

Analgesic Efficacy of Ultrasound Guided Peri Capsular Nerve Group Block versus Femoral Block for Facilitating Spinal Anaesthesia Positioning in Proximal Femoral Fractures: A Prospective Observational Study

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ABSTRACT

Introduction: Positioning patients with proximal femoral fractures for spinal anaesthesia is often associated with severe pain. Femoral nerve block has been traditionally used for analgesia but may cause quadriceps weakness. The Pericapsular Nerve Group (PENG) block is a novel technique designed to provide effective analgesia while preserving motor function.

Aim: To compare the analgesic efficacy and the Ease Of Spinal Positioning (EOSP) between ultrasound-guided PENG block and Femoral Nerve Block (FNB) in patients undergoing surgery for proximal femoral fractures.

Materials and Methods: The present prospective observational study was conducted in the Department of Anaesthesiology at Government Medical College, Kottayam, Kerala, India, from January 2025 to December 2025, included 52 patients undergoing surgery for proximal femoral fractures under spinal anaesthesia. Patients were enrolled using consecutive sampling to PENG block group (n=26) and FNB group (n=26). Pain scores at rest (VAS-R) and during movement (VAS-D) were recorded before block and at 10, 20, and 30 minutes after block. EOSP was assessed on a 0-3 scale during sitting for spinal anaesthesia. Statistical analysis was performed

using appropriate tests, with $p < 0.05$ considered statistically significant.

Results: A total of 52 patients were included in the study, with 26 patients in each group. The mean age was 65.2 ± 8.4 years in the PENG group and 66.1 ± 7.9 years in the FNB group, with no significant difference in demographic characteristics between the groups ($p > 0.05$). Baseline pain scores were comparable between groups (7.24 ± 0.66 vs 7.35 ± 0.69 ; $p = 0.578$). Post-block Visual Analogue Scale (VAS) scores at rest were significantly lower in the PENG group at 10 minutes (3.92 ± 0.79 vs 4.65 ± 0.74 ; $p = 0.001$), 20 minutes (2.46 ± 0.65 vs 3.50 ± 0.76 ; $p < 0.001$), and 30 minutes (2.04 ± 0.45 vs 2.69 ± 0.68 ; $p < 0.001$). EOSP scores were significantly higher in the PENG group (2.46 ± 0.51) compared with the FNB group (2.12 ± 0.59 ; $p = 0.028$). No block-related complications were observed.

Conclusion: Both PENG block group and femoral block group showed significant reduction in VAS scores. But it was noted that Ultrasound-guided PENG block provide better reduction in pain scores compared to FNB and provides superior analgesia. PENG block was associated with better EOSP compared to FNB in patients with proximal femoral fractures undergoing spinal anaesthesia.

Keywords: Analgesia, Hip fractures, Pain measurement, Ultrasonography, Visual analogue scale

INTRODUCTION

Proximal femoral fractures, encompassing neck of femur, intertrochanteric, and subtrochanteric fractures are common orthopaedic injuries, particularly among the elderly, and are associated with significant pain, morbidity, and mortality [1]. Adequate perioperative pain control is essential not only for patient comfort but also to facilitate early surgical intervention and improve outcomes [2]. Effective pain management also helps positioning for neuraxial anaesthesia, and reduce perioperative complications.

Spinal anaesthesia is frequently preferred for surgical management of proximal femoral fractures because of its favourable safety profile, reduced thromboembolic risk, and decreased incidence of postoperative cognitive dysfunction in elderly patients. However, to perform a successful subarachnoid block, patients must often be placed in a sitting or lateral position and positioning patients for neuraxial block is often extremely painful due to fracture-related movement, leading to patient discomfort, sympathetic overactivity, haemodynamic instability, and technical difficulty during spinal anaesthesia [3]. Systemic analgesics such as opioids and non-steroidal anti-inflammatory drugs are commonly used but are often limited by adverse effects like respiratory depression and

delirium particularly in elderly patients with multiple co-morbidities [4].

The FNB has traditionally been employed to reduce pain in patients with hip fractures and has been shown to improve comfort and facilitate positioning [5]. However, it frequently causes quadriceps muscle weakness, which may delay mobilisation and increase fall risk. Additionally, FNB may not consistently provide complete analgesia to the hip joint due to the complex innervation of the anterior hip capsule [6]. The PENG block is a recently described ultrasound-guided technique that selectively targets the articular branches supplying the anterior hip capsule, including branches of the femoral, obturator, and accessory obturator nerves [7,8]. An early study by Lin DY et al., suggests that PENG block provides effective analgesia with minimal motor blockade, making it an attractive alternative for hip fracture patients [9].

In recent years, several studies have evaluated the analgesic efficacy of the PENG block in Proximal femur surgeries [7,9]. These studies consistently demonstrated improved pain scores and reduced opioid consumption with PENG block compared to conventional techniques and have focused on postoperative analgesia or opioid consumption rather than specifically assessing EOSP as an outcome [7,9].

Although studies such as Jadon A et al., have demonstrated improved patient comfort during positioning with regional blocks, direct comparisons between PENG block and FNB specifically for facilitating spinal positioning in proximal femur fracture patients remain limited [3]. Furthermore, evidence from prospective comparative studies evaluating pain scores along with EOSP is still evolving, particularly in the Indian clinical setting. These gaps in the existing literature prompted the present study to evaluate and compare both the analgesic efficacy and EOSP between PENG block and FNB in patients undergoing hip fracture surgery.

Therefore, there remains a need to systematically evaluate whether PENG block offers superior analgesia and improved EOSP compared to FNB in patients undergoing hip fracture surgery. The present study seeks to determine if the PENG block offers a more consistent and effective way to facilitate spinal anaesthesia than the traditional FNB. The present prospective observational study was undertaken to compare the analgesic efficacy of ultrasound-guided PENG block and FNB in terms of pain scores at rest and during movement, and to assess their effect on EOSP in patients scheduled for proximal femur fracture surgery. The primary objectives of the present study were to compare reduction in VAS pain score at rest (VAS-R) and VAS pain score in 15 degree flexion (VAS-D) every 10 min till 30 minutes in patients with proximal femur fractures after USG guided PENG block and femoral block. The secondary objective was to compare the EOSP score at the time of positioning for spinal anaesthesia.

MATERIALS AND METHODS

The present prospective observational study was conducted in the Department of Anaesthesiology at Government Medical College, Kottayam, Kerala, India, over a period of 12 months from January 2025 to December 2025. The study was conducted after obtaining approval from the Institutional Research Committee (Approval No: 4/2025). Written informed consent was obtained from all participants.

Sample size calculation: Sample size was calculated based on a previous study by Malathi K et al., comparing PENG block and FNB for positioning under spinal anaesthesia [10]. The mean (SD) VAS score was 2.23 ± 0.61 in the PENG group and 3.50 ± 0.60 in the FNB group. Sample size was calculated using the formula:

$$N = \frac{(Z\alpha + Z\beta)^2 \times SD^2 \times 2}{(\mu_1 - \mu_2)}$$

$\mu_1 - \mu_2$ is the expected difference in mean VAS scores. The researcher assumed a difference of 0.7 in the VAS scores between the two groups to be clinically significant and at α error of 1% ($Z\alpha = 2.58$) and a power of 90% ($Z\beta = 1.28$).

Substituting the values:

$$= \frac{(2.58 + 1.28)^2 \times (0.61^2 + 0.61^2) \times 2}{0.7^2}$$

$$= \frac{14.9 \times 0.36 \times 2}{0.49} = \frac{10.91}{0.49} = 22$$

Hence, a minimum of 22 patients per group was required. To account for possible dropouts and enhance reliability, 26 patients per group (total=52) were included in the study.

Inclusion criteria: Patients belonging to American Society of Anesthesiologists (ASA) physical status I-III, and scheduled to undergo proximal femur fracture surgery under spinal anaesthesia were included in the present study.

Exclusion criteria: Patients were excluded if they refused participation, had known allergy to local anaesthetic agents, infection

at the site of block, coagulopathy, had pre-existing neurological deficits involving the lower limb, or on chronic opioid use. Total of 52 patients were included in the present study with 26 patients in each group and all completed the study.

Study Procedure

During routine pre-anaesthetic evaluation for patients scheduled to undergo surgery for proximal femur fractures, demographic and clinical details including age, sex, history of co-morbidities, routine laboratory investigations, Electrocardiogram (ECG), and relevant radiological findings were documented as part of standard preoperative assessment.

At the time of evaluation, the attending anaesthetist screened patients for eligibility using a predefined checklist containing the study inclusion and exclusion criteria. When a patient satisfied the eligibility criteria, the primary investigator was informed. The primary investigator subsequently met the patient in the preoperative period prior to surgery, explained the study protocol, and introduced the VAS for pain assessment. The VAS consisted of a 0-10 scale, where 0 represented no pain and 10 represented the worst imaginable pain. Patients were instructed to rate their pain both at rest and during passive 15° elevation of the affected limb. For interpretation, VAS scores of 1-3 were considered mild pain, 4-6 moderate pain, and 7-10 severe pain. Written informed consent was obtained from all participants before inclusion in the present study.

The patients undergoing proximal femur fracture surgery routinely receive either a PENG block or a FNB for analgesia prior to spinal anaesthesia as part of standard clinical practice. The choice of block and its administration were made solely by the attending anaesthetist responsible for the case, who was independent of the current study. The investigator had no role in selecting or administering the intervention and was blinded to the type of block performed during outcome assessment. Both blocks were performed using 20 mL of 0.2% ropivacaine as per institutional protocol. Following block administration, pain scores were assessed by the investigator using the VAS at rest (VAS-R) and during passive 15° elevation of the affected limb (VAS-D) at 10-minute intervals for 30 minutes. After completion of the 30-minute assessment, patients were shifted to the operating room.

For the administration of spinal anaesthesia, patients were positioned in the sitting posture. At this stage, comfort during positioning was assessed using the EOSP Score. The EOSP was graded on a scale of 0-3 as follows:

0- unable to position;

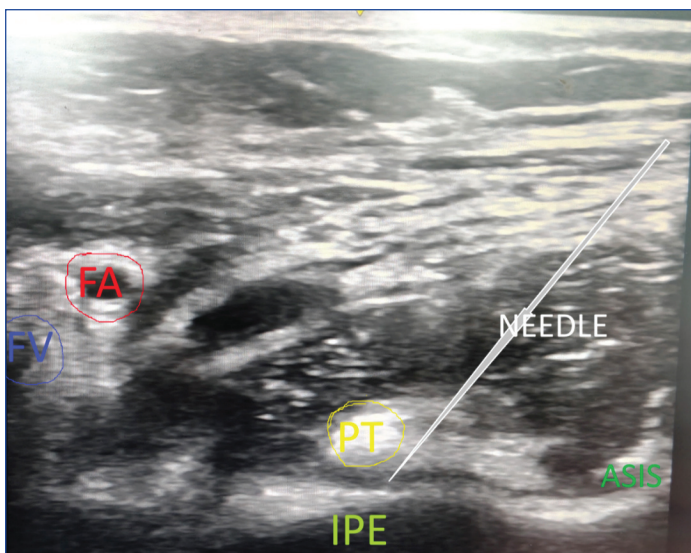
1-abnormal posturing due to pain requiring support for positioning;

2-mild discomfort but able to position without support;

3-optimal condition where the patient is able to position independently without pain.

After completion of assessment, the investigator reviewed the anaesthesia records to identify the type of regional block administered. Patients were then classified into two groups based on the block received: the PENG block group and the FNB group. Consecutive eligible patients were included until the required sample size for each group was achieved.

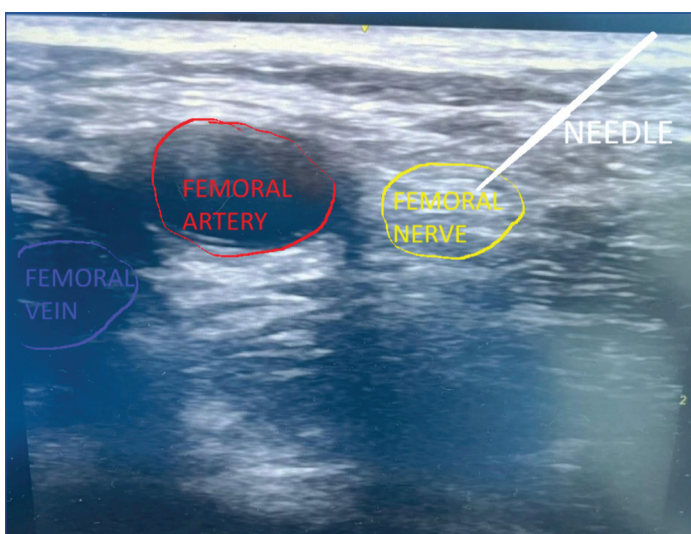
PENG block is performed by placing low-frequency curvilinear probe over the anterior inferior iliac spine and moved inferiorly to visualise the pubic ramus. Then, iliopectineal eminence is visualised, and the femoral artery and iliopsoas muscle is identified in the center. The area between the iliopectineal eminence and pubic ramus is our target point maintaining this view a 10 cm block needle is inserted using an in-plane technique, taking care to avoid injury to the femoral nerve. After good visualisation of the needle tip at the target point; a 20 mL of 0.2% Ropivacaine is injected after negative aspiration at each 5 mL. The local spread of the drug between the psoas muscle and pubic ramus is confirmed on the ultrasound screen [Table/Fig-1].



[Table/Fig-1]: USG view of PENG block.

PT: Psoas tendon; ASIS: Anterior inferior iliac spine; IPE: Ileopectineal eminence; FA: Femoral artery; FV: Femoral vein

Femoral block is performed by placing a low frequency curvilinear probe on the inguinal crease identifying the femoral artery by moving the probe lateral to medial. Femoral nerve is located lateral to femoral artery. The goal is to place the needle tip immediately adjacent to the lateral aspect of the femoral nerve, below the fascia iliaca or between the two layers of the fascia iliaca that surround the femoral nerve. After good visualisation 20ml 0.2% Ropivacaine is injected. Proper deposition of local anaesthetic is confirmed either by observation of the femoral nerve being displaced by the injectate or by the spread of the local anaesthetic above or below the nerve, surrounding and separating it from the fascia iliaca layers [Table/Fig-2].



[Table/Fig-2]: USG view of femoral block.

Study outcomes:

- VAS-R: Pain at rest
- VAS-D: Pain during passive limb movement
- EOSP: Ease of Spinal Positioning (0-3 scale)

Measurements were recorded before block and at 10, 20, and 30 minutes after block and during positioning for spinal anaesthesia.

The study was conducted after obtaining approval from the Institutional Research Committee (Approval No: 4/2025). Written informed consent was obtained from all participants.

STATISTICAL ANALYSIS

Data were analysed using Statistical Package for Social Sciences (SPSS) version 25 software. Continuous variables were expressed as mean±Standard Deviation (SD) and compared using Independent

t-test and categorical variables were analysed using Chi-square test. A p-value<0.05 was considered statistically significant.

RESULTS

All 52 patients completed the study with 26 patients in each group. The two groups were comparable with respect to demographic and clinical characteristics. There was no statistically significant difference in age, gender distribution, weight, height, diagnosis distribution (fracture neck of femur, intertrochanteric fracture, subtrochanteric fracture), or ASA physical status between the groups (p>0.05) [Table/Fig-3].

Variables	PENG (n=26)	FNB (n=26)	T/ χ^2 value	p-value
Age (years) (mean±SD)	65.2±8.4	66.1±7.9	T=0.42	0.676
Gender (M/F)	17/9	13/13	$\chi^2=1.26$	0.262
Weight (kg)	60.7±9.5	65.1±8.3	T=1.76	0.085
Height (cm)	162.4±8.2	161.8±7.3	T=0.30	0.763
ASA physical status I/II/III	5/19/2	4/17/5	$\chi^2=1.50$	0.470
Diagnosis (NOF/IT/subtrochanteric)	15/8/3	14/11/1	$\chi^2=1.50$	0.470

[Table/Fig-3]: Demographic and clinical parameters of patients in the PENG and femoral groups.

Continuous variables-t-test; Categorical variables- Chi-square test
NOF: Neck of femur; IT: Intertrochanteric

Pain scores at rest (VAS-R) were comparable between the two groups at baseline. Following block administration, both groups showed a reduction in pain scores; however, the reduction was consistently greater in the PENG block group at all assessed time intervals [Table/Fig-4].

Pain Scores	PENG (mean±SD)	FNB (mean±SD)	p-value
VAS-R Baseline	7.24±0.66	7.35±0.69	0.578
VAS-D Baseline	8.23±0.6	8.27±0.7	0.834
VAS-R 10 min	3.92±0.79	4.65±0.74	0.001
VAS-D 10 min	4.96±0.8	5.62±0.1	0.010
VAS-R 20 min	2.46±0.6	3.50±0.7	<0.001
VAS-D 20 min	3.27±0.7	4.19±0.7	<0.001
VAS-R 30 min	2.04±0.45	2.69±0.68	<0.001
VAS-D 30 min	2.58±0.7	3.31±0.8	0.001
EOSP	2.46±0.5	2.12±0.59	0.028

[Table/Fig-4]: VAS and EOSP comparison between PENG and femoral groups.

Test used is independent t-test

Baseline pain scores during movement (VAS-D) were similar between the groups. Both groups demonstrated improvement after block administration, but the PENG block group showed significantly better pain relief during movement at all-time intervals.

EOSP was significantly better in the PENG block group compared to the FNB group. Patients in the PENG group were more comfortable and required less assistance during positioning for spinal anaesthesia [Table/Fig-4]. No block-related complications were observed.

DISCUSSION

The present study demonstrates that ultrasound-guided PENG block provides superior analgesia compared to FNB in patients with proximal femoral fractures. Lower VAS scores at rest and during movement indicate improved pain control, which translated into better EOSP. Adequate pain control in patients with proximal femoral fractures is essential for facilitating neuraxial anaesthesia, improving patient comfort, and minimising perioperative stress. Severe pain during positioning for spinal anaesthesia is a well-recognised challenge and may lead to haemodynamic instability, patient anxiety, and technical difficulty in performing the block.

In the current study, both groups were comparable with respect to demographic variables, clinical characteristics, and baseline pain

scores, allowing a reliable comparison of outcomes. Following block administration, pain scores at rest and during movement decreased in both groups; however, the reduction was significantly greater in the PENG group at all post-block time points. This suggests that PENG block offers more effective and consistent analgesia during the critical pre-spinal period, when patient movement is unavoidable. The improved analgesic efficacy observed with PENG block can be explained by its anatomical basis. Sensory innervation of the anterior hip capsule is derived from articular branches of the femoral nerve, obturator nerve, and accessory obturator nerve [11]. The PENG block is designed to target these articular branches selectively, resulting in effective hip joint analgesia while largely sparing motor fibres supplying the quadriceps muscle. In contrast, FNB frequently results in quadriceps weakness, which may compromise patient cooperation during positioning and has been associated with delayed mobilisation and increased fall risk.

Findings in the present study are consistent with existing literature evaluating the role of PENG block in hip fracture patients. Girón-Arango L et al., originally described the PENG block as an effective technique for analgesia in hip fractures [7]. Fahey A et al., reported significant reductions in pain scores and opioid consumption with PENG block when compared to conventional regional techniques [12]. A randomised comparison by Aliste J et al., demonstrated superior dynamic pain relief with PENG block compared to FNB, supporting the significantly lower VAS during movement observed in the present study [13]. Lin DY et al., conducted a trial on 60 patients with primary outcome as pain score and found out that the PENG group experienced less pain compared with the FNB group [9]. In a study of 98 patients undergoing hip fracture surgery under spinal anaesthesia, Iacovazzo C et al., demonstrated that while both PENG and FNBs significantly reduced pain scores, the PENG group achieved a superior reduction in VAS scores compared to the FNB group [14]. Jeevendiran A et al., evaluated the analgesic effects of PENG versus FNBs in 70 patients and observed that the PENG group achieved a statistically superior attenuation of pain as measured by the VAS [15]. Comparative analysis of PENG block vs femoral block on postoperative pain management for THR done by Goncalves L et al., found PENG block as better when compared to FNB [16].

EOSP represents an important procedural outcome, particularly in elderly patients with limited mobility and severe pain. In this study, patients in the PENG group demonstrated significantly better EOSP scores compared to those receiving FNB. Ravichandran L et al., reported similar finding recently in a trial on PENG vs Femoral during spinal positioning and found out that VAS score with PENG is significantly lower when compared to FNB [17]. Improved positioning not only enhances patient comfort but also facilitates smoother and faster neuraxial block placement, potentially reducing multiple attempts and associated complications [18] and lowering the risk of postoperative delirium in elderly patients [19]. This procedural advantage reinforces the clinical relevance of PENG block beyond pain score reduction alone.

No block-related complications were observed in either group in the present study. The use of ultrasound guidance likely contributed to the safety and success of both techniques by allowing accurate localisation of anatomical structures and precise deposition of local anaesthetic [20]. This highlights the importance of ultrasound-guided regional anaesthesia in contemporary anaesthetic practice [21]. Improved EOSP is clinically important as it is likely to facilitate smoother neuraxial block performance and enhances patient comfort [22]. These findings and absence of complications in this study further support the safety of PENG block and effective anaesthesia technique for patients with proximal femur fractures.

Limitation(s)

The present study had certain limitations. Both the VAS and EOSP scores are subjective measures and may be influenced

by individual patient perception and observer variability. Quadriceps motor strength was not formally assessed, and long-term postoperative outcomes were not evaluated, limiting assessment of functional recovery and motor-sparing benefits. Additionally, as the study involved consecutive allocation rather than randomisation, the possibility of selection bias cannot be completely excluded.

CONCLUSION(S)

The present prospective observational study demonstrates that ultrasound-guided PENG block provides significantly better analgesia compared to FNB in patients with proximal femoral fractures. Patients receiving the PENG block had lower pain scores both at rest and during passive limb elevation following block administration. Improved analgesia resulted in significantly better EOSP, facilitating smoother and more comfortable neuraxial block placement. Effective pain relief during positioning is particularly important in elderly patients with hip fractures who often experience severe discomfort and physiological stress during movement. No block-related complications were observed in either group in the present study. Therefore, ultrasound-guided PENG block can be considered a safe and clinically useful regional analgesic technique for facilitating spinal anaesthesia in proximal femur fracture surgery.

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