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Review

Fascia iliaca compartment block reduces pain and opioid consumption after total hip arthroplasty: A systematic review and meta-analysis

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ABSTRACT

Background: Optimal pain management after total hip arthroplasty (THA) remains controversial. We perform a meta-analysis from randomized controlled trials (RCTs) to evaluate the efficacy and safety of fascia iliaca compartment block (FICB) in THA.

Methods: In this meta-analysis, we conducted electronic searches of Pubmed, Medline, Cochrane library, and Web of Science before February 2019. We collected RCTs to compare FICB and placebo for pain control after THA. The outcome measurements consisted of pain score, opioid consumption, length of hospitalization and postoperative complications. All data analyses were conducted using STATA 13.0. Cochrane Collaboration's tool was adopted to assess the risk of bias.

Results: Seven RCTs met our inclusion criteria with 165 patients in the FICB groups, and 160 patients in the placebo groups. The present meta-analysis indicated that there were significant differences between the groups in terms of pain score at postoperative 12 h (WMD = −0.285, 95% CI [-0.460, −0.109], P = 0.002) and 24 h (WMD = −0.391, 95% CI [-0.723, −0.059], P = 0.021). FICB was associated with significant superior in opioid consumption at postoperative 12 h (WMD = −5.394, 95% CI [-8.772, −2.016], P = 0.002) and 24 h (WMD = −6.376, 95% CI [-10.737, −2.016], P = 0.004) compared with placebo. No significant difference was identified regarding length of hospitalization (WMD = 0.112, 95% CI [-0.125, 0.350], P = 0.354).

Conclusion: Fascia iliaca compartment block was effective for pain relief during the early post-operative period after total hip arthroplasty. Meanwhile, it reduced the cumulative morphine consumption and the risk of opioid-related adverse effects.

1. Introduction

Total hip arthroplasty (THA) has been shown well-recognized efficacy in improving pain and joint range of motion for patients with severe hip osteoarthritis and femoral head necrosis [1,2]. It is reported that more than 280 thousand THAs were performed annually in the US and the incidence was increased along with the aging [3]. A majority of patients suffer moderate to severe pain and it may affect physiological function and mental recovery. Delay rehabilitation is associated with several complications, such as pulmonary infection, deep venous thrombosis (DVT) [4] and pulmonary embolism (PE) [5]. Thus, postoperative pain after THA is a major concern for surgeons and patients.

Pain control after THA is still an interesting topic. Effective analgesia results in improved functional recovery and patients' satisfaction. Although several analgesic methods have been used including local infiltration anesthesia, femoral nerve block, epidural analgesia and patients controlled analgesia [6–8], optimal strategy is still under debate. Fascia iliaca compartment block (FICB) is an anterior approach to the lumbar plexus with little side effects [9]. It is reported to effectively block nervi femoralis and nervi cutaneus femoris lateralis when performed by specialists in anesthesiology or orthopedics [10]. Hsu et al. [11] reported that comparing with intravenous analgesic, FICB could provide better quality during positioning of femur fracture patients for a spinal block and a shorter time for spinal anesthesia. However, Behrends et al. indicated that preoperative FICB did not improve pain control after hip arthroscopy but did result in quadriceps weakness, which may contribute to an increased fall risk.

Whether FICB is effective in reducing pain and opioid consumption after total hip arthroplasty remains controversial due to the small number of the published studies, as well as the low quality of the present articles. Therefore, we perform a meta-analysis from randomized controlled trials (RCTs) to evaluate the efficacy and safety of FICB in THA. We hypothesized that FICB was associated with less pain scores and morphine consumption without adverse effects.

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2. Methods

2.1. Search strategy

The work has been reported in line with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) and AMSTAR (Assessing the methodological quality of systematic reviews) Guidelines. We identified relevant studies by an electronic search consisting of five English language databases: MEDLINE (1966 to January 2019), the Cochrane Central Register of Controlled Trials, Physiotherapy Evidence Database (PEDro), EMBASE (1974 to January 2019) and OVID (1946 to January 2019). The keywords and search strategy include: (total hip arthroplasty or total hip replacement) AND (Fascia iliaca compartment block). Where possible, we contacted authors for additional information. Two investigators identified eligible studies and extracted data independently.

2.2. Search strategy

The citations and abstracts generated by the literature search were reviewed by two researchers independently. Inclusion criteria were as follows: (a) patients undergoing THA; (b) fascia iliaca compartment block for postoperative pain management in the experimental group; (c) placebo in the control group; (d) at least one of the following outcome measures was reported: postoperative pain score, opioid consumption, incidence of complications and duration of hospitalization; (e) randomized controlled trials. Exclusion criteria were as follows: (a) reviews, letters and case reports; (b) unavailable data for extraction. A consensus procedure was conducted for study selection. If consensus was not reached, a third reviewer would make a judgment.

2.3. Date extraction

Two researchers independently extracted the data from the included literature. The corresponding author was consulted for details in the case of incomplete data. The following information was extracted: First author name, year of publication, intervening measures, comparable baseline, sample size and outcome measures. Other relevant parameters were also extracted from individual studies.

2.4. Quality assessment of included studies

The Cochrane Collaboration “Risk of bias” tool was used to evaluate the methodological quality of the selected studies. Seven potential risks of bias were judged in the assessment tool: (i) details of randomization method, (ii) allocation concealment, (iii) blinding of participants and personnel, (iv) blind outcome assessment, (v) incomplete outcome data, (vi) selective outcome reporting, and (vii) other sources of bias. Each aspect could further be classified as a low, high or unclear risk. Recommendations Assessment, Development and Evaluation (GRADE) system was used to grading the evidence level. Disagreements were resolved through discussions.

2.5. Statistical analysis

All data analyses were conducted using STATA 13.0. For continuous data, each outcome was calculated using the weighted mean difference (WMD) and 95% confidence intervals (CIs). Risk difference (RD) with a 95% CI were calculated for dichotomous outcomes. Heterogeneity was examined using I^2 statistic. Studies with an $I^2 < 50\%$ were considered to have low heterogeneity, $I^2 > 50\%$ were considered high heterogeneity. If there was significant heterogeneity among the studies, the random-effects model was used; otherwise, the fixed-effects model was considered acceptable.

3. Results

3.1. Literature search

Our initial search yielded a total of 208 relevant articles, of which 102 were excluded for duplicate studies and various reason the basis of the titles and abstracts (Fig. 1). 97 were excluded for irrelevant articles and one was excluded because of case control and review article. In addition, manual search of relevant reference did not identify any additional studies. At last, seven [12–18] randomized controlled trials (RCTs) were selected for this meta-analysis.

3.2. Study characteristics participants

Descriptive data for the RCTs in this meta-analysis were shown in Table 1. All of them were published between 2007 and 2017, involving 325 participants with a diagnosis of osteonecrosis of the femoral head. Experiential groups received fascia iliaca compartment block for postoperative pain management and control groups received placebo. The mean age ranged from 59-year-old to 81-year-old in FICB groups and 62-year-old to 82-year-old in control groups. Average follow up ranged from 1 week to 3 months.

3.3. Risk of bias

Cochrane Collaboration's tool was adopted to assess the risk of bias. As shown in Table 2, five RCTs reported that participants were randomized with a computerized random number generator. Four RCTs showed that opaque, sealed envelope was used to make sure allocate concealment. Four studies performed double blinding. All RCTs provided complete outcome data. Other assessment of bias was unclear. Each risk of the bias item was expressed in terms of the percentage across all the included studies, which indicated the proportion of risk levels for each item bias (Table 3).

3.4. Outcome of meta-analysis

3.4.1. Pain score at 12 h

Seven studies compared the difference in the efficacy of FICB and placebo group on visual analogue score (VAS) at 12 h. There was no significant heterogeneity ($P = 0.081$, $I^2 = 46.7\%$) and a fixed effect modal was used. The aggregated results of these studies suggest that FICB was associated with an improved VAS at 12 h after THA (WMD = −0.285, 95% CI [-0.460, −0.109], $P = 0.002$, Fig. 2).

3.4.2. Pain score at 24 h

Five RCTs reported the VAS at 24 h after THA. A random effect modal was used because significant heterogeneity was found ($P = 0.013$, $I^2 = 68.5\%$). The present meta-analysis indicated that there was significant difference between groups regarding the VAS at 24 h (WMD = −0.391, 95% CI [-0.723, −0.059], $P = 0.021$, Fig. 3).

3.4.3. Pain score at 48 h

A total of four RCTs showed the VAS at 48 h after THA. There was significant heterogeneity and a random effect modal was adopted ($P = 0.002$, $I^2 = 80.0\%$). Our meta-analysis demonstrated that there was no significant difference between groups regarding the VAS at 48 h (WMD = −0.077, 95% CI [-0.169, 0.324], $P = 0.538$, Fig. 4).

3.4.4. Opioid consumption at 12 h

Four studies compared the difference in the efficacy of FICB and placebo group on opioid consumption at 12 h after THA. A random effect modal was adopted ($P < 0.001$, $I^2 = 94.7\%$). The aggregated results of these studies suggest that FICB could significantly reduce opioid consumption at 12 h (WMD = −5.394, 95% CI [-8.772, −2.016], $P = 0.002$, Fig. 5).

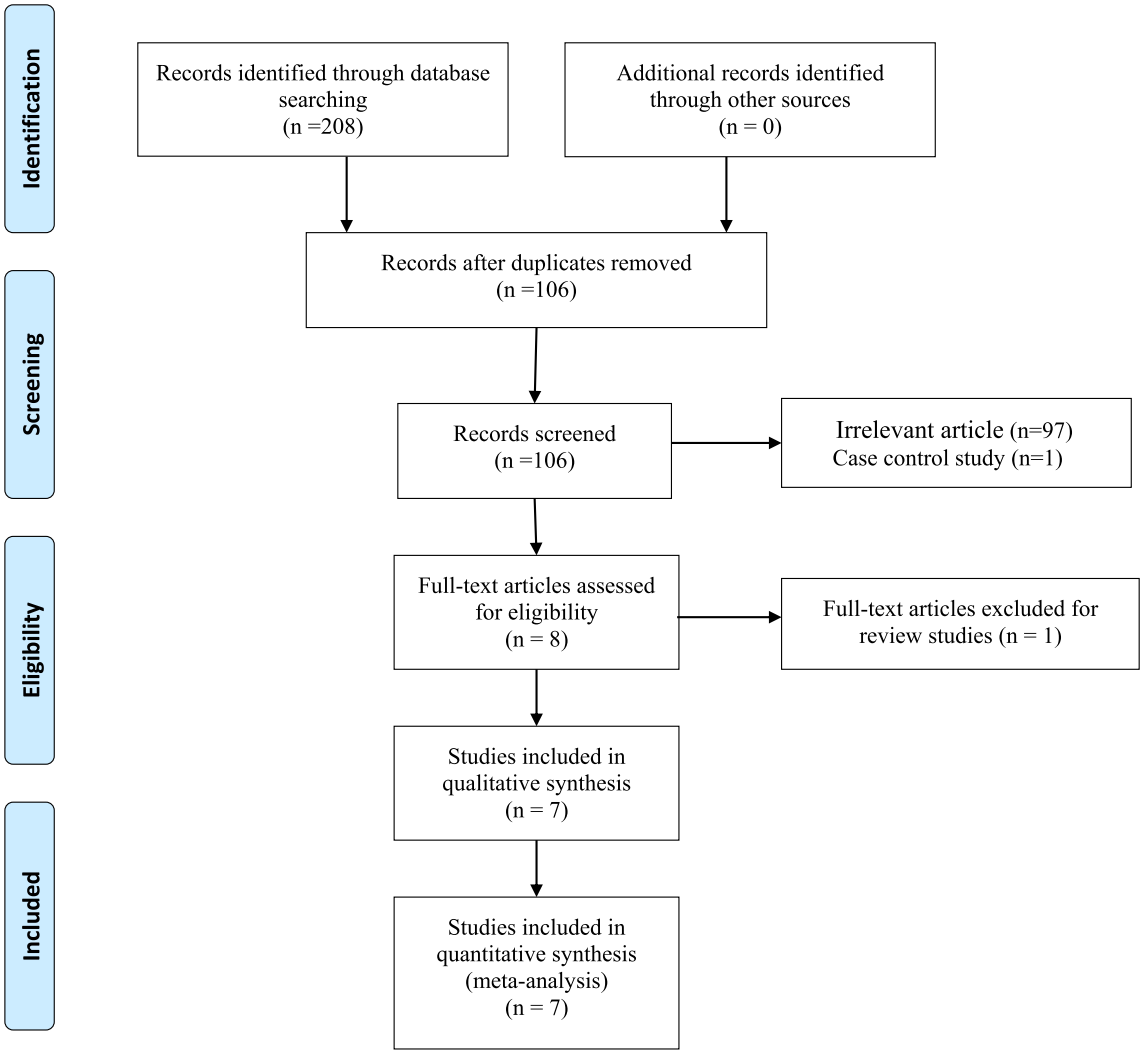


Fig. 1. Flow chart of study selection.

Table 1
Characteristics of the included studies.

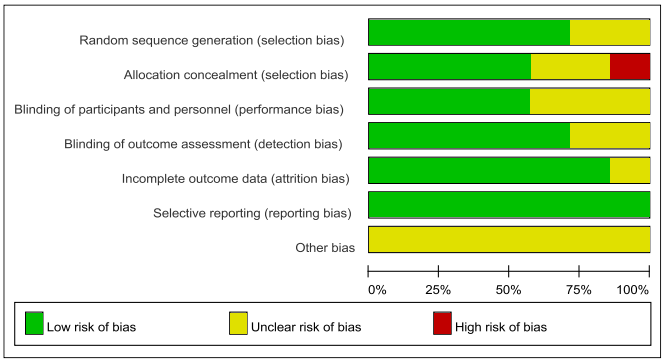
Study	Year	Design	Study	No. of patients	Gender (Male)	Age	Outcomes	Follow up
				FICB Control	FICB Control	FICB Control		
Stevens et al.	2007	RCT	THA	22 22	15 11	69 67	VAS 12–48 h opioid consumption 12–24 h length of hospitalization complications	1 month
Arrola et al.	2009	RCT	THA	24 17	12 7	67 70	VAS 12 h	3 months
Badica et al.	2010	RCT	THA	30 32	13 15	69 72	VAS 12 h opioid consumption 12–24 h length of hospitalization	2 months
Shariat et al.	2013	RCT	THA	16 16	7 8	61 57	VAS 12–24 h length of hospitalization	2 weeks
Deniz et al.	2014	RCT	THA	20 20	12 12	59 62	VAS 12–48 h opioid consumption 12–24 h length of hospitalization complications	1 week
Bang et al.	2016	RCT	THA	11 10	5 2	81 82	VAS 12–48 h length of hospitalization complications	1 week
Desmet et al.	2017	RCT	THA	42 43	14 19	60 67	VAS 12–48 h, opioid consumption 12–24 h complications	1 month

RCT: randomized controlled trial, TKA: total knee arthroplasty.

Table 2
Risk of bias summary: review authors' judgements about each risk of bias item for each included study.

Study	Random Sequence Generation	Allocation Concealment	Blinding of participates and personal	Blinding of outcome assessment	Incomplete Outcome Data	Selective Reporting	Other bias
Stevens	low risk	unclear risk	low risk	low risk	low risk	low risk	unclear risk
Arrola	low risk	low risk	low risk	low risk	low risk	low risk	unclear risk
Badica	unclear risk	unclear risk	unclear risk	low risk	low risk	low risk	unclear risk
Shariat	low risk	low risk	low risk	low risk	low risk	low risk	unclear risk
Deniz	unclear risk	high risk	unclear risk	unclear risk	low risk	low risk	unclear risk
Bang	low risk	low risk	low risk	low risk	low risk	low risk	unclear risk
Desmet	low risk	low risk	unclear risk	unclear risk	unclear risk	low risk	unclear risk

Table 3
Risk of bias graph.



3.4.5. Opioid consumption at 24 h

Four RCTs involving 231 patients reported the opioid consumption at 24 h. There is a high heterogeneity between the included studies (I^2 = 89.3%, P < 0.001). Compared with control group, FICB was associated with a significantly reduction of opioid consumption at 24 h (WMD = −6.376, 95% CI [-10.737, −2.016], P = 0.004, Fig. 6).

3.4.6. Length of hospitalization

Five RCTs provided the outcome of length of hospitalization after THA. No significant heterogeneity was identified in the pooled results, therefore a fixed-effects model was used (I^2 = 0.6%, P = 0.403). Our study demonstrated that there was no significant difference between groups (WMD = 0.112, 95% CI [-0.125, 0.350], P = 0.354, Fig. 7).

3.4.7. Incidence of complications

A total of four RCTs showed the postoperative complications after

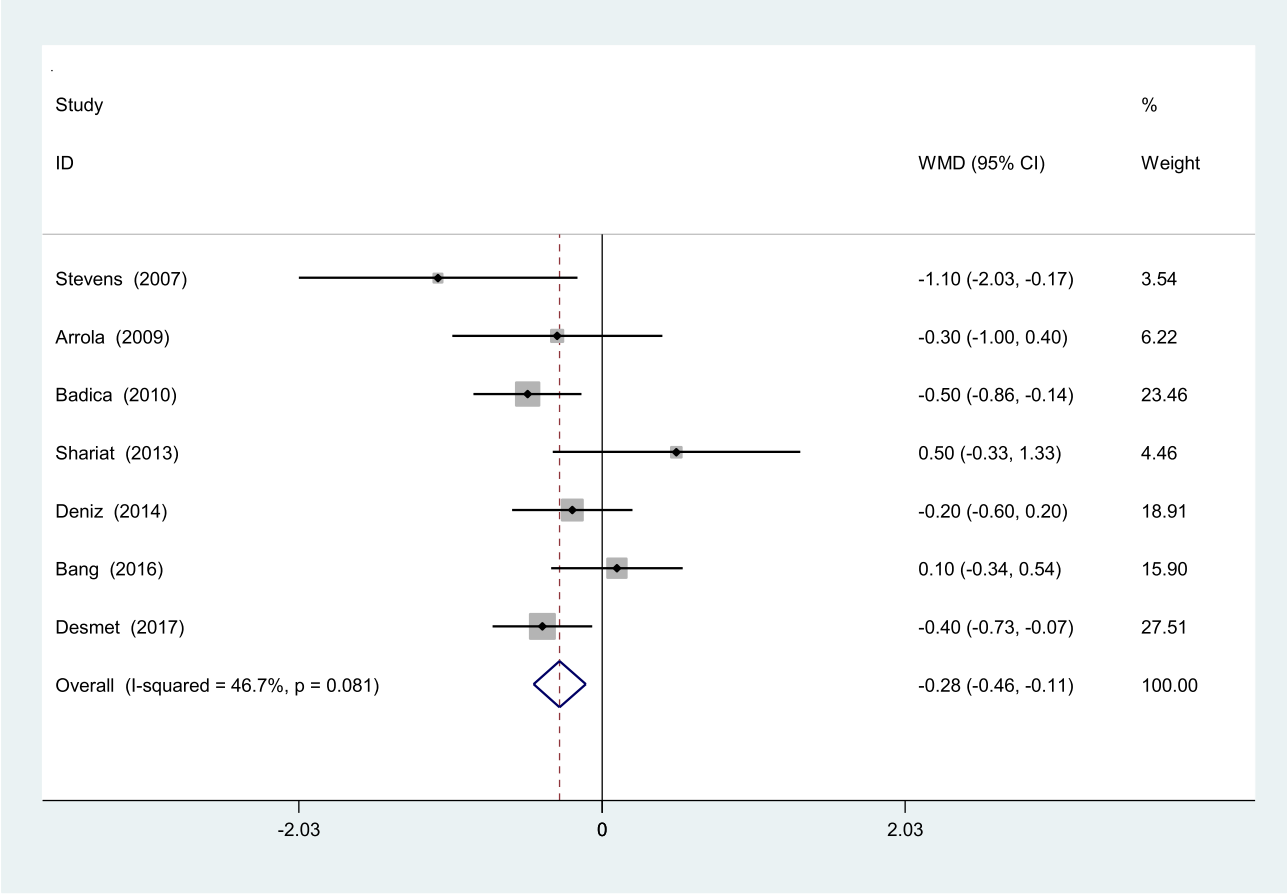


Fig. 2. Forest plot diagram of VAS at 12 h.

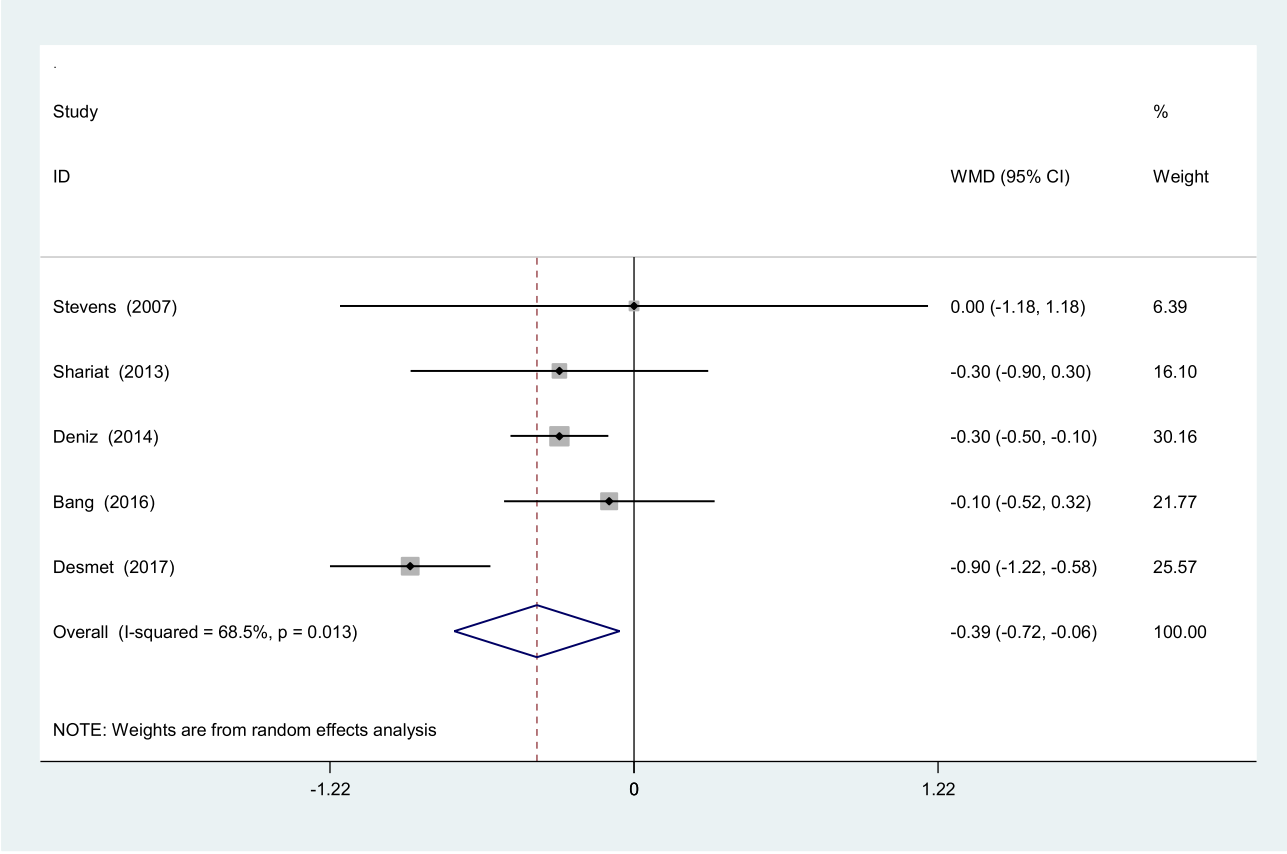


Fig. 3. Forest plot diagram of VAS at 24 h.

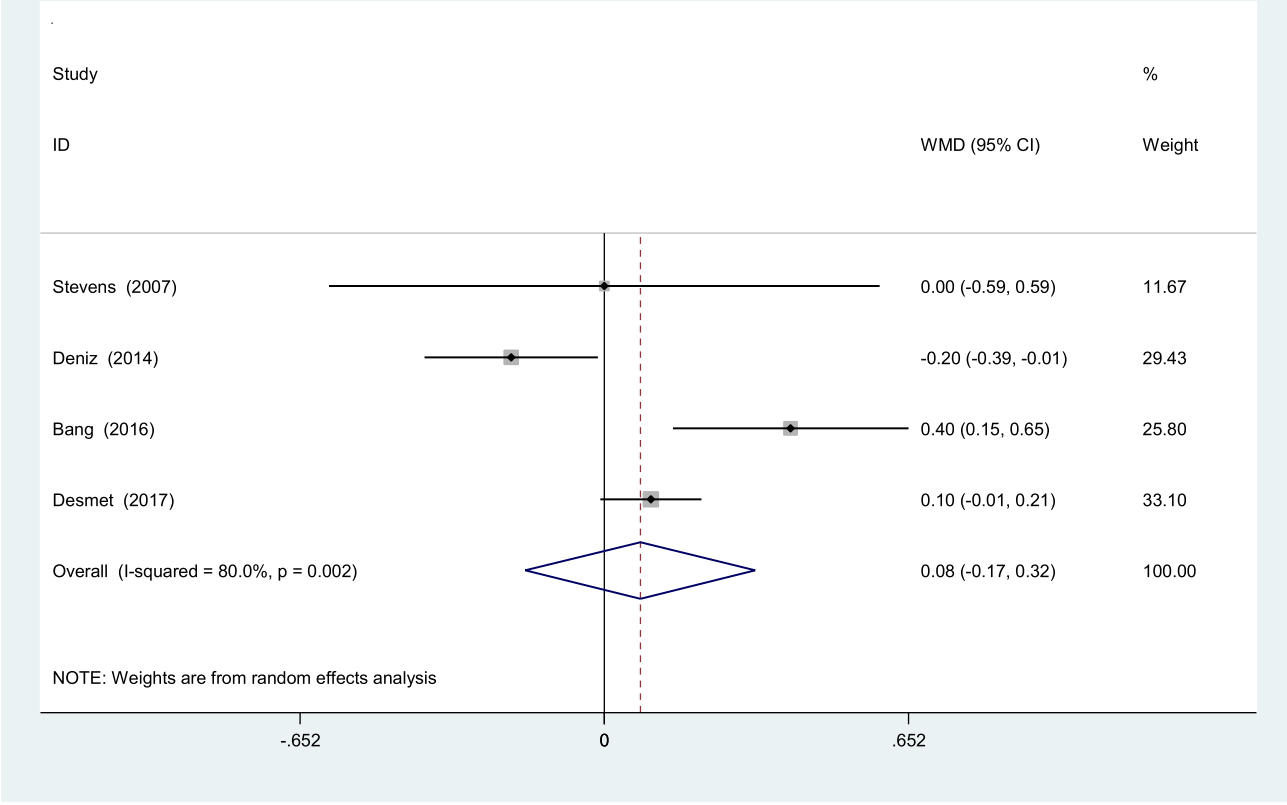


Fig. 4. Forest plot diagram of VAS at 48 h.

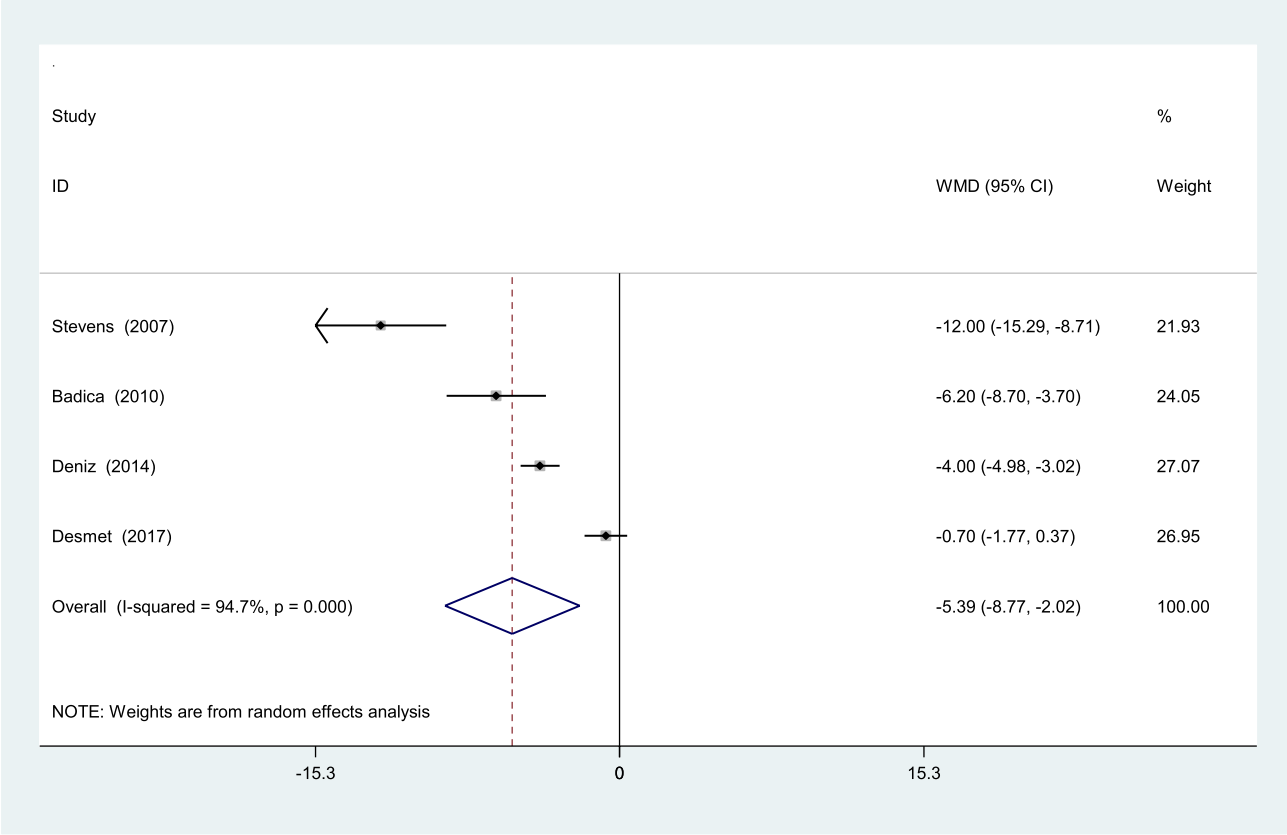


Fig. 5. Forest plot diagram of opioid consumption at 12 h.

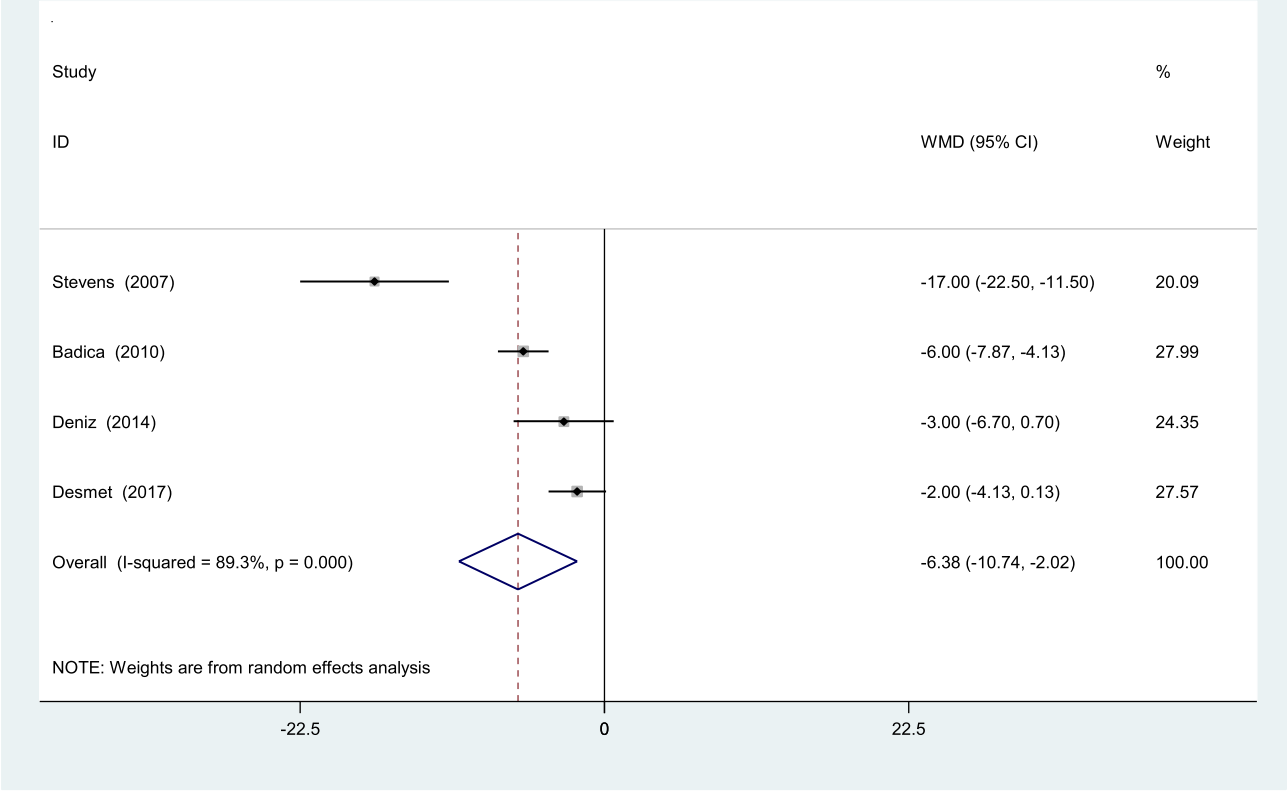


Fig. 6. Forest plot diagram of opioid consumption at 24 h.

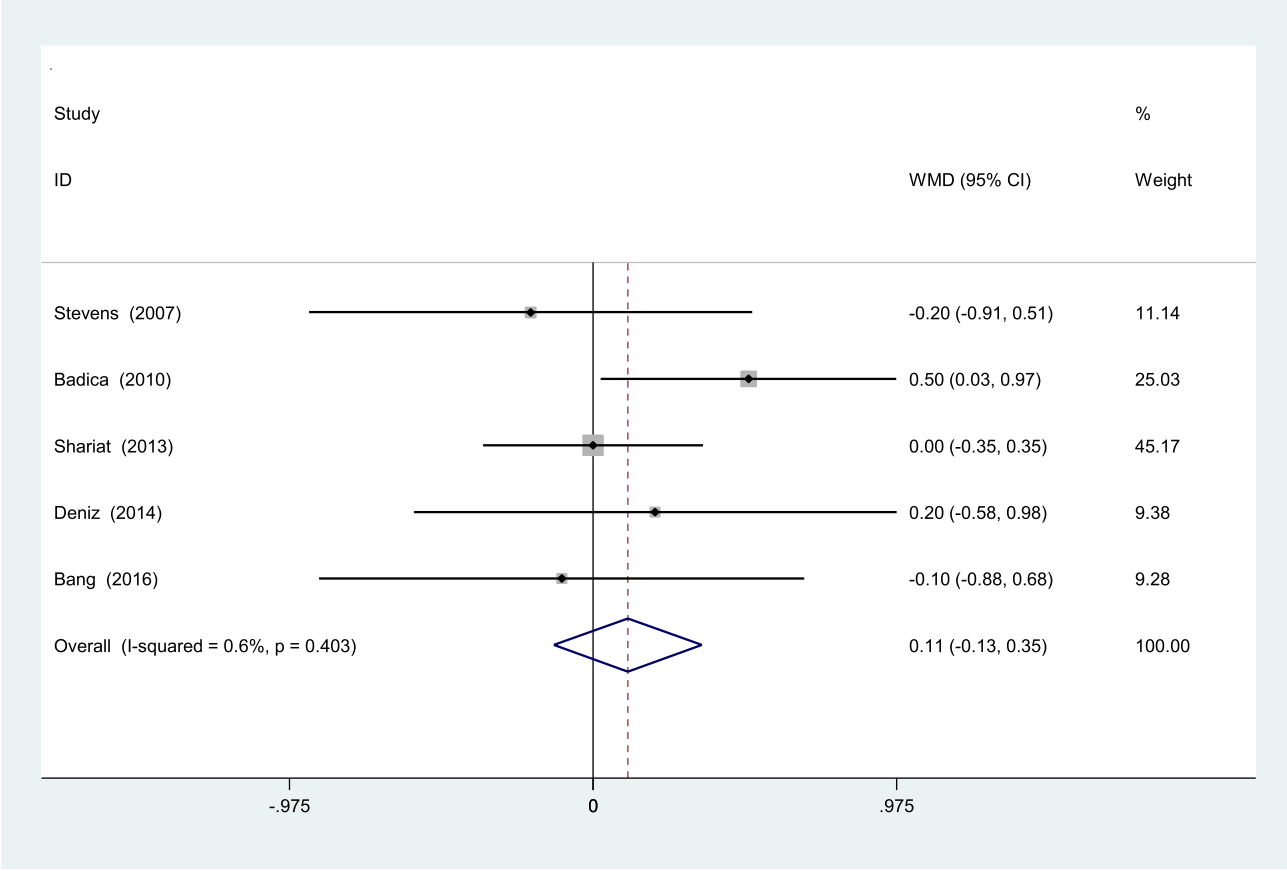


Fig. 7. Forest plot diagram of length of hospitalization.

THA. There was significant heterogeneity and a random effect modal was adopted (P = 0.022, I^2 = 50.6%). Our meta-analysis demonstrated that FICB could significantly reduce the occurrence of gastrointestinal reaction and did not increase the risk of falls (RD = −0.049, 95% CI [-0.096, −0.003], P = 0.037, Fig. 8).

3.4.8. Publication bias and evidence level

A low risk of publication bias was shown for the outcome of VAS at 12 h (Table 4). However, publication bias was a limitation which existed in all meta-analysis.

GRADE system was used to grading the evidence level. The overall evidence was moderate, which indicated that further research was likely to significantly alter confidence in the effect estimate and may change the estimate (Table 5).

4. Discussion

To the best of our knowledge, this is the first meta-analysis from RCTs to assess the efficacy and safety of FICB for pain control after THA. Our study indicated that FICB was associated with an improved pain relief and decreased opioid consumption.

Additionally, FICB could significantly reduce the occurrence of gastrointestinal reaction and did not increase the risk of falls. The overall evidence was moderate, which indicated that further research was likely to significantly alter confidence in the effect estimate and may change the estimate.

With the aging population, osteoarthritis (OA) is more and more common. It was reported that more than fifty million patients suffered from hip osteoarthritis in the USA.

THA is the final choice to reduce pain and improve joint function. The annual workload of THA procedures were expected to reach 3.5 million by 2030. It has been a public health issue. Pain control is crucial for functional recovery and rehabilitation after THA. Optimal analgesia could reduce length of hospitalization and postoperative complications.

Several analgesia methods have been tried for anesthesia and analgesia in hip replacement. Femoral nerve block is effective and easy to administer, and it can decrease the acute pain. Wiesmann et al. [19] reported that single shot femoral nerve block for THA resulted in earlier post-operative care unit discharge capability, improved lung function during the first six hours and better pain control within the first 24 postoperative hours. Tetsunaga et al. [20] demonstrated that there were no clinically significant differences in outcomes between femoral nerve block, epidural analgesia, patient-controlled analgesia after THA. However, some experts have shown that femoral nerve block was associated with a risk of femoral nerve injury and a potential for injury to the femoral vessels [21]. Recently, FICB was recommended and has been widely used for pain management after THA. FICB is an analgesic method which injects local anesthetic under the fascia of the iliacus muscle. It could be operated either guided by ultrasound or with a loss of resistance technique.

Currently, the efficacy of safety of FICB for pain control after THA remains controversial due to the limited number of published studies and poor quality of current evidence. Although previous meta-analysis [22] has shown that FICB was effective in reducing pain after total knee replacement and total hip replacement, they were different surgical procedures and it could cause huge clinical heterogeneity. Therefore, we performed the meta-analysis from high quality RCTs and only THA was included. Seven RCTs with 325 patients showed the outcome of pain score. VAS (0–10 cm) was used for pain measurement after THA, and the present meta-analysis indicated that FICB was associated with a significantly reduction of VAS within the first 24 postoperative hours after THA.

It was reported that approximately 30%–60% of patients suffered moderate to severe postoperative pain, especially within the first 24 h

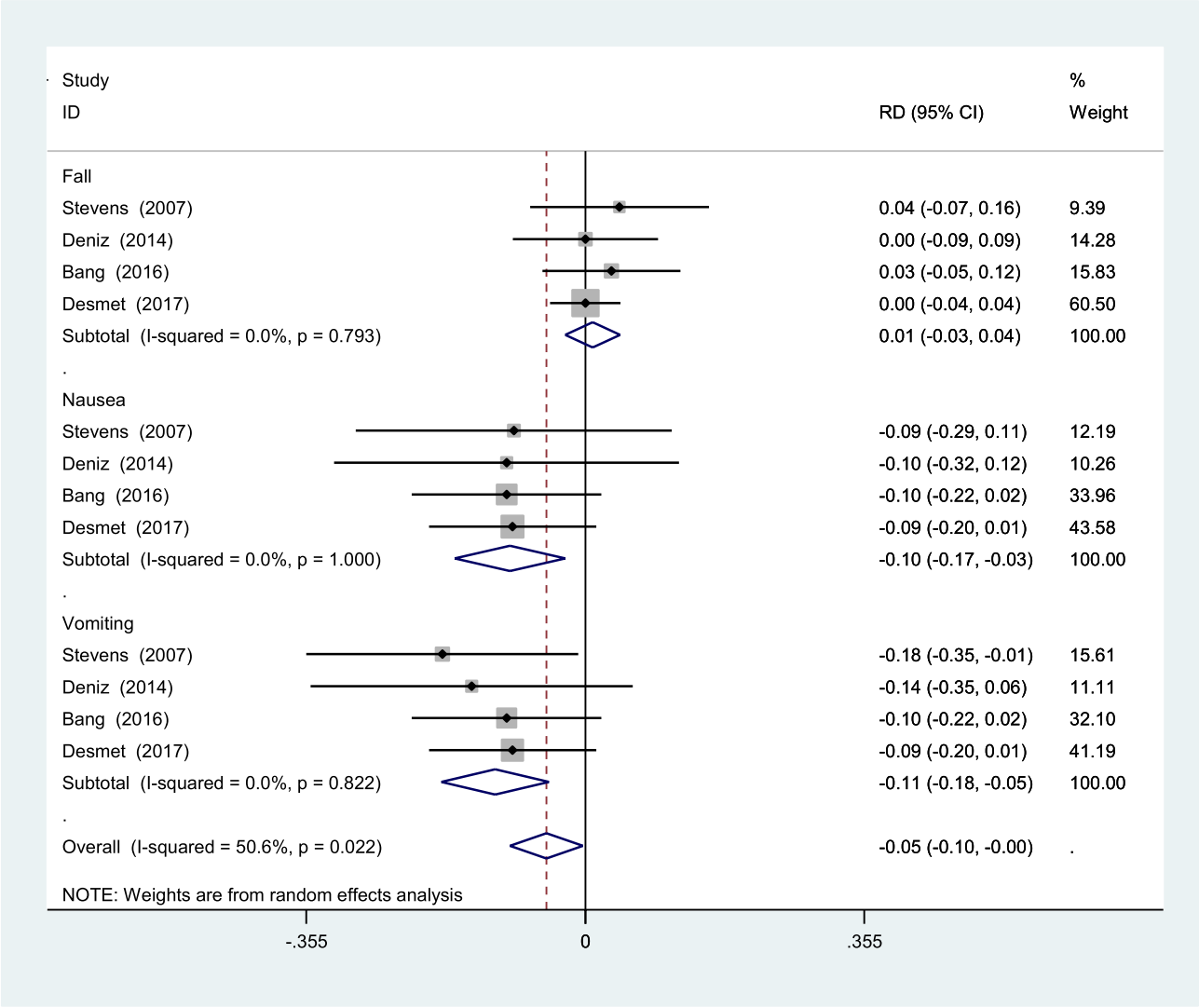
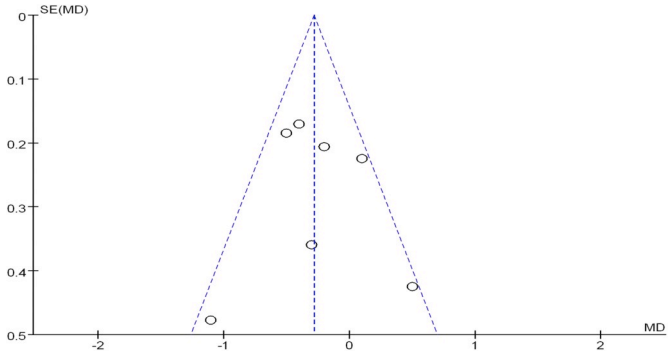


Fig. 8. Forest plot diagram of postoperative complications.

Table 4
Publication bias for VAS at 12 h.



after THA [23]. It has been well established that opioid is usually effective for pain relief, but often incurs side-effects that can prolong the length of hospitalization. Morphine, a mu-opioid receptor agonist, relieves pain by binding and activating the receptors in both the central and peripheral nervous systems [24]. As the most widely used narcotic for postoperative pain control, morphine has been reported a high incidence of adverse effects such as nausea, vomiting, headache, and urine retention, which could severely impede the postoperative convalescence [25,26]. Besides, drug dependence is also a major concern. Thus, it was crucial to decrease opioid consumption so as to improve postoperative recovery. Peripheral nerve block was reported with a morphine-sparing effect and recommended by the UK National Institute of Health and Care Excellence [27]. FICB was operated to block the femoral nerve, the obturator nerve, and the lateral cutaneous nerves. Foss et al. supported the use of FICB in acute management of hip fracture pain because it is an effective, easily learned procedure that also may reduce opioid side effects in this fragile, elderly group of patients. Watts et al. [28] showed that FICB is as effective as femoral nerve block as part of a multimodal anesthetic regimen for total knee replacement. Currently, there was no reliable evidence regarding the morphine-sparing effect for FICB in THA. In our study, four RCTs provided the outcomes of morphine consumption and the present meta-analysis indicated that FICB was associated with a significantly reduction of morphine consumption within the first 24 postoperative hours after THA.

As is known to us all, intravenous morphine was associated with several side effects. Gastrointestinal reactions were the most common. Effective analgesia could reduce opioid consumption and then decrease the risk of opioids-related complications.

A total of four RCTs showed the postoperative complications after THA. The overall incidence of nausea and vomiting is 7/109 in FICB groups compared 16/99 in controls. Our study indicated that the

Table 5
The GRADE evidence quality.

Quality assessment						Effect	Quality	Importance
No of studies	Design	Limitations	Inconsistency	Indirectness	Imprecision			
VAS at 12								
7	RCT	no serious limitations	no serious inconsistency	no serious indirectness	no serious limitations	WMD = −0.285, 95% CI [-0.460, −0.109]	high	CRITICAL
VAS at 24								
5	RCT	no serious limitations	serious inconsistency	no serious indirectness	no serious limitations	WMD = −0.391, 95% CI [-0.723, −0.059]	moderate	CRITICAL
VAS at 48								
4	RCT	no serious limitations	serious inconsistency	no serious indirectness	no serious limitations	WMD = −0.077, 95% CI [-0.169, 0.324]	moderate	CRITICAL
Opioid consumption at 12 h								
4	RCT	no serious limitations	serious inconsistency	no serious indirectness	no serious limitations	WMD = −5.394, 95% CI [-8.772, −2.016]	moderate	CRITICAL
Opioid consumption at 24 h								
4	RCT	no serious limitations	serious inconsistency	no serious indirectness	no serious limitations	WMD = −6.376, 95% CI [-10.737, −2.016]	moderate	CRITICAL
Length of hospitalization								
5	RCT	no serious limitations	no serious inconsistency	no serious indirectness	no serious limitations	WMD = 0.112, 95% CI [-0.125, 0.350]	high	IMPORTANT
Complications								
4	RCT	no serious limitations	serious inconsistency	no serious indirectness	no serious limitations	RD = −0.049, 95% CI [-0.096, −0.003]	moderate	CRITICAL

application of FICB could significantly reduce the risk of the post-operative complications. No dose-dependence analysis has been performed because only four RCTs were included and further investigation was still required. Theoretically, FICB increased the risk of fall because of the motor weakness. No significant difference was identified between groups.

Several limitations should be acknowledged. Firstly, only seven study with small sample sizes were included and statistical tests may be insufficient. Secondly, publication bias is unavoidable because the identified language was restricted to English. Thirdly, some important outcomes, such as range of motion and functional score were not analyzed. Lastly, substantial heterogeneity was found in some results, which might affect the reliability.

5. Conclusion

Fascia iliaca compartment block are effective for pain relief during the early post-operative period after total hip arthroplasty. Meanwhile, it can reduce the cumulative morphine consumption and the risk of opioid-related adverse effects.

Ethical approval

Ethical approval was not required, this is a meta-analysis.

Sources of funding

We did not receive any funding.

Author contribution

Yanping Gao: writing.
Helian Tan: data collections.
Ren Sun: data analysis.
Jie Zhu: study design.

Conflicts of interest

No conflicts of interest exists among authors.

Research registration number

Reviewregistry669.

Trial registry number

None.

Guarantor

Jie Zhu.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Data statement

I confirm that the relevant data is real and you can get them by consulting correspondence author.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijsu.2019.03.014.

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