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THE EFFECTIVENESS OF PASSIVE RANGE OF MOTION (ROM) EXERCISE ON MOTOR RECOVERY IN POST-SPINAL ANESTHESIA PATIENTS

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ABSTRACT
Spinal anesthesia is a commonly used regional anesthetic technique in surgical procedures, but it is often associated with delayed motor recovery postoperatively. Passive Range of Motion (ROM) exercise is a physiotherapy intervention that has the potential to accelerate motor recovery by stimulating the neuromuscular system and enhancing peripheral blood circulation. This study aimed to evaluate the effectiveness of passive ROM exercises on motor recovery in patients after spinal anesthesia. A quasi-experimental design with a posttest-only control group approach was used. This study used consecutive sampling to recruit respondents who met the inclusion criteria. The sample consisted of 30 patients who underwent spinal anesthesia and were evenly divided into an intervention group (n = 15) and a control group (n = 15). The intervention group received passive ROM exercises for 24 hours postoperatively in four scheduled sessions, while the control group received standard postoperative care. The data analysis used was univariate analysis to describe the characteristics of respondents, while bivariate analysis used the Mann-Whitney test to assess differences in Bromage scores. Motor recovery was measured using the Bromage Scale every four hours. A significant difference in Bromage scores was found between the intervention and control groups at the 24th hour (p = 0.019), with the intervention group showing a lower median score (0) compared to the control group (1), indicating faster motor recovery. Passive ROM exercise is effective in accelerating motor recovery in post-spinal anesthesia patients and can be recommended as part of postoperative care protocols.

Keywords: bromage score; motor recovery; passive ROM; spinal anesthesia

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INTRODUCTION

Spinal anesthesia is one of the most commonly used regional anesthesia techniques in surgical procedures involving the lower body, such as cesarean section, orthopedic, and urological surgeries (Garg et al., 2022; Kalluri et al., 2024). This technique involves the injection of local anesthetic into the subarachnoid space, resulting in temporary sensory and motor blockade of the lower extremities. Although spinal anesthesia is effective in managing postoperative pain and has a lower risk of systemic complications compared to general anesthesia, it is often associated with delayed motor recovery, which can hinder early postoperative mobilization (Abdelhady et al., 2024; Kulkarni & Shetty, 2024).

Delayed motor recovery may cause patients to be unable to get out of bed or move their lower limbs in a timely manner (Choi et al., 2022; Milosevic et al., 2024). This condition increases the risk of serious complications such as deep vein thrombosis, pressure ulcers, and muscle atrophy due to prolonged immobilization (Alhassoon et al., 2024; Tippireddy & Ghatol, 2023). Moreover, slow motor recovery may lead to longer hospital stays, higher healthcare costs, and reduced quality of life for patients. Therefore, it is essential to identify effective and efficient interventions to accelerate the return of motor function following spinal anesthesia

(Fu et al., 2025; Jolly et al., 2024).

Various approaches have been explored to promote motor recovery after spinal anesthesia, including early mobilization and active physical therapy. However, the implementation of early mobilization is often hampered by postoperative pain, patient fear of movement, and limited availability of healthcare personnel for supervision (Calkins et al., 2024; Kinjo et al., 2024; Schubert et al., 2023). Additionally, not all patients are capable of participating in active exercise programs, especially those experiencing muscle weakness or coordination issues due to residual anesthetic effects. Thus, passive interventions that do not rely on active patient participation offer a promising alternative.

Passive Range of Motion (ROM) exercises are therapeutic interventions that involve the gentle movement of a patient's joints by a healthcare provider, without requiring active effort from the patient. These exercises aim to maintain joint flexibility, enhance blood flow, and prevent stiffness of muscles and joints during periods of immobilization (Adiningrum, 2022). Several studies have shown that passive ROM exercises can accelerate motor recovery and prevent complications caused by immobility, especially in orthopedic and neurological postoperative patients (Chowdary et al., 2023). However, empirical data on the effectiveness of passive ROM in post-spinal anesthesia patients, particularly in the Indonesian context, remains limited.

The duration of motor recovery following spinal anesthesia varies depending on the patient's physical condition and the type of surgical procedure. Studies in Indonesia have reported average recovery times of 184.75 minutes in ASA I patients and approximately 207 minutes in ASA II patients (Adiningrum, 2022; Saputra et al., 2024). In South Kalimantan, recovery time has been observed to range from 100 to 190 minutes (NM et al., 2024). These durations are longer than global standards, which range between 90 and 150 minutes (Schubert et al., 2023). This data highlights the need for effective, locally implementable interventions to accelerate motor recovery following spinal anesthesia. Based on this background, the present study aims to evaluate the effectiveness of passive ROM exercises in improving motor recovery among post-spinal anesthesia patients at RSUD Banjarmasin.

METHOD

This study employed a quasi-experimental design with a posttest-only control group approach. This design was chosen to enable comparison of the effectiveness of passive Range of Motion (ROM) exercises on motor recovery in post-spinal anesthesia patients without pretest measurements, thereby minimizing bias from initial testing effects. The study was conducted in the surgical inpatient unit of RSUD Banjarmasin. The population of this study consisted of all adult postoperative patients who underwent spinal anesthesia at RSUD Banjarmasin. Sampling was carried out using a consecutive sampling technique, in which patients who met the inclusion criteria were enrolled consecutively until the required sample size was reached. A total of 30 patients were recruited and evenly divided into two groups: 15 patients in the intervention group and 15 in the control group. Inclusion criteria included patients aged 18 years or older, undergoing elective surgery with spinal anesthesia, having a Bromage score of ≤2 two hours postoperatively, being hemodynamically stable, and willing to participate by signing informed consent. Exclusion criteria included patients with a history of neurological or musculoskeletal disorders, those experiencing postoperative complications such as severe hypotension or bleeding, and those medically unfit to receive the intervention.

The intervention group received passive ROM exercises during the first 24 hours following spinal anesthesia. The intervention began two hours after patients were fully conscious and

clinically stable. ROM exercises were administered four times within 24 hours at 4-hour intervals: 10:00, 14:00, 18:00, and 22:00. Each session was conducted by a trained nurse and lasted approximately 20 to 30 minutes. Prior to each session, the nurse assessed the patient's readiness and provided a brief explanation of the purpose and procedure. Passive ROM exercises were performed on three lower extremity joints: the hip, knee, and ankle. Movements at the hip joint included flexion and extension, abduction and adduction, and internal and external rotation, each repeated 10 times. At the knee joint, flexion and extension were performed 10–15 times. At the ankle, dorsiflexion and plantarflexion were performed 15 times, and circumduction was performed in both clockwise and counterclockwise directions five times each. All exercises were performed passively by the nurse without requiring patient muscle contraction. Exercises were discontinued if the patient reported moderate to severe pain and such occurrences were recorded in the observation sheet.

The control group did not receive the ROM intervention and was provided with standard hospital care, including monitoring of vital signs, pain management, general physical observation, and basic patient education according to hospital protocols. Both groups were monitored for motor recovery using the Bromage Scale, a standard tool to assess lower limb motor function following spinal anesthesia. The scale ranges from 0 to 3: score 0 indicates full movement of the hip, knee, and ankle; score 1 indicates movement of the knee and ankle but not the hip; score 2 indicates ankle movement only; and score 3 indicates no movement at all.

Bromage scores were assessed at the same intervals as the intervention every 4 hours for 24 hours by an observer blinded to group allocation to maintain objectivity. Data collected from the observations were analyzed using Univariate analysis was conducted to describe respondent characteristics, and bivariate analysis using the Mann-Whitney test was performed to assess differences in Bromage scores between the intervention and control groups. A p-value of less than 0.05 was considered statistically significant.

RESULT

Respondent Characteristics

Table 1.
Respondent Characteristics (n=30)

No	Characteristic	Category	Intervention Group (n=15)	Control Group (n=15)	Total (n=30)
1	Gender	Male	9 (60%)	10 (66.7%)	19 (63.3%)
		Female	6 (40%)	5 (33.3%)	11 (36.7%)
2	Age (years)	18-30	4 (26.7%)	3 (20%)	7 (23.3%)
		31-45	6 (40%)	5 (33.3%)	11 (36.7%)
		46-60	5 (33.3%)	7 (46.7%)	12 (40%)
3	Type of Surgery	Lower Extremity Orthopedic	7 (46.7%)	8 (53.3%)	15 (50%)
		Urology	5 (33.3%)	4 (26.7%)	9 (30%)
		Obstetrics (elective C-section)	3(20%)	3 (20%)	6 (20%)

Table 1 shows that the majority of respondents were within the age range of 31–60 years. In terms of gender distribution, male patients predominated (63.3%) compared to female patients. The most common type of surgery performed was lower extremity orthopedic surgery (50%), followed by urological and obstetric procedures. There were no notable

differences between the intervention and control groups, indicating that the distribution of respondents was relatively homogeneous.

Comparison of Bromage Scores Post-Intervention

Table 2.
Comparison of Bromage Scores at the 24th Hour Between Intervention and Control Groups
(n = 15 per group).

Group	Median (Min-Max)	(Mean±SD)	p-value*
Intervention	0 (0-1)	0.27±0.46	0.019
Control	1 (0-2)	0.87±0.64	

*Note: Mann-Whitney test, statistically significant if $p < 0.05$

Based on Table 2, the Mann-Whitney test results indicate a statistically significant difference in Bromage scores between the intervention and control groups at the end of the observation period ($p = 0.019$). The intervention group had a median score of 0, suggesting that most patients had fully recovered motor function within 24 hours. In contrast, the control group had a median score of 1, indicating that some patients were still experiencing limitations in fully moving their lower extremities.

DISCUSSION

The results of this study demonstrate that passive Range of Motion (ROM) exercises administered within the first 24 hours following spinal anesthesia significantly accelerated motor recovery in adult patients undergoing surgery under regional anesthesia. This finding is evidenced by the median Bromage score of 0 (range 0–1) in the intervention group, which was superior to the control group's median score of 1 (range 0–2), with a statistically significant p-value of 0.019. These results support the hypothesis that passive ROM exercises have a positive physiological effect in expediting the return of motor function after spinal anesthesia. Spinal anesthesia works by blocking sensory and motor nerve conduction in the spinal cord, leading to temporary loss of sensation and paralysis in the lower limbs. However, the duration of motor recovery post-anesthesia varies depending on factors such as the type and dosage of the anesthetic agent, individual metabolism, and the patient's physiological condition. Literature reports that the average duration of motor recovery following spinal anesthesia ranges from 90 to 150 minutes and can extend up to 180 minutes in some cases, particularly when long-acting agents like hyperbaric bupivacaine are used (Kulkarni & Shetty, 2024; Schubert et al., 2023). In the current study, the control group, which did not receive any additional intervention, still showed Bromage scores greater than 0 after 24 hours, indicating suboptimal recovery when relying solely on standard care.

Passive ROM exercises physiologically facilitate recovery through several mechanisms. Firstly, joint movement enhances local blood flow and tissue perfusion, contributing to better oxygen and nutrient supply to nerve fibers and muscles affected by the anesthesia blockade (Tippireddy & Ghatol, 2023). Secondly, proprioceptive stimulation induced by passive joint movement is believed to activate motor reflex pathways, even without active muscle contraction by the patient (Belova et al., 2025; Bracciano, 2024). This process may shorten the time required for the nervous system to regain normal function after the anesthetic effect dissipates. Other study also supports this, showing that immediate postoperative passive ROM exercises improved joint function and muscle strength in patients undergoing total knee arthroplasty (Kaseb et al., 2022; Oni & Waldstein, 2024). Furthermore, passive ROM exercises help prevent joint stiffness, maintain physiological range of motion, and reduce the

risk of muscle contractures during early immobility. Although this intervention does not require active effort from patients, it still offers substantial benefits in preserving mobility and preparing the body for future active mobilization (Jia et al., 2024; Olasinde et al., 2023; Richter et al., 2022). This aligns with the concept of early rehabilitation in modern postoperative care, where timely, simple interventions can produce clinically meaningful outcomes. The findings of this study are also consistent with a study by (Chevalley et al., 2022), which found that passive mobilization was more effective than no exercise in preventing motor function decline in postoperative hand surgery patients. Although the anatomical focus differs, the physiological principle of passive movement remains relevant, as it stimulates neuromuscular function and improves circulation.

Nevertheless, the effectiveness of passive ROM exercises is influenced not only by the technique used but also by adherence to the exercise schedule, patient comfort, and the readiness of healthcare personnel. In this study, the exercises were performed four times within 24 hours at four-hour intervals, and most patients reported no significant discomfort during the sessions. Consistency and timing in administering the intervention are essential to achieve optimal outcomes. (Olasinde et al., 2023) note that irregular or improperly executed passive exercises may reduce effectiveness and even increase the risk of joint injury or postoperative pain. Therefore, healthcare providers must understand the basic principles and correct techniques for delivering passive ROM interventions.

Clinically, the findings of this study have important implications for nursing practice in postoperative care units. Passive ROM exercises are simple, low-cost, equipment-free interventions that can be carried out by nurses and integrated into standard care protocols for post-spinal anesthesia patients. Given the evidence of their effectiveness in accelerating motor recovery, these exercises may help reduce patient immobility duration, support early mobilization, and lower the risk of complications such as deep vein thrombosis, pressure ulcers, and muscle contractures. These improvements can ultimately enhance care efficiency, reduce hospital costs, and improve patient satisfaction. Despite these positive findings, the study has several limitations. First, the relatively small sample size (n = 30) limits the generalizability of the results. Second, outcome measurement focused solely on Bromage scores as a motor indicator, without evaluating other aspects such as pain, length of hospital stay, or readiness for independent mobilization. Third, the use of a posttest-only design meant that no baseline data were available, making it difficult to control for any minor pre-existing differences. Lastly, the observation period was limited to the first 24 hours postoperatively, so the long-term effects of passive ROM exercises on motor function and mobility remain unknown.

Nevertheless, the study's strengths include its structured intervention protocol, the use of blinded assessors, and the application of an objective, validated instrument to assess motor recovery. This research also provides valuable local insights into postoperative nursing care in Indonesia, particularly in regional public hospitals that may lack access to advanced rehabilitation modalities. Overall, the findings support the integration of passive ROM exercises as part of the standard postoperative care for spinal anesthesia patients, especially during the first 24 hours. To further strengthen these findings, future research should employ randomized controlled trial (RCT) designs, larger sample sizes, and extended observation periods, as well as include additional clinical outcomes such as quality of life, hospital stay duration, and complication rates. It is also recommended to develop training modules for healthcare providers to ensure the safe and effective delivery of passive ROM exercises.

CONCLUSION

This study found that structured passive Range of Motion (ROM) exercises administered during the first 24 hours after spinal anesthesia were effective in accelerating motor recovery in patients. This was demonstrated by a significant difference in Bromage scores between the intervention and control groups at the end of the observation period. Periodic passive ROM exercises stimulated the neuromuscular system, enhanced local blood circulation, and maintained joint flexibility, thereby facilitating faster restoration of motor function after the effects of spinal anesthesia wore off. This intervention is simple, low-cost, does not require special equipment, and can be performed by nurses as part of independent nursing practice. Therefore, passive ROM exercises are recommended to be integrated into standard care protocols for post-spinal anesthesia patients, particularly to promote early mobilization and prevent complications due to immobility. This study contributes significantly to the development of evidence-based nursing practice in postoperative care units.

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