RESEARCH PAPER

Role of Intrathecal Opioid Adjuvants with Local Anaesthetics in Spinal Anaesthesia for Orthopaedic Surgery: A Narrative Review

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Abstract
Background: For lower-limb orthopaedic procedures, spinal anaesthesia is favoured as the regional technique of choice, given its quick onset, a dense sensorimotor block, good muscular relaxation, fewer perioperative complications, and reliable postoperative pain control. Yet when intrathecal local anaesthetic is used on its own, the analgesia it produces frequently does not last long enough to cover major orthopaedic operations. Adding an intrathecal opioid to the local anaesthetic has therefore become a common strategy for improving block quality, extending postoperative pain relief, cutting systemic opioid use, and speeding up rehabilitation. A range of opioids — fentanyl, morphine, sufentanil, buprenorphine, nalbuphine, butorphanol, and tramadol among them — have been studied as such adjuvants, each showing a distinct balance of efficacy and safety.
Objective: This review sets out to summarise and critically appraise the available evidence on the pharmacology, clinical efficacy, safety, and comparative performance of intrathecal opioid adjuvants used alongside local anaesthetics for spinal anaesthesia in orthopaedic surgery.
Materials and Methods: Literature published from 2015 through 2026 was surveyed across **PubMed/MEDLINE, Embase, Scopus, the Cochrane Library, Web of Science, and Google Scholar**. Eligible sources comprised randomized trials, observational studies, systematic reviews and meta-analyses, and evidence-based guidelines examining intrathecal opioid adjuvants in adult orthopaedic patients. Findings were synthesised narratively, with particular attention to block quality, duration of postoperative pain relief, opioid-sparing benefit, haemodynamic effects, adverse events, and relevance to Enhanced Recovery After Surgery (ERAS) pathways.
Results: Across the studies reviewed, adding an intrathecal opioid consistently produced better-quality spinal anaesthesia than local anaesthetic alone. Fentanyl, the most widely studied agent, gave a fast onset, better intraoperative pain control, longer sensory block, and a good safety record. Morphine gave the longest-lasting postoperative pain relief of any agent but demanded closer monitoring, since delayed respiratory depression, pruritus, nausea, and urinary retention were all more common with it. Sufentanil, buprenorphine, nalbuphine, and butorphanol likewise showed encouraging analgesic results with acceptable side-effect profiles, while tramadol's benefit was comparatively modest. Taken together, these adjuvants lowered postoperative pain scores, pushed back the time to first rescue analgesia, cut systemic opioid use, raised patient satisfaction, and allowed earlier mobilisation, without meaningfully worsening haemodynamic stability at the doses used.
Conclusion: Intrathecal opioid adjuvants have become a core part of modern spinal anaesthesia for orthopaedic surgery. Choosing the right opioid and dose meaningfully improves perioperative pain control while keeping side effects manageable. Fentanyl still suits short-to-intermediate procedures best, owing to its quick onset and safety margin, whereas morphine is better suited to major surgery needing prolonged relief. Buprenorphine, nalbuphine, butorphanol, and sufentanil are gaining ground as useful alternatives within multimodal regimens. Larger, multicentre trials are still needed to settle optimal dosing and to clarify how newer agents fit into ERAS-oriented orthopaedic care.

Keywords: Spinal anaesthesia; Intrathecal opioids; Fentanyl; Morphine; Buprenorphine; Sufentanil; Orthopaedic surgery; Local anaesthetics; Postoperative analgesia; ERAS.
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INTRODUCTION

For lower-limb orthopaedic operations, spinal anaesthesia ranks among the regional techniques used most often, valued for its rapid onset, its dense block of both sensory and motor fibres, good muscle relaxation, less intraoperative bleeding, a lower rate

of thromboembolic events, and better postoperative pain control than general anaesthesia typically achieves. Its favourable safety record and cost make it the default choice for operations such as total knee and hip arthroplasty, fixation of hip fractures, intramedullary nailing, and other procedures involving the lower extremities (1,2).

How well spinal anaesthesia performs depends heavily on which local anaesthetic is chosen and on the adjuvants added to it to shape the block's quality and duration. Hyperbaric bupivacaine is still the workhorse intrathecal agent, thanks to its predictable onset, dependable surgical-grade block, and long action. Levobupivacaine and ropivacaine have found increasing favour too, largely because they carry a lower risk of cardiac and neural toxicity without sacrificing sensory block quality (3,4).

Local anaesthetics on their own give excellent surgical conditions, but their effect rarely stretches far enough into the postoperative period, particularly following major orthopaedic surgery where severe pain can hold back mobilisation, physiotherapy, and discharge from hospital. Simply raising the local anaesthetic dose to chase longer analgesia comes with its own costs — a longer motor block, more hypotension, urinary retention, and delayed walking. This is why adjuvants injected intrathecally have become standard practice: they sharpen the block without needing a larger dose of local anaesthetic (5,6).

Of the various intrathecal adjuvants in use, opioids are studied and used the most, since they add analgesia by acting directly on opioid receptors in the spinal cord's dorsal horn. Where local anaesthetics work by blocking voltage-gated sodium channels and thereby stopping impulse conduction outright, intrathecal opioids instead dampen nociceptive signalling with comparatively little effect on motor fibres. Combining the two exploits this difference: opioids and local anaesthetics act through separate but complementary mechanisms, so together they give better intraoperative anaesthesia and longer-lasting postoperative comfort (7,8). Mechanistically, this rests on the dense population of μ, κ, and δ opioid receptors found in the substantia gelatinosa of the dorsal horn. Once injected intrathecally, opioids attach to both pre- and postsynaptic receptors, reduce calcium entry, increase potassium outflow, cut down release of neurotransmitters such as substance P and glutamate, and blunt the ascending pain signal. The net effect is reduced pain perception that allows a smaller dose of local anaesthetic to still deliver adequate surgical block (9,10). Which opioid suits a given case depends largely on its physicochemical profile. Lipophilic agents like fentanyl and sufentanil act quickly, spread little within the cerebrospinal fluid, and wear off comparatively fast — useful traits for shorter or intermediate-length orthopaedic procedures. Hydrophilic morphine, by contrast, moves more slowly through neural tissue, stays in the spinal fluid longer, and so extends postoperative analgesia further, at the cost of a higher chance of delayed respiratory depression and other opioid side effects (11,12).

Fentanyl in particular has become a mainstay intrathecal adjuvant, owing to its high lipid solubility, fast onset, and generally favourable safety record. Trial evidence shows that adding 10–25 μg of fentanyl to hyperbaric bupivacaine sharpens intraoperative analgesia, extends the sensory block, eases tourniquet-related discomfort, and pushes back the need for rescue analgesia after surgery — all without meaningfully lengthening the motor block. Because it is cleared quickly from the spinal cord into surrounding tissue and the circulation, delayed respiratory depression is comparatively rare with fentanyl relative to hydrophilic opioids, which is part of why it suits ambulatory surgery and enhanced-recovery pathways so well (13,14).

Sufentanil, another strongly lipophilic synthetic opioid, is roughly five to ten times more potent than fentanyl and combines fast onset with prolonged receptor binding at the spinal level. When given intrathecally it sharpens sensory block, keeps patients more comfortable through long orthopaedic procedures, and gives good postoperative analgesia with little haemodynamic disturbance. Its potency means only tiny doses — 2.5 to 10 μg — are typically needed, limiting overall opioid exposure without sacrificing efficacy (15,16).

Morphine is still the reference hydrophilic opioid when long-lasting postoperative analgesia is the goal. Because it diffuses only slowly through the cerebrospinal fluid, a single intrathecal dose can provide pain relief for 18 to 24 hours — a property that makes it especially useful after major surgery such as total hip or knee arthroplasty and complex fracture fixation, where uncontrolled pain would otherwise hold back early mobilisation and physiotherapy. The trade-off is that it needs closer postoperative watching, since delayed respiratory depression, pruritus, nausea, vomiting, and urinary retention are all seen more often with morphine than with the lipophilic opioids (17,18).

There is also growing interest in the partial agonist buprenorphine and the mixed agonist–antagonists nalbuphine and butorphanol. Buprenorphine binds μ-opioid receptors with very high affinity and dissociates slowly from them, which translates into long-lasting analgesia with a comparatively lower risk of respiratory depression. Studies combining intrathecal buprenorphine with bupivacaine report

longer postoperative analgesia, less need for rescue medication, and good patient comfort after lower-limb orthopaedic surgery. Nalbuphine and butorphanol perform similarly well, with the added benefit of lower rates of pruritus and respiratory depression, making them reasonable choices in selected patients (19,20).

The shift toward multimodal perioperative analgesia has reinforced the case for intrathecal opioids. Orthopaedic practice today emphasises pain control that still allows early mobilisation, quick rehabilitation, and lower opioid use overall. Within that framework, intrathecal opioids add deep spinal analgesia in the immediate postoperative window alongside peripheral nerve blocks, acetaminophen, NSAIDs, COX-2 inhibitors, and local infiltration techniques. Programmes built around this combined approach tend to show higher patient satisfaction, shorter admissions, better functional recovery, and lower overall costs (21,22).

ERAS protocols now lean more heavily on regional techniques that manage perioperative pain while keeping systemic opioid use low. Spinal blocks built around low-dose local anaesthetic plus a well-chosen intrathecal opioid fit this philosophy neatly — they give effective analgesia, blunt the surgical stress response, spare respiratory function, and support early walking, all of which feed into better overall recovery. For this reason, intrathecal opioids now sit at the centre of many perioperative care pathways for both elective and emergency orthopaedic cases (23,24).

Even though the benefits are well established, choosing which opioid to use is not straightforward — the agents differ markedly in potency, lipid solubility, receptor binding, duration, and side-effect profile. Fentanyl and sufentanil act fast and give strong intraoperative analgesia with little cephalad spread; morphine gives more durable postoperative relief but demands more vigilant monitoring given its higher risk of delayed respiratory depression. The practical upshot is that the choice has to be tailored — to the patient, the length of surgery expected, how much postoperative analgesia is needed, and what monitoring the institution can actually provide (25,26).

How a given patient handles an intrathecal opioid also depends on factors like age, obesity, obstructive sleep apnoea, chronic opioid exposure, kidney function, and other comorbidities. Older patients are typically more sensitive to neuraxial opioids because of age-related physiological change, so smaller intrathecal doses are warranted to avoid haemodynamic swings and drug-related side effects. Younger patients undergoing bigger reconstructive procedures, on the other hand, may do better with a longer-acting opioid that keeps them comfortable enough to start physiotherapy early. Dose titration and an individualised analgesic plan remain core to good neuraxial practice for this reason (27).

Over roughly the past ten years, trials, systematic reviews, and meta-analyses have repeatedly found that adding an opioid to intrathecal local anaesthetic outperforms local anaesthetic given alone, in terms of block quality. The recurring findings are a longer sensory block, a later need for rescue analgesia, higher patient satisfaction, lower pain scores, and less systemic opioid use. These gains, though, come with a cost that varies by agent and dose — pruritus, nausea, vomiting, urinary retention, sedation, and respiratory depression all remain possible (28,29).

Perioperative medicine more broadly has been pushing toward opioid-sparing strategies that don't sacrifice pain control, and neuraxial opioids fit comfortably within that push — a small intrathecal dose delivers targeted spinal analgesia without the exposure that comes with systemic dosing. Used sensibly as part of a multimodal plan, they help control pain while keeping total opioid exposure down and supporting a faster recovery after orthopaedic surgery (30,31).

Newer work has also looked closely at the dose-response curve for these opioids, trying to get the best analgesia for the least side-effect burden. Lower-than-traditional doses of fentanyl, morphine, buprenorphine, and nalbuphine have given comparable analgesic outcomes with fewer complications than the higher doses once used routinely. Comparative studies of newer adjuvants have added further nuance, letting clinicians match drug combinations to the specific procedure, expected pain severity, and the individual patient's risk profile (32,33).

Beyond the immediate postoperative window, these adjuvants also shape rehabilitation. Good analgesia lets patients get moving sooner, engage properly with physiotherapy, regain joint function, and avoid some pulmonary complications, all of which shortens hospital stay. This matters most after total hip or knee arthroplasty and lower-limb trauma surgery, where getting patients up and moving early is closely tied to how well they ultimately recover. That link is why fine-tuning spinal anaesthesia with the right opioid adjuvant has become part of patient-centred perioperative care more generally (34,35).

Given how much the evidence base has grown, and how many intrathecal opioid options are now available, an updated review of the literature seems worthwhile. This narrative review therefore looks critically at current evidence on the efficacy, pharmacology, clinical use, safety, and comparative performance of intrathecal opioid adjuvants

combined with local anaesthetics for orthopaedic spinal anaesthesia — with the aim of giving clinicians a practical, evidence-based basis for choosing among them, optimising perioperative analgesia, limiting adverse effects, and improving outcomes for orthopaedic patients (36–40).

MATERIALS AND METHODS

This review sought to assess current evidence on the efficacy, safety, pharmacology, and clinical use of intrathecal opioid adjuvants combined with local anaesthetics for spinal anaesthesia in orthopaedic patients. The literature search covered PubMed/MEDLINE, Embase, Scopus, the Cochrane Library, Google Scholar, and Web of Science, and was restricted to articles published from January 2015 to June 2026.

Search terms combined Medical Subject Headings with free-text keywords — among them "spinal anaesthesia," "subarachnoid block," "intrathecal opioids," "opioid adjuvants," the names of the individual opioids and local anaesthetics under review, "orthopaedic surgery," "postoperative analgesia," "regional anaesthesia," and "enhanced recovery after surgery (ERAS)" — linked with Boolean AND/OR operators to narrow the results to relevant studies.

Eligible study types spanned randomized controlled trials, prospective and retrospective observational studies, systematic reviews and meta-analyses, other narrative reviews, and evidence-based clinical guidelines, provided they examined intrathecal opioid adjuvants used with local anaesthetics for lower-limb spinal anaesthesia. Both elective and emergency orthopaedic cases in adults were eligible.

Inclusion required English-language publication, human participants, evaluation of at least one intrathecal opioid combined with a local anaesthetic, and reporting of clinically meaningful outcomes — onset or duration of sensory/motor block, postoperative analgesia, need for rescue analgesics, haemodynamic effects, patient satisfaction, adverse events, or recovery measures.

Excluded were paediatric studies, animal or laboratory work, case reports, conference abstracts lacking full text, duplicate publications, non-English articles, and studies of neuraxial techniques other than spinal anaesthesia that did not separately analyse intrathecal opioid use.

Data extracted from the selected studies were assessed qualitatively and drawn together narratively, with the main comparison centred on the pharmacology and clinical performance of the commonly used opioids — fentanyl, morphine, sufentanil, buprenorphine, nalbuphine, butorphanol, and tramadol — across block characteristics, duration of postoperative analgesia, opioid-sparing benefit, haemodynamic stability, side-effect profile, and their place within multimodal analgesia and ERAS pathways. The evidence was appraised critically to flag where consensus exists, where controversy remains, and where further research is still needed.

RESULTS

The search returned a substantial body of evidence on intrathecal opioids as supplements to local anaesthetics in orthopaedic spinal anaesthesia, drawn from randomized trials, prospective observational studies, systematic reviews and meta-analyses, and clinical guidelines published between 2015 and 2026. Taken as a whole, this evidence consistently favoured adding an intrathecal opioid: block quality improved, postoperative analgesia lasted longer, systemic analgesic use fell, and patients reported greater satisfaction than with local anaesthetic alone.

Hyperbaric bupivacaine featured as the local anaesthetic of choice in most of the included studies, with levobupivacaine and ropivacaine used less often. Fentanyl was the most heavily studied opioid, reflecting its rapid onset, safety, and predictable effect; morphine stayed the preferred choice when prolonged postoperative analgesia was the priority after major surgery. Sufentanil, buprenorphine, nalbuphine, butorphanol, and tramadol each performed to varying degrees depending on the procedure and the patient group studied.

In most comparative studies, adding an opioid brought on the sensory block faster and made it denser, though the onset of motor block was largely unchanged. Sensory block duration was reliably longer with an opioid on board, and the need for extra intraoperative analgesia was consistently lower than with local anaesthetic alone.

Every opioid tested extended postoperative analgesia to some extent, though the degree varied. Morphine gave the longest coverage, often beyond 18–24 hours post-surgery. Fentanyl and sufentanil worked fast and effectively but for a shorter window, paired with excellent intraoperative conditions and a smooth recovery. Buprenorphine came close to morphine's duration while causing fewer serious respiratory problems in most of the studies reviewed. Nalbuphine and butorphanol also extended analgesia well, with less pruritus and respiratory depression than the pure agonists, whereas tramadol's efficacy was only moderate and came with more postoperative nausea and vomiting in some reports.

A number of studies also found lower overall postoperative opioid consumption in patients who received an intrathecal adjuvant. Rescue analgesia was needed later, cumulative opioid use in the first 24 hours after surgery was lower, and pain scores improved — a pattern that held across the randomized trials reviewed and that reinforces the

place of intrathecal opioids in both multimodal analgesia and ERAS pathways in orthopaedics.

Haemodynamics stayed largely stable when low-dose opioids were added. Hypotension and bradycardia still occurred, as expected from the sympathetic block that comes with spinal anaesthesia, but adding an opioid at recommended doses did not noticeably add to that instability. On that basis, these adjuvants were judged reasonably safe for most patients having lower-limb orthopaedic surgery, elderly patients included, provided monitoring was adequate.

How often side effects occurred depended on the drug and dose. Pruritus came up most often, especially with fentanyl and morphine. Nausea and vomiting affected a minority and were usually mild, settling with standard antiemetics. Urinary retention was more common with morphine than the lipophilic agents. Delayed respiratory depression was uncommon overall, but it was still the most clinically serious risk tied to hydrophilic opioids — reason enough to keep respiratory monitoring in place after intrathecal morphine in particular.

In sum, the evidence reviewed points to a clear benefit from intrathecal opioid adjuvants in orthopaedic spinal anaesthesia — better sensory block, longer postoperative analgesia, less need for rescue medication, higher patient satisfaction, and easier early recovery. Fentanyl remains the go-to for shorter or intermediate procedures; morphine wins out when the longest possible analgesia is required for major surgery. Buprenorphine, nalbuphine, and butorphanol look like promising alternatives, though better comparative data are still needed to pin down optimal dosing and long-term outcomes.

DISCUSSION

The case for spinal anaesthesia in lower-limb orthopaedic surgery rests on its reliable sensorimotor block, deep muscle relaxation, quick onset, lower perioperative blood loss, reduced venous thromboembolism, fewer pulmonary complications, and better postoperative analgesia than general anaesthesia typically offers (1,2). The gap is that local anaesthetic alone often can't cover the pain that follows major procedures like hip or knee arthroplasty or fracture fixation, where postoperative pain tends to be both severe and prolonged. Intrathecal opioid adjuvants have filled that gap, boosting analgesic efficacy substantially without needing a larger dose of local anaesthetic (3,4).

Combining the two classes works because their mechanisms are different but complementary. Hyperbaric bupivacaine and other local anaesthetics block voltage-gated sodium channels, stopping conduction along sensory, motor, and sympathetic fibres alike. Opioids instead work at μ, κ, and δ receptors in the dorsal horn, damping nociceptive transmission by suppressing substance P and glutamate release and strengthening the descending inhibitory pathways (5,6). Because the two mechanisms don't overlap, smaller doses of each can be used together, giving a better sensory block, longer analgesia, and fewer dose-related side effects than either drug alone at a higher dose.

Fentanyl is still the most-studied and most-used intrathecal opioid in orthopaedic anaesthesia. Its high lipid solubility lets it diffuse quickly into spinal cord tissue, giving a fast onset with little spread up the cerebrospinal fluid. Trial data repeatedly show that 10–25 μg of fentanyl added to hyperbaric bupivacaine lengthens the sensory block, makes patients more comfortable intraoperatively, delays the first request for postoperative pain relief, and reduces opioid use over the first postoperative day (7,8) — reasons enough that it has become the default intrathecal opioid for shorter and intermediate-length orthopaedic procedures.

Its safety profile is one of fentanyl's biggest clinical selling points. It redistributes quickly out of the cerebrospinal fluid into nearby tissue and the bloodstream, so delayed respiratory depression is rare. Hypotension, oversedation, urinary retention, and prolonged motor block are all uncommon at recommended doses too. Pruritus is the side effect seen most often, and it's usually mild enough to settle with antihistamines or a low dose of an opioid antagonist. That combination of speed and safety keeps fentanyl in wide use for ambulatory orthopaedic surgery and ERAS pathways, where quick recovery matters most (9,10).

Morphine's hydrophilicity sets it apart from fentanyl entirely. Rather than clearing quickly, it lingers in the cerebrospinal fluid, spreading widely through the spinal cord and keeping opioid receptors activated for longer — hence analgesia that can run up to 24 hours from one dose. That duration is particularly valuable after total knee or hip arthroplasty, complex trauma surgery, and revision procedures, where uncontrolled pain would otherwise get in the way of early mobilisation and physiotherapy (11,12).

That longer duration comes at a price — pruritus, nausea, vomiting, urinary retention, and delayed respiratory depression are all more common with morphine, largely because it migrates further up the cerebrospinal fluid over time. Guidelines accordingly call for at least 24 hours of postoperative respiratory monitoring after intrathecal morphine, with extra caution in elderly patients and those with obesity, obstructive sleep apnoea, chronic respiratory disease, or ongoing systemic opioid use (13,14). Even so, at low doses — typically 100–200 μg — it remains one of the most effective ways to secure prolonged

postoperative analgesia after major orthopaedic surgery.

More recent systematic reviews and meta-analyses back this up, consistently finding better overall outcomes with an intrathecal opioid than with local anaesthetic alone: lower pain scores, longer pain-free periods, less rescue analgesia, higher satisfaction, earlier physiotherapy, and shorter admissions. This body of evidence is why a carefully chosen intrathecal opioid now has a place in multimodal perioperative regimens, especially in orthopaedic surgery where getting patients moving early is so closely tied to their long-term outcome (15–20).

Sufentanil is another strong option, thanks to its unusually high lipid solubility and potency — around five to ten times that of fentanyl — and its rapid penetration into spinal cord tissue once given intrathecally. Adding a low dose (2.5–10 μg) to hyperbaric bupivacaine has been shown to sharpen intraoperative anaesthesia, extend postoperative analgesia, and keep patients more comfortable through longer procedures, without any real haemodynamic penalty (21,22). Its fast onset and forgiving pharmacokinetics make it a good fit for elderly patients and for cases needing a deep sensory block without much cardiovascular disturbance.

Buprenorphine's unusual pharmacology has also brought it more attention as an intrathecal adjuvant. As a highly lipophilic partial agonist at the μ receptor, with very high receptor affinity and slow dissociation, it delivers prolonged analgesia while its respiratory depression risk plateaus rather than climbing further with dose. Trials of intrathecal buprenorphine report longer postoperative analgesia, less rescue analgesic use, and better patient satisfaction than local anaesthetic alone, and several studies suggest it causes less respiratory depression than morphine at comparable analgesic efficacy — a useful trade-off for patients at higher risk of opioid-related complications (23,24).

Nalbuphine and butorphanol, both mixed agonist–antagonists, have drawn interest for a similar reason: effective spinal analgesia with a comparatively kind side-effect profile. Nalbuphine acts as an agonist at κ receptors and an antagonist at μ receptors, so it provides solid analgesia while limiting the μ-mediated problems of respiratory depression and severe itching. Clinical studies of intrathecal nalbuphine describe a longer sensory block, later need for rescue analgesia, lower pain scores, and stable haemodynamics after lower-limb orthopaedic surgery. Butorphanol shows a similar pattern — better postoperative analgesia with less nausea, vomiting, and respiratory depression than the conventional pure μ-agonists (25,26).

Tramadol works differently again, combining weak μ-agonism with inhibition of serotonin and norepinephrine reuptake. Some studies do report improved postoperative analgesia with intrathecal tramadol, but its efficacy generally falls short of fentanyl, morphine, or buprenorphine, and postoperative nausea and vomiting come up more often — enough that it isn't used routinely and is generally reserved as a second-line option when other agents can't be used (27,28).

Ultimately, much of this comes down to the lipophilic-versus-hydrophilic divide. Lipophilic drugs move quickly into neural tissue and give fast onset, minimal spread toward the head, a shorter analgesic window, and less risk of delayed respiratory depression. Hydrophilic drugs stay in the cerebrospinal fluid longer, giving more prolonged analgesia but at the cost of more cephalad spread and a higher rate of delayed respiratory depression, urinary retention, nausea, vomiting, and pruritus. That single distinction accounts for most of the differences seen across trials and is a reasonable starting point for individualising the choice of opioid to the surgery and the patient (29,30).

ERAS protocols have added further weight to the argument for optimising perioperative analgesia while limiting systemic opioid exposure. Intrathecal opioids fit that agenda well: prolonged spinal analgesia, a blunted stress response, earlier ambulation, better engagement with physiotherapy, shorter admissions, and higher patient satisfaction. Folded into a broader multimodal plan — peripheral nerve blocks, acetaminophen, NSAIDs, COX-2 inhibitors, periarticular infiltration, and structured rehabilitation — they make a meaningful difference to perioperative recovery after major orthopaedic surgery (31,32).

There's also a clear trend in recent studies toward lower-dose regimens. Investigators have found that reduced doses — fentanyl at 10–15 μg, morphine at 100–150 μg, buprenorphine at 60–90 μg, and nalbuphine at 0.4–0.8 mg — give analgesia comparable to higher doses while cutting down on side effects. Getting the dose right, rather than simply using more, is now seen as the better strategy for maximising benefit while limiting complications, particularly for elderly patients or those with significant cardiopulmonary disease (33–35).

Taking the evidence as a whole, intrathecal opioid adjuvants clearly earn their place in orthopaedic spinal anaesthesia, though which one to use should still be tailored to the expected length of surgery, anticipated pain, patient comorbidities, and what monitoring is realistically available. Fentanyl remains the natural choice for shorter cases given its speed and safety; morphine still wins out when the longest

analgesia is needed for major surgery. Buprenorphine, nalbuphine, butorphanol, and sufentanil round out a broader toolkit that lets anaesthesiologists individualise perioperative pain management more than they once could (36–40).

CONCLUSION

Taken together, the evidence shows that intrathecal opioid adjuvants meaningfully raise the quality of spinal anaesthesia for orthopaedic surgery — sharper sensory block, longer postoperative analgesia, less need for rescue medication, and earlier mobilisation. Fentanyl remains the preferred agent for short and intermediate procedures given its speed and safety, while morphine gives the most prolonged postoperative relief for major surgery, so long as adequate postoperative monitoring is in place. Buprenorphine, nalbuphine, butorphanol, and sufentanil round out the options, each showing encouraging efficacy with an acceptable safety margin for individualised analgesic planning.

Ultimately, the opioid chosen should reflect the specific procedure, the pain expected afterward, the patient's comorbidities, and what monitoring the institution can provide. What's still missing is a stronger evidence base from well-designed, multicentre randomized trials that could settle optimal dosing, directly compare the newer adjuvants, and track long-term outcomes within ERAS protocols.

Limitations

This review has its limits: the included studies varied in patient population, opioid dosing, and local anaesthetic regimen, which complicates any direct comparison between individual adjuvants. It is also confined to published English-language literature and does not include a quantitative meta-analysis, both of which may limit how far the conclusions can be generalised.

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