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## Original Research Article

## A comparative study of 0.2% ropivacaine with dexamethasone versus fentanyl in PENG block

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## ABSTRACT

**Background:** The PENG block is recognized for its motor-sparing effect, setting it apart from the femoral nerve block. This interfascial plane block provides good analgesia for proximal femur fracture surgeries.**Aim & Objective:** The primary objective of the research was to analyze the efficacy of Dexamethasone and Fentanyl with Ropivacaine in PENG block for proximal femur surgeries, while the secondary objective was to evaluate the comfort of patients while positioning for spinal anesthesia and any potential side effects.**Materials and Methods:** The study involved 60 patients, classified as ASA grade I/II, split into two groups of 30. Group PD was given 0.2% Ropivacaine (15ml), with Dexamethasone 4mg, and Group PF was given 0.2% Ropivacaine (15ml), with Fentanyl 50mcg in USG guided PENG block. The study documented VAS score before and 10 minutes after the PENG block, patient satisfaction score, postoperative duration of analgesia, hemodynamic effects and adverse effects.**Results:** In both the groups, VAS score before ( $6.567 \pm 1.223$  vs  $6.5 \pm 1.252$ ,  $p=0.408$ ) and 10 minutes after PENG block ( $2.167 \pm 0.791$  vs  $2.234 \pm 0.728$ ,  $p=0.365$ ) and patient satisfaction score ( $2.1 \pm 0.759$  vs  $2 \pm 0.743$ ,  $p=0.328$ ) were comparable i.e. statistically insignificant. The postoperative duration of analgesia ( $655.334 \pm 35.457$  mins in group PD vs  $458.334 \pm 27.518$  mins in group PF,  $p$ -value=0.004), was statistically significant. No significant hemodynamic effects or side effects were observed.**Conclusion:** PENG block has the potential to be beneficial for both preoperative positioning and postoperative pain management. We conclude that Dexamethasone (4mg) and Fentanyl (50 mcg) provide comparable analgesic efficacy as an adjuvant to 0.2% Ropivacaine in the early postoperative period, but Dexamethasone provides a prolonged duration of analgesia.This is an Open Access (OA) journal, and articles are distributed under the terms of the [Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License](https://creativecommons.org/licenses/by-nc-sa/4.0/), which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.For reprints contact: [reprint@ipinnovative.com](mailto:reprint@ipinnovative.com)

## 1. Introduction

Proximal femur surgeries pose several challenges for the anesthetist. Regional anesthesia, particularly spinal or combined Spinal-Epidural, is the preferred method for these procedures. Patients often experience significant pain and encounter difficulties in sitting for regional anesthesia. Moreover, most of the patients posted for such surgeries are from the geriatric age group and

are susceptible to fractures due to fragile bones. They may also have age-related osteoarthritis, which can complicate positioning for spinal anesthesia. Furthermore, age-related comorbidities and postoperative complications add to the challenges. Inadequate pain management can result in delayed ambulation, as well as pulmonary and cardiovascular complications, leading to prolonged hospital stays and increased morbidity.<sup>1-3</sup> Therefore, it is important to incorporate multimodal analgesia such as parenteral analgesics like NSAIDs, opioids, and regional nerve blocks. The site-specific analgesia can be a helpful adjunct.

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For years, the use of femoral nerve block (FNB) or modified technique fascia iliaca compartment block (FICB) has been a common practice to offer pain relief to patients for giving sitting position before spinal or epidural anesthesia for femur surgeries.<sup>4,5</sup> However, they spare the obturator nerve leading to only moderate analgesia and may cause postoperative motor weakness due to femoral nerve block.<sup>6</sup> Numerous nociceptors and mechanoreceptors are found in the anterior capsule of the hip, making it the main contributor to post-surgical pain.<sup>7</sup> L Girón-Arango et al. in the year 2018 developed and introduced the pericapsular nerve block, which popularly came to be known as the PENG block. The distinguishing feature of this block when compared with the Femoral nerve block is its motor-sparing effect.<sup>8</sup> This can aid in early ambulation and patient cooperation with postoperative physiotherapy, ultimately leading to a faster recovery.

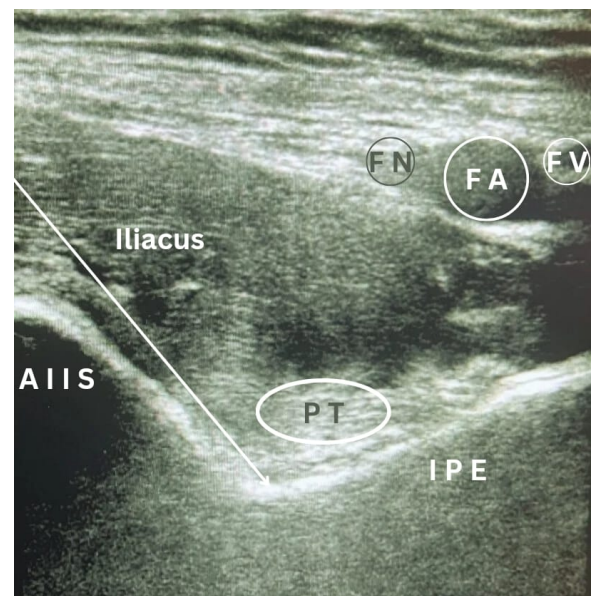
Limited research has been conducted on the utilization of PENG block for providing pain relief to patients undergoing proximal femur surgeries. Therefore, our primary aim was to analyze the impact of either Dexamethasone or Fentanyl added to 0.2% Ropivacaine as a local anesthetic in PENG block for postoperative pain relief after proximal femur surgeries. Additionally, our secondary objective was to evaluate the comfort of patients while positioning for subarachnoid blockade procedure and side effects if any in both groups.

## 2. Materials and Methods

This study was conducted at a tertiary hospital after the Institutional Ethics Committee (approval number: SKNMC/Ethics/App/2024/127) approval and the Clinical Trial Registry-India (CTRI/2024/02/062805) registration. Patients undergoing elective proximal femur surgery under subarachnoid block who were willing to participate were enrolled and informed written consent was taken. This double-blind, prospective randomized study included 60 patients, aged 18-65 years belonging to ASA grade I or II, posted for proximal femur surgery under subarachnoid block. They were randomly assigned to two groups: Group PD {Dexamethasone 4mg +0.2% Ropivacaine (15ml)} and Group PF {Fentanyl 50mcg + 0.2% Ropivacaine (15ml)} for PENG block, using random number tables. The study excluded patients suffering from central or peripheral neuropathies, bleeding disorders, allergy to any study drugs, infection at the block site, psychiatric behavior, obesity (BMI over 30), and pregnant patients.

Each patient underwent a comprehensive preoperative evaluation prior to surgery, during the pre-anesthesia checkup. Baseline tests, such as haemogram, blood sugar, urine routine, PT/INR, and ECG, PFT, CXR for patients older than 40 years, were performed. Patients were briefed on the Visual Analog Scale (VAS) that ranged from 0 (absence of pain) to 10 (worst imaginable pain) for pain

assessment. Standard monitors were set in the operation theatre, and an IV line was established. RL was initiated at 4ml/kg for maintenance fluid therapy. PENG block was performed under all aseptic precautions, using a low-frequency curvilinear ultrasound probe which was first positioned horizontally above the Anterior Inferior Iliac Spine, and then a 45 degrees counter-clockwise rotation was done to achieve alignment with the pubic ramus. This maneuver allowed visualization of the ilio-pubic eminence (IPE), iliopsoas muscle, the psoas tendon, and femoral neurovascular structure. After identifying the landmarks, we used the in-plane technique, directing a 22-gauge spinal needle from the laterally to medially, to place the needle tip in the fascial plane formed by the psoas tendon anteriorly and the pubic ramus posteriorly. When the needle was in position 15 ml of 0.2% ropivacaine with an adjuvant was administered in this plane after negative aspiration (Figure 1).



**Figure 1:** Ultrasound image of PENG Block (FV= Femoral vein, FA=Femoral artery, FN= Femoral nerve, PT= Psoas tendon, IPE= Ilio-pubic eminence, AIIS= Anterior inferior iliac spine. The arrow shows needle trajectory and site for drug deposition)

Following the completion of the block, patients were assessed for pain and given a sitting position for administration of the subarachnoid block ten minutes later. Pulse rate, blood pressure, oxygen saturation, and ECG following the intervention were noted. The pain assessment before and after the block was done using the VAS score. The ease of sitting for the conduct of spinal anesthesia was rated on a scale of 0 to 3, with 0 being unsatisfactory, 1 as satisfactory, 2 as good, and 3 being optimal. If there is no pain relief even after 30 mins of block it is considered as failure of PENG block and such patients were given 100mg of IV Tramadol to facilitate sitting for spinal anesthesia and

they were excluded from the study.

To preload, 15ml/kg of lactated Ringer’s solution was started. Following strict aseptic measures, a conventional midline approach SAB was administered with 26G Quincke’s needle by the anesthetist not participating in the block procedure. A total of 3cc of 0.5% Bupivacaine heavy was administered at the L3-L4 interspace over a period of 30 seconds, following which the patient was instructed to lie down immediately. Fluid therapy was continued with RL at the rate of 10 ml/kg/hr.

An independent anesthesiologist, blinded to the randomization process, assessed the VAS before and after the PENG block, ease of positioning during the subarachnoid block, and other physiological parameters. Heart rate, Spo2, and non-invasive blood pressure were documented intraoperatively: baseline, then every 5 minutes for 15 minutes then at 15-minute intervals for 1 hour, followed by hourly checks for the next 6 hours. Hypotension (blood pressure decreased by more than 20% of the baseline value) was managed by fluid boluses, while 5mg ephedrine was given intravenously in increments if hypotension persisted. Bradycardia was treated with 0.6mg of intravenous atropine.

After the surgical procedure, the intensity of pain was measured using a VAS score initially every 30 minutes for 2 hours, then 2 hourly for the subsequent 8 hours, and then every 4 hours for the next 24 hours post-surgery. Duration of effective postoperative analgesia was determined as the time elapsed from administering the PENG block to the first request for analgesia after surgery or when the VAS score exceeded 3, prompting the administration of Inj Diclofenac 75mg intravenously as a rescue analgesic. If pain persisted, Inj. tramadol (1mg/kg) was administered intravenously, and patients were observed for any potential adverse effects. Post-surgery, all patients were administered 1gm of intravenous Paracetamol twice daily as per institutional guidelines.

Based on a prior study, the sample size was calculated for postoperative analgesia with the use of PENG block.<sup>9</sup> It was assumed that there would be at least 20% reduction in pain scores after adding adjuvant in both the groups. The required sample size for each group, given a study power of 80% and a type I error rate of 5%, was determined to be 25 participants. To account for potential dropouts and enhance result validation, a sample size of 32 subjects representing each group was selected. However, 2 blocks failed in each group resulting in a final sample size of 30 in each group. (Diagram 1)

All necessary data was collected. Statistical analyses were executed with SPSS software (version 20) for Windows (SPSS Science, Chicago, IL, USA). The quantitative data were presented as mean ± SD. A significance threshold of p < 0.05 was applied. The investigator, who was unaware of the drug administration

(Dexamethasone or Fentanyl), conducted the observations. Data analysis involved unpaired t-tests and chi-square tests.

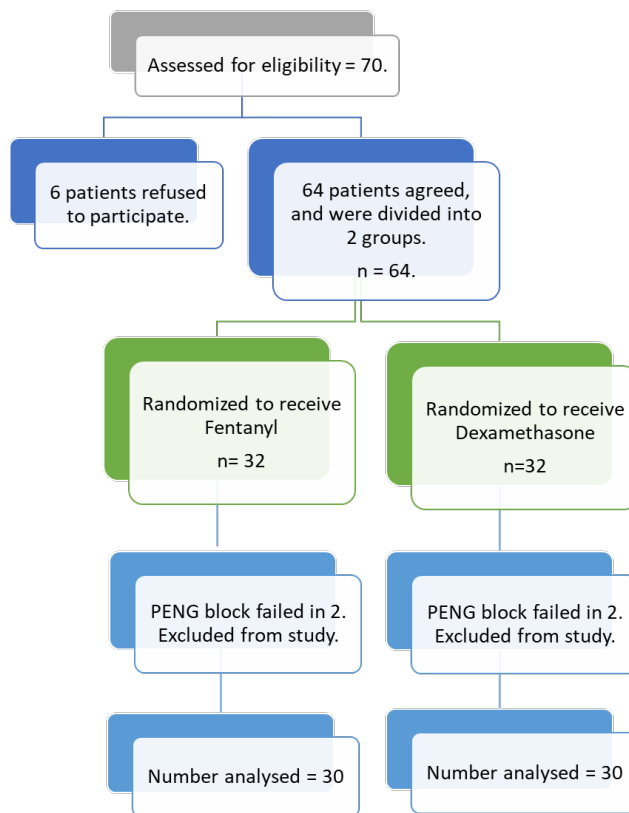


Diagram 1: Consort flow diagram

### 3. Results

This prospective study included 60 patients posted for elective proximal femur surgery under subarachnoid block. They were randomly assigned to two groups Group PD and Group PF to receive study drugs either Ropivacaine with dexamethasone or Ropivacaine with Fentanyl for the PENG block. The demographic parameters and surgery duration were comparable in both groups. (Table 1)

Table 1: Comparison of demographic factors

Variable	Group PD (Mean± SD)	Group PF (Mean± SD)	p-value
Age (years)	53.034±9.686	54.3±10.114	0.305
Gender (M/F)	15/15	16/14	0.500
ASA status (I/II)	18/12	13/17	0.495
Weight (Kg)	63.567±7.704	64.134±7.842	0.291
Duration of surgery (Minutes)	142.6±9.031	146.4±7.295	0.050

We found that both study drugs used in PENG block were equally effective in providing adequate pain relief for patients and helped in giving sitting position for spinal anesthesia. VAS before and after the administration of the PENG block (Table 2) as well as patient satisfaction scores for ease of positioning during spinal anesthesia (Table 3) were comparable in Group PD and Group PF and were statistically insignificant. (p-value > 0.05)

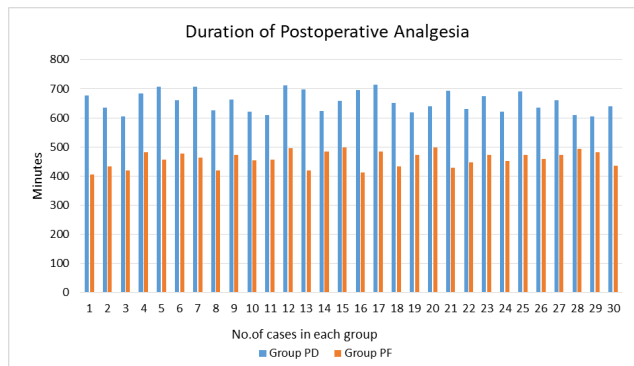
**Table 2:** VAS score

VAS	Group PD (Mean± SD)	Group PF (Mean± SD)	p-value
VAS before PENG	6.567±1.223	6.5±1.252	0.408
VAS after 10 mins	2.167±0.791	2.234±0.728	0.365

**Table 3:** Patient satisfaction score

Variable	Group PD (Mean± SD)	Group PF (Mean± SD)	P value
Patient satisfaction score	2.1±0.759	2±0.743	0.328

We found that the duration of postoperative analgesia was significantly longer in Group PD (655.334±35.457 mins) when compared to Group PF (458.334±27.518 mins) (p- value=0.00468) as shown in (Graph 1).



**Graph 1:** Duration of postoperative analgesia

Both groups showed comparable baseline and intraoperative hemodynamic parameters, including heart rate, mean arterial pressure, and oxygen saturation. There were no observed side effects in group PD as well as group PF.

**4. Discussion**

PENG is a type of interfascial plane block that involves injecting local anesthetic between the psoas muscle and the superior pubic ramus. The articular branches of the femoral nerve, obturator nerve, and accessory obturator

nerve provide sensory innervation to the anterior capsule of the hip joint. PENG block aims to block this anterior hip innervation and provide pain relief to patients and has a motor-sparing effect when compared with femoral nerve block. PENG block is commonly used for providing analgesia following hip or thigh injuries/surgeries like acetabular fractures, femur fractures, and hip replacement procedures. However, it is important to note that PENG block may not be sufficient alone for providing anesthesia for hip surgeries, as it does not block branches of the sacral plexus and sciatic nerve that innervate the posteromedial capsule.

Few meta-analyses were conducted comparing PENG and FICB blocks. One meta-analysis revealed that there was no discernible difference between the PENG block and the FICB within 24 hours in terms of pain levels during rest and movement. Nevertheless, the PENG block exhibited enhanced pain relief and decreased opioid usage within the first 24 hours post-surgery.<sup>10</sup> Other meta-analyses concluded that the PENG block led to decreased opioid usage within the initial 24 hours post-surgery and lower pain scores at rest 12 hours after the surgery.<sup>11,12</sup> Additionally, the PENG block has been shown to delay the need for the first rescue analgesia following surgery. The decreased incidence of motor block following the PENG block leads to better outcomes for patients with postoperative physiotherapy.<sup>12</sup>

Chan Jong Chung.et.al. conducted a study on the impact of the PENG block on opioid usage following hip surgery. The PENG block was administered with either 25mL of 0.5% ropivacaine (PENG group) or 25mL of saline (control group). The PENG group exhibited reduced overall opioid consumption, without any notable effects on quadriceps muscle strength or any other side effects. Moreover, patient satisfaction was noted to be superior in the PENG group compared to the control group.<sup>13</sup>

K S Senthil et al. in their study compared the efficacy of PENG block to Fascia Iliaca Compartment Block (FICB) for managing postoperative analgesia in hip fracture surgeries. The researchers used 0.25% Levobupivacaine 30ml and dexamethasone 4mg for both blocks. The results showed that the PENG block provided a better sensory blockade and had a better motor-sparing effect compared to FICB. Hence, they concluded that PENG block was more appropriate analgesic modality than FICB in patients undergoing hip surgeries as a postoperative analgesic.<sup>14</sup> Similar results with PENG block being a better analgesic were obtained by Hany Bauomy et. al in their study comparing PENG and Supra-inguinal FICB using ropivacaine 0.25% with dexamethasone.<sup>15</sup>

In another study, Huaichang Wen et al. explored the effects of different volumes of 0.33% ropivacaine administered through ultrasound in the PENG block, dividing participants into three groups. Group A, B and



C were given 10 ml, 20 ml and 30 ml of ropivacaine respectively. They evaluated quadriceps muscle strength 6 hrs after surgery. More volume of ropivacaine was linked to higher levels of muscle weakness and lower levels of pain according to their findings.<sup>16</sup>

In our study, we decided to evaluate the effect of Dexamethasone or fentanyl as an adjuvant of 0.2% Ropivacaine 15ml as a local anesthetic in PENG block on the postoperative duration of analgesia. In literature, different doses of fentanyl (25–100 µg) and dexamethasone (2mg–8mg) have been used as an adjuvant to LAs. However, as the dose of fentanyl is increased, the risk of experiencing side effects like nausea and vomiting also increases.<sup>17</sup> Hence, from the safety point of view, we chose an intermediate dose of 50 µg of fentanyl. Dexamethasone in a dose of 4mg is sufficient to produce similar effects as that of 8mg, so we chose a 4mg dose of dexamethasone.<sup>18,19</sup>

Gegal Pruthi et.al conducted a research study to evaluate the effectiveness of dexamethasone (8mg) and fentanyl (50mcg) as adjuvants to 0.75% ropivacaine in ultrasound-guided bilateral ilioinguinal and iliohypogastric nerve block for postoperative analgesia in parturients undergoing LSCS. The findings revealed that both groups demonstrated comparable results in terms of analgesia duration, rescue analgesic requirements, and total tramadol consumption in 24 hours. Consequently, the researchers concluded that dexamethasone and fentanyl are equally effective in providing pain relief.<sup>20</sup> In our study, we found dexamethasone when used as an adjuvant to Ropivacaine provided a longer duration of analgesia than fentanyl in PENG block. Yaghoobi SI et al. found similar results in their two studies.<sup>17,21</sup>

The limitation of our study is that the time taken to perform the procedure was not taken into consideration. Also, we have not assessed the effect on quadriceps muscle strength, which may have proven to be an added advantage in confirming the results. We recommend a multicentric study with a large sample size in ASA III and IV patients.

## 5. Conclusion

Our research findings indicate that the PENG block has the potential to be beneficial for both preoperative positioning and postoperative pain management. It was observed that Dexamethasone (4mg) and fentanyl (50mcg) provide comparable analgesic efficacy in the early postoperative period, but Dexamethasone provides significantly prolonged duration of analgesia.

## 6. Source of Funding

None.

## 7. Conflict of Interest


None.


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