Special Edition - Opioids

The Spine Health Journal

National Spine Health Foundation

Frontiers in Pain Management: Opioids & Their Alternatives

How Your Spine Works and Why It Might Hurt

A New Era in Spine Surgery: Less Pain, Faster Recovery

Guest Editors: Jeffrey Gum, MD and Praveen Mummaneni, MD

NATIONAL SPINE HEALTH FOUNDATION

The National Spine Health Foundation is a 501(c)(3) nonprofit public charity dedicated to improving spinal health care through patient education, patient advocacy, and clinical outcomes research. Our work, including the publication of *The Spine Health Journal*, is made possible by the generous support of individuals, corporations, and foundations who believe in our mission.

The Spine Health Journal provides a deeper understanding of current concepts in spine care wellness, technology, and treatments. It is designed to serve as an invaluable resource for patients and the broader community, offering knowledge and hope.

Philanthropic contributions play a crucial role in our efforts to educate the public with expert-driven, unbiased resources. We extend our heartfelt gratitude to our Spine Health Leadership Council partners for making this publication possible. Their generosity ensures we can continue to empower and support individuals on their spine health journey.

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NATIONAL SPINE HEALTH FOUNDATION

Introduction

A Message from the CEO

Rita T. Roy, MD

The intersection of opioid addiction and spine health represents one of the most pressing public health challenges we face today. As a physician, I've witnessed firsthand how these two issues are inextricably linked, and how education serves as our most powerful tool in addressing both.

Consider this stark reality: in 2016, opioid overdoses claimed more American lives than car accidents. Behind each statistic lies a personal story – a family forever changed; a community deeply affected. At the same time, we're seeing an unprecedented rise in spine-related issues, with an estimated one billion people worldwide suffering from spinal pain. These numbers aren't just statistics; they represent real people struggling with real challenges.

> *"In 2016, opioid overdoses claimed* ***more American lives*** *than car accidents."*

Why focus on public education? Because knowledge truly is power. When we educate our communities about proper spine health – from ergonomics to exercise – we're not just preventing future problems; we're empowering individuals to take control of their well-being. Similarly, when we raise awareness about opioid risks and alternative pain management strategies, we're potentially saving lives.

That is why The National Spine Health Foundation formed the Opioids, Pain, & Spine Health Task Force comprised of internationally renowned spine experts who are fully dedicated to our education mission, as evidenced through their thoughtful contributions in this issue of The Spine Health Journal.

Our educational initiatives, guided by our Task Force, span multiple fronts: from teaching parents about opioid risks to workplace seminars on spine health and ergonomics. We're leveraging digital platforms, community events, and healthcare integration to reach as many people as possible with our addiction prevention messages. These aren't just academic exercises, they're vital interventions that can reduce stigma, encourage early intervention, and promote safer practices.

The economic implications are significant, but the human cost is immeasurable. Every person we help avoid opioid dependence and every spine problem we solve through proper education represent victories in our ongoing battle for public health. By investing in education now, we're investing in a healthier future for all.

As we move forward, I urge healthcare providers, community leaders, and citizens alike to embrace their role in this educational mission. Share knowledge, challenge stigmas, and promote evidence-based practices. Remember, every conversation about spine health and opioid awareness has the potential to change – or save – a life.

Together, we can build a future where fewer people suffer from preventable spine conditions and opioid dependency. The path forward is clear: education, awareness, and action.

Letter from the Guest Editors

Jeffrey Gum, MD[1] and Praveen Mummaneni, MD[2]
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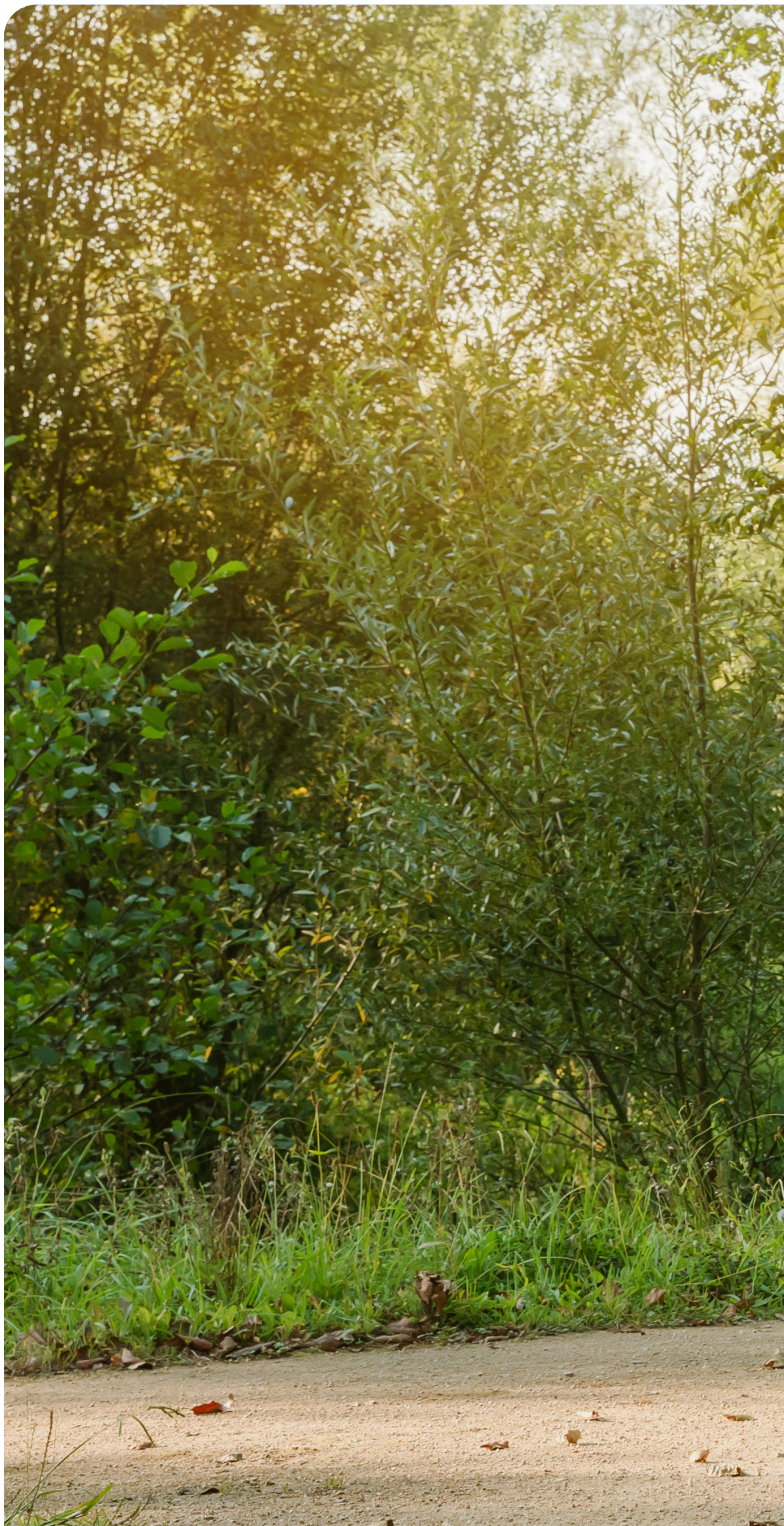
In this issue of the National Spine Health Foundation's *Spine Health Journal,* we are pleased to present a series of articles that highlight a very important aspect of spine treatment: pain control, with a focus on opioid minimization techniques.

This country continues to experience one of the most devasting epidemics in our history, the opioid epidemic. There are several reasons why this crisis has been so profoundly devasting and without a doubt, one of the unfortunate causes is exposure to opioids for pain control.

Spine surgery can be invasive and painful, and most of the traditional care pathways have incorporated opioids as a component of pain control. When incorporated correctly, opioids can be useful, and the negative side-effects can be minimized. This starts with a basic understanding for both providers and patients, which is how we begin this issue.

Spine care has recently embraced non-opioid pain control pathways which are highlighted in this issue as well. Curated by experts in the field, the information in this issue will be very beneficial to patients when navigating choices for spine care with or without the need for surgery.

We are very excited about the progress we have made within our specialty with recent incorporation of regional blocks, multi-modal pain control pathways, more minimally invasive surgery techniques, opioid-sparing anesthesia, and even awake spine surgery. We hope you enjoy this series of articles from some of the nation's leading experts in this field.



*"Curated by experts in the field, the information in this issue will be **very beneficial to patients** when navigating choices for spine care with or without the need for surgery."*

NATIONAL SPINE HEALTH FOUNDATION

Section 1: Opioid Basics

BASIC OPIOID EDUCATION

Opioids 101: What Everyone Should Know

Dawood Sayed, MD, Kelsey Gustafson, MD, and Kenneth Castinado, MD
The University of Kansas Medical Center

Brief Overview of Opioids

Opioids are medications used to reduce the perception of pain. The types of opioids to be aware of are:

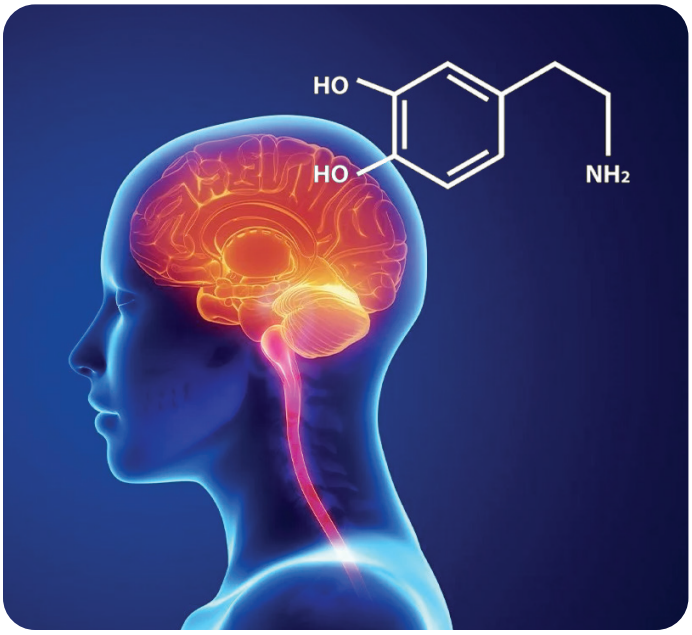
Natural opioids – from nature, such as morphine.

Semi-synthetic opioids – modified natural opioids, such as oxycodone and hydrocodone.

Synthetic opioids – made in a lab, such as fentanyl.

Illicit opioids – any opioid used illegally, without medical oversight, or recreationally, such as heroin, street made pills, and illegally manufactured fentanyl.

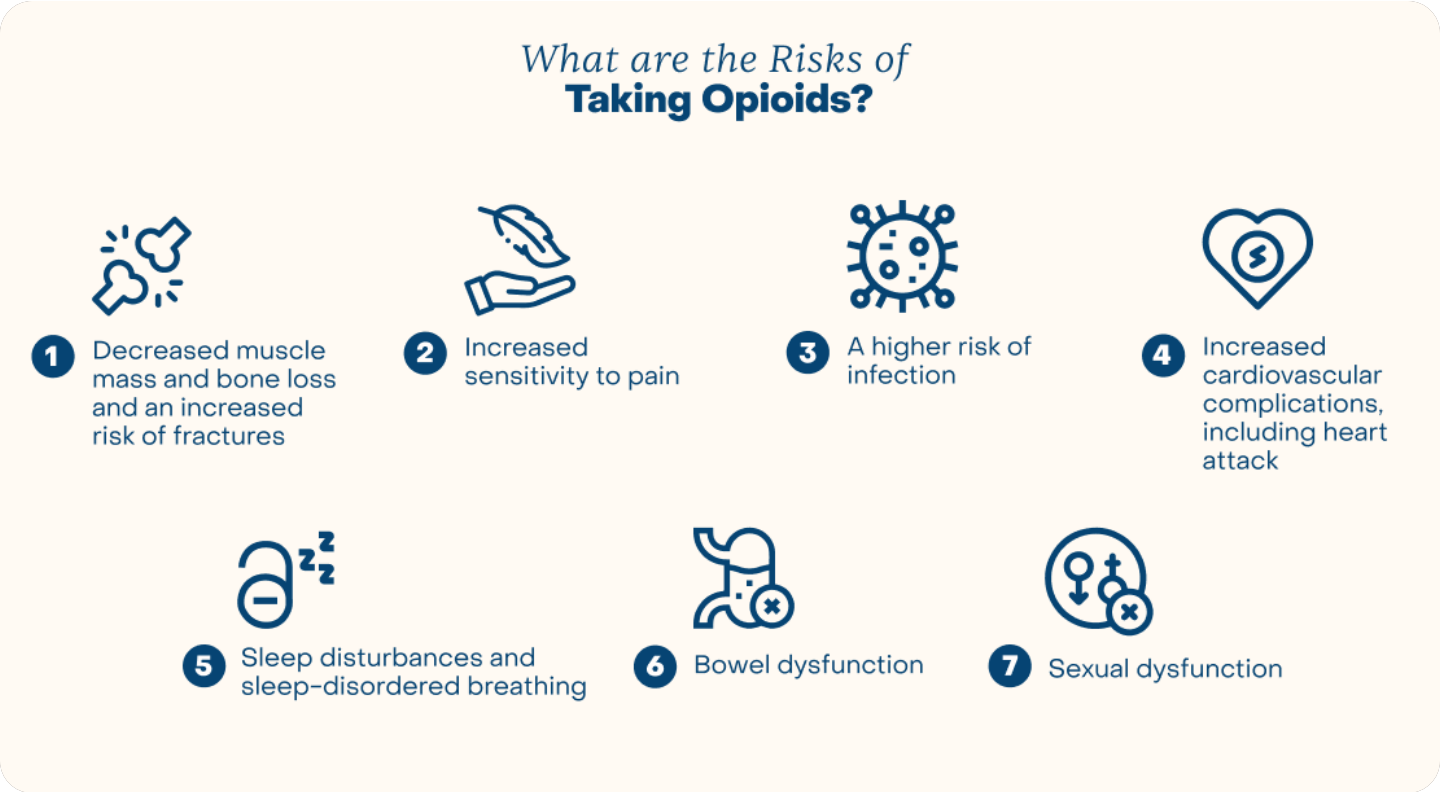
Opioid pain medications work by activating the body's natural pain-relieving receptors in the brain to decrease feelings of pain. These medications also increase dopamine, which plays a key role in reward and addiction pathways and creates feelings of euphoria.



Side Effects & Addiction Potential

Common side effects of opioids include nausea, vomiting, sleepiness, dizziness, itching, and constipation, which can lead to bowel obstructions, falls, fractures, and altered mental status. While the body can adjust to most of the side effects, constipation and itching can be persistent. The most concerning side effect is decreased respiratory drive, causing breathing to slow or stop, leading to unconsciousness and possibly death if left untreated. The risk of this is increased with higher doses of opioids or if taken with other medicines like benzodiazepines, which may be taken to control anxiety.

Taking opioids regularly increases the risk of developing tolerance and dependence. Opioid tolerance is the need for increased doses or more frequent doses of opioids to achieve the same effect. Physical dependence is associated with unpleasant withdrawal symptoms if the medication is stopped. While the time it takes to develop physical dependence or addiction varies by person, it can start in as little as a few weeks. Increased doses of opioids increase the risk of severe side effects while the dose required for an overdose remains the same.



The Opioid Crisis in America

The opioid epidemic has been described by the Centers for Disease Control and Prevention as a 15-year-long trend that has affected communities across the United States. This deadly crisis claimed the lives of 33,000 people in 2015. Numerous factors have been cited as playing a role in the development of this public health dilemma. In the late 1990s, The Joint Commission published rules making pain assessments part of the standard of care for every physician visit. These mandates were created due to widespread concern that pain was being undertreated. As a result of this nationally heightened awareness, pain soon became known as the "fifth vital sign."

Although legally prescribed to treat pain, the resultant increase in prescribing patterns also increased the opioid use overall in this country, which subsequently increased the risk of abuse, misuse, dependence, and diversion. As the deaths attributed to opioids began to rise, physicians decreased their opioid prescribing patterns and illicit and synthetic variants, such as heroin and fentanyl, increased. In 2016, almost 20,000 people died from overdoses involving fentanyl and other synthetic opioids. Rural America has been most affected by the epidemic, especially the states of Kentucky, Pennsylvania, New Hampshire, Ohio and West Virginia.

> *"In 2016, almost* **20,000** *people died from overdoses involving fentanyl and other synthetic opioids."*

When Opioids are Most & Least Effective

Opioids are used for a variety of acute and chronic conditions that cause pain. It is well understood that opioids are most effective for the treatment of acute severe pain after surgery, burns or trauma. They have also proven to be very effective for patients with terminal diseases like cancer or end-of-life palliative care. Additionally, they can be used for more specific conditions, including patients with a history of sickle cell disease who are admitted to the hospital for a vaso-occlusive crisis.

Although there are many instances when opioids can be used effectively, there are also certain clinical scenarios where they are not as beneficial. Opioids have been proven to be less effective in treating discomfort associated with neuropathic pain syndromes. These syndromes have symptoms of numbness, tingling, burning, and electric shock-like sensations that are better treated with other classes of medications that specifically target neurologic symptoms. There is limited benefit in using opioids to treat chronic pain and fibromyalgia, a pain syndrome that causes widespread, constant pain throughout the body. Opioids are also known to be less efficacious in the treatment of headaches and migraines, as they can increase the risk for medication overuse headaches or chronic migraines.

Conclusion

In conclusion, opioids are best used under direct medical supervision for conditions that have been shown to be effectively treated with opioids. These medications should be used at the lowest possible dose to be effective and for the shortest duration necessary. Non-opioid medications and other therapies to reduce pain are alternatives that can have great benefits to those in pain.

[1] Centers for Disease Control and Prevention. Opioid Overdose—Understanding the Epidemic. https://www.cdc.gov/drugoverdose/epidemic/index.html.
[2] Centers for Disease Control and Prevention. Opioid Overdose—Fentanyl. https://www.cdc.gov/drugoverdose/opioids/fentanyl.html.

BACK TO BASICS

How Your Spine Works and Why It Might Hurt

Michael Yang, MD, MSc, M.Biotech, FRCSC and Drew Mulhall, BSc, MD
The University of Calgary

Back pain is a common reason for patients to present to their primary care provider or an emergency department. Accurately diagnosing and treating back pain can be challenging due to the complex anatomy of the spine, the variety of pain generators, and the numerous conditions that can affect the spine. This article will provide the basics of spinal anatomy and will review common pain triggers to be aware of.

Spinal Anatomy

The spine consists of 33 vertebrae – 7 cervical (neck), 12 thoracic (mid back), 5 lumbar (low back), 5 sacral (pelvis) and 4 coccygeal (tailbone). The vertebrae are strong bony structures connected by a complex of soft tissue structures, including intervertebral discs, facet joints, joint capsules, ligaments and paraspinal muscles. These supporting structures play an important role in facilitating and controlling movements of the spine, such as flexion (forward bending), extension (backwards bending), lateral bending (sideways bending), and rotation (twisting). The spine is designed to maintain upright posture and support weight along its entire length. Therefore, these structures are constantly under stress as they support normal spine function.

The vertebrae also serve to protect the spinal cord and its branching nerve roots. Each vertebra, from the cervical spine to sacral spine, has corresponding nerve roots that function to provide limb movement, bodily sensation, and normal organ function, including bowel and bladder control.

When the spine and its associated structures are damaged, a person may experience neck, back, arm, and leg pain. In severe cases, this can lead to weakness or bowel and bladder dysfunction.

Painful Spinal Conditions

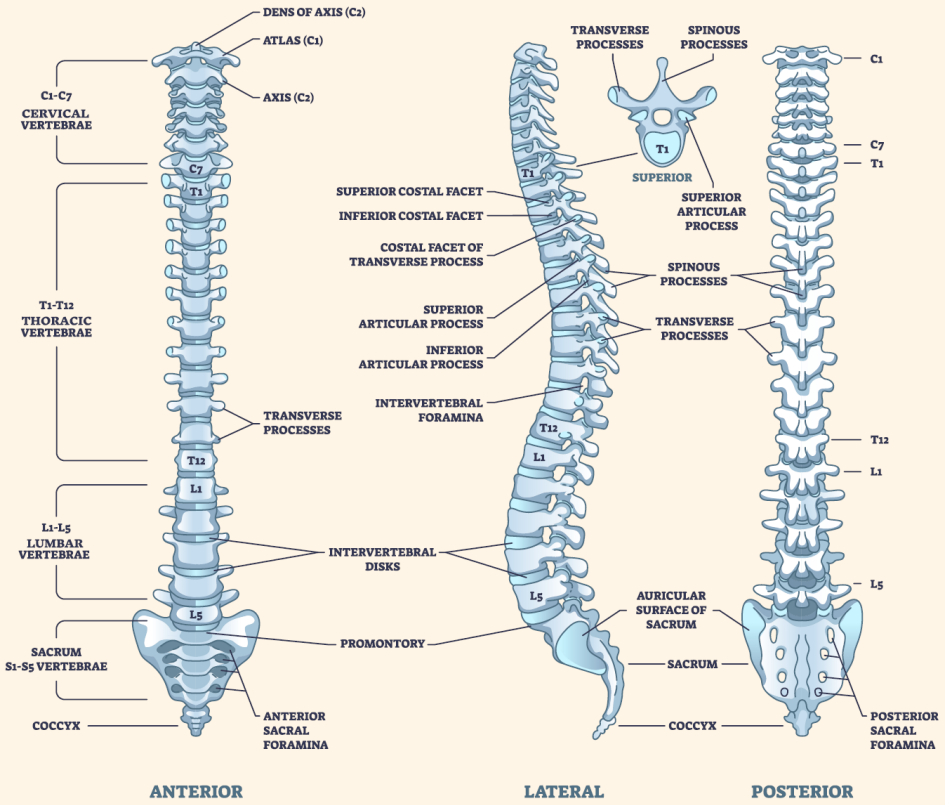
The majority of back pain is not serious or life-threatening. Certain red flag features of back pain may point to more serious underlying causes and warrant medical evaluation. These include but are not limited to fever, night sweats, unintentional weight loss, arm or leg weakness, and bowel or bladder dysfunction.

A number of conditions can affect the spine and its surrounding structures to cause pain. These conditions include:

Degenerative: As a person ages, the spine can slowly wear out and result in painful arthritis between the vertebrae. Degenerative disc disease, cervical and lumbar stenosis (spinal canal narrowing) and disc herniations fall into this category.

Trauma: Injury to the spine can result in a variety of painful conditions, including muscle strain, ligament sprain, disc herniation or vertebral fractures. Certain injuries may lead to back pain or nerve damage, which may result in weakness, numbness, or paralysis in either the arms or legs depending on the location of injury. Some injuries may be severe enough to require surgery.

> *"The **majority of back pain** is not serious or life-threatening."*



Metabolic: Abnormal bone metabolism or mineral deficiencies, such as calcium, may result in poor bone quality. Osteoporosis is an example. Patients with osteoporosis are at greater risk of sustaining nontraumatic compression fractures of the spine.

Infection: Infections from other areas of the body may spread to structures in the spine. Infections can break down the spine's stabilizing structures and result in pain and possibly neurologic injury. Infections may also occur after surgery. Patients with a compromised immune system, diabetes or a history of intravenous substance use are at an increased risk of spine infections. Antibiotics, and possibly surgery, are necessary treat a spine infection.

Tumors: Both benign and malignant tumors may originate in the spine. Additionally, malignant tumors from other areas of the body may metastasize (spread) to the spine. Tumors near the spine may cause pain, fracture or neurologic injury. Tumors may require chemotherapy, radiation therapy, or surgery for treatment.

Inflammatory: Conditions other than infection or malignancies that cause inflammation, such as ankylosis spondylitis and rheumatoid arthritis, may result in back pain.

Congenital: Some individuals may be born with conditions that predispose to back pain. Conditions include scoliosis (abnormal spine curvature) and tethered spinal cord (spinal cord gets stuck to adjacent protective structures).

Postural: Standing for long periods of time can result in back pain. This is most often due to muscle fatigue or strain. Maintaining a healthy weight and routine core and back strengthening exercises can be helpful in preventing and treating postural back pain.

Referred pain: Pain from other organs may radiate to the back. Examples include pain that originates from conditions involving the aortic artery, lungs or abdominal organs.

Ultimately, it is important to understand the quality, duration and severity of symptoms when considering the underlying cause of back pain. A careful evaluation by a medical professional is recommended to identify causes of back pain. Diagnostic imaging is often required to assist with the diagnosis. If specific spine treatments are needed, precise management from a spine specialist can target the pain generators to get you back to your life.

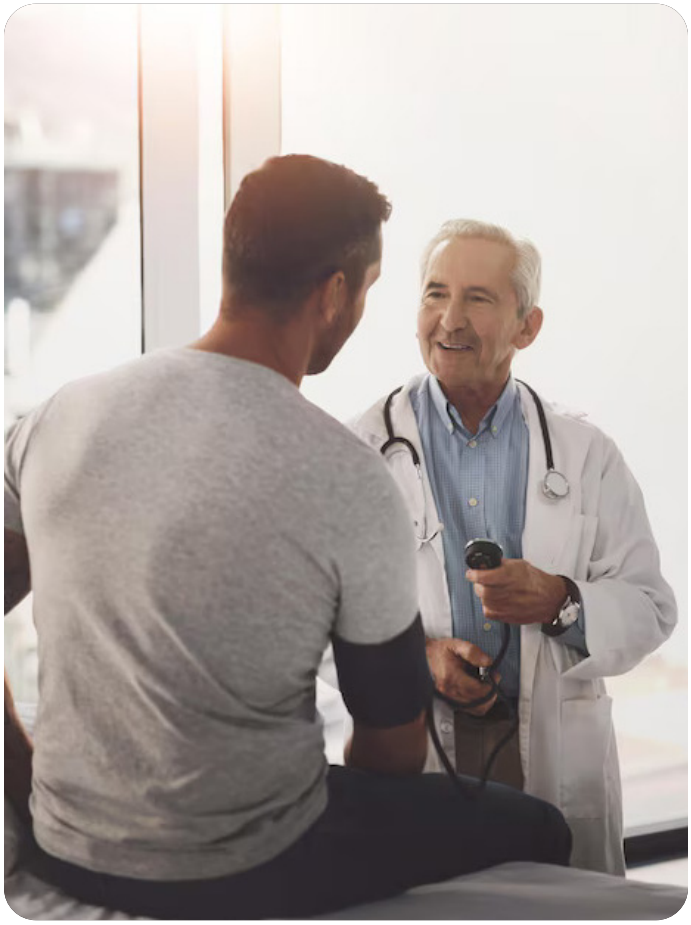
STRIKING THE BALANCE

Responsible Opioid Use For Low Back Pain

Jason Lipetz, MD
Long Island Rehabilitation Medicine

When assessing the impact of opioid use in the treatment of low back pain it becomes truly clear that "we have a problem." **In the past 25 years, over one half a million people have died from opioid overdose in the United States.** Of all developed nations, the use and abuse of opioids in the United States is by far the most problematic. Musculoskeletal pain has the potential of being a major source of pain that results in the prescription of opioids to manage. Among the wide range of musculoskeletal pain generators, low back pain can result in pain at the higher end of the spectrum and will be the focus of this article.

In 2009, accidental deaths from opioid overdose surpassed motor vehicle accident deaths. Most illegal use of opioids, such as heroin and fentanyl, begins with the legal use of opioid pain medications prescribed by physicians. This reality highlights the responsibility that all prescribers in the healthcare system have when considering opioids as a treatment option. **There are three primary scenarios to consider when examining the situations in which opioid prescriptions might be considered for low back pain.**



1 Acute Low Back Pain

The first is the patient presenting with an episode of **acute low back pain** arising from daily activities, sport participation, or a more strenuous or traumatic event. In such instances, there is a role for medications to control pain, often prescribed in conjunction with rehabilitative therapies and alternative medicine techniques such as acupuncture. Most patients presenting with this type of acute pain can be successfully treated with the introduction of anti-inflammatory agents, acetaminophen, and muscle relaxants.

In more severe cases, oral steroids might be prescribed to better control pain and inflammation. Only the minority of these patients will also require a short-term prescription of opioids, such as hydrocodone or oxycodone. A sizable number of patients will not obtain relief from opioid use in these situations and will prefer to avoid their use due to common side effects of drowsiness, nausea, and constipation. In a small but significant subset of patients, the use of opioids for a low back pain episode will unfortunately lead to future opioid dependence and abuse.

2 Following Spine Surgery

Opioids can also be used following **spinal surgery for low back pain.** In such instances, the use of opioids should be limited in dosing and duration. The most concerning of this group is that subset of patients who will become chronic users. The use of opioids after surgery can also result in medical complications and prolonged hospital stays. Studies show the use of alternative pain control strategies following surgery can reduce the need for opioids and the likelihood of complications from opioid use.

Following spine surgery, the combination of anti-inflammatory medications, non-opioid pain relievers such as acetaminophen, muscle relaxers, and medications that target nerve-related pain can provide adequate pain relief. The local use of anesthetics and nerve blocks can be very impactful in controlling postoperative pain. Also, the evolution of more minimally invasive spine surgery has been shown to reduce the degree of postoperative pain intensity and medication needs.

3 Chronic Low Back Pain

Individuals taking opioids for **chronic low back pain,** pain lasting beyond three months, represent a particularly challenging patient population. Studies reveal a lack of benefit to long-term opioid use for chronic pain. In these chronic low back pain patients, other medication classes have been shown to provide the same or greater levels of pain relief. In addition, opioids are not shown to improve function or reduce disability. What is known is that these patients are anticipated to suffer from medication side effects, have a greater likelihood of abuse, and have an overall increase in premature death. When attempting to taper opioid use in this chronic pain population, this must be done gradually with dosage reductions of approximately 10% at regular define intervals using an interdisciplinary team of pain specialists and psychologists.

Conclusion

The opioid crisis in the United States has reduced overall population life expectancy for otherwise healthy individuals. In these three clinical situations, we must be very careful when introducing opioids. Most often, adequate pain control can be achieved without the introduction of opioids at all. In other instances, there is a need for the limited use of opioids for pain control. We must remain mindful of the adverse effects which can arise from prescribed opioids, the potential for abuse, and the subset of patients who become chronically dependent on opioids without benefit. Educating patients suffering from low back pain is one of the most effective tools to avoiding adverse outcomes associated with opioids.

*"Studies show the use of alternative pain control strategies following surgery can **reduce the need for opioids** and the likelihood of complications from opioid use."*

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Section 2: Navigating Spine Surgery

WHEN IS IT TIME FOR SURGERY?

Making the Right Choice for Long-Term Spine Health

Daniel M. Sciubba, MD, MBA, Daniel Schneider, MD, and Sheng-fu Larry Lo, MD
Northwell Health Neurosurgery

As a spine surgeon, one of the most common questions you hear from patients is,

"Do I really need surgery?"

It's a profound question that deserves careful consideration. While surgery is rarely the first answer, there are clear situations when it offers the best path to long-term wellness and a better quality of life.

Understanding Your Options

The decision to undergo spine surgery shouldn't be made lightly. Today's medical landscape offers many treatment options, from physical therapy to medication management. However, there may come a point when non-surgical treatments no longer provide adequate relief. Research shows that prolonged delays in necessary surgical intervention can lead to poorer outcomes in certain spine conditions.[1]

The Evolution of Spine Care

Modern spine surgery has evolved dramatically over the past decade. What once required lengthy hospital stays and extensive recovery periods can now often be performed as minimally invasive procedures with enhanced recovery protocols.[2,3] This evolution has changed how we think about surgical timing and patient selection.

Recognizing When Surgery May Be Needed

The clearest sign that surgery might be necessary is when non-surgical treatments no longer help. If you've diligently tried physical therapy, medications, lifestyle modifications, or more without lasting relief, it's time to have a serious conversation about surgical options. This is especially true when imaging shows progressive structural changes that correlate with your symptoms.

The impact on your daily life is another crucial indicator. When simple tasks become challenging, work performance suffers, and you're missing out on important life events, these aren't just inconveniences, they're signs that your quality of life is significantly compromised. Consistent sleep disruption and decreased activity levels can also often signal that it's time to consider more definitive treatment options. These secondary effects of living with symptoms from a spinal condition can begin to cause negative effects on your overall health as well.

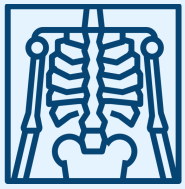
The Critical Role of Pain Management

Pain medication dependency is a serious concern in spine care. Recent research has shown that patients who undergo appropriate surgical intervention earlier in their treatment course have significantly lower rates of long-term opioid use compared to those who delay surgery.[4] While pain medications play an important role in management, they're not intended as a long-term solution. Surgery, when appropriate, can address the root cause of pain rather than merely masking symptoms.

Signs That You Might **Need Surgery**

1. When non-surgical treatments no longer help with pain relief

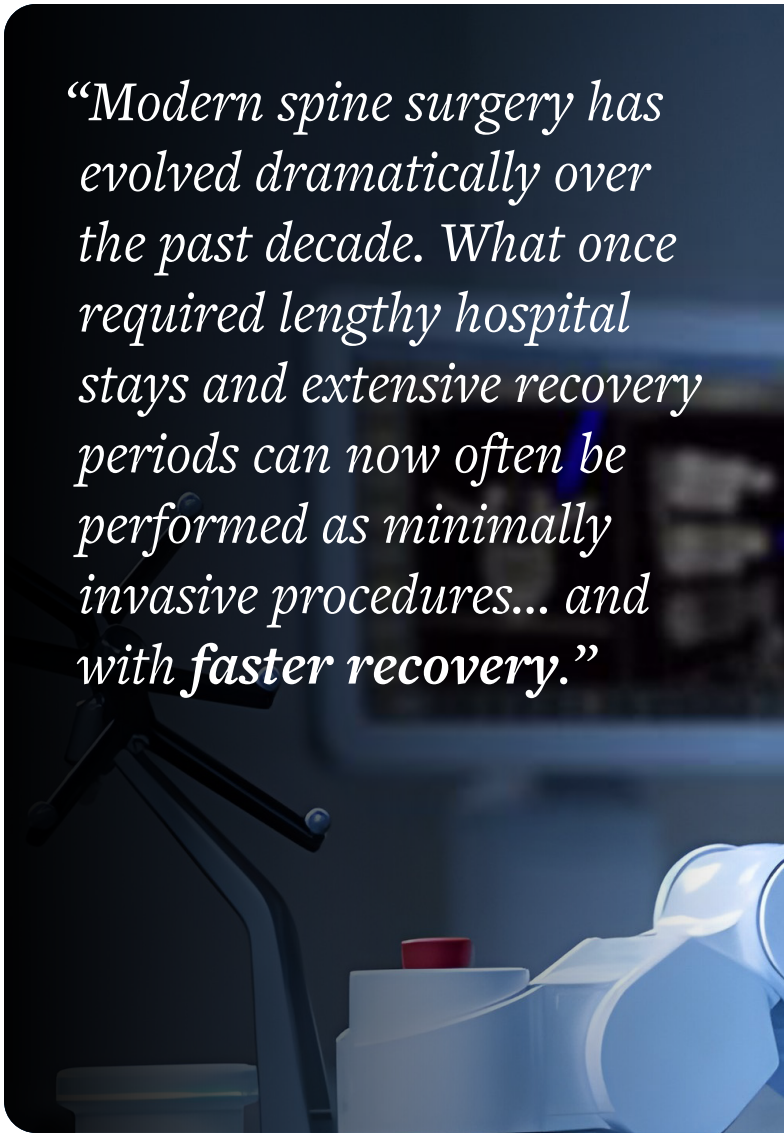
2. When your quality of life worsens, i.e. when simple tasks become challenging



3. When imaging shows progressive changes that correlate with your symptoms

Modern Surgical Advances

Today's spine surgery has been transformed by technological advances. Minimally invasive approaches now allow for smaller incisions and faster recovery. Advanced imaging guidance ensures precise surgical navigation, while enhanced recovery protocols help patients return to normal activities sooner. Robot-assisted procedures and artificial intelligence-assisted surgical planning have further improved our ability to achieve consistent, positive outcomes.



Understanding Recovery

The recovery journey is as important as the surgery itself. Modern approaches begin before the operation with structured pre-habilitation programs. After surgery, clear milestones guide your progress through physical therapy, while comprehensive pain management strategies minimize the need for opioids. Regular follow-up ensures proper healing and individualized return-to-activity guidelines help you safely resume normal activities.

Making Your Decision

The right time for surgery is highly personal. Consider how your condition affects your daily life, work, and relationships, and whether or not you are using opioids to mask the pain. Think about your overall health status and available support system.

Most importantly, have an open dialogue with your surgical team about expectations, recovery requirements, and timing.

If you're considering surgery, start by noting how your symptoms affect your daily activities, what treatments you've tried, and their effectiveness. Prepare specific questions about surgical options and recovery expectations. Understanding the full scope of surgery and the process that follows will help you make an informed decision.

Looking Forward

Successful spine surgery is about more than just treating pain, it is about restoring your quality of life. When conservative measures fall short, surgery can offer a path to lasting relief. The key is to make this decision at the right time for you, with full understanding and appropriate expectations.

The most successful outcomes come from a true partnership between you and your surgical team in order to create the best opportunity for success and a return to an active, fulfilling life.

[1]Hamilton T, Bartlett S, Deshpande N, et al. Association of prolonged symptom duration with poor outcomes in lumbar spine surgery: a Michigan Spine Surgery Improvement Collaborative study. J Neurosurg Spine. 2023;39(4):452-461. doi:10.3171/2023.5.SPINE23249.

[2]Mummaneni PV, Bess S, Fu K, et al. State of the art advances in minimally invasive surgery for adult spinal deformity. Spine Deformity. 2020;8(6):1143-1158. doi:10.1007/s43390-020-00180-8.

[3]Choi JU, Kee TH, Lee DH, et al. Enhanced recovery after surgery protocols in one- or two-level posterior lumbar fusion: improving postoperative outcomes. Journal of Clinical Medicine. 2024;13(20):6285.

[4]Zhou Z, Jin MC, Jensen MR, et al. Opioid usage in lumbar disc herniation patients with nonsurgical, early surgical, and late surgical treatments. World Neurosurgery. 2023;173. doi:10.1016/j.wneu.2023.02.029. PMID: 36775237.

HEALING REDEFINED

The Power of Enhanced Recovery in Spine Surgery

Michael Y. Wang, MD,[1] G. Damian Brusko, MD,[1] and Praveen V. Mummaneni, MD[2]
[1]University of Miami Miller School of Medicine, [2]University of California San Francisco

The History of ERAS

Enhanced Recovery After Surgery (ERAS®) is a novel approach for patients undergoing spine surgery but was first developed in the 1990s for general surgery procedures. The initial ERAS protocols aimed to optimize patient care before, during, and after surgery to reduce postoperative pain, shorten hospital stays, and decrease healthcare costs. The interventions within an ERAS pathway applied basic pathophysiology mechanisms such as intraoperative fluid management and multimodal pain control to optimize recovery for patients following surgery.[1]

Due to the success of ERAS programs in general surgery, other surgical specialties including spine, began adopting these principles and developed evidence-based, specialty-specific ERAS guidelines.

Given the associated pressures of a growing opioid crisis and aging population, spine surgery is particularly amenable to ERAS, which promotes use of fewer opioids and mitigates some of the risks associated with surgery in elderly patients. Therefore, many spine surgeons have implemented ERAS protocols to maximize outcomes for their patients. Although there are over 20 unique interventions within ERAS programs, two of the most important principles are multimodal pain management and patient-physician shared decision making, which are especially important for patients undergoing spine surgery (Figure 1).

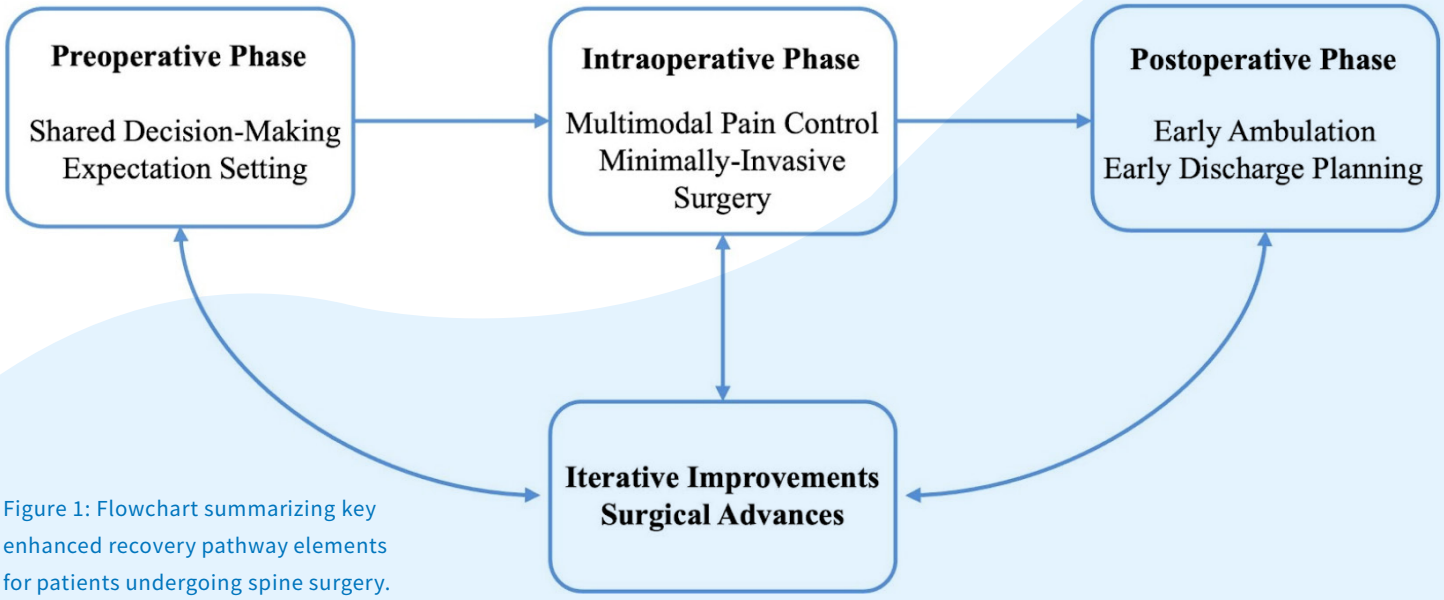


Figure 1: Flowchart summarizing key enhanced recovery pathway elements for patients undergoing spine surgery.

Pain Management Principles

There has been extensive research on various pain management protocols that limit the amount of opioid medications patients require during and after spine surgery. These regimens combine different classes of medications that target unique receptors along the pain pathway and synergize to optimize pain control, while reducing or eliminating the need for opioids. Collaboration between surgeons and anesthesiologists is crucial for optimizing pain-related outcomes for patients. When appropriately indicated, many spine surgeons opt for a minimally invasive surgical approach to limit tissue disruption and decrease postoperative pain. Spinal endoscopy is a recent advancement in surgical technique that can safely be performed under sedation alone, mitigating some of the risks associated with general anesthesia particularly in elderly patients.

Furthermore, in conjunction with the anesthesia team, a preoperative nerve block of the abdominal and paraspinal muscles using a long-acting anesthetic can be administered which provides lasting pain relief for several days after surgery. Alternatively, intraoperative injection of long-acting local pain medications in the surgical field achieves a similar effect. Therefore, ERAS pathways often combine minimally invasive surgical techniques with multimodal pain management to provide the greatest benefit postoperatively for patients, especially for lumbar fusion.

Shared Decision-Making

Prior to any surgical intervention, it is critical that decision-making be shared between the surgeon and patient. Preoperative discussions should include the treatment plan and associated risks, as well as the goals and expectations regarding surgery and the recovery process. One important key to successful ERAS implementation is outlining ERAS principles to prepare patients for their postoperative recovery.

For example, early ambulation aided by adequate pain control encourages shorter hospital stays. However, patients often have pre-existing concerns that they should not move after surgery and will be in significant pain. Thus, setting reasonable expectations prior to surgery helps assuage the psychological stress related to surgery, while the other ERAS interventions alleviate the physiological stress. Furthermore, early discharge planning helps patients and families coordinate the next phase of their postoperative recovery, ensuring a smooth transition from the hospital to home.

Looking Ahead

Over the last decade, spinal ERAS protocols have been developed to treat many different pathologies from cervical to lumbar and degenerative to oncologic, with multimodal pain management and patient expectation setting as key tenets in all of them. The ERAS® Society recently published the first official guidelines for lumbar fusion and may be used as a reference for complete ERAS program development and implementation.[2]

Continued success with respect to patient outcomes has increased adoption of ERAS in spine surgery worldwide and many programs now have begun iterative improvements of their protocols to maximize benefits for patients. This final yet crucial intervention of comprehensive enhanced recovery pathways aims to improve outcomes for future ERAS patients as surgical treatments evolve.

[1]Kehlet H. Multimodal approach to control postoperative pathophysiology and rehabilitation. . Br J Anaesth . 1997;78(5):606–617.
[2]Debono B, Wainwright TW, Wang MY, Sigmundsson FG, Yang MMH, Smid-Nanninga H, Bonnal A, Le Huec JC, Fawcett WJ, Ljungqvist O, Lonjon G, de Boer HD. Consensus statement for perioperative care in lumbar spinal fusion: Enhanced Recovery After Surgery (ERAS®) Society recommendations. Spine J. 2021 May;21(5):729-752. doi: 10.1016/j.spinee.2021.01.001. Epub 2021 Jan 12. PMID: 33444664.

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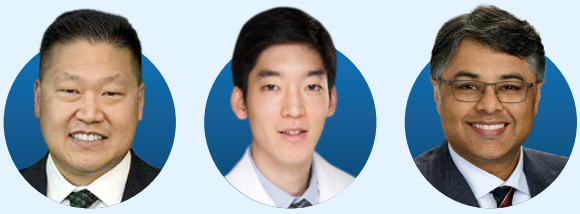
Section 3: Recovery

A NEW ERA IN SPINE SURGERY

Less Pain, Faster Recovery



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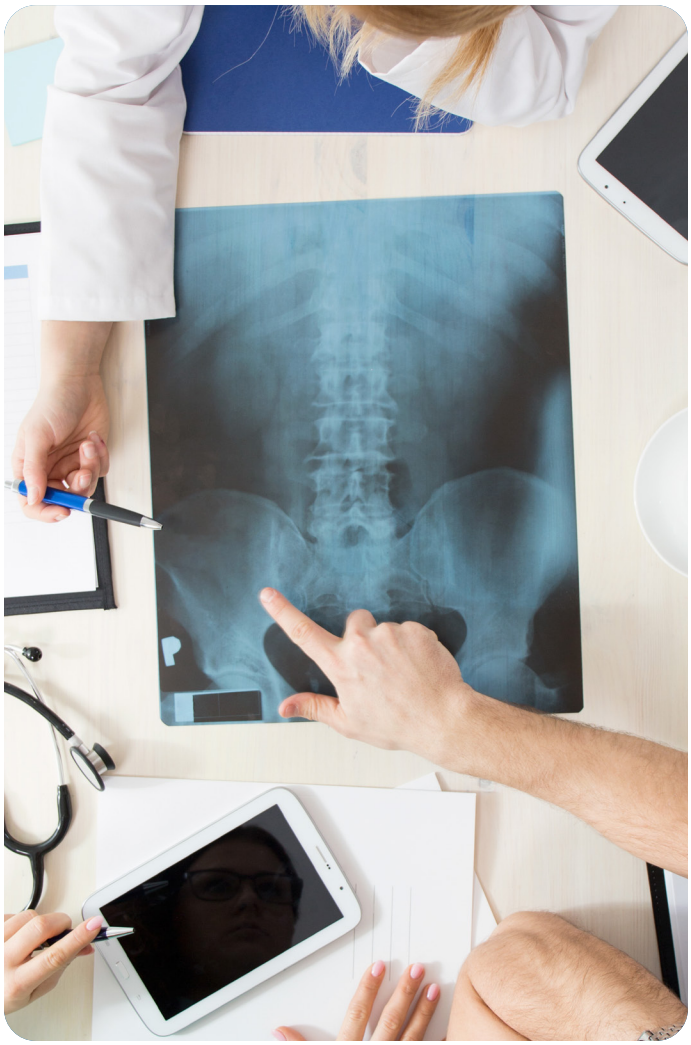
An increasing number of people are suffering from spinal disorders, especially from degenerative conditions of the spine, coinciding with the aging nature of the general population.[1] The societal impact of spinal disorders is immense, with back pain ranking as one of the leading factors in causing highest disability adjusted life years.[2] As such, the number of patients turning to spine surgery for symptom relief has seen a concomitant rise. Fortunately, spine surgery has evolved in many significant ways to allow for focused and personalized treatment. This article will help you understand these advancements and the advantages they offer.

*"Spine surgery has evolved to allow for **personalized** treatment."*

Accessing the Spine

The spinal column is not a surface structure; it is located deep within the body. The overlying layers include muscle, fascia, soft tissue, and skin that must be traversed to reach the spine in surgery. The spine has long been approached from the back (posterior approach) and is widely considered the traditional approach for many spinal procedures. Historically, larger incisions with significant disruption to the surrounding structures were required to adequately visualize and perform spine surgery. Pain is inevitably associated with increased disruption to these structures in this "maximally invasive" approach.

To reduce the pain and disruption associated with traditional open spine surgery, a focus on less invasive approaches have gained interest and have become more prevalent. Utilizing natural anatomic dissection planes allow for greater preservation of the normal surrounding structures.[3] Alternative approaches to access the spine have also been developed to avoid disruption of the posterior musculature, including anterior (from the belly) and lateral (from the side) approaches.



Smaller Incisions

The development of a multitude of recent technologies has led to the further evolution of the field of minimally invasive surgery (MIS), allowing for smaller incisions and minimizing the overall surgical footprint.

For example, a percutaneous approach to the spine is now possible, allowing instrumentation to be placed in the spine through small punctures in the skin rather than making a large incision. The percutaneous approach eliminates the need for direct visualization of the spine and therefore avoids disruption of the surrounding structures. This is achievable by utilizing x-rays, navigation, or robotics.

In addition, special retractors have been developed to gain the access required to perform surgery through openings as small as 2cm, which minimizes muscular damage. Even a small surgical field can be magnified using an operating microscope, which plays a crucial role in minimally invasive surgery. The microscope magnifies the surgical field by a multitude of orders and vastly improves the visualization capabilities.

Beyond the microscope, spinal endoscopy has become increasingly prevalent with the minimally invasive movement. The endoscope includes a direct camera and light source for visualization, while maintaining a minimal profile less than 1cm in diameter. The spine can now be accessed through openings as small as 6 to 7mm pushing the boundaries of what can be performed with these “ultra minimally invasive” approaches.

Anesthesia Advancements

General anesthesia puts patients into a deep sleep so that they do not feel pain and are not aware during surgery, which is the traditional type of anesthesia used during spine surgery. There can be many potential issues associated with general anesthesia including heart and lung complications, long term cognitive dysfunction, postoperative nausea, and delayed discharge from the hospital.[4]

Taking advantage of the decreased tissue disruption associated with MIS, the additional application of advanced anesthetic techniques has opened the possibilities of performing spine surgery even in awake patients. Awake spine surgery is increasingly allowing patients, even those with complex medical comorbidities, to tolerate spine surgery.[5]

Anesthetic techniques performed during awake surgery may include regional blocks such as spinal anesthesia and nerve blocks, which target specific surgical pain generators. Improved pharmacologic formulas of local anesthetics designed specifically to have longer duration have become a powerful adjunct in awake surgery.

The implementation of a perioperative protocol that targets pain control and combines MIS techniques with awake surgery can improve patient outcomes and decrease the hospital length of stay.[6] Even spinal fusions can be performed in this “ultra-MIS” fashion by minimizing the surgical footprint of local tissue trauma, while avoiding the systematic effects of general anesthesia with spinal endoscopy and awake techniques.

Opening Doors

There continues to be an ever-growing interest towards a minimally invasive mindset to spine surgery from both patient and surgeon perspectives. Even “ultra-MIS” spine surgery has become possible through advancements in these techniques. Limitations still exist and not all conditions are appropriate for an MIS approach.

However, the rapidly growing technologies and techniques have propelled the progression from maximally invasive to minimally invasive to ultra minimally invasive spine surgery, and continues to push the current boundaries ever further. The vast number of people suffering from spinal disorders now have focused and personalized options if surgical intervention is needed.

"The rapid growth of technologies and techniques have seen the progression of spine surgery from maximally invasive to minimally invasive to ultra minimally invasive and continues to ***push the current boundaries*** *ever further."*

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BOUNCING BACK FASTER

Advances in Spine Surgery and Recovery

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Spine operations are incredibly common within the United States, and many patients worry they will have a long, painful recovery after spine surgery. Traditionally, spine surgery was performed with an open surgical approach with muscle dissection to achieve decompression of the spinal nerves and perhaps place fixation hardware. While effective, this approach was associated with pain, more days in the hospital after surgery, and a slower recovery. Striving to do better, spine surgeons now have many more options to achieve positive surgical results and a positive recovery experience for their patients.

Minimally Invasive Surgery

Over the past decade, there has been a shift toward less invasive techniques for spinal surgery. Minimally invasive spine surgery is a burgeoning area of technical development. Many of the advances in minimally invasive techniques are driven by so-called "enabling technologies." These include computer-assisted navigation, robotics, microscopy, endoscopy, and even augmented/virtual reality tools to allow surgeons to see deeper anatomic structures than are visible with the naked eye. All of these technologies decrease the need for extensive surgical exposure of the spine. As a result, surgeons can often perform operations faster, with less blood loss, and with less disruption of the surrounding spinal musculature.

Studies have shown that minimally invasive techniques can help decrease the use of postoperative pain medications as well as the length of time that patients spend recovering in the hospital. The minimally invasive approaches may be more cost-effective as well.[1-2] As such, much effort and research is devoted to advancing minimally invasive surgical techniques even further.

Awake Spine Surgery

Recently, there has been interest in awake spinal surgery for select patients.[3] In these patients, spinal anesthetics and local agents are used for pain control during and for 72 hours after surgery. The use of local anesthesia allows for patients to avoid general anesthesia and ventilators which can speed the recovery process. Additionally, many institutions have developed "Enhanced Recovery After Surgery" protocols which involve the use of awake minimally invasive spine surgery, slow-release local anesthetics, and post-surgery care pathways to further decrease opioid usage and hospital stays.[4]

Not every patient is a candidate for these operations and protocols, but their use has increased the number of frail patients that can have the spine surgery they need, when it was not previously possible. For example, patients who are elderly or who have certain heart conditions that make general anesthesia unattractive may be candidates for minimally invasive, awake spinal surgery. With the combination of awake spinal anesthesia, slow-release local anesthesia, and minimally invasive spine techniques, it is possible to convert certain spinal fusions into operations where discharge occurs within 24 hours, as compared to the traditional need for several days of recovery in the hospital.

> *"Spine surgeons now have many more options to achieve a **positive recovery experience** for their patients."*

Less Pain, More Gain

As technology advances, and spine surgeons across the country become more facile with emerging surgical techniques, we hope that spine operations will become even more well-tolerated and recovery times even shorter. Although there will always be a role for large, open spine operations (such as for complex scoliosis or large spinal tumors), there is great potential for even further reduction in the incision size, amount of muscle dissection, and incidental tissue trauma associated with spine surgery. By leveraging new technologies to enhance surgeon technique, we hope to make painful spine surgery truly a thing of the past.

Patient education is important for those who need spine surgery to reset expectations for speed of recovery, improved pain control, and a plan to wean off pain medications after surgery. It is a goal of spine surgery to eliminate the need for opioid pain medications long-term. Patients should discuss the techniques presented in this article with their spine surgeon.

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CUTTING BACK ON PAIN, NOT RELIEF

Reducing Opioid Use in Spine Surgery

Jeffrey Gum, MD
Norton Leatherman Spine Center

Any spine surgery is serious and requires preparation beforehand. From the time surgery is scheduled, the surgeon and surgical team take many steps to coordinate and prepare for surgery behind the scenes, but the preoperative visit is the time for patients to ask any unanswered questions and be sure they understand the surgery, recovery, and expected outcomes.

One of the most common questions patients ask is about how painful their surgery is going to be. Answering this question is not as simple as it seems because every patient and every spine surgery are different, but targeted education can guide and set expectations.

It is very important for patients to have a realistic understanding of the surgery and pain control goals afterwards. Spine surgery can be invasive and painful. Although we have developed more modern techniques to allow for minimally invasive approaches to spine surgery, it still requires one or more incisions, the removal of tissue, and may include the placement of instrumentation. Traditionally, the mainstay of pain control was some form of an opioid pain medication, but the drawbacks and detrimental effects associated with this approach led to reevaluating pain control after surgery.

We have developed alternatives to help reduce the heavy reliance on opioid medications following spine surgery. The goal of this article is to provide an overview of these alternatives.

1 Education is the Key

To start, education, education, education.... goes a long way. There is a lot of information given to patients regarding their spine surgery, but education on the pain management plan must also be discussed in detail prior to surgery. Earlier in this issue, Dr. Sayed and colleagues provided a basic understanding of how opioid medications work. It is also important to understand that any medication containing opioids is potentially addictive, leading to physiological dependence. However, when opioids are used correctly and sparingly, the addictive potential is minimized drastically.

The patient and surgical team should discuss the amount and duration of opioid medications planned following surgery. Setting these expectations allows both the surgeon and patient to have realistic goals and communicate easily to improve patient satisfaction. Although pain control after surgery doesn't always follow the perfect algorithm, the basic concepts are:

- Avoid intravenous (IV) opioids as soon as possible following surgery. The side-effects, specifically constipation, are much worse with IV compared to oral opioids.
- The goal is to wean or de-escalate as soon as possible. Commonly, patients require opioids around the clock to start but over time the dose, amount, and frequency should all be reduced.
- Ultimately, the goal is to discontinue opioids as soon as possible.

*"Opioids can help reduce the pain your brain experiences while asleep during surgery...but **impairs your ability to recover**. They slow the GI tract and cause constipation, they impair the ability to walk, and they cause drowsiness and confusion. All of these have a profound impact on your recovery!"*

2 Pain Control Alternatives - Blocking Pain

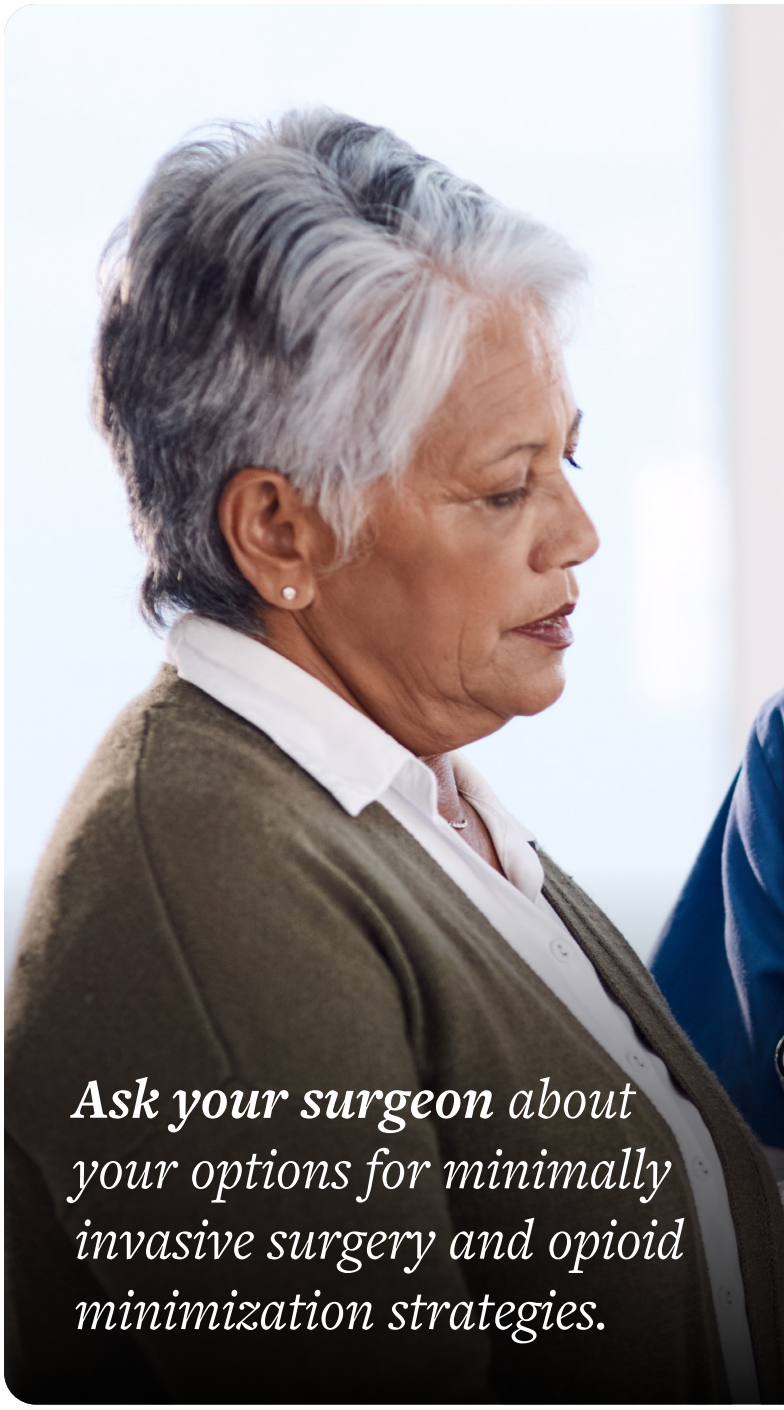
Regional blocks are a type of pain relief technique that can be used to reduce pain from spine surgery by temporarily blocking pain signals from a group of nerves to the brain. These blocks are placed either before or after the surgery to help numb the surgical area, improving the comfort during and after surgery. Typically, they contain a form of local anesthetic similar to what a dentist would use prior to a root canal. Although these blocks are very common in hip and knee replacements, they have been under-utilized in spine surgery until recently. There are two main regional blocks used in spine surgery:

- Transversus abdominis plane (TAP) blocks are used for lumbar spine surgeries approached through the abdomen, such as lumbar disc arthroplasty (LDA) or anterior lumbar interbody fusion (ALIF).
- Erector spinae plane (ESP) blocks are used for posterior (from the back) spine surgeries, primarily in the lumbar spine but research is underway to examine if these are beneficial for thoracic or cervical procedures.

There have been over 100 publications in the last 5 years describing the technique and safety profile of these blocks in spine surgery. Not all centers have adopted the use of these blocks even though they are relatively simple to introduce. I urge patients to ask their surgeon if these are an option for their surgery.

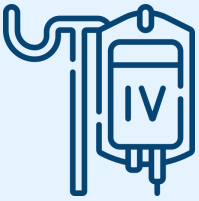
3 Pain Control Alternatives - Opioid Free Anesthesia

Opioid free or opioid sparring anesthesia (OFA/OSA) is a method to omit or minimize opioids used with anesthesia during spine surgery. Opioids can help reduce the pain your brain experiences while asleep during surgery, but too much impairs your ability to recover. They slow the GI tract and cause constipation, they impair the ability to walk, and they cause drowsiness and confusion. All of these have a profound impact on your recovery! There are options to minimize this exposure when under anesthesia for your surgery.



Pain is a complex pathway and there are multiple other types of medications that can target this pathway. Protocols to optimize the use of these non-opioid medications have been developed for spine surgery. Adoption of these protocols is growing but still not the mainstay. The Leatherman Spine Center has published several articles showing the impact of this type of “cleaner” anesthesia during spine surgery.[1-2] Again, I would urge patients to ask their surgeon if this is an option during their spine surgery.

Pain Management **After Surgery**



1. Avoid intravenous (IV) opioids as soon as possible following surgery.

2. The goal is to wean or de-escalate as soon as possible.

3. Ultimately, discontinue use of opioids as soon as possible.

Summary

Recent advances in spine surgery combined with patient education, the addition of regional blocks, and opioid sparring anesthesia have really helped to minimize the side-effects of opioids in the immediate recovery period after surgery and drastically reduced the potential for addiction. Please discuss limiting opioids with your surgeon or center prior to surgery and ask if these or other opioid minimization strategies are available.

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The Research Institute at NATIONAL SPINE HEALTH FOUNDATION

From the Research Institute

31. SAFE STEPS AFTER SPINE SURGERY: WHY AN OPIOID DISPOSAL PLAN MATTERS

SAFE STEPS AFTER SPINE SURGERY

Why an Opioid Disposal Plan Matters

Tamer R. Hage and Yusuf Rafiqzad
The Research Institute at the National Spine Health Foundation

From Plant to Pain Reliever: What are Opioids?

There are three different categories of opioid drugs: Natural opioids, semi-synthetic opioids, and synthetic opioids. Common examples of natural opioids include prescription medications like morphine and codeine, which are derived directly from seed pods of the opium poppy plant. Semi-synthetic opioids include prescription medications like oxycodone and hydrocodone but also include illegal substances like heroin. Lastly, synthetic opioids are made in a laboratory setting without the input of nature at all.[1] A common example of a synthetic opioid is fentanyl, a drug 100 times more powerful than morphine, and that was responsible for over 70,000 deaths in the US in 2022.[2,3]

The use of opioids to treat pain isn't new. In fact, opioids have been around for thousands of years. It wasn't until the early days of modern American history that this famous pain alleviator made its way to North America through the pockets of colonists. Reports from the time cite how opium was used to treat everything from menstrual cramps to teething babies.[4,5] Opioid usage rose dramatically with the start of the American Civil War due to its ability to instantly reduce pain.[6]

Fighting the Opioid Epidemic in Spine Surgery

Historically, spine conditions and spine surgery were associated with significant pain and opioids were often part of the treatment plan. In 2019, a study of over 47,000 patients revealed that 15-18% of opioid-naive patients and 50-64% of chronic opioid users were still using prescription opioids one year after spine surgery.[7] These findings underlined the critical need for spine surgeons to adopt techniques that reduce pain and minimize the need for opioids, which were reviewed in this journal issue.

Personalized strategies that consider the unique social determinants of health for each patient can be developed to adjust the quantity of opioids prescribed, but it is difficult to catch every detail. To enhance this, an exciting development is the role artificial intelligence (AI) can play in identifying subtle differences in needs and risk factors for each patient.

The integration of this technology into healthcare practices is ongoing, but many believe rapid changes are expected within the next decade. That said, other technologies reviewed in this article are already significantly impacting the field of spine surgery, particularly in ways that help reduce post-operative pain and minimize the need for opioid prescriptions.

Patient education is key in combating the opioid crisis. While healthcare professionals understand opioids and addiction, this isn't the case for many patients who may have a limited educational background, face language barriers in healthcare, or are new to the U.S. healthcare system.

Without education on the pitfalls of opioids, diversion can occur as unused opioids become available for unauthorized use and sale on the black market.

It is the duty of the healthcare professional to adequately educate patients on the risk of opioid addiction and the long-term implications of opioid use.[8]

The Need for an Opioid Disposal Plan

The reality is that an array of different strategies are simultaneously needed to quell the exponential increase in deaths related to opioid abuse and addiction, including an opioid disposal plan. A study recently reported that education alone only increased successful opioid disposal by less than 6%. Instead, if education was coupled with a drug deactivation system, adequate opioid disposal increased by 93.5%.[9] One example of an opioid deactivation system incorporates adsorption technology that deactivates medications using activated carbon.

However, implementation of an opioid disposal plan requires careful consideration of patient preferences and needs, especially in spine surgery. A 2023 study found that cost was the most important factor prioritized by patients in a disposal plan. The study concluded that offering a free drug disposal option through pharmacists at the point of medication pickup would be best at ensuring opioids are disposed of properly.[10]

Proper disposal of opioids doesn't only benefit the patient but also can have a lasting positive impact on family and community.

While the rapid increase in synthetic opioids is the leading cause of death involving opioid overdoses, prescription opioid overdoses continue to wreak havoc on our society and are often a gateway for many into the world of synthetic opioids.[11]

80%

of heroin users first misused prescription opioids prior to their heroin addiction.

The number of unused prescription opioids left over from surgeries is astronomical. From 2010 to 2017, the Drug Enforcement Agency (DEA) collected 4,508 tons of unwanted, expired, and unused prescription drugs in the United States, much of which were opioids.[12] A troubling fact is that around 80% of heroin users first misused prescription opioids prior to their heroin addiction.[13] Children and even pets have been found to overdose on opioids accidentally. According to a report by JAMA Network, nearly 9000 children were killed due to poisonings from opioids between 1999 and 2016, with hundreds of these deaths coming from children between 0 to 4 years of age.[14]

A free, accessible, and easy-to-use prescription opioid disposal plan has the potential to not only save current lives but prevent future addictions to more potent forms of opioids such as heroin and fentanyl. As a community, we should continue to advocate for the funding, development, and implementation of deactivation systems combined with patient education on prevention and multimodal pain management approaches.

Proper Disposal Protects the Environment

Improper disposal of opioids can have significant negative impacts on the environment, affecting ecosystems, wildlife, and water quality. As previously mentioned, there are tons of unused prescription opioids that are inadequately disposed of due to the lack of an unstandardized opioid disposal plan.

This waste can then contribute towards landfill and become toxic to our environment. The bioaccumulation of unused medicines like opioids can end up in our soil as well as disseminate through run-off into rivers, lakes, and streams.[14] Proper opioid disposal protects not just individuals and communities but also the environment for future generations.

Conclusion

In summary, while opioids are incredibly successful in reducing symptoms of acute pain, they are not harmless. Extended use of opioids has been shown to have a devastating impact on our society as well as the potential to have severe implications for our environment. While prescription opioids will continue to play a role in treating patients suffering from postoperative acute pain, adequate opioid disposal plans must be implemented alongside proper patient education to minimize risk of addiction and ecotoxicity.

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*"In 2019, revealed that **15-18**% of opioid-naive patients and **50-64**% of chronic opioid users were **still using prescription opioids** one year after spine surgery."*

CHAIRMAN'S NOTE

How to Avoid Opioids In the First Place

Thomas C. Schuler, MD, FACS

The opioid crisis in America is driven by the overuse and misuse of opioids. The best way to stop opioid addiction is to avoid taking them in the first place. Those suffering from neck or back pain may wonder how that approach could be possible, but rest assured that resolving the source of the pain remains the priority. At the same time, preventing the development of chronic pain must also be prioritized.

The following steps are basic but require your participation. You must be motivated to take on an active role in your health for these to work. With time and dedication, you will realize that these methods are far better than any pain pill could achieve.

1 Exercise Regularly

Believe it or not, exercise is the best way to prevent and treat neck and back conditions, even in the face of acute or chronic pain caused by these conditions. Exercise is the best medicine. Participating in a proper fitness routine that includes flexibility, strengthening, and conditioning will help you avoid injuries, treat symptoms, and prevent pain and dysfunction. If you don't know where to begin, a physical therapist can design a program specifically to meet your needs to maintain life or recover from an injury. Once you get into a routine, you will begin to feel the benefits and see your body's potential. You will crave exercise, not medications.

2 Address General Health

If you aim to achieve spine health and eliminate pain, then you must pay attention to your general health because they go hand in hand. In addition to exercise, it is important to maintain a healthy diet. What you eat and how much you eat play a significant role in general health. Some of the worst health offenders are (1) sugary foods and beverages, like sodas and energy drinks, (2) highly processed foods, like pre-packaged snacks, (3) fried foods, like many fast-food chains serve, and (4) high-sodium foods, like canned foods and ready-to-eat meals. Avoid these and opt for fresh foods and minimally processed options packed with nutrients and fuel for your body to support what you are asking it to do.

In addition, work on your posture, your emotional health, avoid nicotine (smoking and vaping), get adequate sleep, limit alcohol, and avoid illicit drugs. Having control of these important factors will determine your overall health and your spinal health. With these intended foundational elements in order, your body will have the power to heal, overcome injury, and eliminate pain.

3 Involve a Specialist Early

Having a spinal condition is not the end of the world. The great news is that the treatments available to solve neck and back problems today are vast, and the avoidance of chronic suffering is possible. To prevent chronic pain, it is best to seek the opinion of a spine specialist early in the acute pain phase. Spine specialists truly understand the wide variety of possible diagnoses and the array of treatments that exist. Having a champion guide your path of recovery ensures it will be the most targeted, rapid and successful recovery. Many times, this is an expert spinal surgeon.

Despite what many people think, most expert spine surgeons operate on less than 10% of the patients they see. They function as great quarterbacks to get you in the right treatment program that achieves resolution of your symptoms and restoration of your lifestyle.

4 Communication is Key

It is very important to communicate with your doctors and physical therapists to make sure they understand your treatment goals. Whether your goal is to walk across the room without pain, get back on the golf course, play with your kids, or carry out your job, your care team needs to understand your priorities. This will guide your treatment program focused on getting you back to a complete and full restoration of your desired lifestyle.

My experience over the decades that I have been in the field is that many times patients do not achieve their desired goal because it was not communicated clearly. Truly great specialists will inquire about this and ask the right questions to understand your expectations, but I encourage you to be your own best advocate and discuss this often.

Conclusion

Using opioids to mask pain solves nothing, creates potential worsening of structural problems down the road, and comes with a host of bad side effects and health risks. The benefits of taking charge of improving your general health and fitness cannot be overstated. We all must work hard on improving strength, flexibility, and conditioning for our entire lives to optimize our health, avoid problems, and keep functioning at the highest level. I often tell my patients: we are empowering you to take care of yourself, but if your neck or back start barking at you again, it is likely a reminder that you need to do more to optimize your health. Remember, what you put in is what you get out.

*"Exercise is **the best way** to prevent and treat neck and back conditions."*

NATIONAL SPINE HEALTH FOUNDATION

About Our Authors

39. GUEST EDITORS:
DR. JEFFREY GUM,
DR. PRAVEEN MUMMANENI

40. DR. JASON LIPETZ,
DR. DAWOOD SAYED

41. DR. DANIEL SCIUBBA,
DR. MICHAEL WANG,
DR. MICHAEL YANG

DR. JEFFREY GUM completed his undergraduate and medical school training at the University of Kansas. He then completed his orthopaedic surgery residency at the University of Louisville. He finished his training with a complex spine fellowship at Washington University in St. Louis, MS. He started with Norton Leatherman Spine Center in 2014 and is an Assistant Clinical Professor at the University of Louisville Department of Orthopaedics (gratis). He currently teaches spine surgery to medical students, orthopaedic residents, fellows and to other surgeons at national and international meetings. He has over 180 peer-reviewed publications, and presents annually at several spine meetings such as the Scoliosis Research Society (SRS), North American Spine Society (NASS) and the American Academy of Orthopaedic Surgeons (AAOS). Dr. Gum holds committee memberships within the SRS and is currently on the Adult Deformity and Program committees. Dr. Gum has numerous awards including the Value Care Award at NASS in 2016, the RS Edgar Dawson Traveling Fellowship in 2016 and the AOA's Emerging Leaders on the move. Additionally he serves as a reviewer for 3 spine journals and is on the editorial board for the American Journal of Orthopaedics.

Dr. Gum specializes in adult and pediatric spine deformity surgery (scoliosis, kyphosis, revision surgery) and robotic-assisted minimally invasive surgery. Additionally, he performs cervical disc arthroplasty (artificial disc) procedures and minimally invasive lumbar discectomies. Dr. Gum is involved in extensive research focusing on adult spinal deformity, robotic-assisted spine surgery and the economics of spine care. He participates in national and international research collaborative groups in all of these areas.

DR. PRAVEEN MUMMANENI is a Joan O'Reilly Distinguished Professor in Spinal Surgery and Vice Chair, UCSF Department of Neurosurgery. He earned his BA/MD through Boston University's accelerated program and completed his neurosurgery residency at UCSF, where he also undertook a complex spine fellowship. After faculty positions at Emory University (2002-2006), he returned to UCSF in 2006. In 2020, he obtained an MBA from Louisiana State University and currently oversees UCSF's surgical services as the lead surgeon for Perioperative Services.Specializing in complex spine surgeries using minimally invasive techniques, Dr. Mummaneni co-directs the UCSF Spine Center and heads its fellowship program. He has authored over 530 peer-reviewed articles and edited 12 spine surgery textbooks.

A recognized leader in neurosurgery, Dr. Mummaneni has served as president of several neurosurgical associations and is the first neurosurgeon to be awarded both the SRS Edgar Dawson and European Traveling Fellowships. He has held significant editorial and directorial positions, including Editor-in-Chief of the Journal of Neurosurgery: Spine, and currently serves as Secretary-elect of the SRS.

DR. JASON S. LIPETZ is the founder and President of Long Island Spine Rehabilitation and has been in clinical and academic practice for the past 25 years. He received his undergraduate degree as a Presidential Honors Scholar and with summa cum laude distinction from the University of Buffalo. He completed his medical training with Alpha Omega Alpha honors from Columbia University College of Physicians and Surgeons. He completed his residency and academic chief residency at Rutgers New Jersey Medical School and Kessler Institute for Rehabilitation. His year of fellowship training in interventional spine medicine transpired at the Penn Spine Center of the Hospital of the University of Pennsylvania. He is board certified in physical medicine and rehabilitation, pain medicine, and electrodiagnostic medicine.

Dr. Lipetz has been published in multiple peer reviewed journals and has produced chapters for leading texts within his field. He is the Medical Director of the Northwell Spine Institute and Chief of Spine Medicine for the Department of Physical Medicine and Rehabilitation. Dr. Lipetz is an associate professor at the Donald and Barbara Zucker School of Medicine at Hofstra/Northwell. He is also the principal investigator for a current prospective randomized multicenter phase 2 FDA clinical trial studying the role of autologous and hypoxically cultured stem cells in the treatment of painful degenerative intervertebral discs.

DR. DAWOOD SAYED is a Professor of Anesthesiology and Pain Medicine and Chief of Pain Medicine at the University of Kansas Hospital. He is the Co-Founder and Vice Chairman of the American Society of Pain and Neuroscience (ASPN) and directs the Multidisciplinary Pain Medicine Fellowship. Dr. Sayed specializes in spinal cord and peripheral nerve stimulation, intrathecal drug delivery, cancer pain management, and minimally invasive spine procedures. He lectures nationally and internationally on advanced interventional techniques and has published over 100 peer-reviewed articles and two textbooks on neuromodulation, interventional spine care, and cancer-related pain management.

Dr. Sayed's areas of clinical interest are primarily focused on lower back pain, neck pain, cancer pain, nerve pain, neuropathy, degenerative disc disease, sacroiliitis, complex regional pain syndrome, neuropathy, radiculopathy, knee pain, shoulder pain, facet pain and tendon pain. He has expertise in multiple procedural treatments such as epidural steroid injections, nerve blocks, image-guided injections, spinal cord stimulation, minimally invasive spine surgery, minimally invasive lumbar decompression, Vertiflex Superion procedure, minimally invasive spine fusion, minimally invasive sacroiliac fusion, intrathecal pumps, radiofrequency ablation, kyphoplasty, vertebroplasty, Tenex/tenotomy procedure, Intracept® procedure and regenerative medicine procedures.

DR. DANIEL M. SCIUBBA serves as Senior Vice President of Neurosurgery at Northwell Health and Chair of Neurosurgery at North Shore University Hospital and Long Island Jewish Medical Center. Ranked among the world's top five spine surgeons by Expertscape, he specializes in complex spine surgery and spinal oncology. Dr. Sciubba authored the definitive text "Spinal Tumor Surgery: A Case-Based Approach" and has performed thousands of complex spine procedures. He completed his neurosurgical training at Johns Hopkins Hospital and holds an MBA from the Wharton School of Business.

A national leader in neurosurgery, Dr. Sciubba has made spine surgery a particular area of focus, with special emphasis on spine tumors and spinal deformity, including scoliosis, kyphosis and spondylolisthesis. With an approach that is as minimally invasive as possible but as far-reaching as necessary, he is recognized for his work in complex en bloc surgery, in which a tumor is removed in its entirety in order to reduce the risk of cancer spread, including in cases where the tumor is wrapped around or otherwise involved in another organ or tissue, such as the spinal cord or aorta.

DR. MICHAEL WANG is a Professor of Neurological Surgery and Rehabilitation Medicine at the University of Miami Miller School of Medicine, where he is Chief of Neurosurgery at University of Miami Hospital, as well as the Spine Neurosurgery Fellowship Director. Dr. Wang specializes in the treatment of complex spinal disorders. He has innovated minimally invasive spine surgery techniques and has led the investigation and development of outcomes assessments in spinal surgery, including Enhanced Recovery After Surgery (ERAS).

He has also served in numerous leadership roles in the AANS/CNS Joint Section on Disorders of the Spine & Peripheral Nerves, Congress of Neurological Surgeons (CNS), North American Spine Society (NASS), International Society for the Advancement of Spinal Surgery (ISASS), Society for Minimally Invasive Spine Surgery (SMISS), the USA Enhanced Recovery After Surgery (ERAS) Society, and the International Spine Study Group (ISSG).

DR. MICHAEL YANG obtained his MD from the University of British Columbia. After graduating from medical school in 2014, he completed his neurosurgery residency at the University of Calgary. Following residency, Dr. Yang completed a clinical fellowship in complex and minimally invasive spine surgery at the University of Miami. Dr. Yang joined the Department of Clinical Neurosciences at the University of Miami in 2022. He is currently the Associate Program Director for the Neurosurgery Residency Training Program.

Dr. Yang's clinical interest in spine surgery includes using minimally invasive and endoscopic techniques to treat spinal pathologies. He is leading the development of an Enhanced Recovery After Surgery (ERAS) program in Calgary with the goal of improving postoperative outcomes after spinal and cranial neurosurgery. He is a member of the Enhanced Recovery After Surgery Society and was instrumental in the development of the first ERAS guideline for lumbar fusion surgery. His research interests include efforts to optimize peri-operative outcomes and improving acute pain control after spinal surgery. For his work, he has won numerous international accolades and awards.

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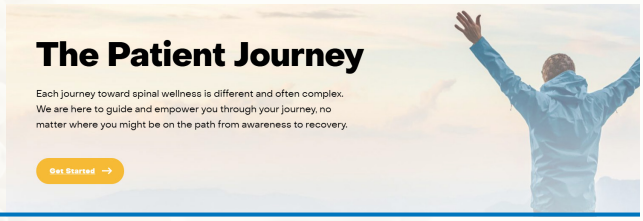

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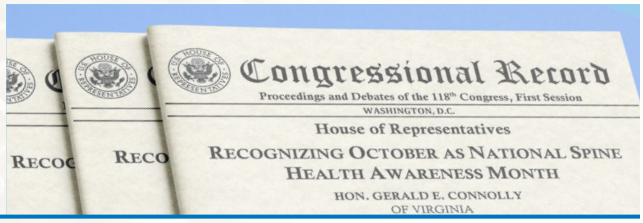

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