

Comparison of Posterior and Lateral Approaches for Ultrasound-guided Popliteal Sciatic Nerve Block in Lower Limb Surgery: A Prospective Interventional Study

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ABSTRACT

Introduction: Popliteal sciatic nerve block is an effective regional anaesthetic technique for lower limb procedures. Ultrasound guidance has enhanced its safety and accuracy.

Aim: To compare the posterior and lateral ultrasound-guided approaches to the popliteal sciatic nerve block in lower limb surgeries with respect to onset of sensory and motor blockade, procedure duration, patient comfort, and postoperative analgesia.

Materials and Methods: This prospective interventional study was conducted at the Department of Anaesthesiology, Coimbatore Medical College Hospital, Tamil Nadu, India, from January 2024 to January 2025. Sixty adult patients of American Society of Anaesthesiology (ASA) physical status I-II undergoing unilateral below-knee surgical procedures were allocated equally into two groups of 30 each. Group P received ultrasound-guided popliteal sciatic nerve block via the posterior approach (prone position), and Group L received the block via the lateral approach (supine position). Both groups received 20 mL of 0.25% bupivacaine with 8 mg dexamethasone. Onset of sensory blockade (pin-prick), motor blockade (plantar/

dorsiflexion), procedure duration, Visual Analogue Scale (VAS) scores, and duration of rescue analgesia were recorded and compared using the independent samples t-test (continuous variables) and Chi-square test (categorical variables).

Results: Baseline demographic characteristics and clinical parameters were comparable between groups; however, baseline pulse rate was significantly lower in Group P than in Group L (85 ± 6 vs. 88 ± 5 bpm, $p=0.040$). The mean onset of sensory blockade was 7.13 ± 2.07 min in Group P and 7.13 ± 1.87 min in Group L (Independent t-test, $p=1.000$). The mean onset of motor blockade was 12.00 ± 1.70 min in both groups (independent t-test, $p=1.000$). The mean procedure duration was significantly shorter in Group P (10.20 min) compared to Group L (13.19 min; independent t-test, $p<0.001$, Cohen's $d=0.978$). The mean duration of rescue analgesia was 472 ± 87.24 min in Group P and 460.67 ± 85.54 min in Group L (independent t-test, $p=0.635$). VAS scores at six hours postoperatively were comparable, with only one patient in Group L recording a score of 4.

Conclusion: The posterior approach was significantly faster while maintaining equivalent sensory and motor block quality.

Keywords: Bupivacaine, Motor blockade, Rescue analgesia, Sensory blockade, Visual analogue

INTRODUCTION

Peripheral nerve blocks are a cornerstone of modern regional anaesthesia, offering superior postoperative analgesia, reduced opioid consumption and improved patient recovery when compared to general or neuraxial anaesthesia [1]. Among these, the popliteal sciatic nerve block is a well-established technique for providing effective anaesthesia and analgesia to the distal lower extremity, making it particularly suitable for foot and ankle surgical procedures.

Ultrasound guidance has significantly transformed the practice of peripheral nerve blocks by enabling real-time visualisation of nerve structures, needle trajectory, and local anaesthetic spread. This has translated into reduced procedural complications, lower block failure rates, faster onset, and enhanced overall safety and efficacy [2].

The sciatic nerve may be accessed at the popliteal fossa via two principal approaches: the posterior approach, performed with the patient in the prone position, and the lateral approach, performed with the patient supine. Each approach carries distinct anatomical considerations, procedural implications, and patient positioning requirements [3].

The posterior approach provides direct visualisation of the sciatic nerve prior to its bifurcation and is associated with well-defined anatomical landmarks. However, patient positioning in the prone position may be challenging in individuals with spinal pathology,

obesity, or haemodynamic instability [4]. The lateral approach avoids prone positioning, thereby improving patient comfort and enabling simultaneous surgical preparation. However, the visualisation of popliteal structures may be relatively more demanding, particularly in patients with elevated body mass index [3].

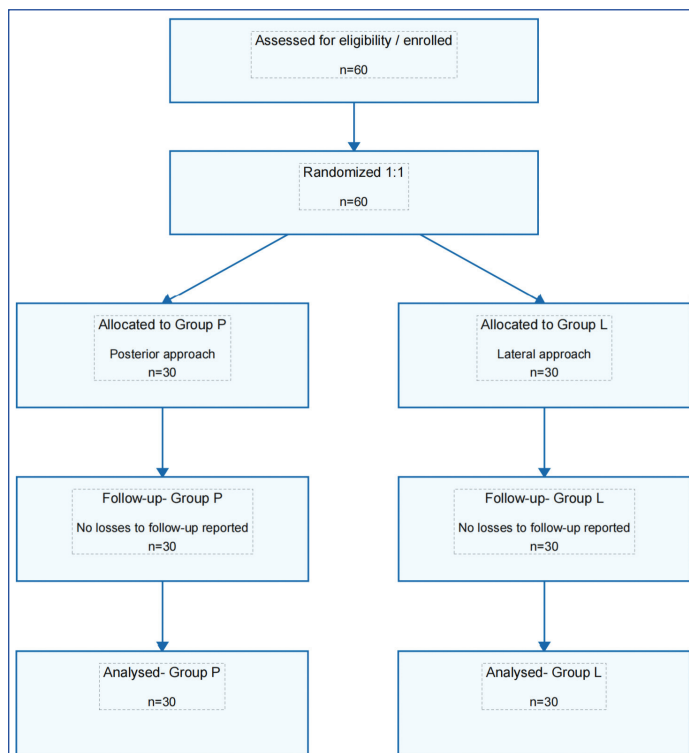
Despite the established use of both approaches, direct comparative evidence remains limited. The present study therefore aimed to compare the posterior and lateral ultrasound-guided approaches to popliteal sciatic nerve block with respect to sensory and motor block onset, procedure duration, patient comfort, and postoperative analgesia.

MATERIALS AND METHODS

This was a prospective interventional study conducted at the Department of Anaesthesiology, Coimbatore Medical College Hospital, Tamil Nadu, India, from January 2024 to January 2025, following Institutional Ethics Committee approval (EC Reg No. ECR/892/Inst/TN/2016; Ref No. 145/2023). Total 60 (30 patients per group) were recruited by consecutive sampling during the study period.

Inclusion and Exclusion criteria: Adult patients aged 18-60 years of either gender, with ASA physical status I or II, scheduled for unilateral below-knee surgical procedures were enrolled. Patients were excluded if they refused participation, had site infection, coagulopathy, obesity with significant surface landmark problems, associated neuropathy, ASA Grade III or IV, or were pregnant.

Patients were randomised in a 1:1 ratio using a variable block randomisation method into two groups of 30 each. Group P (posterior approach) and Group L (lateral approach) both received ultrasound-guided popliteal sciatic nerve block. The Consort flow diagram has been presented in [Table/Fig-1].

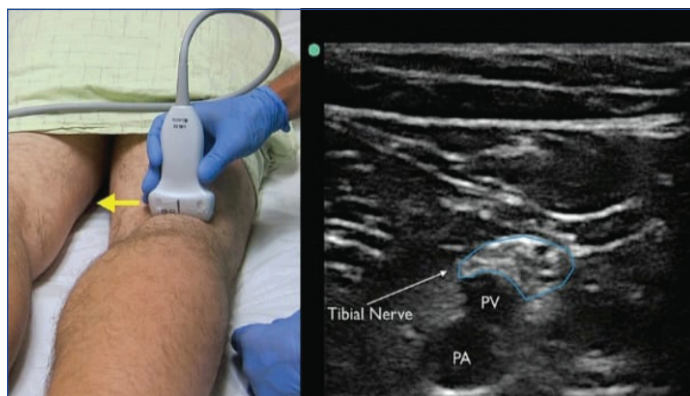


[Table/Fig-1]: Consort flow diagram: Ultrasound-guided popliteal sciatic nerve block: posterior vs. lateral approaches.

Study Procedure

Standard monitoring {Electrocardiogram (ECG), non invasive blood pressure, pulse oximetry} was established and intravenous access secured prior to the block. All blocks were performed by a trained Anaesthesiologist using a high-frequency linear array ultrasound probe (5-10 MHz) and a 22-gauge, 80-100 mm short-beveled insulated needle under aseptic conditions. The local anaesthetic mixture comprised 20 mL of 0.25% bupivacaine with 8 mg dexamethasone.

Posterior approach (Group P): Patients were placed in the prone position. The ultrasound probe was positioned transversely at the popliteal crease at an initial depth of 4-6 cm. The popliteal artery, vein, tibial nerve, and common peroneal nerve were identified. The probe was advanced proximally until the sciatic nerve bifurcation and Vloka's sheath were visualised. A 22-gauge needle was introduced in-plane from the lateral aspect and advanced to the paraneural space within Vloka's sheath. Following negative aspiration, the local anaesthetic was injected until circumferential spread around both nerve components was confirmed [Table/Fig-2a,b].



[Table/Fig-2a,b]: Ultrasonography (USG) image (Posterior approach).

Lateral approach (Group L): Patients were positioned supine with slight internal rotation at the hip. The ultrasound probe was placed transversely at the lateral thigh proximal to the popliteal crease. The sciatic nerve was identified at or proximal to the bifurcation point. A 22-gauge needle was introduced perpendicular to the skin in an out-of-plane technique from the lateral aspect. Following negative aspiration, the local anaesthetic was deposited in the paraneural space under real-time visualisation [Table/Fig-3].



[Table/Fig-3]: Probe positioning- lateral approach.

Outcome measures: The primary outcome was the comparison of onset time of sensory blockade (assessed by pin-prick with a 23-gauge needle over the plantar and dorsal surfaces of the foot) and motor blockade (assessed by plantar flexion and dorsiflexion) between the two groups.

The secondary outcomes included procedure duration (from probe preparation to completion of injection); patient positioning comfort (recorded qualitatively by the attending anaesthesiologist and theatre staff as comfortable, tolerable, or uncomfortable at the time of positioning); VAS scores, ranging from 0 (no pain) to 10 (worst imaginable pain), recorded at 0, 1, 2, 4, 6, 12, and 24 hours postoperatively; and duration of rescue analgesia (time to first analgesic request).

Haemodynamic parameters - heart rate, systolic and diastolic blood pressure, and peripheral oxygen saturation (SpO₂) were recorded at baseline and at 5, 10, 15, and 30 minutes after block administration, and any adverse events were also recorded.

STATISTICAL ANALYSIS

Data were analysed using IBM Statistical Packages of Social Sciences (SPSS) (version 25.0). Continuous variables were compared using the Independent samples t-test and expressed as mean±Standard Deviation (SD). Categorical variables were compared using the Chi-square test. A p-value of <0.05 was considered statistically significant. Effect sizes were computed using Cohen's d.

RESULTS

In each group, 22 patients (73.3%) were male and 8 (26.7%) were female [Table/Fig-4]. Procedures performed included diabetic foot debridement, midfoot amputation, wound debridement, Achilles tendon repair, toe amputation, K-wire/screw/nail fixation, and external fixation with slab application [Table/Fig-5]. Group L had a lower Hb, while platelet count, serum urea, and creatinine were comparable between the groups [Table/Fig-6]. Baseline physiological parameters demonstrated that Group P had a statistically significantly lower mean baseline pulse rate compared to Group L (85±6 vs. 88±5 bpm, p=0.040) [Table/Fig-7].

The mean sensory onset time was identical in both groups. Similarly, the mean motor onset time [Table/Fig-8].

Parameters	Group P (n=30)	Group L (n=30)	p-value
Age (years) (mean±SD)	39.8±12.4	39.9±11.8	0.964
Gender (M/F)	22 (73.3%)/8 (26.7%)	22 (73.3%) /8 (26.7%)	1.000
ASA I/II	7 (23.3%)/23 (76.7%)	7 (23.3%) /23 (76.7%)	-
BMI (kg/m ²) (mean±SD)	23.95±2.16	22.56±2.12	0.204
Diabetes mellitus	4 (13.3%)	5 (16.7%)	-
Hypertension	1 (3.3%)	1 (3.3%)	-

[Table/Fig-4]: Demographic and baseline characteristics.

BMI: Body mass index

Procedure	Group P, n (%)	Group L, n (%)
Diabetic foot debridement	6 (20%)	5 (16.7%).
Midfoot amputation	4 (13.3%)	3 (10%)
Wound debridement	4 (13.3%)	6 (20%)
Achilles tendon repair	2 (6.7%)	1 (3.3%)
Toe amputation	5 (16.7%)	5 (16.7%)
K-wire/screw/nail fixation	6 (20%)	5 (16.7%)
External fixation with slab application	3 (10%)	5 (16.7%)
Total	30 (100%)	30 (100%)

[Table/Fig-5]: Distribution of surgical procedures.

Parameters	Group P (mean±SD)	Group L (mean±SD)
Hb (g/dL)	9.8±1.10	8.6±1.25
Platelet count (×10 ⁵ /μL)	1.25±0.8	1.34±0.6
Serum urea (mg/dL)	21.72±7.29	22.33±6.22
Serum Creatinine (mg/dL)	0.80±0.25	0.87±0.16

[Table/Fig-6]: Baseline haematological and biochemical parameters.

Hb: Haemoglobin

Parameters	Group P	Group L	p-value
Baseline pulse rate (bpm)	85+/-6	88+/-5	0.040
Baseline SpO ₂ (%)	98+/-1	98+/-1	1.000
Systolic BP (mmHg)	132+/-6	130+/-6	0.202
Diastolic BP (mmHg)	84+/-5	82+/-5	0.127

[Table/Fig-7]: Haemodynamic parameters (baseline).

bpm: beats per minute; BP: Blood pressure

Variables	Group P mean (min)	Group L mean (min)	Mean difference	95% CI	t-statistic	p-value	Cohen's d
Sensory blockade	7.13±2.07	7.13±1.87	0.00	(-1.05, 1.05)	0.000	1.000	0.000
Motor blockade	12.00±1.70	12.00±1.70	0.00	(-0.89, 0.89)	0.000	1.000	0.000

[Table/Fig-8]: Comparison of sensory and motor blockade onset times.

The mean procedure duration was significantly shorter in Group P (10.20 min) compared to Group L [Table/Fig-9].

Variables	Group P	Group L	95% CI	t-statistic	p-value
Procedure duration (min)	10.20±2.15	13.19±3.75	(-4.37, -1.61)	-4.153	<0.001*
Rescue analgesia (min)	472.00±87.24	460.67±85.54	(-35.82, 58.49)	0.477	0.635

[Table/Fig-9]: Comparison of procedure duration and rescue analgesia duration.

*Statistically significant (p <0.05)

The duration of rescue analgesia was comparable between groups (Group P: 472±87.24 min; Group L: 460.67±85.54 min; p=0.635). At six hours postoperatively, VAS scores were low in both groups: 18 patients in Group P and 19 in Group L recorded VAS 2 [Table/Fig-10].

Positioning comfort was not captured using a validated scoring instrument in this cohort, and no formal statistical comparison between groups is therefore presented. Qualitatively, patients in Group L reported greater ease of positioning owing to avoiding the

prone position, whereas Group P required additional assistance from theatre staff for prone positioning.

VAS score	Group P (n)	Group L (n)	p-value
2	18	19	0.88
3	12	10	
4	0	1	
Total	30	30	

[Table/Fig-10]: VAS score distribution at 6 hours postoperatively.

No complications were observed in either group, including no intraneuronal or intravascular injection, no Local Anaesthetic Systemic Toxicity (LAST), and no block failures.

DISCUSSION

The present study compared the ultrasound-guided posterior and lateral approaches to the popliteal sciatic nerve block in patients undergoing unilateral below-knee surgical procedures. The principal finding was that both approaches were equivalent in terms of sensory and motor blockade onset time and postoperative analgesic efficacy, while the posterior approach was associated with a significantly shorter procedure duration.

In the lateral approach, the nerve must be identified through an oblique plane from the lateral thigh, which may require additional probe manipulation and needle repositioning, particularly in patients with overweight BMI. This is consistent with the observations of Hadzic A et al., who noted that the posterior approach may be technically simpler for landmark identification, while the lateral approach may be preferred in multispecialty settings where positioning constraints exist [5].

In a separate cohort, Perlas A et al., demonstrated that ultrasound-guided popliteal sciatic nerve block significantly reduced needle passes and procedure time compared with nerve-stimulator-guided techniques, and improved block consistency- findings that support the routine use of ultrasound regardless of the approach employed; needle-pass counts were not recorded in the present study and are noted as a limitation below [6]. No complications were recorded in either group, confirming the safety profile of ultrasound-

guided popliteal blocks. Barrington MJ and Kluger R reported low complication rates with ultrasound-supervised techniques for both approaches [7].

Spinal anaesthesia, although commonly employed for lower limb procedures, carries the risk of haemodynamic instability particularly hypotension and has a limited duration of action. In contrast, the popliteal sciatic nerve block in present study provided a mean analgesic duration of 7-8 hours and circumvented haemodynamic complications entirely, findings consistent with those reported by Pujari MD et al., who described the utility of popliteal fossa block in patients with co-morbidities undergoing foot surgery [8].

Patient comfort was better in the lateral approach owing to the avoidance of prone positioning. This corroborates the findings of Bouaziz H et al., who identified prone positioning as a significant limitation of the posterior approach, rendering it unsuitable in conditions such as morbid obesity, haemodynamic instability, mechanical ventilation, and advanced pregnancy [9]. Additionally, the lateral approach preserves hamstring muscle function and reduces the risk of vascular puncture, as the nerves are positioned posterior and lateral to the popliteal vessels [9].

The present results confirm the equivalent efficacy of both approaches. The identical sensory (7.13 min) and motor (12.00 min) blockade onset times in both groups are consistent with the pharmacokinetic profile of 0.25% bupivacaine with dexamethasone, wherein the latter prolonged the duration and possibly accelerated onset without altering the fundamental nerve-localisation dynamic. Sinha A and Chan VWS demonstrated that circumferential spread of local anaesthetic resulted in rapid onset within 10 minutes and complete anaesthesia of the foot within 20 minutes of injection, which aligns with present observations [2]. These findings are also consistent with Chavan RV and Uddin AM, who compared anterior and posterior approaches to sciatic nerve block in diabetic patients undergoing lower limb and foot surgery and reported comparable block efficacy between techniques [10]. Similarly, Pavithra S et al., reported that sciatic nerve visibility and the performer's ease score were better in the posterior approach than the lateral approach. Other parameters like block success rate, quality of blockade, total duration of analgesia, and need for first rescue analgesia were similar in both the groups [11].

The posterior approach had a significantly longer block performance time than the lateral approach (9.5 ± 2.15 vs. 5.6 ± 1.25 min; $p < 0.001$), while block efficacy was comparable. Position-related discomfort was greater with the posterior approach, whereas needle-insertion discomfort was greater with the lateral approach [12].

Limitation(s)

The single-blind design may introduce observer bias. The exclusion of obese patients limits the generalisability of the lateral approach findings to this population. Patient positioning comfort was assessed qualitatively rather than with a validated instrument, and needle-pass counts were not recorded, limiting quantitative comparison of these secondary outcomes.

CONCLUSION(S)

Ultrasound-guided popliteal sciatic nerve block via both the posterior and lateral approaches provides equivalent sensory and motor blockade onset, and comparable postoperative analgesia for unilateral below-knee surgical procedures. The posterior approach offers a shorter procedure duration, while the lateral approach

provides superior patient comfort by avoiding prone positioning. The choice of approach should be guided by patient-specific factors, surgical requirements, and operator familiarity. Ultrasound guidance is recommended for both approaches to maximise safety and block success.

Editorial disclosure: Prospective trial registration was not completed before participant enrolment. The journal recognize the unique clinical value of this data. Henceforth publication is permitted as an exception with transparent disclosure.

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