

Comparison of hamstring stretch position with modified rider sitting position on patient comfort in patients with fracture around the knee undergoing spinal anaesthesia – a randomized crossover trial

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Abstract

Background: Patient positioning plays a crucial role in the success of spinal anaesthesia by influencing both patient comfort and ease of identifying anatomical landmarks. In patients with fractures around the knee, pain and restricted mobility makes positioning challenging, necessitating techniques that minimize discomfort while ensuring adequate access to the interspinous space.

Objectives: To compare patient's comfort between hamstring stretch position and modified rider sitting position during spinal anaesthesia and to compare anaesthesiologist's ease in finding interspinous space in both hamstring stretch position and modified rider sitting position.

Methods: This prospective randomized crossover study included 94 adult patients undergoing surgery under spinal anaesthesia for fractures around the knee. Each participant was evaluated in both HSP and mRSP. Patient comfort was assessed using the Numerical Rating Scale (NRS), and the ease of interspinous space identification was graded using the Spinal Landmark Grading System (SLGS). Data were analyzed using JAMOV software (version 2.5.3) and SPSS version 29. Paired t-test was used to compare differences in pain scores between HSP and mRSP. Wilcoxon signed rank test was used to compare the ease of ISS identification between the two positions.

Results: 94 participants were recruited in this study. Pain was consistently lower in the mRSP (mean NRS: 5), when compared to the HSP (mean NRS: 4) (mean difference=0.99±1.3, 95% confidence interval (CI): 0.7 to 1.3; p<0.001). Spinal landmark grading demonstrated a clear shift toward easier identification in mRSP than HSP position.

Conclusion: The modified Rider Sitting Position produces lesser procedural pain and discomfort for patients with fractures around the knee being positioned for spinal anaesthesia as compared to the Hamstring Stretch Position without compromising the anaesthetist's ability to locate interspinous space landmarks.

Trial registration: This trial was registered with Clinical Trials Registry India registration (CTRI/2025/07/091336) on July 21, 2025.

Introduction

Spinal anaesthesia is one of the most commonly practiced regional anaesthesia techniques for a wide range of surgical procedures, particularly those involving the lower limbs. It is widely preferred over general anaesthesia because of its benefits, including minimal cardiovascular and respiratory disturbances, early recovery of gastrointestinal function, avoidance of airway manipulation, reduced incidence of postoperative nausea and vomiting, and overall cost-effectiveness (1). The success of spinal anaesthesia depends on multiple factors, including patient co-operation, anatomy of the spine, clinician's skill, the type of spinal needle used, and, critically, patient positioning (2).

Adequate positioning ensures widening of the interspinous space, reduction of lumbar lordosis, and optimal exposure of the subarachnoid space, all of which are prerequisites for safe and effective needle placement (3). Suboptimal positioning, in contrast, is associated with increased needle–bone contact, multiple puncture attempts, prolonged procedure time, and a higher incidence of complications such as post-dural puncture headache, neural injury, and epidural haematoma (2).

One of the key factors that ensures adequate positioning during spinal anaesthesia which is administered to a conscious patient is comfort and patient cooperation. This is particularly relevant in patients with trauma and related pain. Discomfort and pain during positioning may cause involuntary patient movement, muscle guarding, and reduced cooperation, all of which can directly compromise procedural success (1, 4). The level of comfort experienced by the patient can significantly influence their ability to maintain the required posture, thereby affecting both the ease and success of the procedure (5).

Patient positioning plays a critical role in optimising anatomical alignment, facilitating identification of the interspinous space, and improving the overall experience for both the patient and the anaesthetist (6). Knight and Mahajan emphasized that correct positioning is not merely a technical prerequisite, but also a fundamental component of patient care that influences perioperative outcomes (4). O'Connor and Radcliffe further highlighted that poor positioning may contribute to patient distress, failed blocks, and increased anaesthesia-related complications (6). Therefore, selection of the optimal positioning strategy must balance both patient comfort and procedural efficiency.

Various positions have been described for the administration of spinal anaesthesia, each offering distinct biomechanical advantages and limitations. The classical sitting position, wherein the patient sits upright with knees and hips flexed and feet supported on a stool, remains the most widely used posture globally. While associated with reliable landmark identification in most patients, this position cannot be assumed by patients with trauma around the knee.

The hamstring stretch position (HSP) is commonly employed, wherein the patient sits upright with both legs extended forward and the spine flexed by leaning slightly forward (4)(Fig. 1). By stretching the hamstring muscles and inducing posterior pelvic tilt, this position theoretically reduces lumbar lordosis and widens the interspinous space to facilitate needle insertion (7, 8). However, the degree of flexion achieved depends on individual hamstring flexibility, and the position may not always produce the maximal lumbar rounding required for easy needle access (3, 7).

The rider sitting position, in which the patient straddles the operating table with legs hanging bilaterally in a straddling posture, has been shown to lengthen the lumbar intervertebral distance, potentially facilitating easier needle placement (1). However, this position requires bilateral lower limb mobility and may not be feasible in patients with trauma or injury to one or both lower limbs (2).

Fractures around the knee present a unique positioning challenge. These injuries often involve the distal femur, proximal tibia, or patella, and are associated with significant pain, soft tissue swelling, and

restricted joint mobility (9). This subset of patients are unable to assume positions such as the classical sitting position or the rider sitting position. To overcome these limitations, the modified rider sitting position (mRSP) has been proposed as a viable alternative. In this position, the patient allows the unaffected limb to hang freely off the side of the table in the rider posture, while the affected limb is maintained in an extended hamstring stretch position on the table surface (Fig. 2). This hybrid posture combines elements of both the hamstring stretch and rider sitting positions and aims to minimise pain at the fracture site while preserving adequate spinal flexion for subarachnoid needle insertion (10).

Evidence is limited on positioning during spinal anaesthesia in patients with fracture around the knee that prioritizes patient comfort and the anaesthetist's ability to locate interspinous space. This study aimed to compare the patient comfort between the HSP and the mRSP in patients undergoing spinal anaesthesia with fractures around the knee. We further compared the ease of identifying the interspinous space (ISS) by the anaesthetist between the two positions.

Materials and methods

This prospective randomized crossover study was conducted at a tertiary care hospital from July 2025 to March 2026 for a duration of 8 months. Study was commenced after obtaining approval from the Institutional Research Committee (IRC), Institutional Ethics Committee of Kasturba Medical College and Kasturba Hospital, Manipal (IEC2: 309/2025), and Clinical Trials Registry India registration (CTRI/2025/07/091336), registered on July 21st, 2025. This study was conducted in accordance with the Declaration of Helsinki and complied with Consolidated Standards of Reporting Trials (CONSORT) guidelines. Written informed consent was obtained from all participants. Adults above 18 years of age scheduled for surgery under spinal anaesthesia with fracture around the one knee, belonging to American Society of Anesthesiologist (ASA) physical status I, II or III, capable of adopting both the HSP and mRSP prior to the acute injury as per history were included. Patients with spine deformities, previous spine surgery, history of low back ache, pelvic trauma, pregnancy, neurocognitive disability, injury to both lower limbs, body mass index $> 35 \text{ kg/m}^2$ (based on height and weight recorded prior to injury) and patients with contraindication to spinal anaesthesia such as hypovolemia, coagulopathy, raised intracranial pressure, head injury, fixed cardiac output state were all excluded.

The sample size was calculated using G*Power software for comparison of two related means with an effect size of 0.3, power of 80% and significance level of 5%. The calculated sample size was 90 participants, to which an anticipated dropout rate of 5% was added, generating a final sample size of 94 participants.

Both the HSP and mRSP were explained to the participants. On the day of the surgery, participants were transferred to the operation theatre; standard ASA monitors were connected and intravenous line patency confirmed. Participants were advised to sit in one of the two positions based on a coin toss- Heads-HSP first followed by mRSP, Tails- mRSP first followed by HSP (Fig. 1 and Fig. 2).

After assuming each position, the participant rated comfort from 0 (very comfortable with no pain) to 10 (worst possible discomfort) using the Numeric Rating Scale (NRS), and the anaesthetist rated the ease of locating the interspinous space (ISS) using the spinal landmark grading system (SLGS) (grade 1- easily visible ISS, grade 2- ISS not visible but palpable, grade 3 ISS not visible and not palpable)(11). The participants were advised thereafter to assume one of the above two positions according to their level of comfort, and spinal anaesthesia was proceeded with. The final position assumed by the participants was noted down.

Statistical analysis:

Data were entered into Microsoft Excel and statistical analysis was conducted using JAMOVI software (version 2.5.3) and SPSS version 29. Data were summarized as mean $\pm$ standard deviation for continuous data, median and interquartile range with frequency and percentage for categorical variables. Normality was assessed visually using histograms. Paired t-test was used to compare differences in pain scores between HSP and mRSP. Gate-keeping approach was used for the analysis of the secondary outcome, i.e., ease of ISS identification (12). Wilcoxon signed rank test was used to compare the ease of ISS identification between the two positions. ISS grades were dichotomized as 'favourable' (Grades 1 and 2) and 'unfavourable' (Grade 3). This was based on the clinical ease of visualization (Grade 1) and palpation (Grade 2) for the identification of ISS as opposed to Grade 3 where neither visualization not palpation of the ISS was possible. The McNemar test was used to compare the frequencies in ISS across grades. Mean differences in pain and change in categorization of ISS grades with each position was explored in those less than and over 60 years. To explore bias based on order of sequence, pain and ISS were compared against the sequences using independent t-test and Wilcoxon signed rank test respectively. Correction for multiplicity of test was not considered since the gate-keeping approach to analysis was followed. A p-value of < 0.05 was considered statistically significant.

Results

99 participants were screened, and 94 participants recruited (Fig. 3). The baseline characteristics of the participants are described in Table 1.

Table 1: Baseline characteristics of participants (n=94)

Variable	Value
Age, mean $\pm$ SD, (range)	45 $\pm$ 17.4 (19-81)
Gender	
Male, n (%)	66 (70.2)
Female, n (%)	28 (29.8)
ASA PS	
I, n (%)	53 (56.4)
II, n (%)	39 (41.5)
III, n (%)	2 (2.1)
Comorbidities	
Nil, n (%)	53 (56.4)
HT, n (%)	35 (37.2)
DM, n (%)	1 (1.1)
HT + DM, n (%)	5 (5.3)
Surgical procedure	
ORIF, n (%)	30 (31.9)
IM nail, n (%)	42 (44.7)
TBW, n (%)	1 (1.1)
External fixator, n (%)	1 (1.1)
ORIF + IM nail, n (%)	19 (20.2)
ORIF + BG, n (%)	1 (1.1)

Abbreviations: ASA PS – American Society of Anesthesiologists Physical Status, HT - Hypertension, DM – Diabetes mellitus, ORIF – Open Reduction and Internal Fixation, IM - Intramedullary, TBW – Tension Band Wire, BG – Bone Graft.

Pain was consistently lower in mRSP (mean NRS: 5), when compared to the HSP (mean NRS: 4) (mean difference=0.99 $\pm$ 1.3, 95% confidence interval (CI): 0.7 to 1.3; p<0.001).

Spinal landmark grading demonstrated a clear shift toward easier identification in mRSP than HSP position. The Wilcoxon signed-rank test showed a significant difference between positions (Z = -3.727, p < 0.001). 52 participants' ISS grading remained unchanged irrespective of change in position. Grade 1 ISS was observed more frequently in mRSP (n=45) than in HSP (n=28) (Table 2). When dichotomised into favourable and unfavourable outcomes, 81 participants had favourable identification in both

positions. Among discordant pairs, 9 participants improved from unfavourable in the HSP to favourable in the mRSP, whereas 2 showed the opposite pattern. Two participants remained unfavourable irrespective of the position. Despite this directional difference, the number of discordant observations was small, and McNemar testing did not reach statistical significance (exact $p = 0.065$).

When stratified for categories, there was no statistically significant difference in NRS scores between younger and older participants in either position (HSP: mean difference = 0.604, CI: -0.121-1.329; mRSP: mean difference = 0.321, CI: -0.502-1.143), suggesting that the benefit of the modified position was consistent regardless of age. For identification of the ISS, favourable outcomes were observed in 64 of 72 participants aged <60 years and 19 of 22 aged ≥ 60 years for the HSP. Corresponding values for the mRSP were 70 and 20, respectively. There was no meaningful variation in distribution across age categories.

The distribution of baseline characteristics was comparable across sequence allocation groups, and no effect of sequence was detected for the primary and secondary outcomes ($p > 0.05$). Although pain was lower in the mRSP, this difference was not dependent on which position was tested first, i.e., the randomization sequence (Mean difference: -0.46, 95% CI: -1.02 to 0.10, $p = 0.105$).

Table 2: Interspinous Space Identification and Change with Position

			mRSP			Total
			Favourable		Unfavourable	
			Grade 1, n	Grade 2, n	Grade 3, n	
HSP	Favourable	Grade 1, n	21	7	0	28
		Grade 2, n	24	29	2	55
	Unfavourable	Grade 3, n	1	8	2	11
Total			46	44	4	94

Abbreviations: mRSP – modified Rider’s Sitting Position, HSP – Hamstring Stretch Position.

Discussion

In this randomized crossover trial, the mRSP offered better comfort to participants with fractures around the knee when positioned for spinal anaesthesia as compared to the HSP. Furthermore, the mRSP facilitated the identification of the ISS by the anaesthetist. The mRSP is therefore a practical and effective alternative to the HSP in this patient population.

The HSP requires the patient to extend both knees while leaning forward, which stretches the hamstring musculature, and may transmit traction forces to the injured periarticular structures. In patients with fractures around the knee, this can lead to aggravated pain, muscle spasm, and increased resistance

during positioning (5). In contrast, the mRSP allows the unaffected limb to hang freely while the injured limb remains extended and supported on the operating table. This arrangement minimizes mechanical strain on the fracture site and allows patients to adopt a more relaxed spinal flexion posture, thereby improving tolerance.

These findings align with prior observations from the broader anaesthesia literature. Fisher et al., in their randomized trial comparing the traditional sitting position with the hamstring stretch position for labour epidural placement, reported that the hamstring stretch position did not consistently improve patient experience and was associated with increased discomfort in certain patient groups (13). Mohammadi et al. also demonstrated that hamstring stretch and squatting positions improved patient tolerance and facilitated spinal needle insertion compared to conventional positioning techniques (5). The present study extends these observations to a specific high-risk subgroup—patients with acute fractures around the knee where comfort during positioning is of heightened clinical importance.

Our study favoured mRSP for the ISS identification. Toker et al. demonstrated using ultrasound that the rider sitting position produced a significantly larger lumbar intervertebral distance at the L3–L4 level compared to other sitting positions, suggesting that this posture may, in fact, enhance rather than diminish access to the neuraxial space (1). Singh et al., in their observational study comparing neuraxial acoustic target windows across four sitting positions, reported that the rider sitting position provided a superior acoustic window compared to the hamstring stretch, cross-leg, and classical sitting positions (2). The findings of Özhan et al., derived from a multicenter randomized controlled trial, further support the utility of modified sitting positions in maintaining or improving ease of spinal landmark identification during combined spinal-epidural anaesthesia (3). Afolayan et al. observed comparable ease of interspinous space identification between a modified sitting position with legs parallel on the table and the traditional sitting position, suggesting that modified postures that minimise patient discomfort can achieve similar technical outcomes (10). Mangala et al. similarly found no significant difference in successful spinal needle placement between the crossed-leg sitting position and the traditional sitting position, reinforcing that patient-friendly modifications do not necessarily compromise procedural success (14). Taken together, the existing literature and the present findings consistently support the conclusion that the mRSP maintains adequate anatomical access while offering superior comfort in patients with fractures around the knee.

This study had a few limitations. The study was conducted at a single tertiary-care centre, which may limit the generalisability of the findings to other clinical settings or patient populations. The grading of interspinous space by a single consultant anaesthesiologist, while reflective of routine clinical practice, may be subject to inter-observer variability. Blinding was not feasible given the nature of the intervention. Wash-out period was not possible between assuming the two positions given the situation i.e., positioning for spinal anaesthesia for surgery. Outcome measures such as the number of needle redirections, time to successful block, or first-pass success rate were not captured in the present study, and future investigations should incorporate these endpoints to provide a more comprehensive evaluation of procedural efficacy.

Conclusion

The modified Rider Sitting Position produces lesser procedural pain and discomfort for patients with fractures around the knee being positioned for spinal anaesthesia as compared to the Hamstring Stretch Position without compromising the anaesthetist's ability to locate interspinous space landmarks. Improved patient comfort may translate into better patient cooperation, reduced movement during needle insertion, and potentially fewer attempts, thereby enhancing both patient safety and procedural efficiency. Collectively, these findings reinforce the notion that the mRSP represents a clinically sound, patient-centered positioning alternative for this challenging population.

Abbreviations

HSP- hamstring stretch position

mRSP- modified rider sitting position

ASA- American society of anaesthesiologists

NRS -Numeric Rating Scale

ISS- interspinous space

SLGS- spinal landmark grading system

Declarations

Ethics approval and consent to participate:

This study was approved by the Institutional Research Committee (IRC), Institutional Ethics Committee of Kasturba Medical College and Kasturba Hospital, Manipal (IEC2: 309/2025), and Clinical Trials Registry India registration (CTRI/2025/07/091336), registered on July 21st, 2025. This study was conducted in accordance with the Declaration of Helsinki and complied with Consolidated Standards of Reporting Trials (CONSORT) guidelines. Written informed consent was obtained from all participants.

Consent for publication:

Not applicable.

Availability of data and materials:

The datasets generated and analysed during this study are available from the corresponding author on reasonable request.

Competing interests:

The authors declare that they have no competing interests.

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Authors' contributions:

NSM: conceptualization, methodology. RA: manuscript writing. PS and BD: data collection. SA and SK: Data analysis.

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Figures



Figure 1

Hamstring stretch position



Figure 2

Modified rider sitting position

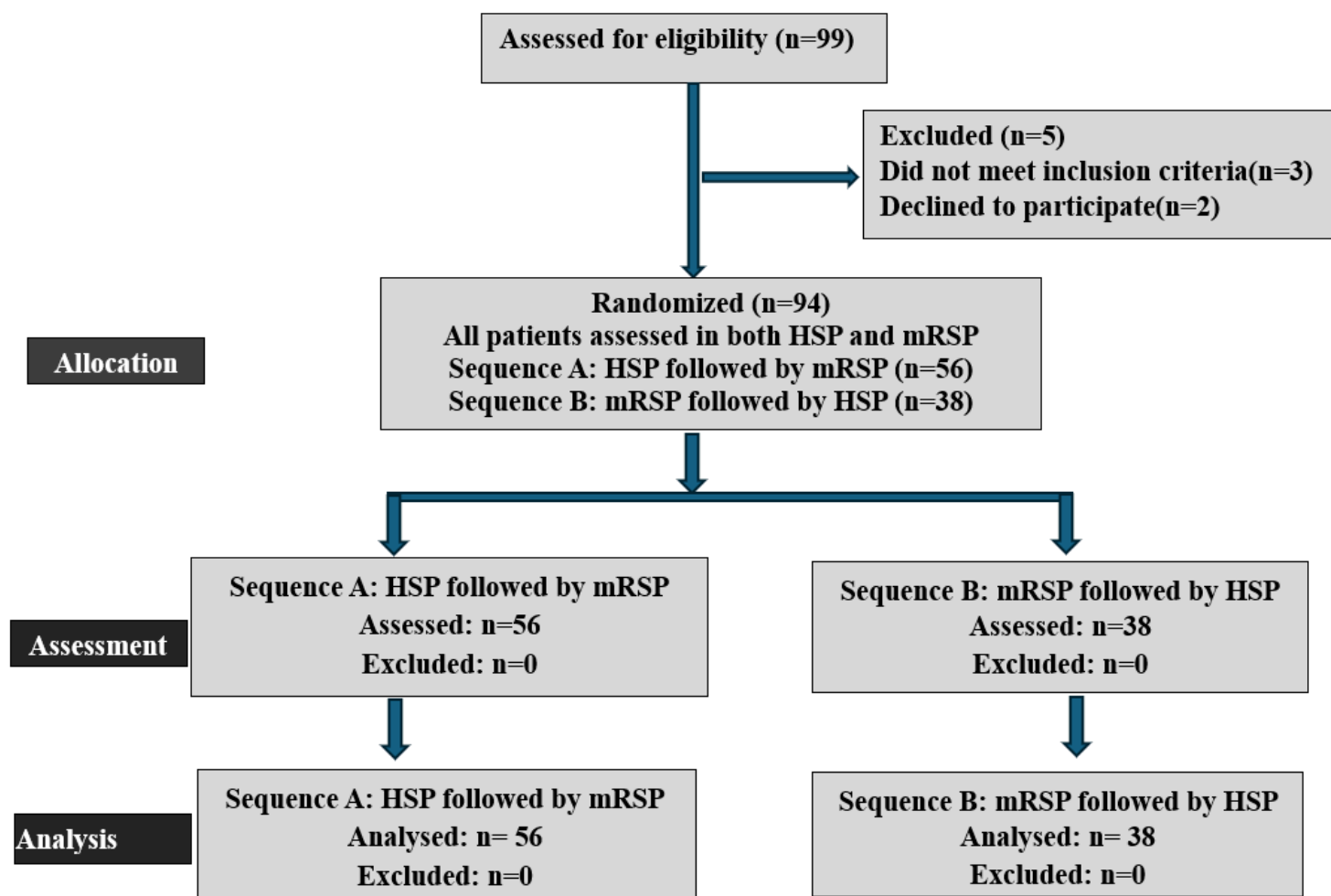


Figure 3

CONSORT 2010 flow diagram

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