



## Comparison of Femoral Nerve Block Versus Peng Block in Treating Femoral Neck Fractures

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#### Abstract

Femoral neck fractures frequently occur in the elderly, leading to significant pain and reduced movement. Effective analgesia is crucial for minimising problems, facilitating early mobilisation, and enhancing overall results. Regional nerve blocks are progressively utilized for analgesia in these fractures. The femoral nerve block (FNB) has traditionally been utilized, however the pericapsular nerve group (PENG) block has lately surfaced as a viable option, providing targeted analgesia with possible motor-sparing advantages. To compare the efficacy, safety, and functional outcomes of FNB versus PENG block in patients with femoral neck fractures. The present study was a prospective study was conducted in 60 patients diagnosed with femoral neck fractures for a period of 6 months. Participants were divided into two groups: one receiving an ultrasound-guided FNB and the other a PENG block. Primary outcomes included pain scores measured by the Visual Analog Scale (VAS) at rest and during movement at 0, 1,6,12, and 24 hours post-procedure. Secondary outcomes assessed motor block intensity, opioid consumption, time to mobilization, and any block-related complications. Results were analysed using SPSS 20.0 version and the association was tested using Chi square test. The baseline characteristics of patients in the FNB and PENG groups were comparable, with no significant differences in age, sex, ASA status, or type of surgery ( $p > 0.05$ ). The PENG group showed significantly lower cumulative morphine consumption at 48 hours ( $18.4 \pm 6.2$  mg vs.  $26.7 \pm 7.8$  mg,  $p < 0.001$ ) and reduced VAS pain scores at 2, 12, and 24 hours postoperatively ( $p < 0.05$ ). Quadriceps strength was better preserved ( $p < 0.001$ ), and time to first ambulation was shorter ( $p < 0.001$ ) in the PENG group. Opioid-related side effects were also lower ( $p = 0.04$ ), with no difference in hospital stay length ( $p = 0.27$ ). The PENG block provides superior analgesia with better motor preservation compared to the femoral nerve block in the management of femoral neck fractures. These findings support its use as a preferred regional anaesthesia technique in preoperative and perioperative settings for improved patient outcomes.

## INTRODUCTION

Femoral neck fractures represent a considerable clinical challenge, especially in the elderly, because to their elevated incidence, related morbidity, and considerable effect on functional independence<sup>[1]</sup>. These fractures typically arise from low-energy trauma in elderly adults with osteoporosis and are linked to severe discomfort, immobility, and an elevated risk of sequelae, including pressure sores, deep vein thrombosis, and pulmonary infections if not addressed promptly and efficiently<sup>[2,3]</sup>.

Effective pain management is fundamental in the first treatment of individuals with femoral neck fractures. Effective analgesia promotes optimal patient placement for spinal anaesthesia, mitigates the physiological stress response, and enables early mobilization—all essential elements of enhanced recovery procedures<sup>[4]</sup>. Conventional systemic analgesics, particularly opioids, are commonly employed but pose considerable concerns in geriatric patients, including respiratory depression, psychosis, constipation, and heightened fall risk. Consequently, regional anaesthesia techniques have become prominent due to their focused analgesia and opioid-sparing benefits<sup>[5]</sup>.

The Femoral Nerve Block (FNB) has been employed for analgesia in hip and femoral neck fractures for an extended period. It is relatively simple to execute under ultrasound guidance and significantly alleviates pain by anaesthetising the femoral nerve. Nevertheless, the FNB frequently leads to considerable motor blockage of the quadriceps muscle, thus hindering mobilisation and elevating the risk of falls, especially in the postoperative period. This motor impairment restricts its effectiveness in early therapy and functional recovery<sup>[6,7]</sup>.

The Pericapsular Nerve Group (PENG) Block, a novel regional anaesthesia procedure announced in 2018, specifically targets the articular branches of the femoral nerve, obturator nerve, and auxiliary obturator nerve that innervate the anterior hip capsule.<sup>8</sup> The PENG block selectively targets the sensory innervation of the anterior hip capsule while preserving motor fibres. This targeted blockage may deliver excellent pain relief while preserving quadriceps function, so facilitating early mobilisation and improving recovery, especially in weak or elderly individuals<sup>[9,10]</sup>.

Despite its theoretical benefits, clinical evidence directly contrasting the PENG block with the conventional FNB in the context of femoral neck fractures is still scarce. Assessing the comparative efficacy of these blocks regarding analgesia, motor function retention, and functional results is crucial for enhancing perioperative management.

This study aimed to assess the analgesic efficacy, motor-sparing effects, and overall therapeutic value of the PENG block with the FNB in patients with femoral neck fractures. The results intend to inform anaesthetic choices and enhance the development of regional anaesthesia in orthopaedic trauma management.

### Aims and Objectives:

- To compare the efficacy, safety, and functional outcomes of FNB versus PENG block in patients with femoral neck fractures.

## MATERIALS AND METHODS

The study was conducted in Department of Anaesthesia, Sree Mookambika Institute of Medical sciences a tertiary care center, over a period of 6 months from December 2024 to May 2025. A total of 60 patients diagnosed with femoral neck fractures were included in the study. Patients were randomly allocated into two equal groups (n = 30 each):

**Group FNB:** Received ultrasound-guided Femoral Nerve Block.

**Group PENG:** Received ultrasound-guided Pericapsular Nerve Group (PENG) Block.

### Inclusion Criteria:

- ASA Physical Status I–II
- Radiologically confirmed femoral neck fracture
- Ability to provide informed consent
- Willing to participate in the study

### Exclusion Criteria:

- Allergy to local anesthetics
- Coagulopathy or anticoagulant therapy
- Infection at the injection site
- Neurological or muscular disorders affecting the lower limbs
- Cognitive impairment preventing pain assessment

Randomization was performed using a computer-generated random number table. Group allocation was concealed using sealed opaque envelopes. The anesthesiologist performing the block was not involved in postoperative assessment. Pain assessments were conducted by a blinded observer. Baseline demographic data and surgical details were recorded.

All patients underwent standard ASA monitoring (ECG, NIBP, SpO<sub>2</sub>) and were provided with intravenous access and preload therapy. Both blocks were executed in the pre-anesthesia room under sterile settings by proficient anaesthesiologists utilising a Mindray TE7 ultrasonography equipment.

A curvilinear low-frequency (5 MHz) probe was positioned transversely over the anterior inferior iliac

spine (AIIIS) and rotated parallel to the pubic ramus for the PENG block. A regional anaesthesia needle (80 mm) was inserted in-plane, and 20 ml of ropivacaine at a concentration of 3.5 mg/ml was administered between the psoas tendon and the pubic ramus, aiming at the articular branches of the femoral, obturator, and auxiliary obturator nerves.

A high-frequency (12 MHz) linear probe was utilized to visualise the femoral nerve at the inguinal crease during the femoral nerve block. A 22-gauge needle was inserted to administer 20 ml of ropivacaine at a concentration of 3.5 mg/ml surrounding the femoral nerve, adjacent to the femoral artery.

All patients underwent early postoperative evaluations. Postoperative data encompassed cumulative morphine consumption at 48 hours post-surgery, expressed in oral morphine equivalents, VAS pain scores at 2, 12, 14, and 48 hours, the percentage of patients experiencing inadequate analgesia (VAS = 4) at 24 and 48 hours, quadriceps motor function prior to discharge from the recovery room, time to ambulation, duration of hospital stay, and occurrence of opioid-related adverse effects within 48 hours following surgery. The quadriceps motor strength was assessed via the Medical Research Council (MRC) scale, rated from 0 to 5.

Statistical analysis was performed using SPSS version 20.0. Continuous variables were expressed as mean  $\pm$  standard deviation or median with interquartile range, depending on normality of distribution, and compared using the independent t-test or Mann-Whitney U test. Categorical variables were expressed as counts and percentages, and analyzed using the chi-square test or Fisher's exact test where appropriate. A p-value of  $<0.05$  was considered statistically significant.

## RESULTS AND DISCUSSIONS

The baseline characteristics of patients in the FNB and PENG groups were comparable, with no significant differences in age, gender distribution, ASA physical status, or type of surgery performed ( $p > 0.05$ ). (Table 1)

Cumulative morphine consumption over the first 48 postoperative hours was significantly lower in the PENG group compared to the FNB group ( $18.4 \pm 6.2$  mg vs.  $26.7 \pm 7.8$  mg,  $p < 0.001$ ), indicating improved opioid-sparing analgesia with the PENG block. Postoperative pain assessed by VAS scores was significantly reduced in the PENG group at 2, 12 and 24 hours after surgery ( $p < 0.05$ ). However, at 48 hours the pain scores showed no significance between groups ( $p = 0.09$ ) (Table 2).

The proportion of patients experiencing moderate to severe pain (VAS = 4) was significantly lower in the PENG group at 24 hours and 48 hours ( $p < 0.05$ ) (Table 3).

Quadriceps motor strength measured by the MRC scale two hours postoperatively was significantly better preserved in the PENG group compared to the FNB group ( $p < 0.001$ ). Time to first ambulation was significantly shorter in the PENG group versus the FNB group ( $p < 0.001$ ). No significant difference was observed in the length of hospital stay between the groups ( $p = 0.27$ ). Incidence of opioid-related side effects such as nausea and vomiting was lower in the PENG group compared to the FNB group ( $p = 0.04$ ). No serious complications related to the nerve blocks were reported (Table 4).

The present study demonstrated that baseline data, including age, gender distribution, ASA physical status, and type of surgery, were evenly matched between the two groups, thereby ensuring comparability and reducing confounding variables.

The PENG block group had significantly reduced cumulative morphine consumption within the initial 48 hours postoperatively, indicating enhanced opioid-sparing analgesic efficacy relative to the FNB group. The reduction in opioid use corresponds with the diminished pain scores reported by patients who underwent the PENG block at 2, 12, and 24 hour post-surgery. Despite pain scores aligning by 48 hours, the early postoperative analgesic benefit is essential for augmenting patient comfort and possibly facilitating recovery.

The percentage of patients reporting moderate to severe pain (VAS $>4$ ) was dramatically diminished in the PENG group after 24 and 48 hours, underscoring the therapeutic significance of enhanced analgesia with this block. The PENG block aims at the articular branches of the femoral, obturator, and auxiliary obturator nerves, delivering targeted sensory blocking of the hip capsule while preserving the motor fibres of the quadriceps. The selective blocking resulted in markedly superior preservation of quadriceps muscular strength in the PENG group, as assessed by the MRC scale two hours postoperatively.

Allard C *et al.*<sup>[11]</sup> observed that within 24 hours post-surgery, two (9%) patients in the "PENG block" group reported a VAS=4, compared to three (14%) patients in the "femoral block" group ( $p=1.00$ ). Forty-eight hours post-surgery, two (9%) patients in the "PENG block" group experienced a VAS=4, compared to two (9%) patients in the "femoral block" group ( $p = 1.00$ ).

Early mobilization is essential for orthopaedic patients to mitigate the risks of sequelae, including deep vein thrombosis, pulmonary embolism, and muscle deconditioning. In the current study, patient mobilization occurred almost 10 hours earlier in the PENG group compared to those receiving the femoral nerve block.

Allard C *et al.*<sup>[11]</sup> noted that postoperative quadriceps muscle strength was superior in the PENG

Table 1: Comparison of baseline characteristics among both groups

Characteristic	FNB Group (n=30)	PENG Group (n=30)	p-value
Age (years)	68.4 ± 8.1	71.6 ± 7.8	0.67
Sex (M/F)	18 / 12	17 / 13	0.79
ASA physical status (I/II)	12 / 18	11 / 19	0.91
Type of surgery (THA/HA)	16 / 14	15 / 15	0.80

Table 2: Comparison of baseline characteristics among both groups

Mean VAS score	FNB Group (n=30)	PENG Group (n=30)	p-value
2 hours	5.8 ± 1.2	4.2 ± 1.0	<0.001
12 hours	5.2 ± 1.3	3.9 ± 1.1	0.002
24 hours	4.8 ± 1.4	3.7 ± 1.0	0.005
48 hours	3.5 ± 1.2	3.1 ± 1.0	0.09

Table 3: Comparison of proportion of patients with VAS =4

VAS score	FNB Group (n=30)	PENG Group (n=30)	p-value
VAS = 4 at H24, n (%)	13 (43%)	6 (20%)	0.04
VAS = 4 at H48, n (%)	9 (30%)	3 (10%)	0.03

Table 4: Comparison of secondary outcomes between both groups

Secondary outcomes	FNB Group (n=30)	PENG Group (n=30)	p-value
Quadriceps MRC score at 2h, mean ± SD	3.2 ± 0.7	4.5 ± 0.5	<0.001
Time to first ambulation (hours), median (IQR)	28 (24–34)	18 (15–22)	<0.001
Length of hospital stay (days), mean ± SD	7.8 ± 2.1	7.5 ± 2.4	0.27
Incidence of nausea/vomiting, n(%)	10 (33%)	4 (13%)	0.04

group compared to the Femoral group (5/5 vs. 2/5, p = 0.001).

In the study conducted by Lin DY *et al.*<sup>[12]</sup> the median duration of FNB was 15 hours and 35 minutes (range 4:08–30:45), while the median duration of PENG was 22 hours and 50 minutes (range 6:00–32:00).

Lin DY *et al.*<sup>[13]</sup> observed that Quadriceps strength was more effectively maintained in the PENG group within the recovery unit (measured via Oxford muscular strength grading, 60% intact in the PENG group compared to none in the FNB group; p<0.001) and on day 1 (90% intact versus 50%, respectively; p=0.004). No differences were observed in any outcomes.

While the duration of hospital stay did not significantly vary between groups, the enhanced functional recovery associated with the PENG block may yield long-term advantages that were not addressed in the present study. In contrast to the current study, Lin DY *et al.*<sup>[12]</sup> found that the time to discharge readiness was shorter in the PENG group (3 days, range 1–14 days) compared to the FNB group (4 days, range 2–15 days).

The occurrence of opioid-related adverse effects, especially nausea and vomiting, was markedly diminished in the PENG group, presumably due to decreased opioid demands. The decrease in side effects enhances patient satisfaction and may lead to a reduction in surgical complications.

Hua H *et al.*<sup>[14]</sup> conducted a comparison of the PENG block and fascia iliac block in geriatric patients undergoing hip arthroplasty for femoral neck fractures. The PENG block demonstrated markedly reduced static and dynamic VAS ratings, enhanced analgesic satisfaction, and fewer motor problems compared to the fascia iliac block. It offered rapid onset and enhanced analgesia with negligible adverse effects. The study determined that the PENG block is a safer

and more effective perioperative analgesic method for this population, justifying its wider clinical implementation.

In their meta-analysis, Dolstra J *et al.*<sup>[15]</sup> identified 17 studies from a total of 118 that matched the inclusion criteria, comprising 14 randomised controlled trials (RCTs) and 3 observational studies, of which 5 exhibited a low risk of bias. Twelve trials indicated reduced pain scores with PENG block compared to FICB/FNB, but five reported no significant change. Opioid consumption was reduced in four studies, while patient satisfaction was elevated in five using PENG. Spinal placement was facilitated in four trials supporting PENG. No notable difference in adverse events was detected, and no study favoured FICB/FNB for any outcome.

Duan L *et al.*<sup>[16]</sup> compared continuous PENG block with continuous fascia iliac compartment block (FICB) for postoperative analgesia following complete hip arthroplasty. The PENG group had markedly reduced resting and exercise NRS pain levels, enhanced quadriceps strength, expedited ambulation, and fewer activations of patient-controlled neural analgesia (PCNA) along with diminished requirements for rescue analgesia compared to the FICB group. The study's findings indicated that continuous PENG block provides enhanced analgesia and functional recovery with reduced motor deficits.

Tangtong S *et al.*<sup>[17]</sup> reported that the PENG block markedly diminished Tramadol usage and postponed the requirement for the initial dose in comparison to FNB during hip fracture surgery. Pain levels were diminished during the 4–12 hour postoperative interval, and quadriceps strength was more effectively maintained (71.43% vs. 22.86%). Furthermore, postoperative nausea and vomiting occurred less frequently with PENG.

## CONCLUSION

The study demonstrates that the PENG block offers better postoperative pain control and significantly reduces opioid consumption compared to the femoral nerve block in patients undergoing hip arthroplasty for femoral neck fractures. Additionally, the PENG block preserves quadriceps motor strength, enabling earlier ambulation and faster functional recovery. Patients receiving the PENG block also experienced fewer opioid-related side effects such as nausea and vomiting. Although hospital stay length was similar between groups, the improved analgesia and motor preservation with the PENG block highlight its potential as a safer, more effective regional anesthesia technique for hip fracture surgery. However, limitations include a relatively small sample size and short follow-up period, which may affect the generalizability and assessment of long-term outcomes. Future research should involve larger, multicenter trials with extended follow-up to evaluate the impact of PENG block on long-term functional recovery.

**Conflicts of Interest:** There are no conflicts of interest

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