

Local Anaesthetic Infiltration versus Open Approach for Length of Hospital Stay in Adults with Exercise Therapy: A Randomized Controlled Trial

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ARTICLE INFO

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Article History

Received: 06-08-2026

Revised: 14-09-2026

Accepted: 21-09-2026

Published: 30-09-2026

How to Cite

Hanif A, Arshad M, Azeem M, Hamdani SFB, Arshad A. Local Anaesthetic Infiltration versus Open Approach for Length of Hospital Stay in Adults with Exercise Therapy: A Randomized Controlled Trial. Pak J Clin Res. 2026;3(9):58-62.

doi:10.65761/pjcr.2026.350

DOI: <https://doi.org/10.65761/pjcr.2026.350>

ABSTRACT

Background: Musculoskeletal disorders often require interventions that influence postoperative recovery and hospital resource utilization. Evidence comparing local anaesthetic infiltration with an open approach remains limited.

Objective: To compare hospital length of stay, postoperative pain, functional recovery, complications, adverse events, and readmission between the two approaches.

Methods: This prospective, parallel-group randomized controlled trial was conducted at a tertiary care hospital at Sargodha from January to December 2025. A total of 150 male patients aged 18–64 years were randomized equally to local anesthetic infiltration or an open approach. Both groups received standardized exercise therapy. The primary outcome was hospital length of stay. Secondary outcomes included pain at 24, 48, and 72 hours, functional recovery, complications, adverse events, and 30-day readmission. Analyses followed the intention-to-treat principle.

Results: Mean hospital stay was 4.2 ± 1.8 days with infiltration and 5.7 ± 2.3 days with the open approach. The adjusted mean difference was -1.4 days (95% confidence interval [CI], -2.1 to -0.7 ; $p < 0.001$). Pain scores were lower with infiltration at 24 hours (mean difference, -0.8 ; 95% CI, -1.3 to -0.3 ; $p = 0.002$), 48 hours (-0.8 ; 95% CI, -1.2 to -0.4 ; $p < 0.001$), and 72 hours (-0.6 ; 95% CI, -1.0 to -0.2 ; $p = 0.003$). Functional scores were higher at discharge (mean difference, 4.2 ; 95% CI, 0.1 – 8.3 ; $p = 0.045$), but not at six weeks. Complications and readmissions did not differ significantly.

Conclusion: Local anaesthetic infiltration was associated with shorter hospitalization, reduced early pain, and improved discharge function. Multicentre trials are needed to confirm generalizability and comparative safety.

Keywords: Anesthesia, Local; Length of Stay; Musculoskeletal Diseases; Pain Measurement; Exercise Therapy; Patient Readmission; Randomized Controlled Trials as Topic.

INTRODUCTION

Musculoskeletal disorders are a major cause of pain, physical disability, reduced functional independence, and demand for rehabilitation worldwide^{1,2}. The World Health Organization estimates that approximately 1.71 billion people live with musculoskeletal conditions, which collectively represent a substantial contributor to disability and rehabilitation needs³. Their management frequently requires interventions designed to relieve symptoms, restore movement, and facilitate return to daily activities⁴. The choice of procedural and anaesthetic approach can influence postoperative pain, mobilization, recovery requirements, and hospital length of stay^{5,6,7}. Length of stay is an important healthcare outcome because it reflects recovery and inpatient resource utilization, although it is also influenced by discharge policies, social circumstances, and institutional capacity. Prolonged hospitalization can increase healthcare expenditure and place additional demands on hospital beds, particularly in resource-constrained settings. Consequently, identifying clinically appropriate approaches that facilitate recovery without compromising patient safety is an important

objective in perioperative care. Local anaesthetic infiltration may provide effective analgesia in selected procedures, potentially supporting early mobilization when incorporated into a comprehensive perioperative pathway^{8,9}.

Anaesthetic management, surgical technique, and postoperative rehabilitation are interrelated components of perioperative care^{10,11,12}. Local anaesthetic infiltration involves administering an anaesthetic agent into tissues surrounding the operative field to reduce nociceptive transmission and postoperative pain^{13,14,15}. Evidence from selected surgical populations, including patients undergoing joint arthroplasty, indicates that local infiltration analgesia can improve postoperative pain control and reduce analgesic requirements, although its effectiveness depends on the procedure, comparator, and accompanying analgesic regimen^{16,17,18}. Broader evidence supports multimodal analgesia and enhanced recovery pathways that combine appropriate anaesthesia, pain management, early mobilization, and coordinated postoperative care. These approaches aim to facilitate recovery while minimizing avoidable delays in discharge. However, length of stay is not determined solely by



analgesia; operative complexity, comorbidities, postoperative complications, and institutional discharge criteria also contribute. Structured exercise therapy, including range-of-motion exercises, progressive strengthening, and functional training, can support physical recovery in relevant musculoskeletal conditions^{19,20}. Rehabilitation recommendations emphasize interventions tailored to the condition, functional limitations, and individual capacity rather than assuming that a single programme is appropriate for every patient²¹. Differences in surgical indications, anaesthetic protocols, rehabilitation intensity, outcome definitions, and discharge practices can therefore limit comparisons across studies^{22,23}.

Despite these advances, the comparative effect of local anaesthetic infiltration and an open surgical approach on hospital length of stay remains insufficiently established for the specific clinical population and procedures examined in the present trial. Existing evidence concerning local infiltration analgesia largely relates to defined procedures and should not automatically be generalized to other musculoskeletal operations or interpreted as evidence that infiltration can replace necessary surgical intervention. Differences in procedural technique and anaesthetic management may also complicate attribution of observed recovery differences to any single intervention component²⁴. Furthermore, valid comparisons require clearly defined outcomes and appropriate consideration of baseline disease severity, anatomical site, and other factors that may influence hospitalization.

Evaluation of postoperative pain, functional recovery, complications, readmission, and adverse events is necessary to determine whether differences in hospital stay occur alongside acceptable short-term clinical outcomes. A randomized comparison, with standardized exercise therapy provided to both groups, can strengthen causal inference regarding the assigned treatment strategies. Nevertheless, a single-centre study involving male patients cannot by itself establish generalizability to women, other institutions, or all musculoskeletal conditions²⁵. Transparent reporting of allocation, participant flow, outcomes, and statistical methods is therefore essential to interpreting the evidence. This study aimed to compare hospital length of stay between adult male patients with musculoskeletal disorders allocated to local anaesthetic infiltration and those allocated to an open surgical approach, with standardized exercise therapy provided to both groups. The primary research question was whether the assigned approaches differed in duration of hospitalization. Secondary objectives were to compare postoperative pain intensity at 24, 48, and 72 hours; functional recovery at discharge and six weeks; postoperative complications; 30-day readmission; and adverse events.

Pain was assessed using a numerical rating scale, an established approach for quantifying pain intensity, while functional recovery was intended to be assessed using an appropriate validated extremity-specific instrument. By examining these outcomes together, the study sought to evaluate hospital utilization alongside early recovery and short-term safety, without presuming that shorter hospitalization necessarily indicates superior overall clinical outcomes. A prospective, parallel-group randomized controlled trial was conducted at a tertiary care hospital at Sargodha between January and December 2025, using concealed allocation and intention-to-treat analysis. The findings are intended to inform further evaluation of these treatment strategies in comparable clinical settings, subject to the study's population, procedural context, and methodological limitations.

METHODOLOGY

A prospective, parallel-group, randomized controlled trial was conducted at tertiary care hospital at Sargodha, Pakistan from

January to December 2025 to compare hospital length of stay between patients allocated to local anaesthetic infiltration and an open surgical approach, with standardized exercise therapy provided to both groups. Adult male patients aged 18–64 years with a musculoskeletal disorder requiring surgical intervention, symptom duration of at least three months, and clinical suitability for both approaches were eligible. Patients with contraindications to either intervention, active operative-site infection, uncontrolled coagulopathy, inability to participate in exercise therapy, or unstable systemic illness likely to independently affect hospitalization were excluded. Eligible patients were recruited consecutively from outpatient clinics and inpatient services. The target sample of 150 participants (75 per group) was calculated using an anticipated between-group difference in hospital stay of 1.5 days, a standard deviation of 3.0 days, 80% statistical power, a two-sided significance level of 0.05, and 15% anticipated attrition, using PASS version 15.0 (NCSS, LLC, Kaysville, Utah, USA).

Following written informed consent and baseline assessment, participants were randomized in a 1:1 ratio using computer-generated block randomization with randomly varying block sizes of two and four, stratified by anatomical site. Allocation was concealed through a centralized web-based randomization system managed independently of recruitment. The local anaesthetic infiltration group received ultrasound-guided infiltration of the operative field, where applicable, using 2% lidocaine with adrenaline at a maximum dose of 7 mg/kg. The open-approach group underwent standard open surgical exploration and repair under general or regional anaesthesia, as determined by the anaesthesiologist. Both interventions followed standardized institutional protocols and were performed by appropriately qualified clinicians. Exercise therapy comprised range-of-motion exercises, progressive strengthening, and functional training, delivered by a qualified physiotherapist twice daily for 30 minutes at moderate intensity (Borg rating 11–13). Exercises progressed according to pain and functional tolerance, and adherence, modifications, and reasons for non-adherence were documented.

The primary outcome was length of hospital stay, calculated in hours from recorded inpatient admission to actual physical discharge and expressed in days, retaining fractional values for analysis. Secondary outcomes included pain intensity measured using a 0–10 numerical rating scale at 24, 48, and 72 hours, functional recovery assessed using the appropriate validated upper- or lower-extremity functional scale at discharge and six weeks, postoperative complications, 30-day readmission, and adverse events. Baseline data included demographic characteristics, comorbidities, disease severity, symptom duration, previous treatment, functional status, pain intensity, and range of motion. Data were collected using standardized case report forms and electronic medical records, entered into a secure coded database, and checked for completeness and consistency. Patients and treating clinicians were not blinded; however, outcome assessors and the statistician remained blinded to treatment allocation where feasible.

Analyses followed the intention-to-treat principle. Categorical variables were summarized as frequencies and percentages, while continuous variables were reported as means and standard deviations or medians and interquartile ranges, as appropriate. The primary treatment effect was the between-group mean difference in hospital stay, estimated using linear regression with robust standard errors, adjusted for baseline disease severity and anatomical site. Model assumptions were assessed using residual diagnostics. Secondary outcomes were analysed using methods appropriate to their measurement scales, including mixed-effects models for repeated pain measurements. Missing data were

addressed using multiple imputation with chained equations, generating 20 imputed datasets, with complete-case sensitivity analyses. Analyses were conducted in R version 4.3.1, using a two-sided significance threshold of $P < 0.05$.

The protocol was approved by the Institutional Review Board of the participating hospital approval number: PT12/263-10S. Written informed consent was obtained from all participants, and confidentiality was maintained through coded identifiers and restricted data access. The protocol, statistical analysis plan, data dictionary, and analysis code were retained for reproducibility, with de-identified data available on reasonable request subject to ethical and institutional requirements.

RESULTS

Of 187 patients screened during the 12-month recruitment period, 37 were excluded before randomization: 18 did not meet inclusion criteria (12 had contraindications to local anaesthetic, 4 had contraindications to the open procedure, 2 could not undertake exercise therapy), 11 declined, and 8 had other reasons (5 had conditions independently determining hospitalization, 3 could not provide consent). The remaining 150 patients were randomized, with 75 allocated to local anaesthetic infiltration and 75 to the open approach. All 150 received their allocated intervention and were analysed by intention to treat; none were lost to follow-up for the primary outcome (Table 1).

Table 1. Participant flow

Stage	LA infiltration (n = 75)	Open approach (n = 75)	Total (N = 150)
Screened	—	—	187
Excluded	—	—	37
Randomized	75	75	150
Analysed	75	75	150

Baseline Characteristics

Groups were similar at baseline (Table 2). Mean (SD) age was 42.3 (11.8) and 43.1 (12.4) years; all participants were male. Hypertension affected 14 (18.7%) and 15 (20.0%) participants, and diabetes mellitus 9 (12.0%) and 10 (13.3%). Mean (SD) baseline pain (0–10 NRS) was 6.4 (1.5) and 6.5 (1.6); functional scores were 42.1 (10.3) and 41.5 (10.8).

Table 2. Baseline characteristics

Characteristic	LA infiltration (n = 75)	Open approach (n = 75)
Age, years, mean (SD)	42.3 (11.8)	43.1 (12.4)
Male, n (%)	75 (100.0)	75 (100.0)
Hypertension, n (%)	14 (18.7)	15 (20.0)
Diabetes mellitus, n (%)	9 (12.0)	10 (13.3)
Symptom duration, months, mean (SD)	8.6 (4.2)	8.9 (4.5)
Baseline pain (0–10 NRS), mean (SD)	6.4 (1.5)	6.5 (1.6)
Baseline functional score, mean (SD)	42.1 (10.3)	41.5 (10.8)

Main Results

Mean (SD) hospital stay was 4.2 (1.8) days with LA infiltration and 5.7 (2.3) days with the open approach. The unadjusted mean difference was –1.5 days (95% CI –2.2 to –0.8; $p < 0.001$), and the adjusted difference (baseline disease severity, anatomical site; robust standard errors) was –1.4 days (95% CI –2.1 to –0.7; $p < 0.001$) (Table 3).

Table 3. Length of hospital stay

Analysis	LA infiltration (n = 75)	Open approach (n = 75)	Estimate (95% CI)	p
Mean (SD), days	4.2 (1.8)	5.7 (2.3)	—	—
Median (IQR), days	4.0 (3.0–5.0)	5.0 (4.0–7.0)	—	—
Unadjusted difference	—	—	–1.5 (–2.2 to –0.8)	< 0.001
Adjusted difference	—	—	–1.4 (–2.1 to –0.7)	< 0.001

Secondary Results

Complications occurred in 6 (8.0%) and 11 (14.7%) participants (OR 0.51, 95% CI 0.18 to 1.45; $p = 0.205$). Pain scores at 24 hours were 3.8 (1.4) and 4.6 (1.6) (difference –0.8, 95% CI –1.3 to –0.3; $p = 0.002$); at 48 hours, 3.1 (1.2) and 3.9 (1.5) (difference –0.8, 95% CI –1.2 to –0.4; $p < 0.001$); and at 72 hours, 2.6 (1.1) and 3.2 (1.4) (difference –0.6, 95% CI –1.0 to –0.2; $p = 0.003$). The group-by-time interaction was not significant ($p = 0.412$). Functional scores at discharge were 58.4 (12.1) and 54.2 (13.5) (difference 4.2, 95% CI 0.1 to 8.3; $p = 0.045$) and at 6 weeks 72.6 (14.8) and 70.1 (15.3) (difference 2.5, 95% CI –2.2 to 7.2; $p = 0.297$). Readmission occurred in 3 (4.0%) and 5 (6.7%) participants (OR 0.58, 95% CI 0.13 to 2.53; $p = 0.469$); adverse events in 4 (5.3%) and 7 (9.3%).

LA infiltration was associated with a shorter hospital stay (adjusted difference –1.4 days; 95% CI –2.1 to –0.7; $p < 0.001$), lower pain at 24–72 hours, and higher discharge functional scores, with no statistically significant differences in complications, 6-week function, readmission, or adverse events.

DISCUSSION

This randomized controlled trial found that local anaesthetic infiltration combined with standardized exercise therapy was associated with a significantly shorter hospital stay than the open surgical approach combined with the same rehabilitation programme. The adjusted mean difference was 1.4 days in favour of local anaesthetic infiltration (95% CI, 0.7–2.1 days; $p < 0.001$). This finding suggests that the anaesthetic and procedural approach may influence postoperative recovery and hospitalization. The consistency between adjusted and unadjusted estimates supports the robustness of the primary finding within the analysed sample. Nevertheless, because the interventions differed in both anaesthetic technique and surgical approach, the independent contribution of each component cannot be determined.

Several factors may explain the shorter hospitalization observed in the infiltration group. Avoidance of general anaesthesia, where applicable, may reduce anaesthesia-related recovery requirements, while a less invasive operative approach may limit tissue trauma and facilitate earlier mobilization. Lower postoperative pain may also improve participation in physiotherapy and functional activities, potentially supporting earlier discharge. In this study, pain scores were significantly lower in the infiltration group at 24, 48, and 72 hours, with between-group differences ranging from 0.6 to 0.8 points on the 10-point numerical rating scale. Although statistically significant, these differences should be interpreted in relation to their clinical importance. Furthermore, the nonsignificant group-by-time interaction suggests that the pattern of pain reduction over time did not differ significantly between groups, despite consistently lower scores in the infiltration group.

Functional outcomes provided additional evidence of early recovery. Participants receiving local anaesthetic infiltration had higher functional scores at discharge, with a mean difference of 4.2 points (95% CI, 0.1–8.3; $p = 0.045$). However, the difference was not statistically significant at six weeks (2.5 points; 95% CI, –2.2 to 7.2; $p = 0.297$). This pattern may indicate that the principal advantage of infiltration relates to early postoperative recovery rather than sustained functional superiority. Both groups received standardized exercise therapy, which may have contributed to functional improvement during follow-up. However, without a comparison group receiving a different rehabilitation strategy, the independent effect of exercise therapy cannot be established.

Postoperative complications occurred less frequently in the infiltration group than in the open-approach group (8.0% versus 14.7%), although the difference was not statistically significant ($p = 0.205$). Similarly, 30-day readmission rates were numerically lower with infiltration (4.0% versus 6.7%; $p = 0.469$), and adverse events were reported in 5.3% and 9.3% of participants, respectively. These findings do not establish equivalent safety or demonstrate a definitive reduction in complications. The relatively small number of events limits statistical precision, and the confidence interval for complications includes both potentially meaningful benefit and no benefit. Larger trials with detailed adverse-event classification and longer follow-up are needed to clarify comparative safety.

The trial has several strengths, including randomized allocation, concealed assignment, intention-to-treat analysis, blinded outcome assessment where feasible, and a clearly defined primary outcome. However, important limitations affect generalizability. Recruitment from a single teaching hospital and the inclusion of male participants only restrict applicability to women, other healthcare settings, and broader patient populations. Additionally, the absence of detailed procedure-specific results limits assessment of whether treatment effects vary by anatomical site or surgical indication. Discharge practices, resource availability, and institutional protocols may also influence hospital stay.

In conclusion, local anaesthetic infiltration was associated with shorter hospitalization, lower early postoperative pain, and better functional scores at discharge than the open approach. However, longer-term functional differences and reductions in complications or readmissions were not statistically established. Multicentre trials involving diverse populations, standardized discharge criteria, procedure-specific analyses, and adequately powered safety outcomes are warranted before broader clinical recommendations can be made.

CONCLUSION

Local anaesthetic infiltration combined with standardized exercise therapy was associated with significantly shorter hospital stays, reduced postoperative pain at 24, 48, and 72 hours, and improved functional recovery at discharge compared with the open approach. However, functional outcomes at six weeks did not differ significantly between groups. Although complications, readmissions, and adverse events were numerically less frequent in the infiltration group, the observed differences were not statistically significant, and comparative safety remains uncertain. These findings suggest that local anaesthetic infiltration may facilitate early postoperative recovery and reduce inpatient resource utilization in appropriately selected patients. Nevertheless, the single-centre design and inclusion of male patients only limit generalizability. Larger multicentre randomized controlled trials are needed to confirm these findings and establish procedure-specific effectiveness and safety.

Ethical Approval

Ethical approval for the conduct of this study was obtained from tertiary care hospital at Sargodha, Sargodha, Pakistan with the approval number: PT12/263-10S. The study was conducted in accordance with the ethical principles and institutional requirements governing research involving human participants.

Data Availability

The data analyzed in this study are available from the corresponding author upon reasonable request.

Author Contributions

Conceptualization: Anam Hanif, Mafia Arshad

Methodology: Anam Hanif, Mehreen Azeem

Data Collection: Anam Hanif, Areej Arshad

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All authors take responsibility for ensuring that any questions related to the reliability or integrity of any part of the work are appropriately investigated and resolved. All authors agree to take public responsibility for the content of the manuscript.

Informed Consent

Informed consent was obtained from all participants before their enrollment in the study. The participants were adequately informed about the study objectives and procedures, and their privacy and confidentiality were ensured throughout the study.

Funding

No.

Conflict of Interest

No.

Acknowledgments

The authors would like to acknowledge the support of all individuals who contributed to the completion of this study.

Declaration of AI-Assisted Language Editing

Grammarly AI was used for language and grammar correction, while Gemini AI was used for figure generation.

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