

# Comparison of Pericapsular Nerve Group Block and Femoral Nerve Block for Ease of Positioning During Spinal Anaesthesia in Hip Fracture Surgeries: A Prospective Randomized Controlled Trial

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## Abstract

**Background:** Hip fractures often require spinal anaesthesia for surgery, but positioning for spinal anaesthesia is painful, necessitating preoperative regional nerve blocks. This study compares ultrasound-guided pericapsular nerve group (PENG) and femoral nerve block (FNB) for positioning efficacy in hip fracture patients.

**Methods:** In current prospective, randomized controlled trial, 70 patients with unilateral hip fractures were allocated to either PENG (n=35) or FNB (n=35) group. Pain was assessed via Numerical Rating Scale (NRS), Positioning quality was categorized by hip flexion angle and rescue analgesia requirement was recorded.

**Results:** NRS scores were lower in the PENG group at 20 minutes (4.74 vs. 6.20,  $p=0.001$ ), 30 minutes (2.80 vs. 4.83,  $p=0.001$ ), and during positioning of spinal anaesthesia (1.74 vs. 2.97,  $p=0.001$ ). The PENG group had better positioning quality, with Category A achieved by 20 (57.14%) patients versus 12 (34.29%) in the FNB group ( $p=0.036$ ). Rescue analgesia was needed by 1 (2.86%) patient in PENG group versus 7 (20%) patients in FNB group ( $p=0.027$ ).

**Conclusions:** The PENG block offers superior pain relief and positioning quality for spinal anaesthesia in hip fracture patients, with less rescue analgesia required compared to FNB.

**Keywords:** Pain Management, Patient Positioning, Bupivacaine, Ultrasonography, Regional Anaesthesia

## Introduction

The hip joint, commonly known as a "ball and socket" joint, is an important joint where the acetabulum (the socket) cradles the femoral head (the ball). The femoral neck connects the head to the shaft and intertrochanteric region, forming an essential link in the hip's anatomy [1,2]. Hip fractures can occur in any of these areas and are particularly common among older adults with existing health conditions [3]. It poses high morbidity and mortality, with an derived estimate of

200,000 hip fractures annually in India over 50 years [4]. There are several treatments available [5], but ultimately they often require specialised surgical interventions [6]. Hip surgery is generally performed under spinal anaesthesia due to its simplicity, effectiveness and low perioperative complications [7]. However, positioning these patients for spinal anaesthesia can be difficult and extremely painful requiring regional nerve blocks to enhance patient comfort and procedural ease [7,8]. Preoperative regional nerve blocks such as the femoral

nerve block (FNB), fascia iliaca block, and pericapsular nerve group (PENG) block are employed to enhance spinal anaesthesia [9,10,11]. These blocks improve patient positioning, provide immediate pain relief, reduce postoperative pain, enabling earlier mobilization and shorter hospital stays [8,12].

As a relatively new technique, the PENG block has limited research comparing it to the well-established FNB. To bridge this gap, this study was aimed to evaluate the analgesic efficacy of ultrasound-guided PENG and FNB in facilitating spinal anaesthesia positioning for hip fracture patients. The primary objective was to compare the analgesic effects, while the secondary objectives were to assess quality of position during spinal anaesthesia and postoperative pain relief among the two blocks.

## Methods

In this prospective, randomized study conducted at a tertiary care centre in northern India, researchers compared two regional anaesthesia techniques for positioning during spinal anaesthesia in hip fracture patients from January to December 2024. The study received approval from the Biomedical Research Ethics Committee (BREC/23/TH-Anaesthesia/36) and was registered with the Clinical Trial Registry of India (CTRI/2024/01/061612).

The study included ASA Physical Status I–III adult patients aged 18–85 years, of any gender, with a unilateral hip fracture scheduled for surgery under spinal anaesthesia. However, individuals with bleeding tendencies, multiple fractures, anticoagulant therapy, peripheral neuropathy, fractures older than a week, allergies to amide local anaesthetics, mental health conditions, local infections at the injection site, inability to report pain scores, or those who declined participation were excluded.

Sample size was determined based on a study by Lin Dy et al. [13], using an  $\alpha$  of 1.96,  $\beta$  of 0.84, 80% power, a 7% effect size ( $\Delta$ ), and a standard deviation ( $\sigma$ ) of 0.1.

Each patient underwent a thorough clinical history review and examination. Subjects were explained about the study's purpose, protocol, Numerical Rating Scale (NRS) [14,15] for pain (0–10) and a written informed consent was obtained. Using computer-generated randomization, patients were assigned to one of two groups:

Group PENG (n=35): Received a Pericapsular Nerve Group (PENG) block before spinal anaesthesia and

Group FNB (n=35): Received a Femoral Nerve Block (FNB) before spinal anaesthesia.

Following ASA fasting guidelines, patients were brought to the premedication room 30 minutes before surgery. There, standard monitoring was done with ECG, non-invasive blood pressure (NIBP), and oxygen saturation (SpO<sub>2</sub>), and an IV access was secured and ringer lactate infusion was started.

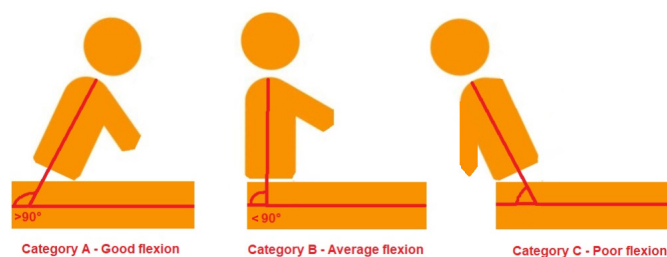
Both PENG and FNB blocks were performed under ultrasound-guidance as it improves the efficacy and safety of the regional block, reducing the risk of adverse events while providing effective analgesia [16]. Sonosite Edge-II ultrasound machine with a curvilinear (3.5–5 MHz) transducer was used. A consultant anaesthesiologist with five years of ultrasonography experience administered the blocks, injecting 20 ml of 0.25% bupivacaine in 5-ml increments, ensuring proper spread and performing negative aspiration at the start and after each 5-ml dose.

A different consultant anaesthesiologist, unaware of the study group recorded the study observations.

Pain was assessed using Numerical Rating Scale (NRS) at different time points: before the block (T<sub>0</sub>), 20 min after the block (T<sub>1</sub>), 30 minutes after the block (T<sub>2</sub>). Patients were then shifted to the operating theatre. Spinal anaesthesia was performed using a 23G Quincke's needle in the sitting position via a midline approach. Pain score was assessed during positioning for spinal anaesthesia (T<sub>3</sub>). If a patient reported an NRS score  $\geq 4$ , they received 1g of paracetamol, and positioning was reattempted. A block was deemed optimal if the NRS remained  $<4$  during positioning. Postoperative NRS scores were also noted at 4 hours (T<sub>4</sub>) and 24 hours (T<sub>5</sub>), with additional analgesia provided as and when needed by the surgical team.

The quality of patient positioning was measured using a goniometer to assess hip flexion angle, categorized as shown in Figure 1: Category A: Good flexion ( $>90$  degrees), Category B: Average flexion ( $<90$  degrees without twisting or using hand support), Category C: Poor flexion (and/or twisting or using hand support) [12].

Number of spinal anaesthesia attempts, the time taken, and the need for rescue analgesics were also recorded.



**Figure 1** – Quality of positioning Categorization

Image Credit: Tarun Yadav.

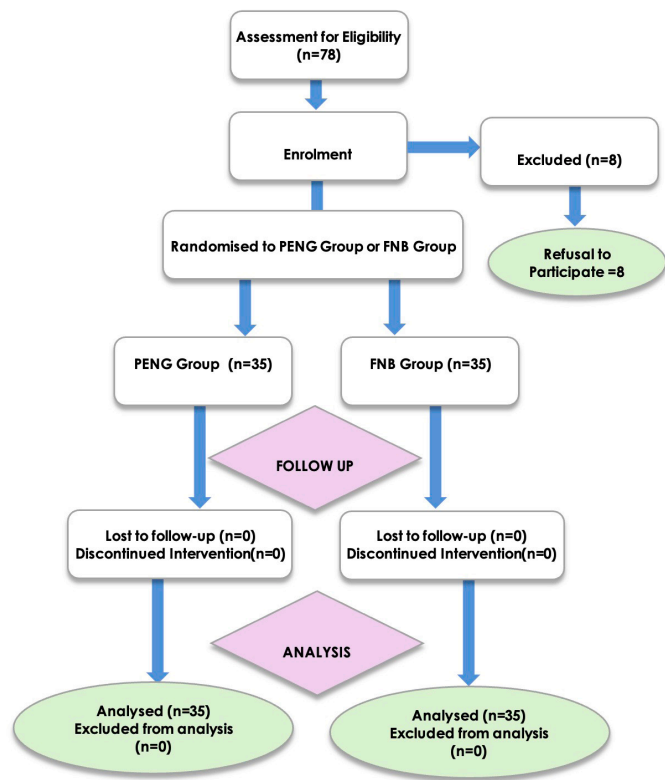
## Results

This study compared the efficacy of Pericapsular Nerve Group Block (PENG) with Femoral Nerve Block (FNB) in facilitating spinal anaesthesia focusing on comparing pain relief, quality of positioning, rescue analgesic requirements. Study assessed a total of 78 patients, out of which 8 patients refused to participate so finally 70 patients were enrolled and were subsequently randomized into either PENG group or FNB group (Figure 2).

Demographics between PENG and FNB groups were comparable, with no significant differences in age, sex, weight, height, BMI, or ASA grades. Both groups had similar mean ages, sex distributions, and physical characteristics and ASA grades (Table 1).

Comparison of quality of positioning during spinal anaesthesia demonstrated that PENG group had a better quality of position compared to the FNB group with Category A having 20 (57.14 %) of PENG group patients versus 12 (34.29%) of FNB group patients, Category B having 13 (37.14%) of PENG group patients versus 14 (40.00%) of FNB group and Category C having only 2 (5.71%) of PENG group patients versus 9 (25.71%) of FNB group with a significant statistical difference (p-value 0.036) (Figure 3).

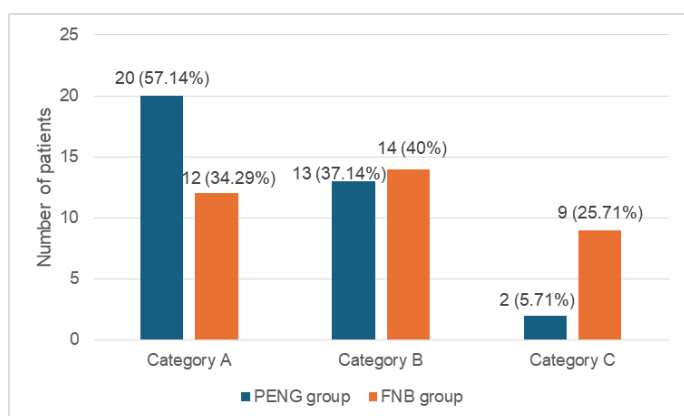
In the PENG group, 32 (91.43%) patients achieved spinal anaesthesia in 1st attempt, 3 (8.57%) patients in 2nd attempt,



**Figure 2** – CONSORT flow chart

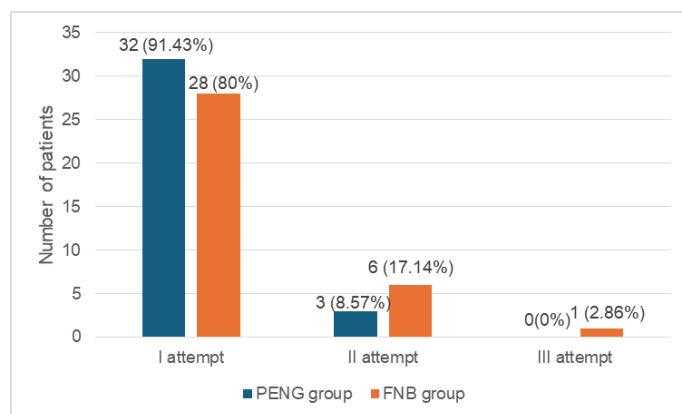
| Parameter                | PENG Group    | FNB Group     | p-value |
|--------------------------|---------------|---------------|---------|
| Mean Age (years)         | 61.89 ± 15.26 | 61.71 ± 15.93 | 0.754#  |
| Male                     | 23 (65%)      | 17 (48%)      | 0.160*  |
| Female                   | 12(35%)       | 18 (52%)      |         |
| Weight (kg)              | 64.34 ± 10.80 | 66.69 ± 6.69  | 0.280#  |
| Height (cm)              | 166.17 ± 6.03 | 167.17 ± 7.80 | 0.950#  |
| BMI (kg/m <sup>2</sup> ) | 24.02 ± 2.41  | 23.60 ± 2.58  | 0.484#  |
| ASA Grade I              | 3 (8.57%)     | 3(8.57%)      | 0.727*  |
| ASA Grade II             | 23 (65.71%)   | 20(57.14%)    |         |
| ASA Grade III            | 9 (25.71%)    | 12(34.29%)    |         |

# Unpaired *t* test, \* chi-square test



**Figure 3** – Comparison of quality of positioning during spinal anaesthesia among PENG and FNB groups

X axis: Hip flexion angles categories; Y axis: Number of patients; PENG: Pericapsular nerve group block ; FNB: Femoral nerve block; Category A: Good flexion; Category B: Average flexion; Category C: Poor flexion.



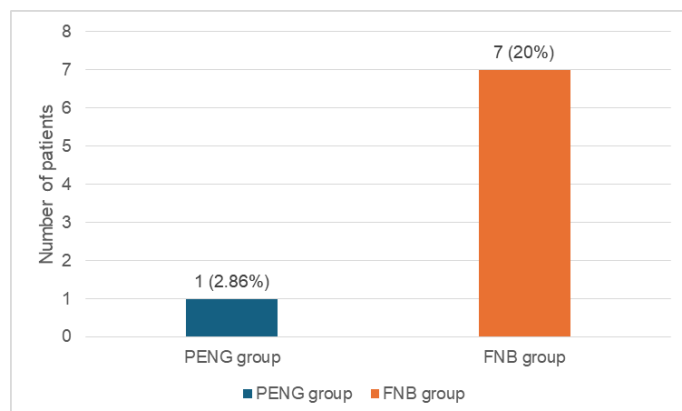
**Figure 4** – Number of spinal anaesthesia attempts among PENG and FNB groups

X axis: Number of attempts to achieve spinal anaesthesia; Y axis: Number of patients; PENG: Pericapsular nerve group block ; FNB: Femoral nerve block.

and none of the 0 (0%) patients required IIIrd attempt. While in the Femoral group, 28 (80%) patients achieved spinal anaesthesia in Ist attempt, 6 (17.14%) patients in IIInd attempt and 1 (2.86%) patient in IIIrd attempt. Comparison of number of attempts between two groups during spinal anaesthesia showed statistically non-significant difference (p-value 0.32) (Figure 4).

The mean time taken for spinal anaesthesia was 46.14±8.70 sec in PENG group and 46.29±10.31 sec in FNB group which were comparable with non-significant difference (p=0.48).

In the PENG group, only 1 (2.86%) patient needed rescue analgesia while positioning during spinal anaesthesia whereas, in the FNB group, 7 (20%) participants needed rescue analgesic. Rescue analgesia requirement in PENG group was significantly lower when compared to FNB group (p-value 0.027) (Figure 5).



**Figure 5** – Rescue Analgesic requirement among PENG and FNB groups

X axis: Rescue Analgesic requirement; Y axis: Number of patients; PENG: Pericapsular nerve group block; FNB: Femoral nerve block.

When NRS pain score was compared among PENG and FNB groups, PENG group had significantly lower pain scores at 20 min after block (T1) (4.74±0.74 vs. 6.20±0.87; p=0.001), 30 min after block (T2) (2.80±1.05 vs. 4.83±0.93; p=0.001), and during positioning of spinal anaesthesia (T3) (1.74±0.74 vs. 2.97±0.99; p=0.001). However, difference was not statistically

Table 2

Comparison of NRS pain score at different time intervals among PENG and FNB groups

| Conditions                                 | PENG group  | FNB group   | p-value  |
|--------------------------------------------|-------------|-------------|----------|
| <b>Baseline (T0)</b>                       | 8.91 ± 1.04 | 8.91 ± 1.01 | 1.000    |
| 20 mins after regional group (T1)          | 4.74 ± 0.74 | 6.20 ± 0.87 | 0.001(S) |
| 30 min after regional group (T2)           | 2.80 ± 1.05 | 4.83 ± 0.93 | 0.001(S) |
| During spinal anaesthesia positioning (T3) | 1.74 ± 0.74 | 2.97 ± 0.99 | 0.001(S) |
| 4hr Postoperatively (T4)                   | 2.97 ± 0.75 | 2.89 ± 1.18 | 0.718    |
| 24hr Postoperatively (T5)                  | 5.17 ± 0.66 | 5.43 ± 0.78 | 0.141    |

significant at baseline (T0) ( $p=1.0$ ), 4 hrs postoperatively (T4) ( $p=0.718$ ) and 24 hrs postoperatively (T5) ( $p=0.141$ ) (Table 2).

## Discussion

The present study aimed to compare pericapsular nerve group block (PENG) and femoral nerve block (FNB) for ease of positioning during spinal anaesthesia in hip fracture surgeries.

The PENG block demonstrated superior pain relief, with significantly lower Numeric Rating Scale (NRS) scores at 20 minutes after block (T1) (4.74 vs. 6.20,  $p=0.001$ ), 30 minutes after block (T2) (2.80 vs. 4.83,  $p=0.001$ ), and during spinal anaesthesia (T3) (1.74 vs. 2.97,  $p=0.001$ ) compared to the FNB. This is likely due to the PENG block's targeting of the femoral, accessory obturator, and obturator nerve articular branches, which innervate the anterior hip capsule's nociceptive mechanoreceptors [9]. In contrast, the FNB may not adequately block these branches, resulting in suboptimal pain relief. Similar findings were reported by Jeevendiran et al. [17] and Chaudhary et al. [18], who noted significant reductions in pain scores with the PENG block.

In current study positioning quality, assessed by hip flexion angle, was significantly better in the PENG group, with 57% of patients achieving Category A (Good flexion) compared to 34% in the FNB group ( $p=0.036$ ). This aligns with Jeevendiran et al. [17], who reported better sitting angles in the PENG group (63% vs. 26%,  $p=0.001$ ), and Alrefaey et al. [12], who observed 87% of PENG patients achieving flexion  $>90^\circ$ . Improved positioning likely results from enhanced analgesia, facilitating patient cooperation. However, Chaudhary et al. [18] found no significant difference, possibly due to differing measurement scales, suggesting a need for standardized assessment tools.

No significant difference was observed in spinal anaesthesia attempts, with 91.43% of PENG group and 80% of FNB group patients receiving spinal anaesthesia on the first attempt ( $p=0.32$ ). This is similar with Erten et al. [19] and may reflect the expertise of the consultant anaesthesiologists, minimizing procedural variability.

The PENG group required significantly less rescue analgesia during spinal anaesthesia (3% vs. 20%,  $p=0.027$ ) over FNB group, supporting its superior analgesic profile. Jeevendiran et al. [17] reported similar results (5.7% vs. 25.7%,  $p=0.045$ ), highlighting the PENG block's effectiveness in reducing supplemental analgesia needs. Sahoo et al. [20] in a case series also found a significant reduction in VAS scores at

rest (baseline:  $6.77 \pm 1.20$ ; 30 minutes post block:  $0.44 \pm 0.52$ ).

Postoperative NRS scores at 4 hours (2.97 vs. 2.89,  $p=0.718$ ) and 24 hours (5.17 vs. 5.43,  $p=0.141$ ) showed no significant differences, likely due to the waning effect of single-shot blocks and postoperative use of other analgesics (e.g., tramadol, NSAIDs). Allard et al. [21] reported similar findings, while Chaudhary et al. [18] noted significant pain relief in the PENG group at 6 and 8 hours, possibly due to protocol differences. Continuous blocks may improve postoperative outcomes.

No complications (e.g., bleeding, nerve injury, infection) were reported in either group, likely due to ultrasound guidance and experienced consultants.

## Limitations

The study's single-centre design and small sample size ( $n=70$ ) limit generalizability. Postoperative mobility, muscle function, and hospital stay were not assessed, and single-shot blocks may have restricted prolonged postoperative analgesia. Future studies should explore continuous blocks, larger multicentre cohorts, and functional outcomes.

## Conclusion

In conclusion, the PENG block demonstrated significantly superior positioning quality for spinal anaesthesia compared to the femoral nerve block. Patients in the PENG group reported significantly lower NRS pain scores and required less rescue analgesia during positioning. These findings suggest that the PENG block offers clear advantages in terms of patient comfort and procedural facilitation. Further multi-centre, large-scale studies incorporating continuous postoperative nerve blocks are warranted to confirm these results and further explore the clinical benefits of the PENG block.

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## References

1. Foster KW. Overview of common hip fractures in adults. In: Asplund CA, Gammons M, editors. UpToDate. Waltham, MA: UpToDate; 2025.



2. Kapandji IA. The physiology of the joints volume 2: lower limb. London, United Kingdom: *Churchill Livingstone Elsevier*; 2007. P. 90–115.
3. Dhanwal DK, Dennison EM, Harvey NC, Cooper C. Epidemiology of hip fracture: worldwide geographic variation. *Indian J Orthop*. 2011; 45: 15–22. <http://doi.org/10.4103/0019-5413.73656>
4. George J, Sharma V, Farooque K, Mittal S, Trikha V, Malhotra R. Injury Mechanisms of Hip Fractures in India. *Hip Pelvis*. 2021; 33(2): 62–70. <http://doi.org/10.5371/hp.2021.33.2.62>
5. Kaushik RK, Singh V, Sharma R, Gupta A, Jaiman A. Integrative approach to fracture healing: A review. *J Clin Med Kaz*. 2022; 19(3): 16–18. <https://doi.org/10.23950/jcmk/12143>
6. Manap N, Mursalov N, Abilmazhinov M. Assessment of Outcomes of the Modified Stoppa Approach in the Treatment of Acetabular Fractures: A Retrospective Cohort Study. *J Clin Med Kaz*. 2024; 21(6): 73–78. <https://doi.org/10.23950/jcmk/15614>
7. Urwin SC, Parker MJ, Griffiths R. General versus regional anaesthesia for hip fracture surgery: a meta-analysis of randomized trials. *Br J Anaesth*. 2000; 84(4): 450–455. <http://doi.org/10.1093/oxfordjournals.bja.a013468>
8. Orosz GM, Magaziner J, Hannan EL, Morrison RS, Koval K, Gilbert M, McLaughlin M, Halm EA, Wang JJ, Litke A, Silberzweig SB, Siu AL. Association of timing of surgery for hip fracture and patient outcomes. *JAMA*. 2004; 291(14): 1738–1743. <http://doi.org/10.1001/jama.291.14.1738>
9. Girón-Arango L, Peng PW, Chin KJ, Brull R, Perlas A. Pericapsular nerve group (PENG) block for hip fracture. *Reg Anesth Pain Med*. 2018; 43: 859–863. <http://doi.org/10.1097/AAP.0000000000000847>
10. Beaudoin FL, Nagdev A, Merchant RC, Becker BM. Ultrasound-guided femoral nerve blocks in elderly patients with hip fractures. *Am J Emerg Med*. 2010; 28(1): 76–81. <http://doi.org/10.1016/j.ajem.2008.09.015>
11. O'Reilly N, Desmet M, Kearns R. Fascia iliaca compartment block. *BJA Educ*. 2019; 19(6): 191–197. <http://doi.org/10.1016/j.bjae.2019.03.001>
12. Alrefaey AK, Aboulela MA. Pericapsular nerve group block for analgesia of positioning pain during spinal anesthesia in hip fracture patients, a randomized controlled study. *Egypt J Anaesth*. 2020; 36(1): 234–239. <https://doi.org/10.1080/11101849.2020.1828017>
13. Lin DY, Morrison C, Brown B, Saies AA, Pawar R, Vermeulen M, Anderson SR, Lee TS, Doornberg J, Kroon HM, Jaarsma RL. Pericapsular nerve group (PENG) block provides improved short-term analgesia compared with the femoral nerve block in hip fracture surgery: a single-center double-blinded randomized comparative trial. *Reg Anesth Pain Med*. 2021; 46: 398–403. <http://doi.org/10.1136/rapm-2020-102315>
14. Jensen MP, Karoly P, Braver S. The measurement of clinical pain intensity: a comparison of six methods. *Pain*. 1986; 27(1): 117–126. [http://doi.org/10.1016/0304-3959\(86\)90228-9](http://doi.org/10.1016/0304-3959(86)90228-9)
15. Ferreira-Valente MA, Pais-Ribeiro JL, Jensen MP. Validity of four pain intensity rating scales. *Pain*. 2011; 152(10): 2399–2404. <http://doi.org/10.1016/j.pain.2011.07.005>
16. Yadav T, Bansal G, Golhar M, Ghai A. Evaluation of thoracic paravertebral block for pain relief in rib fractures. *J Clin Med Kaz*. 2023; 20(6): 41–44. <https://doi.org/10.23950/jcmk/13874>
17. Jeevendiran A, Suganya S, Sujatha C, Rajaraman J, R S, Asokan A, A R. Comparative evaluation of analgesic efficacy of ultrasound-guided pericapsular nerve group block and femoral nerve block during positioning of patients with hip fractures for spinal anesthesia: a prospective, double-blind, randomized controlled study. *Cureus*. 2024; 16(3): e56270. <http://doi.org/10.7759/cureus.56270>
18. Chaudhary K, Bose N, Tanna D, Chandnani A. Ultrasound-guided pericapsular nerve group (PENG) block versus femoral nerve block for positioning during spinal anaesthesia in proximal femur fractures: a randomised comparative study. *Indian J Anaesth*. 2023; 67(10): 913–919. [http://doi.org/10.4103/ija.ija\\_553\\_23](http://doi.org/10.4103/ija.ija_553_23)
19. Erten E, Kara U, Simşek F, Eşkin MB, Bilekli AB, Öcal N, Şenkal S, Ozdemirhan İ. Comparison of pericapsular nerve group block and femoral nerve block in spinal anesthesia position analgesia for proximal femoral fractures in geriatric patients: a randomized clinical trial. *Ulus Travma Acil Cerrahi Derg*. 2023; 29: 1368–1375. <http://doi.org/10.14744/tjtes.2023.33389>
20. Sahoo RK, Jadon A, Sharma SK, Nair AS. Pericapsular nerve group (PENG) block for hip fractures: another weapon in the armamentarium of anesthesiologists. *J Anaesthesiol Clin Pharmacol*. 2021; 37(2): 295–296. [http://doi.org/10.4103/joacp.JOACP\\_295\\_20](http://doi.org/10.4103/joacp.JOACP_295_20)
21. Allard C, Pardo E, de la Jonquière C, Wyniecki A, Soulier A, Faddoul A, Tsai ES, Bonnet F, Verdonk F. Comparison between femoral block and PENG block in femoral neck fractures: a cohort study. *Plos One*. 2021; 16(6): e0252716. <http://doi.org/10.1371/journal.pone.0252716>