ISSN 2466-488X (Online) doi: 10.5937/sjait2602015S

Original article

EFFECT OF PERICAPSULAR NERVE GROUP BLOCK IN PATIENTS WITH HIP FRACTURE FOR SPINAL ANAESTHESIA POSITIONING: A RANDOMIZED CONTROLLED STUDY
(PENG BLOCK FOR SPINAL ANAESTHESIA POSITIONING)

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Datum prijema rada: 23.09.2025. Prva ispravka rukopisa: 18.12.2025. Datum prihvatanja rada: 06. 03. 2026.

Abstract

Introduction: *Severe pain sometimes makes it difficult to position the patients with hip fractures for spinal anaesthesia, which might impede cooperation and lengthen the process. Recently, the pericapsular nerve group (PENG) block has gained recognition as a potentially effective regional analgesic method. The purpose of this study was to assess how well it facilitates spinal anaesthesia placement.* **Methods:** *Sixty patients (ASA physical status I–III, ages 18–60) scheduled for elective hip surgery under spinal anaesthesia were included in this prospective, randomised trial. The patients were split into two groups of thirty each at random. Thirty minutes before placement, patients in the PENG group received a PENG block, whereas those in the Control group did not. Parameters recorded were operator satisfaction, hemodynamic alterations, positioning pain levels, sitting angle, time to cerebrospinal fluid (CSF) flow, number of tries, and problems associated with blocks.* **Results:** *The demographic traits of the groups were similar. The PENG group associated with much lower VAS scores than the control group ($p < 0.05$), during positioning. While the control group experienced higher pain grades more frequently ($p < 0.05$), the PENG group saw much lower pain scores during positioning, with the majority of patients reporting little to no discomfort. 27 patients in the PENG group and none in the control group ($p < 0.05$) were able to achieve optimal sitting position. The PENG group also showed improved hemodynamic stability, fewer tries, shorter time to CSF flow, and higher operator satisfaction ($p < 0.05$). There were no issues noted.* **Conclusion:** *For patients with hip fractures, the PENG block provides safe and efficient analgesia for spinal anaesthesia placement. Stable hemodynamics were maintained. Operator satisfaction was increased. Procedure time and attempts were reduced, and patient placement was improved.*

Key words: *PENG Block; Hip fracture; Spinal Anaesthesia Positioning*

Introduction

Hip fractures, one of the most common orthopaedic emergencies, with an incidence rate of 182.5 per 100000 populations.[1] Hip fractures involve fractures of the femoral neck, intertrochanteric and subtrochanteric regions. Among younger patients, these fractures usually occur following high-energy trauma such as motor vehicle collisions or falls from height. Older individuals are more susceptible to these fractures even after falling at home due to decreased bone density, reduced activity, vitamin D deficiency.[2]

Hip fracture typically causes severe, often excruciating pain**.** Pain severity in hip fractures varies according to fracture location. Intracapsular femoral neck fractures typically cause mild to moderate pain, particularly when non-displaced, due to limited periosteal involvement. In contrast, extracapsular fractures such as intertrochanteric and subtrochanteric fractures are associated with more severe pain because of extensive periosteal innervation, greater instability, muscle traction, and soft-tissue injury.[3]

A hip fracture requires early surgical intervention within 24 to 48 hours after the injury, which

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allows early mobilization and rehabilitation. However, surgery can be delayed up to 48 to 72 hours post-injury in patients with comorbidities which require stabilization.[2] Femoral neck fractures may require total or hemiarthroplasty, while intertrochanteric/subtrochanteric fractures may require intramedullary fixation.

Operative treatment may result in surgical site infection, perioperative blood loss, thromboembolic events, implant failure, non-union, avascular necrosis, residual functional impairment. Non-operative management, typically reserved for medically unfit patients, is associated with a high incidence of immobilization-related complications including pressure ulcers, pneumonia, venous thromboembolism, chronic pain, functional decline, and increased mortality.[3]

Due to severe pain, high morbidity, and mortality linked to these injuries, the best possible perioperative pain management is crucial.[2] In instances of hip fractures, regional analgesia is frequently used to control perioperative discomfort. Although nonsteroidal anti-inflammatory medications (NSAIDs) and opioids are often used, their usage is limited by possible side effects. The advantage of regional anaesthetic procedures is that they give focused analgesia with fewer systemic consequences, providing efficient pain management during movement (dynamic) and at rest (static).[4]

The two primary peripheral nerve blocks used to provide analgesia for patients with hip fractures are the femoral nerve block (FNB)[5,6,7,8] and fascia iliaca compartment block (FICB).[9,10,11] FICB may not always completely block the femoral and obturator nerves, although FNB may inadequately block the articular branches of the hip joint capsule. However, by focusing on the articular branches of the femoral and obturator nerves, the pericapsular nerve group (PENG) block successfully reduces pain related to femoral neck fractures while preserving the motor function. According to studies, the PENG block provides efficient dynamic analgesia and may be better than or on par with more conventional blocks like FICB and FNB, particularly when it comes to helping with positioning and easing hip fracture pain.[12]

The PENG block has demonstrated potential as a hip fracture analgesic treatment[12], although its ability to facilitate spinal anaesthesia placement has not yet been adequately evaluated. This research aimed to evaluate the effects of PENG block on the ease of use and comfort of spinal anaesthesia settings for patients with hip fractures.

Objectives

Primary Objective**:** Pain profile during positioning for Subarachnoid Block after giving PENG block.

Secondary Objectives:

- Best angle obtained for spinal anaesthesia positioning
- Time to CSF flow (seconds)
- Operator satisfaction
- Number of attempts for subarachnoid block
- Any side effects

Methods

At B. J. Medical College & Civil Hospital in Ahmedabad, India, a prospective, randomised interventional trial was carried out after receiving ethics committee clearance (Ref No. 15/2023 Dated-19/08/2023). Clinical trials registry registration number for the study is CTRI/2023/11/059919. Before being included in the study, all individuals provided written and informed permission.

Sixty patients of either gender, aged between 18 and 60 years, physical status I–III according to the American Society of Anaesthesiologists (ASA) with 48 to 72 hours old unilateral hip fracture without any other musculoskeletal injury, and planned for elective surgery under spinal anaesthesia were included in the study. Patients who were unable to cooperate, declined participation, had known allergies to local anaesthetics, injection site infections, pregnant, coagulation issues, spinal deformities, advanced degenerative diseases of spinal cord, and neuromuscular abnormalities were all excluded.

Using computer-generated randomisation numbers, participants were divided into two equal groups (n = 30 each): a PENG group (n = 30) and a Control group (n = 30) (Figure 1). On the day before surgery, 100 mg of tramadol was injected intravenously into each patient every 12 hours. Before the process, all participants received an explanation of the Visual Analogue Scale (VAS) scoring method.

Fracture age, body mass index (BMI), electrocardiogram (ECG), pulse, noninvasive blood

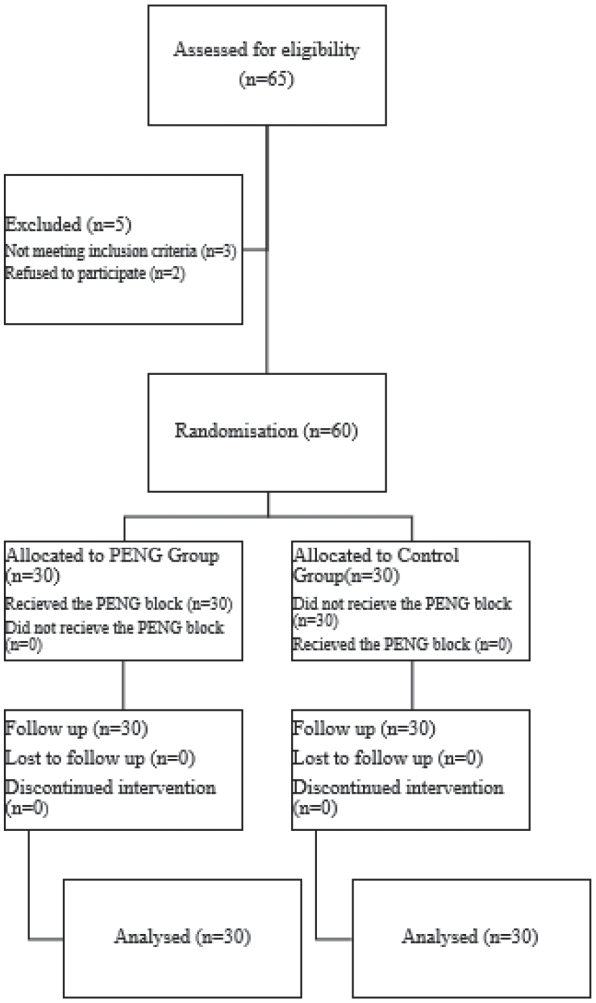

Figure 1. Consort Flow Diagram

pressure (NIBP), oxygen saturation (SpO_2), breathing rate, and VAS score were the baseline characteristics recorded when the patient arrived in the operating room. Cutaneous traction at ankle on fractured limb was continued till sensory blockade of spinal anaesthesia was achieved. The IV cannula has been fastened. Procedure was performed with the patient in supine position, under the guidance of ultrasonography (SonoSite M-Turbo).[13,14] 2-5 MHz C60 curvilinear probe was initially placed in the transverse plane over the anterior inferior iliac spine (AIIS) and then rotated approximately 45° anticlockwise to align with the pubic ramus. A 22-gauge, 80 mm spinal needle was placed in the musculofascial plane between the psoas tendon anteriorly and the pubic ramus posteriorly in the PENG group. Following a negative blood aspiration, 20 ml of 0.5% ropivacaine was given in 5 ml increments to ensure the injective had spread enough. PENG block was performed by a senior anaesthesiologist. Monitoring, pain assessment and spinal anaesthesia was performed by a second anaesthesiologist. Patients' vital signs and VAS scores were checked every five minutes, for thirty minutes after the injection. Standardized protocol was followed across both groups while administration of spinal anaesthesia.

A modified scale based on earlier research was used to assess and rate the pain felt during spinal anaesthesia placement[13][15]: Grade 1: capable of sitting pain-free and with little help; Grade 2: minor discomfort that is expressed verbally or by grimacing; Grade 3: severe pain that may be tolerated with help; Grade 4: unable to bear positioning and in need of more analgesics.

Each patient's ideal spinal flexion angle was categorised as follows[13]: A represents good flexion (angle > 90°), B represents medium flexion (angle < 90°) without hand support or twisting, and C represents poor flexion with hand support or twisting. The number of tries needed and the duration between needle insertion and cerebrospinal fluid (CSF) flow were noted. Following the operation, the anaesthesiologists who conducted the block rated operator satisfaction on a four-point scale: Excellent, Good, Average, or Poor.

Sample size calculation

A pilot study involving 15 patients in each group was undertaken to estimate the variability in postoperative visual analogue scale (VAS) scores. The pooled standard deviation (σ) was found to be 1.5. Assuming a clinically significant mean difference of 1.08 between the two anaesthetic drug groups, with 95% confidence and 80% power, sample size of 30 per group (a total of 60 patients) was calculated using open epi software version 3.1.

Statistical Analysis

Following the summarisation of continuous data as mean values with corresponding standard deviations, the student's t-test was employed to see whether any differences existed. Categorical data were compared using either Fisher's exact test or the chi-square test, depending on the circumstances. P values below 0.05 were regarded as statistically significant. Microsoft Excel 2.16 and Epi Info 7 were used for all statistical analyses.

Results

Three patients did not match the inclusion requirements, and two patients declined to participate in the research out of the 65 patients that were evaluated for inclusion (Figure 1). For both groups, demographic factors such as age, gender, and BMI were similar (Table 1).

Statistically significant difference in pain intensity measured by VAS score was observed between the two groups, with the PENG group showing a mean VAS score of 2.70 ± 0.95, whereas control group had a mean VAS score of 7.57 ± 0.94 (p = 0.0001), as shown in Table 2. Furthermore, as shown in figure 2, patients in the PENG group reported noticeably less discomfort during spinal

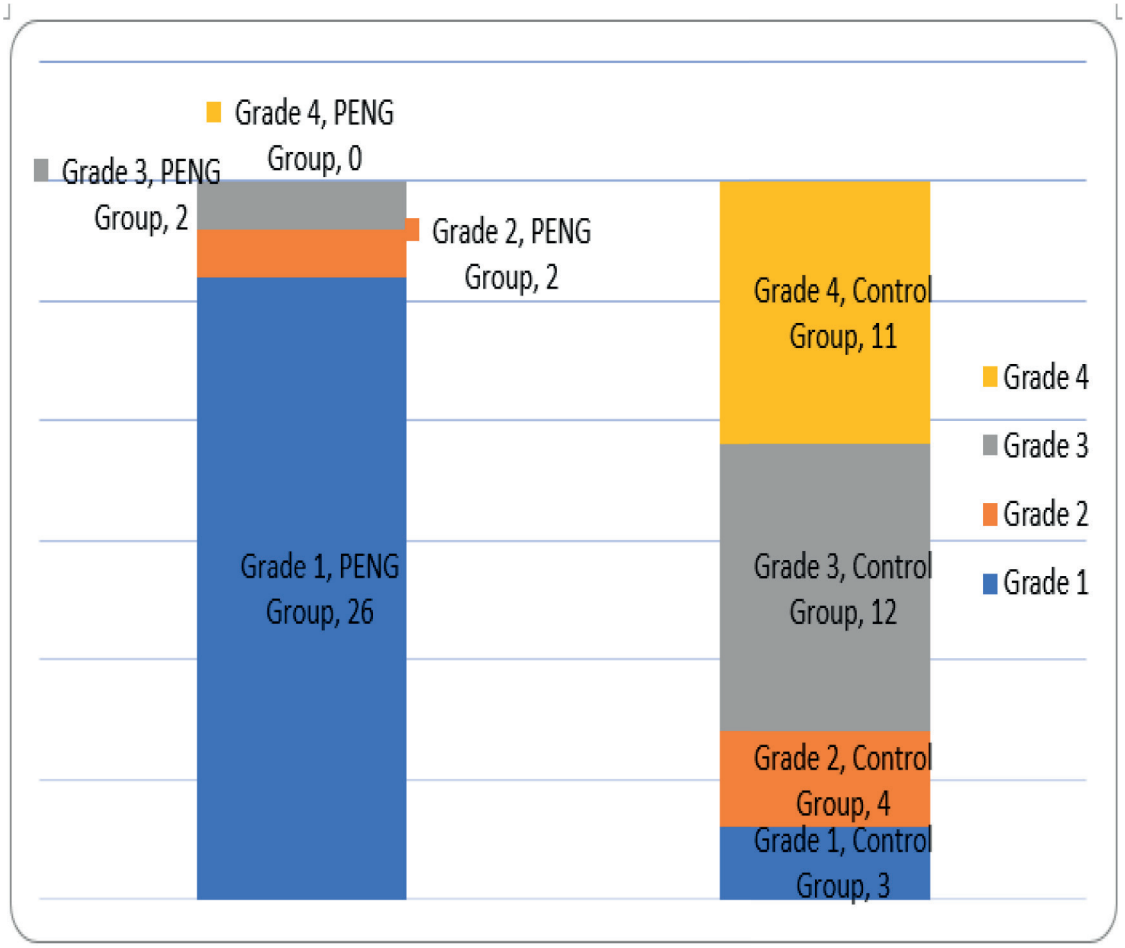

Figure 2: Pain Profile of the patients during Spinal Anaesthesia Positioning

Table 1: Demographic Data

VARIABLE	PENG Group	Control Group
AGE	50.23±9.76*	50.07±9.81*
MALE/FEMALE	19/11	22/8
BODY MASS INDEX	22.53±2.43*	22.03±1.54*

*data shown as a mean ± standard deviation

anaesthesia placement than those in the control group.

With p values of 0.0001 and 0.006, respectively, the PENG group showed a substantially shorter duration for CSF flow and fewer tries than the control group (Table 3). Additionally, the PENG group had higher anaesthesiologist satisfaction. During spinal anaesthesia, patients in this group also showed better sitting posture. Neither group had any difficulties.

Table 2: VAS Score distribution among groups in Preoperative period and during Spinal Anaesthesia (After PENG Block)

Variables	VAS SCORE*	
Groups	**Preoperative**	**During Positioning**
PENG Group	7.63±0.81	2.70±0.95
Control Group	7.57±0.94	7.57±0.94
p VALUE	0.79	0.0001

*In the above table, VAS score shown as (MEAN±SD).

Table 3: Spinal Anaesthesia Trial outcomes

Outcome Variables		PENG Group	Control Group	p VALUE
Time to CSF* Flow (seconds)		29.5±2.8	37.2±3.2	0.0001
Number of Attempts		1.1±0.3	1.4±0.5	0.006
Operator Satisfaction n (%)		28(93.3%)	14(46.6%)	0.0001
Patient Sitting Angle n (%)	Good	27(90%)	1(3.33%)	0.0001
	Average	2(6.6%)	15(50%)	
	Poor	1(3.3%)	14(46.6%)	

*CSF- Cerebrospinal Fluid

Discussion

Hip fractures, which can occur in both young and old people, are among the most common surgical fractures. They are usually accompanied by excruciating pain and can be caused by trauma, fractures, tumour surgery, joint pathology, or other factors. Hip fractures are frequently caused by falls in the elderly or high-energy trauma in younger persons, and known risk factors include advancing age, female gender, living alone, history of previous falls, physical restrictions, and the use of mobility aids.[16]

Hip fracture pain therapy has historically involved the use of systemic oral or intravenous analgesics; nevertheless, achieving sufficient pain relief is sometimes challenging, and side effects are frequent, especially in elderly patients. Because they offer better analgesia and a lower risk of complications, regional anaesthesia procedures are recommended. Additionally, they decrease hospital stays and improve patient satisfaction.

Peripheral nerve blocks, including the femoral nerve block (FNB)[5,6,7] and the fascia iliaca compartment block (FICB)[10,11,17], have been the subject of several investigations. Nevertheless, FNB frequently falls short of achieving total blockage of the articular branches of the hip capsule, while FICB might not consistently anaesthetise the femoral and obturator nerves. Furthermore, both may weaken the quadriceps muscles, which would reduce their usefulness.[8,9]

The pericapsular nerve group (PENG) block is a novel technique that targets the articular branches of the femoral, obturator, and auxiliary obturator nerves. By administering a local anaesthetic between the pubic ramus and the psoas tendon, PENG block successfully reduces hip pain without impairing motor function.[12] Although it has been used to treat hip fracture pain, little research has been done on how well it works to help with the placing of spinal anaesthesia.

When compared to controls in this study, patients who received PENG block had better sitting posture and noticeably lower pain levels during spinal anaesthesia positioning. The majority of patients in the PENG Group reported grade 1 pain, while individuals with higher grades predominated in the Control Group. In a similar vein, practically every patient in the PENG Group had a decent sitting angle, but none of the Control Group

patients had ideal posture. These outcomes are in line with earlier research.[13]

Our findings are consistent with previous publications. The greater analgesic impact of PENG block over other blocks was supported by Girón-Arango et al.'s[12] report of a substantial reduction in pain intensity in patients undergoing PENG block. Similar improvement was shown in our trial, where the mean VAS dropped from 7.63 ± 0.81 before surgery to 2.70 ± 0.95 after placement.

Consistent with our findings, Alrefaey and Abouelela[13] also observed reduced pain scores, better sitting angles, increased operator satisfaction, and a quicker time to CSF flow following PENG block. Acharya and Lamsal[18] highlighted increased comfort for anaesthesiologists during positioning and reported similar decreases in numerical rating scale ratings.

In a prospective cohort, Sahoo et al.[19] verified the efficacy of PENG by demonstrating notable decreases in VAS ratings under both static and dynamic circumstances, with most patients obtaining good or optimum compliance for spinal anaesthesia. By precisely measuring posture and discomfort during spinal positioning as opposed to passive leg movement, our work builds on previous findings. Roy et al.[20] recommended a lateral femoral cutaneous nerve block in addition to the PENG block to provide more comprehensive postoperative analgesia; however, the current study could only evaluate the preoperative phase.

Consistent with previous accounts, our patients showed no signs of problems.[19] Additionally, the PENG group maintained hemodynamic stability better, indicating greater patient comfort.

There are several restrictions on this study. Since spinal anaesthesia was given after placement, postoperative analgesia could not be assessed. Longer-lasting analgesia may be possible with continuous PENG procedures or catheter-based treatments[21], but infection risk needs to be taken into account. Complete hip anaesthesia may be achieved by combining PENG and sciatic blocks[22], which calls for more research. Additionally, the study had a tiny sample size and was only carried out at one location.

To validate these results and evaluate the function of PENG block in perioperative and postoperative analgesia, larger multicenter trials are required.

Conclusion

The pericapsular nerve group (PENG) block is a safe treatment option for individuals with hip fractures, and efficient method of providing analgesia while the patient is positioned for spinal anaesthesia. While preserving hemodynamic stability, it dramatically lessens discomfort, promotes the best possible sitting position, cuts down on the number of tries, shortens the time it takes for cerebrospinal fluid to flow, and increases anaesthesiologist satisfaction.

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