e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(9); 652-657

Original Research Article

Comparative Assessment of Postoperative Recovery After Orthopaedic Procedures Using Different Anaesthetic Techniques

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Received: 14-07-2026 / Revised: 13-08-2026 / Accepted: 15-09-2026
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Conflict of interest: Nil

Abstract:

Background: Quality of postoperative recovery is an important outcome following orthopaedic surgery. The choice of anaesthetic technique may influence postoperative pain, opioid requirements, and recovery. This study compared recovery quality among patients receiving general or regional anaesthesia, with postoperative recovery assessed using the QoR-40 questionnaire.

Methods: This prospective observational study included 134 adult patients undergoing orthopaedic procedures between April 2025 and March 2026. Patients were categorized into general anaesthesia (n = 65) and regional anaesthesia (n = 69) groups. QoR-40 scores were assessed preoperatively and on postoperative days 1 and 7, while perioperative recovery outcomes were also recorded.

Results: The groups were comparable in demographic and clinical characteristics, except for a longer anaesthesia duration in the general anaesthesia group (P = 0.019). Global QoR-40 scores and postoperative domain scores did not differ significantly between the groups. Regional anaesthesia was associated with lower postoperative pain scores, reduced rescue opioid use, and lower cumulative fentanyl consumption (P < 0.001). Postoperative nausea and vomiting and PACU stay were also significantly lower with regional anaesthesia (P = 0.024 and P = 0.018, respectively).

Conclusion: Regional anaesthesia provided better immediate postoperative analgesic outcomes and reduced opioid requirements. However, overall quality of recovery measured by QoR-40 was comparable between the two anaesthetic techniques.

Keywords: General Anaesthesia; Regional Anaesthesia; Orthopaedic Surgery; Quality of Recovery; QoR-40; Postoperative Pain; Opioid Consumption.

DOI: 10.25258/ijcpr.18.9.95

Introduction

Orthopaedic surgery constitutes a substantial component of surgical care in India, where fractures, osteoarthritis, and other musculoskeletal conditions contribute considerably to disability and healthcare utilization [1]. A population-based study conducted in Mumbai estimated the annual surgical need in India at approximately 3,646 procedures per 100,000 population, with musculoskeletal procedures accounting for nearly 13% of the estimated surgical workload. Fracture surgeries alone represented approximately 3.27% of all procedures performed in the study population [2]. In addition, the estimated number of osteoarthritis cases in India increased from 23.46 million in 1990 to 62.35 million in 2019, highlighting the growing need for orthopaedic interventions [3]. With the increasing volume of orthopaedic procedures, optimizing perioperative care and ensuring satisfactory postoperative recovery have become important clinical priorities.

Postoperative recovery is a multidimensional process that extends beyond the absence of complications or mortality and includes the restoration of physical function, emotional well-being, independence, and the ability to resume normal activities. Delayed or poor recovery may result in persistent pain, fatigue, nausea, impaired mobility, prolonged hospitalization, delayed return to work, and increased healthcare costs. Consequently, patient-reported quality of recovery has emerged as an important outcome in perioperative medicine. The quality of recovery may be influenced by several factors, including the choice of anaesthetic agents, administration of regional nerve blocks, postoperative analgesia, and multimodal perioperative interventions [4-6]. The

type of anaesthesia used during orthopaedic surgery may therefore influence postoperative pain, opioid consumption, nausea and vomiting, mobilization, and overall patient satisfaction [7, 8].

General and regional anaesthesia differ in their physiological effects and recovery profiles, and both are widely used in orthopaedic practice. Regional anaesthesia, including peripheral nerve blocks and neuraxial techniques, may provide effective analgesia and reduce systemic opioid requirements; however, these benefits do not necessarily translate into superior overall quality of recovery [9, 10]. Although previous studies have compared anaesthetic techniques with respect to pain relief, haemodynamic stability, opioid consumption, and other perioperative outcomes, evidence regarding their effect on patient-centred quality of postoperative recovery remains limited, particularly across different orthopaedic procedures [11, 12]. Therefore, the present study aims to assess and compare the quality of postoperative recovery among patients undergoing orthopaedic procedures under different anaesthetic techniques, thereby contributing to evidence-based and patient-centred perioperative care.

Materials and Methods

Study Design: This prospective, observational study was conducted to assess and compare the quality of postoperative recovery among patients undergoing orthopaedic procedures under general or regional anaesthesia.

Study Setting: The study was conducted in the Departments of Orthopaedics and Anaesthesiology at a tertiary healthcare centre from April 2025 to March 2026. Written informed consent was obtained from all participants.

Study Population: The study included adult patients undergoing orthopaedic procedures under general or regional anaesthesia during the study period.

Inclusion Criteria

- Patients aged ≥18 years.
- Patients undergoing orthopaedic procedures under general or regional anaesthesia.
- Patients willing to provide written informed consent.
- Patients able to understand and complete the QoR-40 questionnaire.

Exclusion Criteria

- Patients who declined consent.
- Patients with cognitive impairment or communication difficulties preventing questionnaire completion.
- Patients with a history of major psychiatric illness that could interfere with recovery assessment.
- Patients with contraindications to the planned anaesthetic technique.
- Patients who developed complications substantially interfering with postoperative recovery assessment.

Sample Size: A total of 134 patients who fulfilled the eligibility criteria were included in the study. Based on the anaesthetic technique selected during routine clinical care, 65 patients were categorized into the general anaesthesia group and 69 into the regional anaesthesia group.

Study Procedure: Eligible patients were enrolled after obtaining written informed consent. Baseline demographic and clinical characteristics were recorded before surgery. Patients were categorized into general or regional anaesthesia groups according to the technique selected by the treating anaesthesiologist as part of routine clinical care. The choice of anaesthesia was based on the type of procedure, patient characteristics, comorbidities, anaesthesiologist assessment, and patient preference, where applicable. Postoperative recovery was assessed before surgery and at 24 hours and 7 days after surgery. Perioperative and postoperative recovery outcomes were documented using a structured data-collection proforma.

Anaesthetic Management: Anaesthetic management was performed according to institutional protocols and the clinical requirements of each patient. Standard intraoperative monitoring, including electrocardiography, non-invasive blood pressure, and pulse oximetry, was used. In the general anaesthesia group, anaesthesia was induced and maintained using intravenous and inhalational agents, with airway management and reversal of neuromuscular blockade as clinically indicated. In the regional anaesthesia group, the appropriate regional technique was performed under standard aseptic precautions, with ultrasound guidance where indicated, and sedation was administered as required. The type of anaesthesia, relevant anaesthetic agents, regional blocks, intraoperative events, and perioperative analgesic interventions were recorded. Postoperative analgesia was administered according to the institutional protocol.

Assessment of Postoperative Recovery: The primary outcome was the quality of postoperative recovery, assessed using the validated Quality of Recovery-40 (QoR-40) questionnaire. The QoR-40 consists of 40 items covering five dimensions: emotional state, physical comfort, psychological support, physical independence, and pain. Each item is scored on a five-point Likert scale, giving a total score ranging from 40 to 200, with higher scores indicating better recovery. The questionnaire was

administered preoperatively, on postoperative day 1, and on postoperative day 7. The global QoR-40 score and individual domain scores were recorded at each assessment.

Data Collection: Demographic and clinical characteristics, including age, sex, BMI, ASA physical status, type of orthopaedic procedure, duration of surgery, duration of anaesthesia, and duration of hospital stay, were recorded. Postoperative recovery variables included PACU pain score using the Numeric Rating Scale (NRS, 0–10), rescue opioid use, cumulative fentanyl consumption, postoperative nausea and vomiting, and duration of PACU stay. The occurrence of intraoperative and postoperative adverse events was also documented.

Statistical Analysis: Continuous variables were compared between the general and regional anaesthesia groups using the Mann–Whitney U test or independent-samples t-test, as appropriate. Categorical variables were compared using the chi-square test or Fisher's exact test. A P value <0.05 was considered statistically significant.

Results

The general and regional anaesthesia groups were comparable in terms of age, sex, ASA physical status, BMI, duration of surgery, and hospital stay (P > 0.05). However, the duration of anaesthesia was significantly longer in the general anaesthesia group than in the regional anaesthesia group (P = 0.019) (Table 1).

Table 1: Patient Demographics and Clinical Characteristics

Variable	General Anaesthesia (n = 65)	Regional Anaesthesia (n = 69)	P value
Age (years)	44.0 (32.0–54.0)	41.5 (29.5–56.0)	0.860
Male sex, n (%)	36 (55.3)	40 (58.0)	0.951
ASA physical status I, n (%)	43 (66.2)	54 (78.3)	0.273
BMI (kg/m²)	24.8 ± 4.2	24.2 ± 3.6	0.486
Duration of surgery (min)	45.0 (25.0–70.0)	35.0 (24.5–61.3)	0.088
Duration of anaesthesia (min)	90.0 (65.0–110.0)	65.0 (50.0–100.0)	0.019*
Duration of hospital stay (days)	6.0 (5.0–8.0)	6.0 (5.0–8.0)	0.437

The median global QoR-40 scores were comparable between the general and regional anaesthesia groups preoperatively and on postoperative days 1 and 7, with no statistically significant differences (P > 0.05). Similarly, the individual QoR-40 domains on postoperative day 1 did not differ significantly between the groups (Table 2).

Table 2: Quality of Postoperative Recovery According to QoR-40 Scores

Assessment	General Anaesthesia (n = 65)	Regional Anaesthesia (n = 69)	P value
Preoperative global QoR-40	177.0 (166.0–191.0)	182.5 (172.8–193.5)	0.201
Postoperative day 1 global QoR-40	169.0 (143.0–185.0)	175.0 (158.0–186.5)	0.158
Postoperative day 7 global QoR-40	181.5 (171.3–196.0)	189.0 (182.8–196.4)	0.207
Postoperative day 1 physical comfort	52.0 (48.0–56.0)	55.0 (52.0–58.0)	0.059
Postoperative day 1 emotional status	39.0 (33.0–42.0)	41.0 (37.0–43.3)	0.068
Postoperative day 1 physical independence	18.0 (11.0–22.0)	17.5 (14.0–21.0)	0.685
Postoperative day 1 psychological support	31.0 (28.0–34.0)	33.0 (27.0–35.0)	0.572
3	30.0 (26.0–33.0)	31.5 (29.0–34.0)	0.140

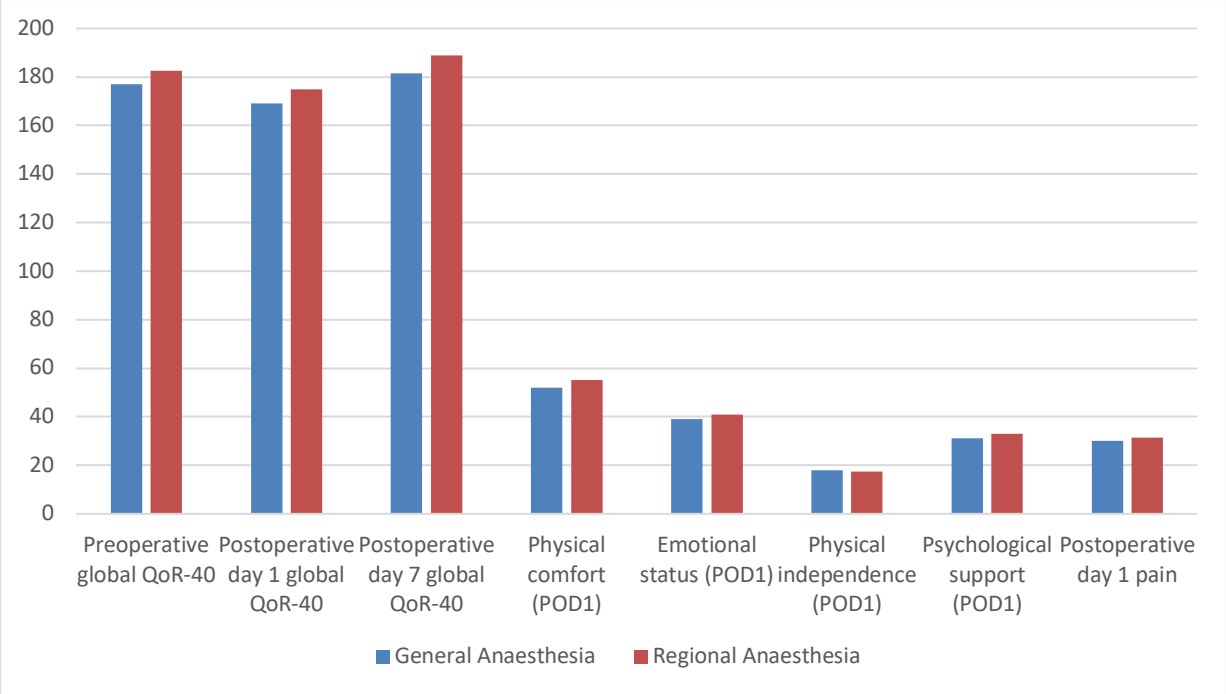

Figure 1: Comparison of QoR-40 Scores Between General and Regional Anaesthesia Groups

Patients in the regional anaesthesia group had significantly lower postoperative pain scores, reduced rescue opioid requirements, and lower cumulative fentanyl consumption compared with those in the general anaesthesia group ($P < 0.001$).

The incidence of postoperative nausea and vomiting and the duration of PACU stay were also significantly lower in the regional anaesthesia group ($P = 0.024$ and $P = 0.018$, respectively) (Table 3).

Table 3: Postoperative Recovery Profile

Variable	General Anaesthesia (n = 65)	Regional Anaesthesia (n = 69)	P value
Postoperative pain score (NRS, 0–10)	3 (2–4)	0 (0–0)	<0.001*
Rescue opioid use, n (%)	19 (29.2)	0 (0)	<0.001†
Cumulative fentanyl consumption (µg)	0 (0–52)	0 (0–0)	<0.001*
Postoperative nausea and vomiting, n (%)	7 (10.8)	0 (0)	0.024††
Duration of PACU stay (min)	65.0 (60.0–90.0)	60.0 (50.0–70.0)	0.018*

Values are presented as median (IQR), mean ± SD, or number (%).

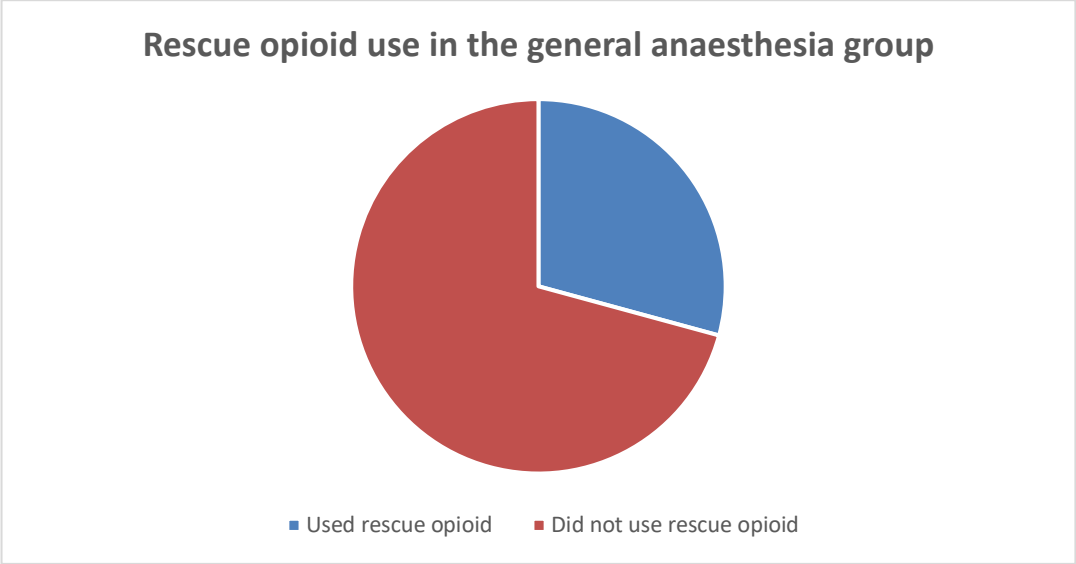

Figure 2: Rescue Opioid Use in the General Anaesthesia Group

Discussion

The present study evaluated 134 patients undergoing orthopaedic procedures under general or regional anaesthesia and found that the two groups were comparable in terms of age, sex, ASA physical status, BMI, duration of surgery, and hospital stay. However, the duration of anaesthesia was significantly longer in the general anaesthesia group (90 vs. 65 minutes, P = 0.019). This difference may be explained by the additional time required for induction, airway management, maintenance, and emergence from general anaesthesia, whereas regional anaesthesia generally avoids these stages. A similar difference in anaesthesia duration was reported by Doo et al., who observed longer anaesthesia maintenance time in patients receiving general anaesthesia during orthopaedic forearm surgery [13]. Nevertheless, the comparable duration of surgery and hospital stay in the present study suggests that the difference in anaesthesia duration did not translate into a measurable difference in overall hospitalization. This is consistent with evidence indicating that hospital stay after orthopaedic surgery is influenced by several factors, including surgical complexity, postoperative mobilization, pain control, and discharge practices, rather than anaesthetic technique alone [14-16].

The principal finding of the present study was that regional anaesthesia did not produce a statistically significant improvement in global QoR-40 scores compared with general anaesthesia. The median global QoR-40 scores were 169.0 and 175.0 on postoperative day 1 and 181.5 and 189.0 on postoperative day 7 in the general and regional groups, respectively, with no significant between-group differences. None of the individual QoR-40 domains on postoperative day 1 differed significantly between the groups. These findings closely agree with Doo et al., who reported comparable QoR-40K scores at baseline, postoperative day 1, and postoperative day 7 following orthopaedic forearm surgery under general or regional anaesthesia [13]. The present findings also support the observation by a review that although peripheral nerve blockade may improve the early postoperative course, differences in recovery may not persist at day 7 [4]. This may be because QoR-40 captures several dimensions of recovery, including emotional state, psychological support, physical independence, physical comfort, and pain; therefore, an advantage in one domain may not be sufficient to produce a significant difference in the total score [5]. In addition, the relatively high preoperative QoR-40 scores in both groups suggest limited room for improvement, particularly by postoperative day 7.

Despite the absence of a significant difference in global recovery, regional anaesthesia was associated with clearly better immediate postoperative outcomes. Patients in the regional group had lower PACU pain scores (median 0 vs. 3), lower rescue opioid use, lower cumulative fentanyl consumption, and no reported postoperative nausea and vomiting, compared with 10.8% PONV in the general anaesthesia group. These findings are consistent with the established analgesic and opioid-sparing effects of regional anaesthesia [17, 18]. Kehlet and Dahl emphasized that effective perioperative analgesia can reduce postoperative stress responses, facilitate mobilization, and improve early recovery [19]. Similarly, a systematic review by Memtsoudis et al. reported that neuraxial and peripheral regional techniques may reduce opioid-related adverse effects and improve selected perioperative outcomes in orthopaedic patients [20]. However, the present findings demonstrate that these benefits were most evident in the PACU and did not translate into significantly higher QoR-40 scores on postoperative day 1 or day 7. This distinction is clinically important: regional anaesthesia may improve specific early recovery outcomes, particularly pain and opioid-related effects, without necessarily improving the overall patient-reported recovery trajectory.

The findings should be interpreted in the context of the observational design and the heterogeneity of orthopaedic procedures included in the study. Since the anaesthetic technique was selected according to clinical judgment and patient preference, differences in patient characteristics, surgical procedures, and perioperative management may have influenced the observed outcomes. Furthermore, the use of different regional techniques and postoperative analgesic regimens may have affected the magnitude and duration of analgesic benefit. The QoR-40 questionnaire is a validated and reliable measure of postoperative recovery, but its total score may not fully reflect clinically meaningful differences in individual outcomes such as pain, opioid consumption, or PONV [5]. Therefore, the present study suggests that regional anaesthesia may be preferable when the primary objective is to reduce immediate postoperative pain and opioid-related adverse effects, whereas the choice of anaesthetic technique alone may not determine overall quality of recovery. Larger prospective studies with standardized surgical procedures, predefined anaesthetic protocols, and adjustment for potential confounders are required to establish whether these early benefits translate into clinically meaningful improvements in patient-centred recovery.

Conclusion

Regional anaesthesia was associated with better immediate postoperative analgesia, reduced opioid requirements, lower fentanyl consumption, less postoperative nausea and vomiting, and shorter PACU stay. However, global QoR-40 scores and individual recovery domains were comparable

between the groups. Thus, regional anaesthesia may offer advantages in early postoperative recovery, although both anaesthetic techniques demonstrated similar overall quality of recovery following orthopaedic procedures.

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