# NONSTEROIDAL ANTI-INFLAMMATORY DRUGS IN NEUROSURGERY: CURRENT PERSPECTIVES ON THE MANAGEMENT OF LOW BACK PAIN

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**Abstract:** *Low back pain (LBP) is one of the leading causes of disability worldwide and represents a major public health challenge. Degenerative disorders of the lumbar spine, including intervertebral disc degeneration, facet joint arthropathy, ligamentous hypertrophy, and inflammatory changes in paraspinal structures, are among the most common causes of chronic pain requiring conservative or surgical treatment. Nonsteroidal anti-inflammatory drugs (NSAIDs) remain the cornerstone of pharmacological management because of their analgesic, anti-inflammatory, and antipyretic properties. In neurosurgical practice, NSAIDs are widely used before and after spinal surgery to reduce pain, improve functional recovery, and support early mobilization. However, their use should be balanced against potential gastrointestinal, renal, cardiovascular, and bleeding-related adverse effects. This review summarizes current evidence regarding the mechanisms of action, clinical efficacy, safety profile, perioperative considerations, and role of NSAIDs in the management of patients with low back pain in neurosurgical practice.*

**Keywords:** *low back pain, neurosurgery, nonsteroidal anti-inflammatory drugs, NSAIDs, spinal disorders, postoperative pain.*

## INTRODUCTION

Low back pain is one of the most prevalent musculoskeletal disorders worldwide and is recognized as a leading cause of disability and reduced quality of life. According to global epidemiological studies, nearly 80% of adults experience at least one episode of low back pain during their lifetime, and a substantial proportion develop recurrent or chronic symptoms. The socioeconomic burden associated with chronic pain includes healthcare expenditures, loss of productivity, work absenteeism, reduced physical activity, and long-term disability. In many countries, low back pain is among the most frequent reasons for outpatient visits, imaging studies, and referral to spine specialists.

Degenerative changes involving the intervertebral discs, facet joints, ligaments, and paraspinal muscles represent the principal pathological mechanisms responsible for chronic lumbar pain. In neurosurgical patients, pain may result from lumbar disc herniation, spinal stenosis, degenerative spondylolisthesis, vertebral instability, postoperative inflammatory processes, or persistent radicular irritation. In addition, pain may be influenced by psychosocial factors, central sensitization, obesity, smoking, and reduced physical conditioning. Therefore, effective pain management is an essential component of conservative treatment and perioperative care.

Among pharmacological options, NSAIDs remain the first-line medications because they provide rapid analgesia while reducing inflammation. Their widespread use is explained by their accessibility, relatively fast onset of action, and ability to reduce the need for opioid analgesics. At the same time, the clinical use of NSAIDs in neurosurgery requires

careful consideration of the balance between benefit and risk, especially in older patients and in those with comorbid cardiovascular, renal, or gastrointestinal disease.

Epidemiology and Clinical Burden of Low Back Pain

Low back pain affects individuals across all age groups, although its prevalence increases with age and cumulative exposure to mechanical stress. In working-age adults, it is a major cause of reduced productivity and temporary disability. In older populations, degenerative spinal disease, osteoporosis, and sarcopenia contribute to persistent pain and functional decline. The burden is particularly high in patients with physically demanding occupations, sedentary lifestyles, or preexisting spinal deformities.

From a clinical perspective, low back pain is often classified as acute, subacute, or chronic. Acute pain usually lasts less than six weeks and is frequently associated with mechanical strain or disc-related irritation. Subacute pain persists for six to twelve weeks, while chronic pain lasts longer than three months and is more likely to involve structural degeneration, inflammatory mechanisms, and neuroplastic changes. Chronic low back pain is especially challenging because it often requires multimodal treatment and long-term follow-up.

In neurosurgical practice, low back pain is not only a symptom but also a marker of underlying pathology that may require imaging, neurological assessment, and sometimes operative intervention. Patients with progressive neurological deficits, severe radiculopathy, cauda equina syndrome, or spinal instability may require surgery. Even in such cases, pharmacological pain control remains essential before surgery, immediately after surgery, and during rehabilitation.

Mechanisms of Action of NSAIDs

NSAIDs exert their therapeutic effects by inhibiting cyclooxygenase (COX) enzymes responsible for prostaglandin synthesis. COX-1 participates in physiological functions including gastric mucosal protection, platelet aggregation, and renal blood flow regulation. In contrast, COX-2 is induced during inflammation and contributes to pain, edema, and tissue injury.

Non-selective NSAIDs inhibit both COX-1 and COX-2, whereas selective COX-2 inhibitors primarily suppress inflammatory pathways while reducing gastrointestinal toxicity. Nevertheless, prolonged administration of selective COX-2 inhibitors has been associated with increased cardiovascular risk in susceptible individuals. The degree of COX selectivity varies among agents, which partly explains differences in efficacy and adverse-event profiles.

Beyond prostaglandin inhibition, NSAIDs may influence peripheral and central pain pathways. They reduce sensitization of nociceptors, decrease inflammatory mediator release, and may modulate spinal cord processing of pain signals. These effects are particularly relevant in low back pain, where inflammation around nerve roots, facet joints, and paraspinal tissues contributes to symptom generation. Some NSAIDs also have mild antipyretic effects and may improve mobility by reducing pain-related muscle spasm and guarding.

The pharmacological characteristics of individual NSAIDs differ in terms of half-life, potency, route of administration, and tissue penetration. Short-acting agents may be

preferred for acute pain, while longer-acting drugs can be useful in chronic conditions when continuous symptom control is needed. In neurosurgical settings, the choice of agent often depends on the expected duration of treatment, bleeding risk, renal function, and the need for postoperative analgesia.

Classification and Commonly Used Agents

NSAIDs can be broadly divided into non-selective COX inhibitors and selective COX-2 inhibitors. Commonly used non-selective agents include ibuprofen, diclofenac, naproxen, ketorolac, and indomethacin. Selective or preferential COX-2 inhibitors include celecoxib and etoricoxib in some regions. Each agent has specific advantages and limitations.

Ibuprofen is widely used because of its favorable safety profile at standard doses and its availability in oral formulations. Naproxen is often considered to have a relatively lower cardiovascular risk compared with some other NSAIDs, although gastrointestinal toxicity remains a concern. Diclofenac is effective for musculoskeletal pain but has been associated with a higher cardiovascular risk in some studies. Ketorolac is frequently used in the perioperative period because of its potent analgesic effect, but its use is usually limited to short durations due to bleeding and renal concerns. Celecoxib is commonly selected when gastrointestinal risk is a major concern, although cardiovascular risk must still be considered.

The route of administration may also influence clinical use. Oral NSAIDs are most common in outpatient management, while intravenous or intramuscular formulations may be used in the immediate postoperative period or when oral intake is not possible. Topical NSAIDs have limited utility in deep spinal pain but may be helpful for associated soft tissue discomfort in selected patients.

NSAIDs in Neurosurgical Practice

NSAIDs are widely used in neurosurgery for patients with lumbar disc herniation, spinal stenosis, vertebral osteoarthritis, and postoperative pain after spinal procedures. Their principal therapeutic effects include reduction of inflammatory edema surrounding compressed nerve roots, relief of nociceptive pain, decreased opioid requirements, and accelerated postoperative mobilization. These benefits are particularly important in enhanced recovery pathways, where early ambulation and functional restoration are key goals.

In conservative management, NSAIDs are often prescribed as part of an initial treatment strategy for acute or subacute low back pain. They may be combined with activity modification, physical therapy, heat application, and patient education. In patients with radicular pain, NSAIDs may reduce the inflammatory component of nerve root irritation, although their effect on true neuropathic pain is limited. For this reason, they are often used alongside other medications when symptoms are mixed.

In the perioperative setting, NSAIDs can contribute to multimodal analgesia by reducing the need for opioids and improving postoperative comfort. This is especially relevant after lumbar decompression, discectomy, or fusion procedures, where pain control influences mobilization, respiratory function, and rehabilitation participation. However, the use of NSAIDs after spinal fusion remains controversial because of concerns about

impaired bone healing. Although evidence is mixed, many surgeons prefer short courses or selective use in patients at low risk of nonunion.

Current multimodal analgesia protocols recommend combining NSAIDs with acetaminophen, local anesthetics, and other non-opioid analgesics whenever appropriate to optimize pain control while minimizing opioid exposure. In selected patients, muscle relaxants, gabapentinoids, or short-term opioids may be added, but the overall strategy should aim to reduce polypharmacy and adverse effects.

Clinical Effectiveness

Numerous randomized clinical trials and systematic reviews have demonstrated that NSAIDs provide superior short-term pain relief compared with placebo in patients with acute and chronic low back pain. Clinical guidelines recommend NSAIDs as first-line pharmacological therapy when non-pharmacological interventions alone are insufficient. Their effectiveness is most evident in the early phase of treatment, when inflammatory mechanisms are prominent.

However, evidence suggests that the magnitude of benefit is generally moderate, emphasizing the importance of combining pharmacotherapy with exercise therapy, rehabilitation, patient education, and lifestyle modification. NSAIDs should not be viewed as a stand-alone solution for chronic spinal pain. Instead, they are best used as part of a broader treatment plan that addresses mechanical, functional, and psychosocial contributors to pain.

The response to NSAIDs varies among patients. Some individuals experience substantial symptom relief, while others derive only limited benefit. Factors influencing response may include the underlying pain generator, duration of symptoms, degree of inflammation, comorbid conditions, and adherence to treatment. In clinical practice, a trial of one NSAID may be followed by another agent if the initial response is inadequate, provided that safety considerations are respected.

Evidence also supports the use of NSAIDs in reducing postoperative opioid consumption. This opioid-sparing effect is clinically important because it may decrease nausea, constipation, sedation, and the risk of dependence. In addition, better pain control may facilitate earlier discharge and improved patient satisfaction. Nevertheless, the analgesic benefit must always be weighed against the possibility of bleeding, renal dysfunction, or gastrointestinal complications.

Safety Considerations

Despite their efficacy, NSAIDs are associated with several adverse effects. Gastrointestinal complications include dyspepsia, peptic ulcer disease, and gastrointestinal bleeding. Renal impairment may occur in patients with chronic kidney disease, dehydration, heart failure, or concomitant use of diuretics and renin-angiotensin system inhibitors. Cardiovascular events have been reported with prolonged use of certain COX-2 selective agents and some non-selective NSAIDs, particularly in patients with preexisting cardiovascular disease.

Bleeding risk is an important concern in neurosurgical patients. Because NSAIDs can impair platelet function, they may increase perioperative bleeding, especially when used in combination with anticoagulants, antiplatelet agents, or other drugs affecting hemostasis.

This issue is particularly relevant in spinal surgery, where even small hematomas can have serious neurological consequences. For this reason, timing of discontinuation before surgery and resumption after surgery should be individualized.

Other adverse effects include fluid retention, hypertension, liver enzyme elevation, hypersensitivity reactions, and bronchospasm in susceptible individuals. Older adults are at increased risk of complications because of reduced renal reserve, polypharmacy, and multiple comorbidities. In patients with a history of peptic ulcer disease, concomitant proton pump inhibitor therapy may be considered to reduce gastrointestinal risk.

Careful patient selection, use of the lowest effective dose for the shortest possible duration, and assessment of individual risk factors are essential components of safe NSAID therapy. Clinicians should review the patient's medication list, renal function, blood pressure, cardiovascular history, and bleeding risk before prescribing NSAIDs. Monitoring should be intensified in patients receiving prolonged treatment or those with complex medical conditions.

Perioperative Use in Spine Surgery

The perioperative period is one of the most important settings for NSAID use in neurosurgery. After lumbar decompression or discectomy, pain is often driven by tissue trauma, local inflammation, and muscle spasm. NSAIDs can reduce these symptoms and support early mobilization. In minimally invasive procedures, where tissue injury is limited, NSAIDs may be especially useful as part of enhanced recovery protocols.

In spinal fusion surgery, the situation is more complex. Some experimental and clinical data suggest that prostaglandin inhibition may interfere with osteogenesis and fusion biology, particularly when NSAIDs are used in high doses or for prolonged periods. As a result, many surgeons avoid routine long-term NSAID use after fusion or restrict it to short courses in carefully selected patients. The decision should consider the type of fusion, number of levels involved, patient age, smoking status, bone quality, and other risk factors for nonunion.

Preoperative NSAID use also requires attention. In patients scheduled for surgery, discontinuation may be recommended several days before the procedure depending on the specific drug and institutional protocols. This is especially important for agents with stronger effects on platelet function. Postoperatively, resumption should be guided by hemostasis, wound status, renal function, and the surgeon's assessment of bleeding risk.

Multimodal analgesia pathways increasingly incorporate NSAIDs together with acetaminophen, local infiltration analgesia, and non-pharmacological measures. Such protocols aim to reduce opioid exposure while maintaining adequate pain control. In many centers, this approach has improved patient comfort, shortened hospital stay, and facilitated rehabilitation.

Special Populations

Certain patient groups require special caution when NSAIDs are prescribed. In older adults, the risk of gastrointestinal bleeding, renal dysfunction, and drug interactions is higher. Dose reduction and close monitoring are often necessary. In patients with chronic kidney disease, NSAIDs may worsen renal perfusion and should generally be avoided or used only with strong justification and careful supervision.

Patients with cardiovascular disease, hypertension, or heart failure may experience fluid retention or blood pressure elevation during NSAID therapy. In such cases, the choice of agent and duration of treatment should be conservative. Patients taking anticoagulants, antiplatelet drugs, or corticosteroids are at increased risk of bleeding and gastrointestinal complications. For these individuals, alternative analgesic strategies or gastroprotective measures may be appropriate.

Pregnant patients represent another special population, as NSAID use may be restricted depending on gestational age because of fetal and maternal risks. Although pregnancy is less relevant in many neurosurgical cohorts, it remains important in general clinical practice. Similarly, patients with asthma, aspirin sensitivity, or prior hypersensitivity reactions may not tolerate certain NSAIDs.

In patients with chronic pain syndromes, depression, anxiety, or sleep disturbance, NSAIDs alone are unlikely to provide sufficient relief. These patients may benefit from a multidisciplinary approach that includes rehabilitation, psychological support, and individualized pharmacotherapy. Neurosurgical teams should recognize that pain intensity does not always correlate with structural findings, and treatment should be tailored to the overall clinical picture.

Drug Interactions and Practical Prescribing Issues

NSAIDs interact with several commonly used medications. Concomitant use with anticoagulants increases bleeding risk, while combination with diuretics, ACE inhibitors, or angiotensin receptor blockers may worsen renal function. NSAIDs can also reduce the antihypertensive effect of some blood pressure medications. In patients receiving lithium or methotrexate, NSAIDs may increase serum concentrations and toxicity risk.

Practical prescribing should include clear instructions regarding dose, frequency, duration, and warning signs of adverse effects. Patients should be advised to avoid taking multiple NSAID-containing products simultaneously, as this increases toxicity without improving efficacy. Over-the-counter availability of many NSAIDs can lead to unintentional overuse, especially in patients with chronic pain who self-medicate.

When prescribing NSAIDs for low back pain, clinicians should consider the following principles:

1. Confirm that the pain is likely to have an inflammatory or mechanical component that may respond to NSAIDs.
2. Assess gastrointestinal, renal, cardiovascular, and bleeding risk before treatment.
3. Use the lowest effective dose for the shortest necessary duration.
4. Reassess pain relief and adverse effects after initiation.
5. Combine NSAIDs with non-pharmacological measures whenever possible.
6. Avoid prolonged use without clear benefit.
7. Consider gastroprotection in high-risk patients.

These practical steps help maximize benefit while minimizing harm and support rational use in both outpatient and inpatient neurosurgical settings.

Future Perspectives

Current research focuses on personalized analgesic strategies, identification of biomarkers predicting treatment response, and development of safer anti-inflammatory

agents. Enhanced Recovery After Surgery (ERAS) protocols increasingly incorporate NSAIDs into multimodal perioperative pain management while emphasizing individualized treatment plans. Future studies may clarify which patients benefit most from specific NSAIDs, optimal dosing schedules, and the safest duration of therapy after different types of spinal surgery.

Another promising direction is the development of analgesic regimens that preserve anti-inflammatory efficacy while reducing gastrointestinal, renal, and cardiovascular toxicity. Pharmacogenomic approaches may eventually help identify patients at higher risk of adverse reactions or poor response. In addition, better integration of pharmacological treatment with rehabilitation, behavioral interventions, and digital health tools may improve long-term outcomes in chronic low back pain.

There is also a need for more high-quality evidence regarding NSAID use after spinal fusion, particularly in relation to dose, timing, and fusion success rates. Large prospective studies could help resolve ongoing controversy and support more precise clinical recommendations. As neurosurgical practice continues to evolve, the role of NSAIDs will likely remain important but increasingly individualized.

Conclusion

NSAIDs remain fundamental medications for the management of low back pain in neurosurgical practice.

Their proven analgesic and anti-inflammatory effects contribute to symptom relief, improved functional recovery, and reduced opioid consumption.

Appropriate patient selection and awareness of potential adverse effects are essential to maximize therapeutic benefits while minimizing complications.

In both conservative and perioperative settings, NSAIDs should be used as part of a broader multimodal strategy that includes rehabilitation, education, and individualized clinical decision-making.

Future research should focus on personalized treatment strategies, optimization of multimodal analgesic protocols, and clarification of the safest approaches for use after spinal surgery.

## LIST OF LITERARURE:

1. Chou R, et al. Noninvasive Treatments for Low Back Pain. Annals of Internal Medicine. 2017.
2. Foster NE, et al. Prevention and treatment of low back pain. The Lancet. 2018.
3. Maher C, et al. Non-specific low back pain. The Lancet. 2017.
4. Qaseem A, et al. Clinical Practice Guideline for Low Back Pain. Annals of Internal Medicine. 2017.
5. Katz JN. Lumbar Disc Disorders and Low Back Pain. New England Journal of Medicine. 2006.
6. Deyo RA, et al. Low Back Pain. The Lancet. 2006.
7. van Tulder M, et al. European Guidelines for the Management of Low Back Pain.
8. WHO. Low Back Pain Facts. 2023.

9. American College of Physicians. Noninvasive Treatments for Acute, Subacute, and Chronic Low Back Pain. 2017.

10. NICE. Low back pain and sciatica in over 16s: assessment and management. 2020.