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Comparison between pericapsular nerve group block and fascia iliaca compartment block for perioperative pain control in hip surgeries: A meta-analysis from randomized controlled trials

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ABSTRACT

Background: To alleviate pain related to hip surgeries, pericapsular nerve group block (PENG) is introduced as an innovative approach aims to improve analgesia without interfering with muscle motor activity. In this study, we compared the effectiveness and safety of PENG block to fascia iliaca compartment block (FICB) for managing acute pain related to hip operations.

Methods: Systematically looking through electronic databases, we only included randomized controlled trials (RCTs) involving hip surgeries. The perioperative pain scores at various time periods, postoperative narcotic demands in 24 h, the time of first opioid request, quality of patient positioning during spinal anesthesia (SA), patients' satisfaction, and adverse event incidence between the two groups were obtained through the study.

Results: The analysis included nine RCTs with a total of 524 patients. Compared to the FICB, PENG significantly reduced the pain scores early at 30 min post-block during positioning for SA (SMD = −0.98, 95% CI: −1.76 to −0.20, P = 0.01), improved the quality of positioning, and enhanced patient satisfaction. However, no significant differences were observed between PENG and FICB regarding pain scores postoperatively at different time periods during rest and exercise. Patients in the FICB group had more narcotic demands at 24 h post-surgical (MD = −8.09, 95% CI: −14.25 to −1.93, P = 0.01). Otherwise, no differences were detected regarding the time of first opioid request, postoperative complications, or length of hospitalization.

Conclusions: PENG offered better benefits in terms of reducing pain, while the patient is being positioned for SA and minimizing narcotic consumption over the first 24 hours following hip surgeries.

1. Introduction

Pain associated with hip surgery is a significant problem that needs to be addressed since it can result in a variety of complications, morbidities, and low levels of patient satisfaction [1]. Previous literature has linked persistent pain to poor patient outcomes because it puts the patient at an increased risk for anxiety, cognitive impairment, and sleep disturbance [2]. Additionally, pain makes it difficult to recover physically and delays mobilization, which raises the risk of thrombo-embolic events, prolongs hospital stays, and raises the expenses of medical services [3].

Numerous analgesic techniques such as peripheral nerve blocks, epidural analgesia, and intravenous opioids have been suggested [4]. Unfortunately, they all have their drawbacks. Opioid systemic use has been linked to several unwanted side-effects including respiratory depression, nausea, vomiting, and itching [5]. Patients who received epidural analgesia were more likely to experience hypotension and urine retention than other techniques [6]. In lower extremity joint procedures, multimodal analgesia along with

peripheral nerve block has been encouraged and is regarded as the gold standard for pain control [4].

It is challenging to deliver an effective perioperative nerve block in patients undergoing hip surgery because of the complexity of hip joint innervation. Histologically, the posterior hip capsule lacks sensory fibers and contains mostly mechanoreceptors, while the anterior capsule primarily contains nociceptors [4]. Anatomical research revealed that sensory supply of the hip joint anterior capsule consists of articular branches arising from obturator, accessory obturator, and femoral nerves. This means that all these nerves should be the primary targets for hip pain control [7].

The frequently used peripheral nerve blocks guided by ultrasound in the hip region are fascia iliaca compartment block (FICB), femoral nerve block (FNB), and 3-in-1 block [8–10]. However, the literature implies that the articular sensory branches supplying the anterior hip capsule are unpredictably inhibited so the analgesic effect of these blocks is not always satisfactory [11].

The FICB is a widely used regional analgesia that is favored by many anesthesiologists as it provides

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immediate and late postoperative analgesia in hip surgery [12]. Yet, it has been criticized for reducing the surgical limb muscle power, thus impeding postoperative patient mobilization, and postponing discharge following an outpatient hip arthroplasty [13]. Moreover, it has been reported that blocks, such as FICB, frequently fail to adequately block the obturator nerve, which contributes to the sensory supply of the anterior hip capsule [14].

A novel approach guided by ultrasound was introduced by Girón-Arango and colleagues in 2018; it stated that the articular branches from obturator, accessory obturator, and femoral nerves could be blocked using pericapsular nerve group (PENG) technique in which local anesthetic was deposited in the musculo-fascial plane between the psoas muscle tendon and the pubic ramus [14]. It has been used successfully as a localized anesthetic technique to control hip surgery pain without impairing muscle motor power [15]. Numerous studies have focused on the utility of PENG block in managing hip fracture and post-surgical pain, however more investigation is still needed to confirm its role [16]. Recently, few randomized controlled trials (RCTs) with limited sample sizes have been published to ascertain whether PENG block is equivalent to FICB block for analgesia in hip surgeries. Therefore, current meta-analysis was carried out to systemically collect and analyze results from these RCTs to verify the effectiveness and safety of PENG in comparison with FICB for perioperative pain control in hip surgical procedures.

2. Materials and methods

According to PRISMA (the Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement, this meta-analysis was reported. No ethical approval or patient agreement was necessary because all analyzed data were collected from previously published trials.

2.1. Search strategy

Electronic databases used to identify the possibly related studies, included Web of Science, PubMed, SCOPUS, ScienceDirect, and the Cochrane Library. The search was conducted by using Boolean operators (AND/OR) to link the following keywords: "hip surgeries OR fracture OR arthroplasty," "pericapsular nerve group block,", and "fascia iliaca block," Language was not constrained in any way. Most of the literature search was done in June 2022, and a second literature search was done in November 2022. To find more articles, manual cross-referencing of the collected trials and related publications was performed. The search process steps are described in Figure 1.

2.2. Eligibility criteria

Studies meeting the following criteria were included:
(1) Population: Adult patients who underwent elective hip arthroplasty or hip fracture surgeries.
(2) Interventions: Intervention group received pericapsular nerve group (PENG).
(3) Comparisons: Control group received fascia-iliaca compartment block (FICB).
(4) Outcomes: Pain scores, narcotic utilization, time to first rescue opioid, quality of positioning for spinal anesthesia, patients' acceptance, and incidence of postoperative complications. The included study must have reported at least one of the mentioned results.
(5) Study design: Clinically randomized controlled trials (RCTs).

Studies that did not follow the previous criteria were excluded from current meta-analysis. Data reported in the form of conference abstracts, case reports, protocols, or reviews were also eliminated.

2.3. Selection criteria

After database search, the two reviewers checked the abstracts of the collected studies independently. Next, both reviewers checked the full text of eligible articles that matched the inclusion criteria, and a decision was made. Any disagreements over which studies to include were resolved by the senior author.

2.4. Data extraction

Data were extracted from the included papers by the two authors independently. The following information was extracted and documented in a worksheet: first author name, year of publication, country, sample sizes, surgery type, anesthesia method, intervention timing, type and dose of used local anesthetic, regimen of postoperative analgesia, and outcome parameters. The study primary outcomes included static and dynamic pain scores (assessed with visual analog scale (VAS) or numeric rating scale (NRS)) at 0–1, 4–6, 8–12, and 24 hours after surgery. The secondary outcomes included total opioid (oral morphine equivalent doses) intake during 24 hours after surgery, time to first rescue analgesia, quality of positioning during spinal anesthesia, patient satisfaction, length of hospitalization, and postoperative nausea and vomiting (PONV).

2.5. Quality assessment

The two reviewers evaluated the quality of each RCT using the Cochrane Handbook for Systematic Reviews of Interventions as a guide. A risk of bias table, provided in part-2, Chapter-8.5 of the handbook [17], was
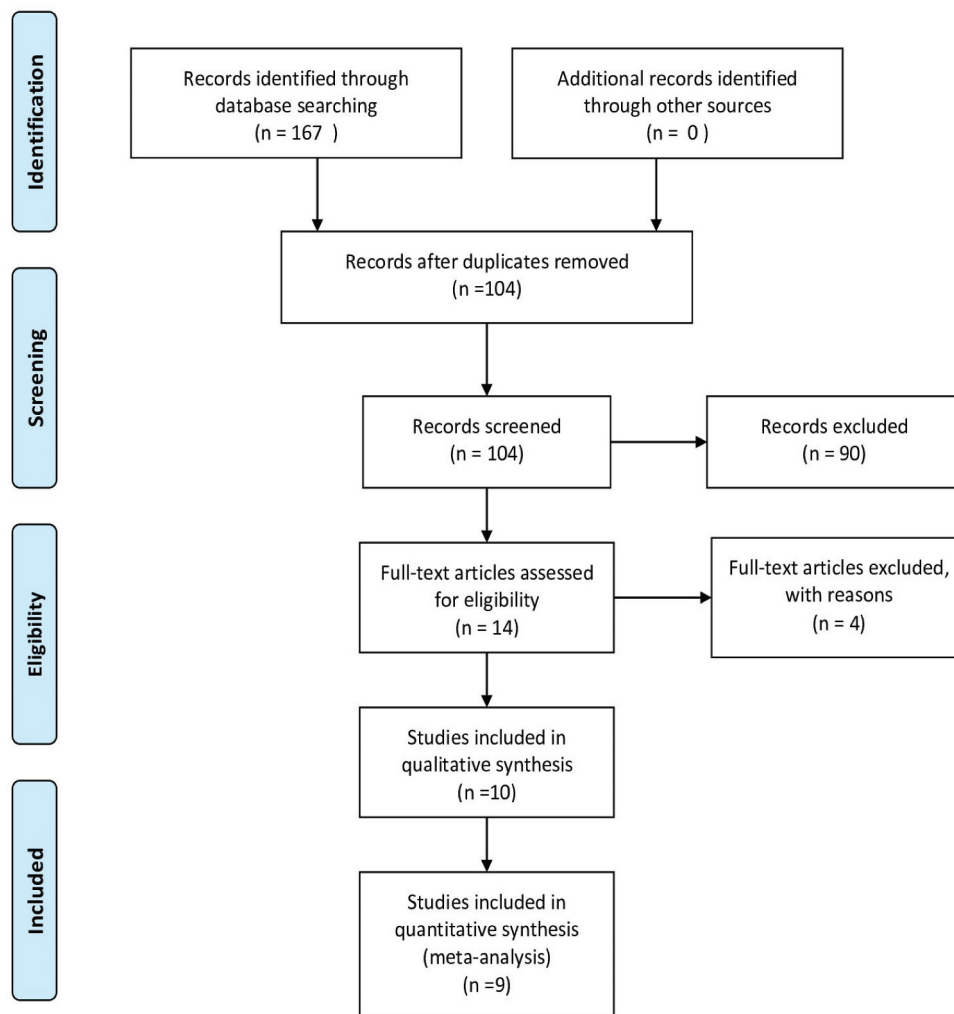
Figure 1. (PRISMA) flow chart representing the search and selection process.

employed. The table comprises seven main domains as follows: random-sequence generation, allocation-concealment generation, blinding of patients, blinding of physician, inadequate outcome data, selective outcomes reporting, and other potential causes of bias. For each item: Yes, No, or Unclear was recorded.

2.6. Data analysis and statistical methods

The collected data were processed and analyzed using the RevMan5.3 (Cochrane Collaboration, Oxford, UK) software. For heterogeneity measurement, the chi-square test was used to calculate P and I square values. No significant heterogeneity was identified if ($P > 0.10$) and ($I^2 < 50\%$), so a fixed-effect model for analysis of data was applied. When there was a significant heterogeneity, a random-effects model is applied. Continuous variables, such as pain scores, narcotic utilization, and quality of positioning, were pooled as mean difference (MD), or standard mean difference (SMD) with 95% confidence intervals (CI) using the generic inverse variance method. Meanwhile, dichotomous variables such as patient acceptance, PONV, and length of

hospital stay were pooled as relative risks with 95% CI using the Mantel–Haenszel (M–H) method. P values below 0.05 were used to verify the statistical significance.

3. Results

3.1. Literature search

Through the initial search, 167 studies were identified in total. Due to duplication, 63 studies were eliminated. Ninety papers could not be included after scanning the abstracts. Therefore, only 14 RCTs were remained, four of which were excluded. In the four excluded studies, two studies were published as conference abstracts without a subsequent full-text [18,19], and two studies combined Lateral Femoral Cutaneous Nerve Block with PENG block versus FICB in the procedure [20,21]. Another study was excluded from the quantitative analysis due to inadequate data reporting [22]. Finally, nine RCTs [](23,24,25,26,27,28,29,30,31) published between 2020 and 2022 were involved in the current meta-analysis as shown in Figure 1. These trials included 266 patients in the intervention group (PENG)

and 258 patients in the control group (FICB). All studies language was English, and no papers were extracted from gray literature.

3.2. Study characteristics

According to Table 1, the selected studies revealed both similarities and differences in several clinical aspects as follows: the sample sizes of all available literature were quite small, they ranged from 24 to 80 patients. All papers evaluated the analgesic efficacy of PENG compared to FICB in hip arthroplasty or hip fracture surgeries. PENG was given to the experimental groups, while FICB was given to the control groups. The dose and type of local anesthetics varied between articles. Preoperative nerve block was applied in eight studies (22,23,25,26,27,29,30,31), postoperative nerve block was used in two studies (24,27), and intra-operative nerve block was applied in one study (28). Nine studies (22,23,24,25,26,27,29,30,31)used spinal anesthesia (SA), and only one study (28) employed the general anesthesia. Participates in five studies (24,27,28,29,31) received patient-controlled analgesia (PCA) with opioids for acute pain management, while the remaining participants received IV analgesics at fixed time intervals with additional rescue opioid doses as needed. Pain intensity was expressed as a visual analog score or numeric rating score at different time points.

3.3. Risk of bias

To determine the probability of bias in RCTs, the Cochrane Handbook tool was used. All RCTs defined their randomization approach using computer software and offered clear inclusion and exclusion criteria. In seven studies, allocation concealment was achieved by sealed opaque envelopes. Blinding of both participants and outcome assessors was reported in five RCTs (23,25,27,28,31), and the rest reported single blinding to the assessor except for one article [30] that did not attempt to blind the investigator. All RCTs offered a clear outcome data presentation except for one study [22] which was eliminated from the quantitative analysis. The quality assessment of the study's methodology is summarized in Figure 2. The percentage of all included trials across every risk of bias item is presented in Figure 3.

3.4. Outcomes for meta-analysis

The remarkable finding, revealed by this meta-analysis, was that the PENG group demonstrated lower post-operative opioid use than the FICB group within the first 24 h and better quality of positioning during spinal anesthesia. PENG also had comparable analgesic action to FICB in the first 24 h following surgery. No

significant differences regarding PONV and length of hospital stay were identified.

(1) Pain score during positioning for spinal anesthesia [30 minutes post-block]:

Five included studies reported the pain score during positioning (23,25,26,29,31). The total pooled results preferred PENG group regarding low pain scores during spinal anesthesia placement (SMD = −0.98, 95% CI: −1.76 to −0.20, P = 0.01) as shown in Figure 4. A significant heterogeneity was detected among trials (x^2 = 37.59, df = 4, I^2 = 89%, P < 0.00001), so a random-effects model was applied.

(2) Postoperative static pain scores at different time periods:

Information about postoperative pain scores at variable time periods (0–1 h, 4–6 h, 8–12 h, 24 h) was available in all studies while at rest. Subgroup analysis was conducted to distinguish different time points of post-operative pain assessment at rest. The total pooled results of the subgroups revealed non-significant differences between PENG group and FICB group at the rest time points (0–1, 4–6, 8–12, 24 hrs) postoperatively (SMD = −0.10, 95% CI: −0.39 to 0.18, P = 0.48; SMD = 0.17, 95% CI: −0.03 to 0.37, P = 0.10; SMD = −0.24, 95% CI: −0.52 to 0.04, P = 0.09; SMD = 0.09, 95% CI: −0.24 to 0.42, P = 0.60 respectively) as shown in Figure 5. A significant heterogeneity was detected in the pain scores at 24 h (x^2 = 15.53, df = 6, I^2 = 61%, P = 0.02), so a random-effects model was applied.

(3) Postoperative dynamic pain scores at different time Points:

Information about postoperative pain scores at variable time periods (4–6 h, 8–12 h, 24 h) was available in five studies (24,25,27,28,29) during movement. Subgroup analysis was conducted to distinguish different time points of postoperative pain assessment with movement. The total pooled results of the subgroups revealed non-significant differences between PENG group and FICB group at the rest time points (4–6, 8–12, 24 hrs) postoperatively (SMD = −0.41, 95% CI: −0.84 to 0.03, P = 0.07; SMD = 0.15, 95% CI: −0.13 to 0.44, P = 0.28; SMD = −0.16, 95% CI: −0.59 to 0.27, P = 0.48, respectively) as shown in Figure 6. A random-effects model was applied due to the existence of a significant heterogeneity in the pain score at 4–6 h and 24 h (x^2 = 11.53, df = 4, I^2 = 65%, P = 0.02 and x^2 = 11.45, df = 4, I^2 = 65%, P = 0.02, retrospectively.

(4) Opioids consumption for 24 hours postoperative:

Table 1. Baseline characteristics of the included trials.

| No.	Study ID	Country	Number (PENG/FICB)	Surgery	Anesthesia	Time of intervention	LA Dose (PENG/FICB)	Postoperative analgesia	Outcomes
1	Shankar 2020 [23]	India	60 (30/30)	Hip fracture	SA	Preoperative	25 ml of 0.25% Ropivacaine	Tramadol 1 mg/kg IV as rescue analgesic	Pain scores (VAS), Opioid consumption, Quality of patient positioning.
2	Aliste 2021 [24]	Canada	40 (20/20)	Primary total hip arthroplasty	SA	Postoperative in PACU.	100 mg adrenalized levobupivacaine with epinephrine 5 μg/mL	PCA morphine infusion, paracetamol (1 gm/6 hr) and ketoprofen (100 mg/8 hr).	Pain scores (NRS) at rest and movement, Opioid consumption, Incidence of quadriceps motor block, Block-related adverse events, Length of hospital stay.
3	Jadon 2021 [25]	India	66 (33/33)	Hip fracture surgeries	SA	Preoperative	25 ml mixture of 0.25% bupivacaine and 8 mg dexamethasone	Paracetamol 1 gm IV every 8 h and 50 mg tramadol as rescue analgesia	Pain scores (NRS) at rest and movement, Opioid consumption, Quality of patient positioning.
4	Kulkarni 2021 [26]	India	60 (30/30)	Hip fracture surgeries	SA	Preoperative	20 mL of 0.25% bupivacaine	Not reported	Pain scores (NRS) during positioning, Quality of positioning, Patient acceptance
5	Natrajan 2021 [22]	India	24 (12/12)	Dynamic hip screw fixation or hemiarthroplasty	SA	Preoperative	20 mL of 0.5% ropivacaine	Paracetamol 1 gm, IV as rescue analgesic.	Pain scores (NRS), Time to first rescue analgesic, PONV.
6	Senthil 2021 [27]	India	40 (20/20)	Dynamic hip screw fixation and proximal femur nailing	SA	At the end of surgery	30 mL 0.25% Levobupivacaine and 4 mg dexamethasone	PCA fentanyl infusion	Pain scores (NRS, VAS) at rest and movement, Opioid consumption, Quadriceps femoris muscle strength.
7	Choi 2022 [28]	Korea	54 (27/27)	Unilateral total hip arthroplasty	GA	After induction of anesthesia	20 mL of ropivacaine 0.2% with epinephrine 1:200,000	PCA fentanyl infusion, celecoxib 200 mg orally and paracetamol 1 gm IV every 12 h.	Pain scores (NRS) at rest and movement, Opioid consumption, Quadriceps femoris muscle strength, Length of hospital stay, PONV, Patient satisfaction.
8	Hua 2022 [29]	China	48 (24/24)	Hip arthroplasty	SA	Preoperative	20 ml ropivacaine 0.4%	PCA sufentanil infusion and oxycodone 1 mg IV as rescue analgesia	Pain scores (VAS) at rest and movement, Opioid consumption, Block-related adverse events. Patient satisfaction.
9	Krishnamurty 2022 [30]	India	80 (40/40)	Hip fracture surgeries	SA	Preoperative	25 ml Bupivacaine 0.25%	Tramadol as rescue analgesic	Pain scores (VAS), Opioid consumption, Quality of patient positioning.
10	Mosaffa 2022 [31]	Iran	52 (30/22)	Hip fracture surgeries	SA	Preoperative	3 mL/kg (maximum 40 mL) ropivacaine 0.5%	PCA morphine infusion.	Pain scores (VAS), Opioid consumption, Time to first rescue analgesic.
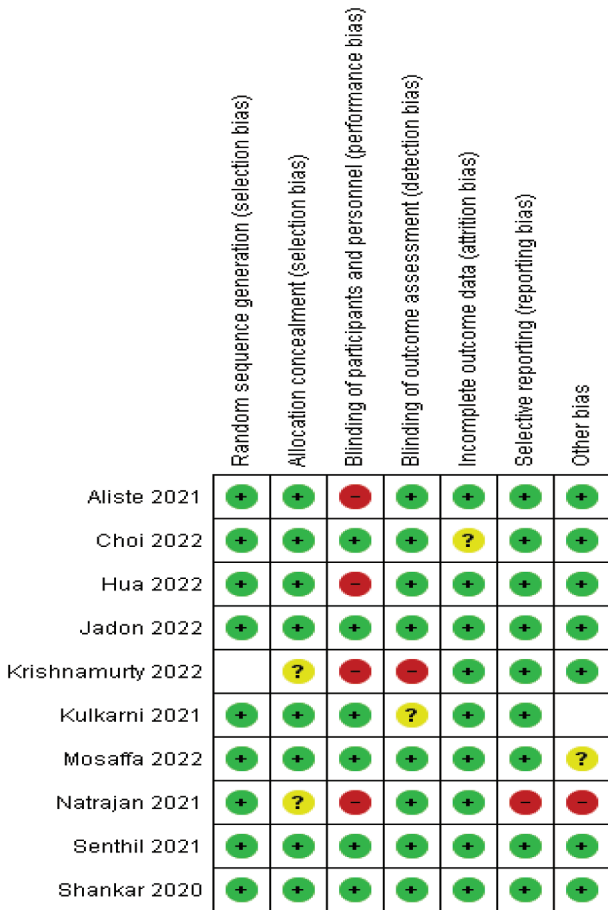
Figure 2. Risk of bias summary according to the Cochrane risk of bias assessment tool; risk of bias domains includes mainly (selection bias, performance bias, detection bias, attrition bias, and reporting bias).
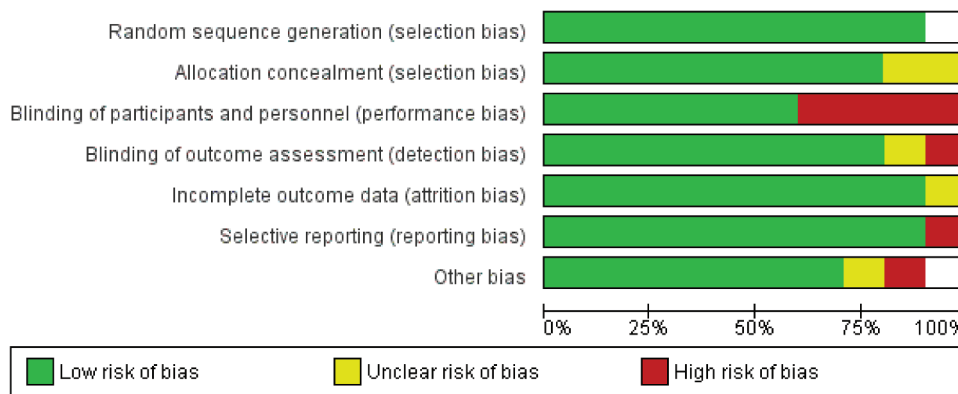
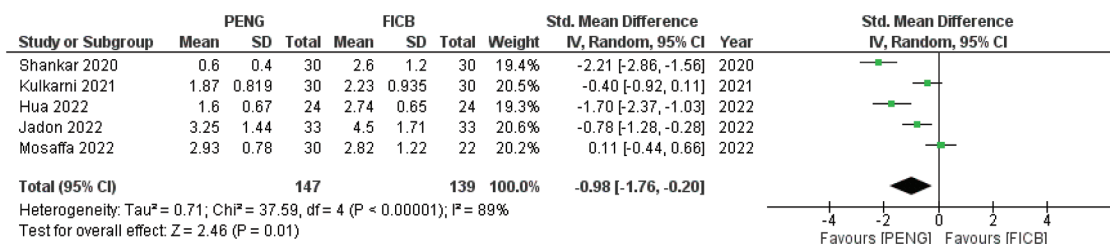Five included studies (24,27,28,29,31) reported cumulative 24 h opioids (oral morphine equivalent) consumption. The pooled results revealed a significant reduction regarding post-operative narcotic usage in PENG compared to FICB (MD = −8.09, 95% CI: −14.25 to −1.93, P = 0.01) as shown in Figure 7. A significant heterogeneity was detected among trials (x^2 = 14.25, df = 4, I^2 = 72%, P = 0.007), so random-effects model was applied. Because most of the studies employed different analgesic regimens for postoperative pain control, heterogeneity was considerable.

(5) Time to first rescue analgesic delivery:

Four included studies (23,25,30,31) reported the time of first rescue opioid demand. The total pooled results revealed no significant differences preferring any group (MD = 0.27, 95% CI: −0.35, 0.89, P = 0.40) as presented in Figure 8. A significant heterogeneity was detected among trials (x^2 = 24.61, df = 3, I^2 = 88%, P < 0.0001), so random-effects model was applied.

(6) Quality of positioning during spinal anesthesia:

Four included studies [23,25,27,30] reported the quality of positioning during spinal anesthesia using the ease of spinal positioning (EOSP) scale. The pooled results revealed a significantly higher quality of positioning in PENG group than FICB group (MD = 0.57, 95% CI: 0.12 to
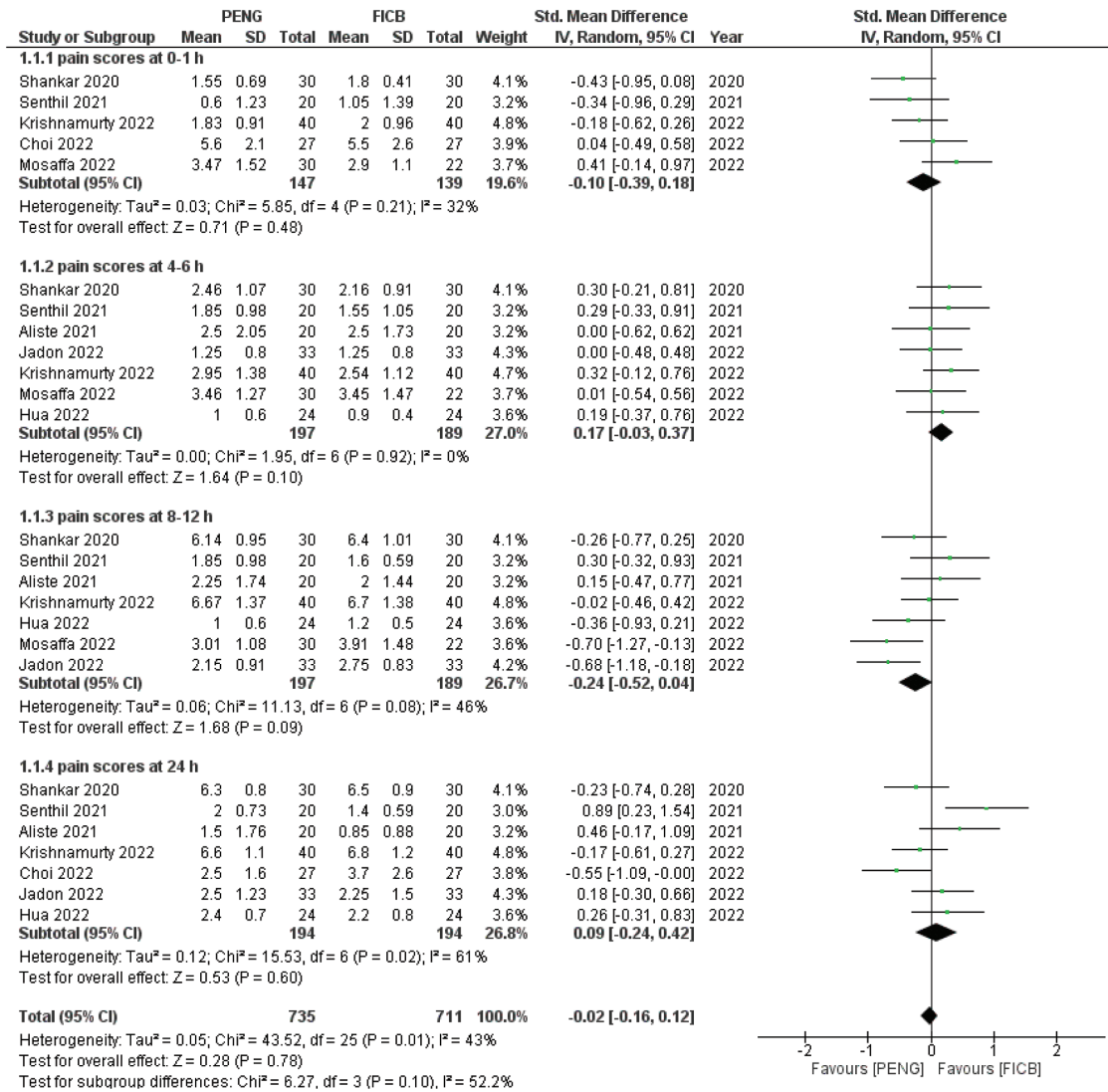

Figure 3. Risk of bias graph for included studies.

Figure 4. Forest plot for pain scores during patient positioning for spinal anesthesia.

Figure 5. Forest plot for static pain scores measured at different time points postoperatively.

1.01, P = 0.01) as presented in Figure 9. A significant heterogeneity was detected among trials (x^2 = 28.06, df = 3, I^2 = 89%, P < 0.00001), so random-effects model was applied.

(7) Patients' satisfaction:

Four included studies (23,25,26,30)reported the incidence of patients' satisfaction. The pooled results revealed lower incidence of patient dissatisfaction in PENG group than FICB (RR = 0.26, 95% CI: 0.15 to 0.47, P < 0.001) as shown in Figure 10. A fixed-effects model was applied since the pooled studies were homogeneous (x^2 = 3.68, df = 3, I^2 = 18%, P = 0.30).

(8) Postoperative nausea and vomiting (PONV):

Two included studies [24,28] reported the incidence of PONV. The pooled results revealed no significant differences preferring any group (RR = 1.73, 95% CI: 0.67 to 4.47, P = 0.26) as shown in Figure 11. A fixed-effects model was applied since the pooled studies

were homogeneous (x^2 = 0.65, df = 1, I^2 = 0%, P = 0.42).

(9) Length of hospital stay:

Two included studies [24,28] reported the length of hospitalization. The pooled results did not prefer either PENG or FICB (MD = 0.01, 95% CI: −0.09 to 0.11, P = 0.86) as shown in Figure 12. A fixed-effects model was used since the pooled studies were homogeneous (X^2 = 0.82, df = 1, I^2 = 0%, P = 0.37).

4. Discussion

In adult patients undergoing hip surgical procedures, there is a growing belief that application of enhanced recovery after surgery (ERAS) approaches can minimize hospitalization length, reduce morbidities, and be relatively economic [32]. Peripheral nerve block is a recommended technique in ERAS protocol, as it can alleviate pain, speed up mobilization and reduce the
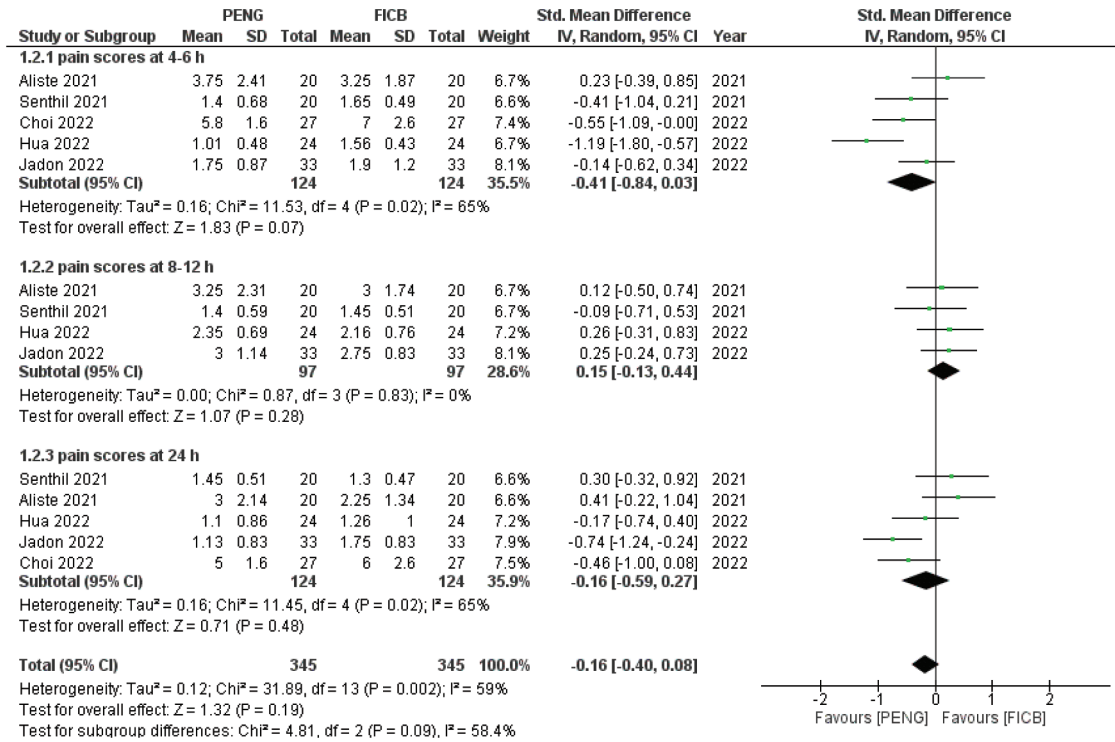
Figure 6. Forest plot for dynamic pain scores measured at different time points postoperatively.
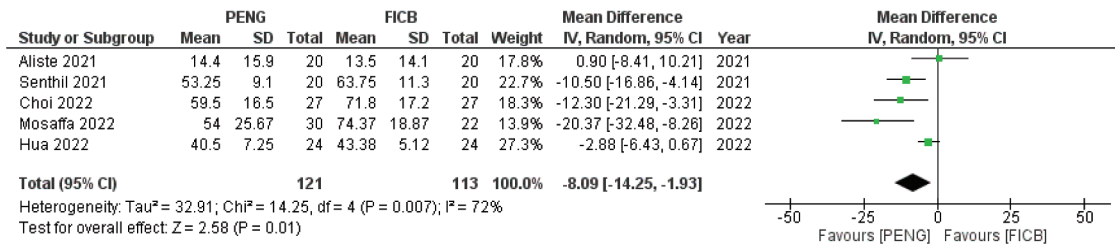

Figure 7. Forest plot for accumulated opioid consumption (equivalent morphine dose by mg) within 24 hours postoperatively.
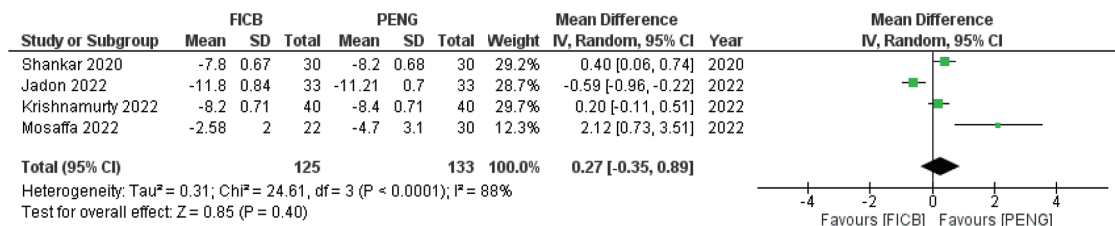

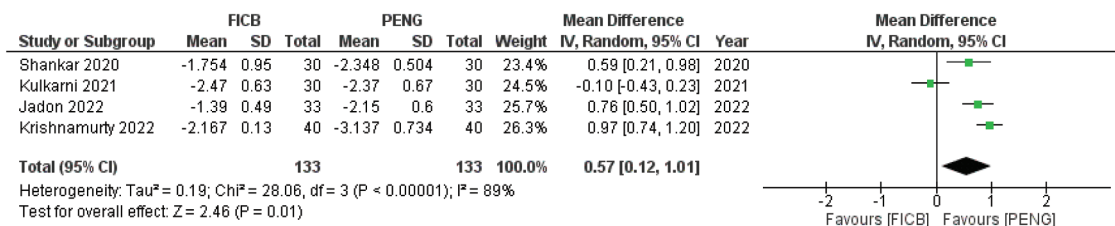**Figure 8.** Forest plot for time to first rescue analgesia request postoperatively.

Figure 9. Forest plot for quality of positioning during spinal anesthesia.

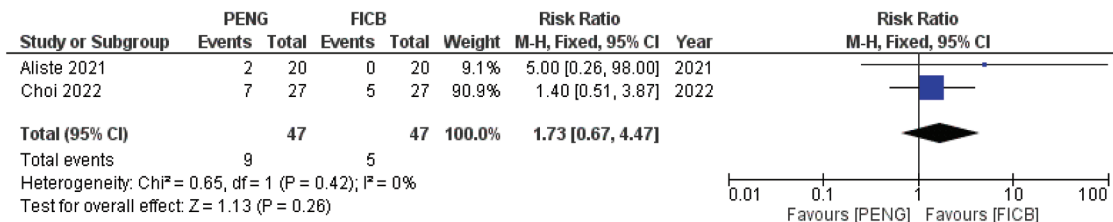**Figure 10.** Forest plot for incidence of patient dissatisfaction.

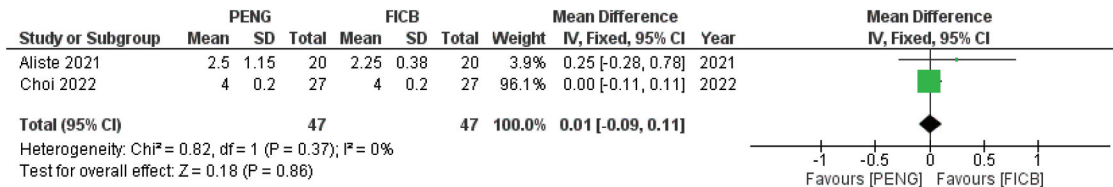**Figure 11.** Forest plot for incidence of PONV.

Figure 12. Forest plot for length of hospital stay in days.

usage of opioids and its associated negative outcomes in the early postoperative period when compared to traditional IV opioids [33].

PENG blockade was originally created for pain reduction and analgesia supplementation to those who had hip fractures. The block is applied in the supine position, which is appropriate for individuals suffering from acute or persistent pain after hip fractures; this is one of the technique key benefits. It also has a motor-sparing action since it only affects the sensory branches of the accessory obturator nerve and femoral nerve [14].

The current meta-analysis primary finding is the significant increase in analgesic effect produced by PENG compared to FICB at the early stage following the block and during patient placement for SA. Subsequently, higher quality of positioning during SA administration was detected in PENG group. However, pain scores measured at different time periods after surgery were comparable between both groups at rest and during movements. However, dynamic pain scores in the early postoperative period (4–6 h) were significantly higher, favoring the PENG group. Our results are consistent with the findings of all involved papers except for two papers (26,31). Both papers reported

no difference between PENG and FICB groups regarding pain scores observed early during positioning for SA, and one of them [26] reported insignificant difference regarding the quality of positioning between both groups.

In Del Buono et al. review, the PENG block was referred as an opioid-sparing analgesic approach for hip pain relief [16]. Current meta-analysis findings also revealed a significant decline in cumulative opioid doses, used in the first 24 h postoperative, supporting PENG group with mean difference of 8.09 mg morphine equivalent dose (p = 0.01). However, no statistical difference was noted regarding the time to first analgesic request between both groups. Our results are consistent with the findings of all included papers, apart from three papers (24,25,29) reported no difference between both groups regarding 24 h postoperative opioid consumption. Still, these variations may not indicate inferiority of the PENG technique.

This clinical variation can be attributed to the neuroanatomical features of both interventions. There is a debate over the exact articular branches that the FICB approach targets and how well it relieves pain [34]. A previous anatomical study of hip innervation claimed that the analgesic impact of the FICB was overstated in

earlier studies [35]. According to MRI results, the diffusion of local anesthetics after the FICB technique did not cover the obturator nerve, suggesting that this block may not result in effective analgesia [14,34]. The PENG is an interfacial plane blockade designed to inhibit the articular sensory branches from the obturator, accessory obturator, and femoral nerves [14]. When the dye was injected by PENG technique in cadaveric research, the anterior hip capsule region associated to the sensory branches of the mentioned nerves was all stained [36]. As, PENG block reaches more articular nerves of hip joint than FICB, it appears that this technique can produce superior analgesia.

To our knowledge, three meta–analysis studies (37,38,39) have discussed the efficiency and safety of PENG technique for pain management following hip surgeries. Each study compared PENG blocks against a number of different comparators, either control group (no block) or another block. In contrast, current meta-analysis identifies only one comparator (FICB) to match against PENG block. Two meta–analysis studies have (37,38) reported that PENG block is superior to other pain control strategies in lowering postoperative opioid usage and early pain. As a result, patients receiving PENG block declared more satisfaction with the outcome. However, PENG block effect diminishes over time, which implies that the way of LA injection needs to be modified. A successful example of an extended analgesic action was accomplished by PENG block for 3 days utilizing a catheter, according to a recent case report by Singh et al. (40). Further research is still required to assure the analgesic efficacy of continuous or multi-dose PENG block.

On the contrary, one meta–analysis study (39) stated that PENG block approach only demonstrated a non-inferior effect and did not outperform the control group when it came to pain-related outcomes including postoperative pain scores and opioid use. However, the evidence quality in this study was low to very low that suggests uncertain conclusions.

Even though Girón-Arango et al. [14] claimed that using PENG block resulted in maintenance of quadriceps muscle power in the postoperative phase, the extracted data related to quadriceps muscle weakness were unsuitable for meta-analysis as different measurement scales were applied to identify the results. Four included papers (24,27,28,29)evaluated the quadriceps femoris muscle strength or the incidence of muscle weakness after the blocks, and all results stated that muscle weakness was less in PENG than FICB.

Patients' satisfaction was assessed in six studies (23,25,26,28,29,30) and all of them preferred PENG technique, apart from two studies [25,28] that revealed equal patient satisfaction results in both groups. Despite being a subjective outcome, it reflects the potency of the technique analgesic action. None of the included studies, which comprised 524 participants, revealed any negative intervention-related side effects, such as puncture site infections or hematomas, which strongly suggests that PENG block use is just as safe as FICB block. However, antiseptic measurements should be applied carefully to avoid infection because the PENG approach targets a region near to the hip joint.

Postoperative complications were also reported and analyzed as follows; PONV was mentioned in two studies [24,28], and current meta-analysis revealed no statistically significant results preferring any group regarding the lower incidence of PONV. Similarly, pruritus was reported in one study [24]; urine retention was reported in another study [28]; and none of them revealed any significant difference between PENG and FICB groups. Otherwise, no significant differences regarding the length of hospitalization were observed.

5. Limitations

The limited sample sizes of the included trials may have resulted in a high degree of inaccuracy regarding many findings. Additionally, there were several clinical differences across the included studies, such as the timing of block applications, the types and dosages of local anesthetics, the timing of outcome evaluation, analgesic regimens for postoperative pain control, and the kind of rescue opioids. Thus, a significant chance of random error might occur. Another drawback of the meta-analysis is that operative factors, including the nature of hip surgery, the duration of the procedure, and the existence of intraoperative problems, may also cause an impact on the level of pain. Finally, because of the brief duration of follow-up, complications can be underestimated. Therefore, it is important to take these aspects into account for future research on the best application of the PENG approach in hip procedures.

6. Conclusion

The present meta-analysis revealed that PENG block technique can offer superior analgesic effect in the early post-block stage, resulting in better quality of patient positioning and less 24 h opioid intakes than FICB approach. Patients undergoing PENG block consequently report higher levels of overall satisfaction. However, PENG block seems to lose its superiority with time, consequently similar degrees of pain were detected postoperatively in both groups. The ambulation is better than the FICB approach since there is less possibility of motor block. In all other respects, the length of the hospital stays and the duration until the first opioid request were similar. Both groups reported having a low incidence of postoperative complications. To effectively compare PENG with FICB, higher-quality RCTs with larger sample sizes are needed.

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