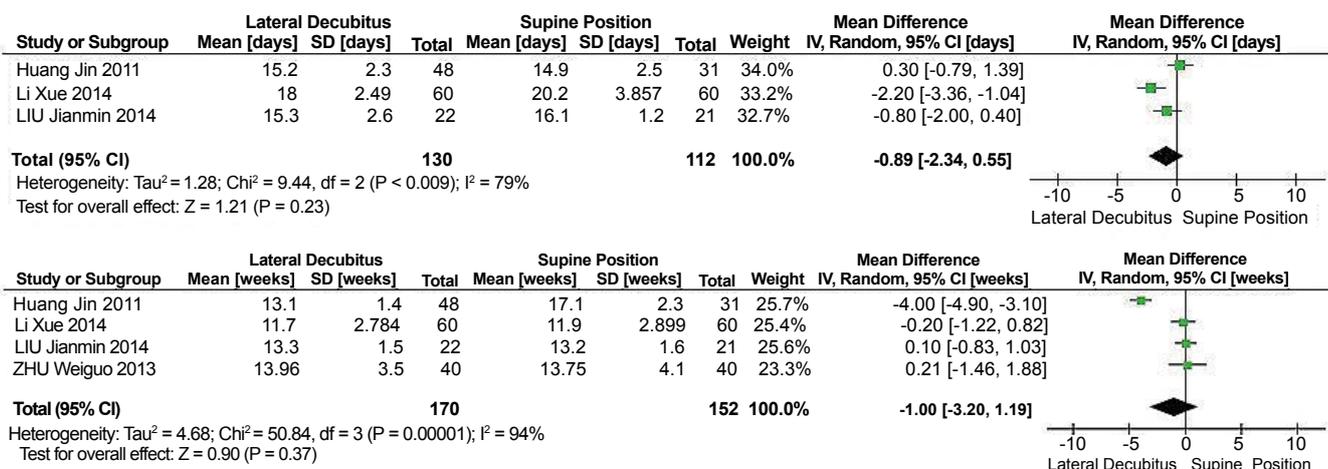


Figure 5: Forest plot of pooled WMD with 95% CI for comparing lateral decubitus with supine position for surgery for intertrochanteric fractures on the assessment of hospital stay and union time (The size of the data marker corresponds to the weight of the study. The diamond and vertical broken line represent the summary estimate).

in supine position (WMD_{Harris values} = 1.36 points, 95%CI 0.01 to 2.70, P=0.05) (Figure 4). Besides, sensitivity analysis by sequential omission of individual studies showed the significance of WMD_{Harris values} was robust, which suggested this outcome was credible.

Hospital stay and union time

Data for hospital stay were reported in 3 trials (Table 3 and Figure 5). There was significant heterogeneity among these trials (I²=79%, P=0.009). The random effects model was used to pool the results. Meta-analysis showed that there was no different in term of the hospital stay between these two groups (WMD_{Hospital stay} = -0.89 days, 95%CI -2.34 to -0.55, P=0.23) (Figure 5). Besides, sensitivity analysis by sequential omission of individual studies showed the significance of WMD_{Hospital stay} was robust, which suggested this outcome was credible.

Data for union time were reported in 4 trials (Table 3 and Figure 5). There was significant heterogeneity among these trials (I²=94%, P<0.00001). The random effects model was used to pool the results. Meta-analysis showed that there was no different in term of the union time between these two groups (WMD_{Union time} = -1.00 weeks, 95%CI -3.20 to -1.19, P=0.37) (Figure 5). Besides, sensitivity analysis by sequential omission of individual studies showed the significance of WMD_{Union time} was robust, which suggested this outcome was credible.

Discussion

Proximal femoral nail antirotation is widely used in surgery for intertrochanteric fractures [2,3]. Surgeons can finish the surgery with PFNA either in lateral decubitus or in supine position. There are some studies comparing the outcomes of lateral dicubitus and supine

position for surgery for intertrochanteric fractures, but there is obvious inconsistency of effects of those studies [14-21]. The better surgical position of surgery with PFNA remains controversial. Therefore, we performed this meta-analysis by including 6 randomized controlled trials to provide the most comprehensive assessment of lateral decubitus or supine position for surgery for intertrochanteric fractures. This meta-analysis showed the result that there were less blood loss ($WMD_{\text{Blood loss}} = -52.12$ ml, 95%CI -87.61 to -16.63, $P=0.004$), less operation time ($WMD_{\text{Operation time}} = -14.77$ min, 95%CI -16.55 to -12.99, $P<0.00001$), smaller incision ($WMD_{\text{Length of incision}} = -2.47$ cm, 95%CI -2.64 to -2.30, $P<0.00001$) and higher Harris values score ($WMD_{\text{Harris values}} = 1.36$ points, 95%CI 0.01 to 2.70, $P=0.05$) in lateral decubitus group. However, there was no difference in term of hospital stay ($WMD_{\text{Hospital stay}} = -0.89$ days, 95%CI -2.34 to -0.55, $P=0.23$) and union time ($WMD_{\text{Union time}} = -1.00$ weeks, 95%CI -3.20 to -1.19, $P=0.37$) between those two groups.

The PFNA, which have been widely adopted for patients with intertrochanteric fractures, is an intramedullary device with a helical blade rather than a screw for better purchase in the femoral head [4-6,22,23]. Surgery with PFNA in supine position has a high require of operating bed and equipment of fluoroscopy, which limits it being used in more primary hospitals. On the contrary, Surgery with PFNA in lateral decubitus doesn't need an extension table, so it can be performed in primary hospitals [18,19]. According to our meta-analysis, surgery with PFNA in lateral decubitus can benefit intertrochanteric fractures patients with less blood loss, less operation time, shorter incision and high Harris values scores. Thus, we should improve surgical technique with PFNA in lateral decubitus and generalize it to primary hospitals so that it can benefit more and more patients with intertrochanteric fractures.

Significant heterogeneity was observed between the included trials for intraoperative blood loss, hospital stay and union time. This heterogeneity may be attributable to variation in the skills of the surgeons and the different types of intertrochanteric fractures. The eligibility criteria for inclusion of intertrochanteric fractures patients were different from each other. The difference may have an influence on the obvious consistency of effects across those included studies and result in the heterogeneity. Besides, samples in trials included in this meta-analysis are not quite large, which may influence the heterogeneity. An individual patient data meta-analysis is necessary to ensure uniformity in either defining patients' characteristics for intertrochanteric fractures or defining outcome measures [24,25]. More randomized controlled trials with large samples are needed to decrease heterogeneity and make the outcome more meaningful.

In conclusion, surgery with PFNA in lateral decubitus can benefit intertrochanteric fractures patients with less blood loss, less operation time, shorter incision and high Harris values scores compared with surgery in supine position. In term of hospital stay and union time, there is no difference in these two surgical positions. However, more powered randomized studies are needed to identify the outcomes from this meta-analysis. Long-term period effects also need further studies.

Compliance with Ethical Standards

Disclosure of potential conflicts of interest

The authors declare that they have no conflict of interest.

Research involving human participants and/or animals

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

Informed consent

For this type of study formal consent is not required.

Conflict of Interest

The authors declare that they have no conflicts of interest concerning this article.

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