

Guidelines

Evidence-Based Orthopaedic Post-Operative Opioid Prescribing Recommendations Following Spine Surgery

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The initiation of illegal opioid use often stems from legal prescriptions, emphasizing the pivotal role of healthcare practitioners, particularly physicians, in addressing this crisis. Opioid medications are frequently prescribed after surgeries, with orthopedic and neurosurgery procedures demonstrating higher rates of opioid utilization. Notably, spine surgeries exhibit the highest rates of long-term opioid prescription usage. Preoperative opioid use is prevalent among patients undergoing spine surgery and is associated with an increased risk of opioid dependence one year after the procedure. It is crucial to consider specific surgical characteristics when deciding on postoperative opioid use, as fewer intensive procedures tend to have a higher likelihood of discontinuing opioid use compared to lumbar interbody arthrodesis. Orthopedic spine surgeons must address unique pain management challenges, considering preoperative opioid use and focusing on multimodal pain relief methods to improve patients' quality of life.

INTRODUCTION

The use and misuse of prescription opioids remain a significant public health issue. Previous reports have highlighted the substantial economic costs associated with the widespread use of opioids.¹⁻³ Most drug overdoses in 2017 were attributed to prescription opioids, accounting for more than 50% of all cases.^{4,5} The commencement of illegal opioid use is often traced back to legal prescriptions, underscoring the crucial role that healthcare practitioners, especially physicians, and prescribers, may bear in addressing this crisis.⁶ Following surgeries in the United States, opioid medications have been prescribed to most patients. Although a significant number of these patients were not taking opioid medications before their surgeries, most of them were prescribed such medications as a routine postoperative measure. Compared to other surgical specialties, orthopedic and neurosurgery procedures typically exhibit elevated rates of opioid utilization. Interventional spinal procedures, which share features of orthopedic and neurosurgery specialties, demonstrate comparable levels of opioid use.^{7,8}

One study analyzed chronic opioid prescription rates after 50 orthopedic procedures and found that spine surgeries had the highest rates of long-term opioid prescription usage among eight out of the ten surgeries with the highest rates.⁹ Studies have also revealed that a substantial percentage of patients undergoing spine surgery have preoperative opioid use, with higher use linked to greater opioid dependence one year after surgery. One large prospective study found that 55% of patients had preoperative opiate use, with increased preoperative use associated with increased opiate dependence one year postoperatively.¹⁰ Patients on chronic opiates with multiple opiate prescribers are more likely to have increased long-term opiate use postoperatively.¹¹

It is essential to consider specific surgical characteristics when contemplating the use of opioids after surgery. For example, patients who underwent less intensive discectomy and decompression procedures were more likely to discontinue opioid use than those who underwent lumbar interbody arthrodesis.¹²

PDMPs (Prescription Drug Monitoring Programs) are data systems run by states that keep track of patients and their controlled substance records, which are mainly filled in outpatient pharmacies.¹³⁻¹⁸ Studies showed that strict

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PDMPs (Prescription Drug Monitoring Programs) decreased prescription opioid-related deaths/hospitalizations.¹⁹ Over the years, PDMP, provider education on opioid prescribing, and multimodal analgesia strategies have led to a 19% reduction in annual opioid prescribing rates in the United States from 2006 to 2017. Moreover, there has been a 7% decrease in prescription opioid-related death rates in the United States between 2018 and 2019.¹³ Although improvements have occurred, the quantity of opioids prescribed to each person, measured in morphine milligram equivalents (MME), is still more than three times higher than in 1999.¹³

Orthopedic spine surgeons face distinctive challenges in pain management, as many of their patients suffer from chronic pain and are often prescribed opioids preoperatively by primary care or pain management physicians. Spine surgeons must be aware of the unique issues facing the spine surgery patient demographic and focus on methods to provide pain relief utilizing multimodal pain programs rather than solely relying on opiate medications. Surgery should not only relieve pain but also improve quality of life.

Spine surgeons are generally high-volume surgeons who routinely prescribe significant amounts of opioids post-operatively. It is paramount for spine surgeons and similar prescribers to improve opioid prescribing through opioid stewardship while still meeting their patients' analgesia requirements.

PROBLEM STATEMENT

Elective spine surgeries may result in inadvertent opioid dependency, abuse, diversion, and even death. Currently, there is a lack of guidelines for appropriate postoperative opioid prescribing and analgesia strategies following spine surgery.

PROPOSED SOLUTION

Enhanced postoperative analgesic regimens for common spine procedures, backed by extensive evidence-based guidelines derived from a comprehensive review of published literature on spine surgery and the broader medical/surgical field.

STRATEGIES

Pain management can vary based on individual circumstances. Analgesic principles are typically divided into acute pain, post-operative pain, chronic pain, and palliative pain management. Defining principles for postoperative analgesia regimens are outlined in this section; detailed, evidence-based regimen recommendations are presented later.

Non-pharmacological treatments should be utilized whenever possible, such as frequent changes in position while lying down and early mobilization from the bed.

Non-opioid analgesics should be considered a first-line pharmacologic treatment for pain and the foundational

agent in a multi-modal pain management strategy of pain. Moreover, non-opioid analgesics are best utilized on standing rather than on an as-needed (PRN) basis. Specifically, acetaminophen and non-steroidal anti-inflammatory drugs (NSAIDs) have shown remarkable effectiveness in multimodal analgesia studies.^{14,18,20} Although effective at providing pain relief, NSAID medications may decrease fusion rates essential to the success of spine surgeries.^{21,22}

Opiate medications are frequently prescribed for breakthrough pain; however, risk factors for opioid abuse and dependence must be considered before providing opioid prescriptions. These include preoperative chronic opiate use, depression, and significant medical comorbidities.²³⁻²⁶ Providers should utilize their state's PDMP to review the patient's prescription drug history before prescribing opioids and periodically throughout their therapy beyond the acute period.

Before prescribing an opioid, counseling on safe opioid use should be performed with the patient. Counseling should establish the duration of therapy and goals of opioid use and may include the use of a physician-patient opioid agreement. If an opioid is prescribed, the lowest dose and shortest duration possible should be prescribed.²⁷ The CDC recommends that for most acute musculoskeletal injuries, the maximum prescription of opioids should not exceed 50 morphine milligrams equivalents, equivalent to approximately six doses of 5mg of Oxycodone. Furthermore, this prescription should not be given for more than 3-7 days. Tramadol may be considered a first-line opioid agent as it may be equally efficacious as other more potent opioids with a lower risk of dependency.²⁸ The consideration of medication interactions with tramadol should be done on an individual basis.

Surgeon prescribers should engage other providers in the patient's healthcare delivery team during the perioperative period (i.e., primary care provider or pain management specialist). This communication can avoid double-prescribing and discrepancies in prescribing assumptions.²⁹ If patients with prior opioid use history proceed to surgery, postoperative analgesia is best managed by their pain management provider preferentially.

MEDICATIONS

1. NON-STEROIDAL ANTI-INFLAMMATORY DRUGS (NSAIDS)

NSAIDs are an effective medication for pain control after orthopedic procedures. Literature in total joint arthroplasty demonstrates that NSAIDs are effective in pain control postoperatively and can effectively reduce opiate requirements post operatively.³⁰ The spine literature indicates similar results. Multiple meta-analyses demonstrate that NSAIDs are effective in postoperative pain control after spine surgery and help to decrease overall postoperative opiate consumption.^{31,32}

Even though there is a pain control benefit to NSAIDs in the immediate postoperative period after spine surgery, the use of NSAIDs has been controversial because of their effect on fusion rates. NSAIDs are hypothesized to decrease

bony formation and prevent bone healing by inhibiting COX enzymes. The impact on bony formation is secondary to reduced prostaglandin formation, essential for the osteoclast/osteoblast pathway of bone formation.³³ One large meta-analysis examined fusion rates in patients treated with high-dose ketorolac compared to standard doses of NSAIDs in the intraoperative and immediate postoperative period (<14 days). This analysis found significantly higher nonunion rates in the high-dose group but no negative effect on the regular-dose group union rates. Overall, this suggests a dose-dependent relationship between NSAIDs and union rates.²¹ Other literature reviews have found similar results suggestive of a dose and duration-dependent relationship between NSAIDs and spinal fusion rates. However, no level I evidence has ever been published on this topic.²²

2. ACETAMINOPHEN

Unlike NSAID medications, acetaminophen has not been shown to impact fusion rates. Acetaminophen is frequently used post-operatively in a scheduled fashion due to the potential benefit of pain relief with low risks. In the immediate inpatient period after spine surgery, intravenous (IV) acetaminophen has been shown to provide significant pain relief. However, the literature has shown varied results for using IV acetaminophen in opiate reduction. One retrospective study examining IV compared to oral acetaminophen demonstrated shorter length of stay, improved discharge status, and lower average morphine equivalent doses postoperatively.³⁴ These findings, however, conflict with another retrospective database study that found IV acetaminophen did not affect opiate usage or adverse outcomes.³⁵ Only one randomized controlled trial has examined the efficacy of intravenous (IV) acetaminophen after spine surgery in adolescents and found that although it did improve pain scores, it did not decrease the postoperative opiate requirements.³⁶

The FDA recommendation remains a maximum of 4000 mg daily for less than ten days in healthy adults with normal liver function, no other acetaminophen sources, and less than two alcoholic drinks daily. Patients with abnormal liver function tests, active hepatitis, cirrhosis, or another active hepatic disease should consider a daily maximum of 2000 mg daily or less. Standard precautions and contraindications should be regarded, and pharmacy or medical specialists should be consulted for assistance in unclear cases.

3. NEUROMODULATORY AGENTS

Spine surgeries often involve localized bony pain and neuropathic pain due to nerve root involvement. Neuromodulatory medications such as gabapentin and pregabalin have demonstrated usefulness in treating neuropathic pain both pre and postoperatively. These medications were initially developed to treat seizures but have been useful for nerve-related pain control.

One 2018 meta-analysis of randomized controlled trials examined the effect of preoperative gabapentin administration on postoperative pain following spine surgery. This

found a significant improvement in pain scores in the immediate post-operative period and decreased total MME consumption within the first 24 hours.³⁷ Another meta-analysis of randomized controlled trials looked at gabapentin and pregabalin for postoperative pain control after spine surgery. This analysis found that medications effectively managed pain in the immediate postoperative period and decreased opiate requirements.³⁸

One additional benefit of gabapentin in the postoperative period is that its dosage can be increased significantly and titrated over time if pain persists postoperatively. However, it is essential to be aware of the potential sedative side effects when prescribing these neuromodulatory medications. In addition, the medication concentration is affected by kidney function, so patients with decreased kidney function will need renal dosing.

4. STEROIDS

Steroids administered epidurally have been suggested as an adjunct to pain control measures in post-operative spine patients. One systematic review found good evidence that intraoperative epidural steroids effectively reduce immediate post-operative pain and opiate requirements.³⁹ In addition to short-term pain control, perioperative epidural steroids have been associated with shorter length of stay (LOS).^{40,41} Even with good evidence for pain control and decreased length of stay, epidural steroids have not been widely adopted due to the risk of infection. A 2022 meta-analysis found significantly higher infection rates in patients who had undergone steroid injection within 30 days preoperatively of surgery (OR 1.79).⁴²

5. NON-BENZODIAZEPINE ANTISPASMODICS

Antispasmodics, also known as muscle relaxants, are commonly used to treat back pain and are often prescribed postoperatively after spine surgery. One extensive systematic review published on the effectiveness of muscle relaxants found they are effective for managing nonspecific back pain.⁴³ Although no controlled studies have been performed to assess the efficacy of muscle relaxants in the spine postoperative period, these medications have shown promise in other surgical fields. One randomized controlled study examined patients in the immediate postoperative period after thyroidectomy. Patients treated with tizanidine in addition to an anesthetic block had decreased postoperative opiate use and reduced posterior neck pain when compared to block alone.⁴⁴ Another prospective double-blinded study was performed to assess the effectiveness of oral tizanidine on patients undergoing laparoscopic cholecystectomy. This study found that 4mg of tizanidine given preoperatively decreased postoperative pain and opiate consumption compared to controls.⁴⁵

One potential downside to muscle relaxants is the possible sedative side effects. Due to these side effects, these medications have a black box warning against the operation of heavy machinery. The one exception is metaxalone, which does not have this warning and is seen as less sedative than other medications in the same class.

6. CURRENT EVIDENCE FOR POSTOPERATIVE OPIOID REQUIREMENTS

Concerning spine surgery, very few large-scale studies or reviews comment on the average MME prescribed postoperatively. The lack of literature limits transparency and makes creating evidence-based standardized protocols challenging. Only one large database study, including over 47,000 patients, was useful in quantifying the amounts of opiates prescribed within the first 30 days postoperatively after common spine surgeries. This study was beneficial because it grouped patients into opiate naïve and chronic opiate user categories.⁴⁶ The results of this study are listed below and converted into MME.

- After single-level lumbar decompression, the average number of MME obtained within 30 days postoperatively was found to be 682.5 in opiate naïve and 952.5 in patients chronically on opiates.
- After single-level anterior cervical decompression and fusion (ACDF), the average number of MME obtained within 30 days postoperatively was 570 in naïve and 1125 in chronic groups.
- After single-level posterolateral lumbar fusion, the average MME obtained within 30 days postoperatively was 652.5 in naïve and 1102.5 in chronic groups.
- After single-level posterior interbody fusion, the average MME obtained within 30 days postoperatively was 682.5 in naïve and 1140 in chronic groups.⁴⁶

Due to the current opiate epidemic, much of the spine literature focuses on the factors that are determinants for chronic opiate use after spinal surgery. Some of the most important conclusions to take away from these studies include:

- The greatest risk factor for long-term/chronic opiate use post-operatively after spine surgery was preoperative opiate use.^{11,24–26,47}
- Medical comorbidities of migraines, diabetes, depression, and smoking increased the odds of needing opiate prescriptions >3 months postoperatively.^{25,26}
- Patients undergoing revision surgeries are at increased risk for long-term opiate use.²⁵
- Preoperative chronic opiate therapy for >90 days has been associated with increased ED visits, 90-day wound complications, and increased risk for revision.²⁴
- In 1 and 2 level lumbar fusions, chronic opiate dependence was associated with increased complications and longer postoperative length of stay.²³
- After lumbar spine surgery, 13% of patients who were opiate naïve preoperatively continued to be prescribed opiates for >3 months postoperatively.¹¹

Surgeons should be familiar with these studies to predict better which patients are at increased risk of developing chronic opiate dependence after spine surgery. Increased efforts can be made to minimize preoperatively risk factors to limit surgeons' role in perpetuating the opiate epidemic.

RECOMMENDATIONS

Multimodal anesthesia remains the gold standard when treating acute post-operative pain in the setting of spine surgery. Opiates may be used but should be seen as a tool for acute breakthrough pain rather than as the primary source of pain control. Multiple multimodal pain strategies have previously been described in the literature, all showing substantial benefits compared to an opiate-based pain control strategy. Postoperative multimodal pain regimens for various spinal procedures are listed below [Table 1].

One option for postoperative pain control is the use of acetaminophen. While inpatient, we recommend standing intravenous acetaminophen 650mg every 4 hours until discharge. Upon discharge, we recommend a standing dose of oral acetaminophen 3000mg daily (500mg q4 hours standing) for up to 10 days postoperatively.

We recommend avoiding intraoperative or postoperative ketorolac when spinal fusion is involved. This is due to ketorolac's potential to cause decreased fusion rates. When the surgery only involves lumbar decompression, we recommend 30mg ketorolac IV intraoperatively. For postoperative management of decompression and fusion surgeries, we recommend oral Celecoxib 200mg 2 times per day during the inpatient stay. A proton pump inhibitor should be prescribed along with NSAIDs if the patient is over 50 years old or at high risk for developing a gastric ulcer.

Gabapentin and pregabalin are also effective neuromodulatory medications used to treat pain in the setting of spine surgery. Many patients have been prescribed these medications preoperatively and should be resumed on their home dosage postoperatively. We recommend a preoperative or intraoperative loading dose followed by standing pregabalin 75 mg every 12 hours postoperatively for patients without a preexisting prescription. This medication should be prescribed at discharge for administration at home every 12 hours for the next two weeks until follow-up. At the follow-up time, a decision can be made whether to continue the medication, titrate the dosage, or stop the medication.

We do not recommend using intradural steroid injections in the perioperative period due to the increased risk of infection. We do recommend a muscle relaxant prescription for breakthrough spasms. While inpatient, we recommend metaxalone 800mg every 8 hours as needed. We recommend a home prescription of metaxalone 800mg every 8 hours as needed with 10 dispensed.

Opiate medications prescribed postoperatively are meant to be used as rescue medications taken as needed for significant breakthrough pain. For postoperative inpatient guidance, we recommend an oral oxycodone 5 mg every 6 hours for moderate breakthrough pain or oxycodone 10mg every 6 hours for severe breakthrough pain. Patients should be educated about the purpose of opiate medications as breakthrough pain medications only, and patients should be encouraged to minimize consumption. At discharge, patients are prescribed oxycodone 5mg every 6 hours for moderate pain or two 5mg pills for severe pain, with 60 pills dispensed.

Table 1. SUMMARY OF POSTOPERATIVE RECOMMENDATIONS

Surgery Type	Inpatient Recommendations	Post-Discharge Medications
Posterior Lumbar Decompression	IV Acetaminophen 650mg q6 Pregabalin 75mg q12 Intraoperative IV ketorolac 30mg once Celecoxib 200mg 2 times daily with meals Metaxalone 800mg q8 Oxycodone 5mg q6 PRN for 8/10 pain OR Oxycodone 10mg q6 PRN for >8/10	Oral Acetaminophen 500 mg q4 hours standing, Dispense 60 Pregabalin 75mg q12, Dispense 30 Celecoxib 200mg 2 times daily with meals, Dispense 30 Metaxalone 800mg q8 PRN, dispense 10 Oxycodone 5mg q6 PRN for 8/10 pain OR Oxycodone 10mg q6 PRN for >8/10, Dispense 60
Posterior Lumbar Decompression/ Fusion Transforaminal Lumbar Interbody Fusion Anterior Lumbar Interbody Fusion Posterior Cervical Decompression/Fusion	IV Acetaminophen 650mg q6 Pregabalin 75mg q12 Celecoxib 200mg 2 times daily with meals Metaxalone 800mg q8 Oxycodone 5mg q6 PRN for 8/10 pain OR Oxycodone 10mg q6 PRN for >8/10	Oral Acetaminophen 500 mg q4 hours standing, Dispense 60 Pregabalin 75mg q12, Dispense 30 Metaxalone 800mg q8 PRN, dispense 10 Oxycodone 5mg q6 PRN for 8/10 pain OR Oxycodone 10mg q6 PRN for >8/10, Dispense 60
Anterior Cervical Decompression/ Fusion	IV Acetaminophen 650mg q6 Pregabalin 75mg q12 Celecoxib 200mg 2 times daily with meals Metaxalone 800mg q8 Oxycodone 5mg q6 PRN for 8/10 pain OR Oxycodone 10mg q6 PRN for >8/10	Oral Acetaminophen 500 mg q4 hours standing, Dispense 60 Pregabalin 75mg q12, Dispense 30 Metaxalone 800mg q8 PRN, dispense 10 Oxycodone 5mg q6 PRN for 8/10 pain OR Oxycodone 10mg q6 PRN for >8/10, Dispense 40

CONCLUSIONS

Optimizing opioid use is critical in addressing the ongoing opioid epidemic in the United States, and spine surgeons can play a vital role in opioid stewardship. With the worsening of the opioid crisis, it is even more imperative to adopt appropriate opioid dosing and postoperative multimodal analgesic strategies. The guidelines presented here provide evidence-based, comprehensive, and practical analgesic regimens and opioid dosages for common spine surgeries, emphasizing the importance of incorporating non-pharmacologic pain management strategies whenever possible. By following these guidelines, spine surgeons can help control the opioid epidemic while ensuring optimal pain management and quality of life for their patients.

DECLARATION OF CONFLICT OF INTEREST

The authors do not have any potential conflicts of interest in the information and production of this manuscript.

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