

# Minimally Invasive Procedures for Lumbar Spinal Disorders

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# Overview

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- Causes of LBP
- Evaluation
- Goals of Management
- Non-operative Options
- Surgical Options
- Minimally Invasive Options

# Epidemiology

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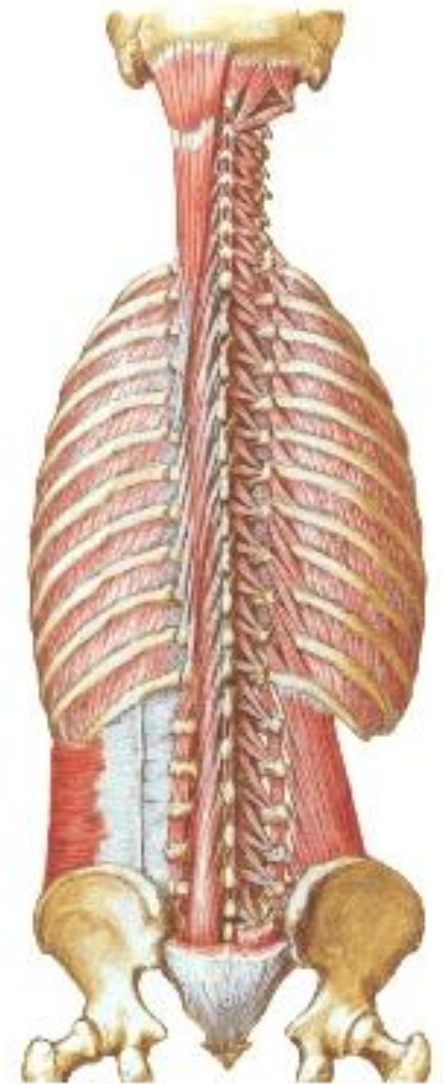
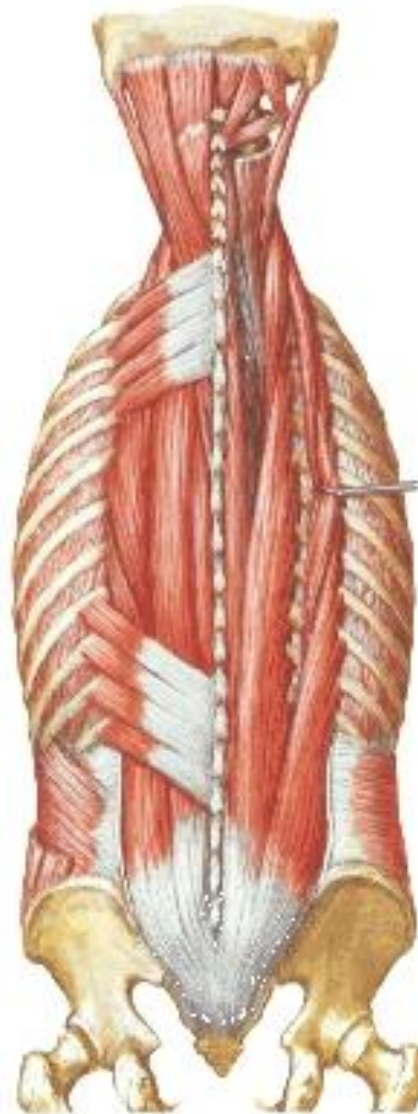
- 80% of all Americans will have episode of LBP
- 90% of these improve without surgery
- Most common cause of job-related disability
  - Costs employers \$7-\$20 billion/year
- \$50 billion annually spent on LBP
- 2<sup>nd</sup> most common reason for doctors' visits in the U.S.



[www.chatea.cl](http://www.chatea.cl)

# Anatomy

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# Potential Causes of Pain

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- Changes in strength and flexibility
- Improper body mechanics (e.g., posture, lifting)
- Obesity
- Congenital conditions (rare)

# Potential Causes of Pain

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- Muscle strain
- Ligament or tendon sprain
- Trauma
- Infection
- Inflammation

# Potential Causes of Pain

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- Deformity
  - An abnormal curvature of the spine such as scoliosis
- Degeneration
  - Occurs naturally with age
  - Alteration of spinal structures including discs, ligaments and joints

# Origins of low back and leg pain

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- Non-spinal
  - Urologic
    - Renal
    - Ureteral
  - Gynecologic
    - Ovarian
    - Uterine
  - Vascular
    - AAA
  - Psychiatric
- Spinal
  - Musculoligamentous injury
  - Degenerative disc disease
  - Facet arthropathy
  - Disc herniation
  - Spinal stenosis
  - Instability
  - Fracture
  - Tumor
  - Infection

# Types of Pain

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- Acute Pain
  - Sudden, intense pain that resolves in less than 6 weeks
  - Usually due to strain of muscles, ligaments, or tendons
  - 80-90% recover without intervention
- Chronic Pain
  - Pain lasting at least 2-3 months
  - Less than 10% of patients
  - Leg pain, numbness or tingling warrants medical attention

# Warning Signs

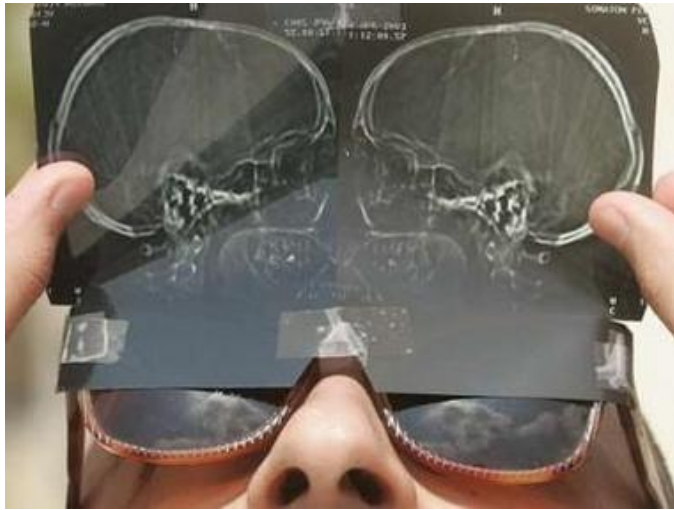
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- Pain is getting significantly worse
- Pain lasting longer than six weeks
- Pain affects every day activities
- Severe symptoms
- Leg weakness or numbness
- Loss of bowel or bladder control

# Evaluation

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- Plain X-rays
  - assess fracture, deformity and dislocation
- CAT scan
  - examine changes in bony structures
- Myelography
  - Requires lumbar puncture (spinal tap)
- Magnetic Resonance Imaging
  - define nerves and soft tissues
- EMG/Nerve Conduction Studies
- Discography



# Goals of Management

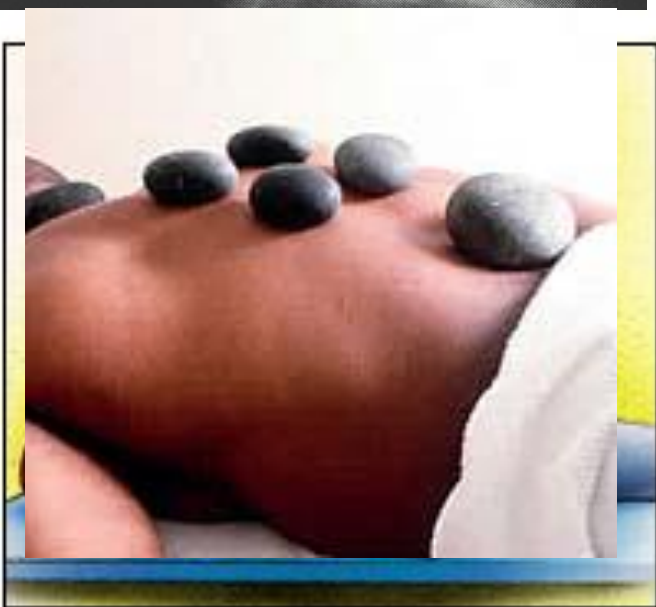
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- Diagnosis
- Pain control
- Protect/restore neurological function
- Palliation versus cure

# Non-Operative Options

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- Medications
  - NSAIDs, muscle relaxants
- Bracing
- Physical Therapy/Exercise
  - Core strengthening
  - Stretching
- Educational Programs
  - “Back School”
- Injections
  - Epidural
  - Facet Joint



# Role for Surgery

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- Weigh risks of intervention against benefits on quality of life
- Surgery as best option for QOL
  - Peul et al, NEJM 2007
  - Malmivaara et al, Spine 2007
  - Weinstein et al, NEJM 2007
  - Weinstein et al, JAMA 2007 Moore et al, *Spine* 2002
  - Fritzell et al, *Spine* 2001
  - Molinari et al, *Spine* 2001
  - Atlas et al, *Spine* 2000
  - Moller et al, *Spine* 2000
  - Butterman et al, *Spine* 1998
  - Deguchi et al, *J Spinal Disorders*, 1998
  - Thomsen et al, *Spine* 1997
  - Mardjetko et al, *Spine* 1994
  - Herkowitz et al, *JBJS(A)* 1991

# Surgical Options

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- Decompression of nerves
- Fusion of the bones
- Arthroplasty

# Surgical Approaches

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- Back
- Front
- Side

# COMPLICATIONS OF APPROACHES

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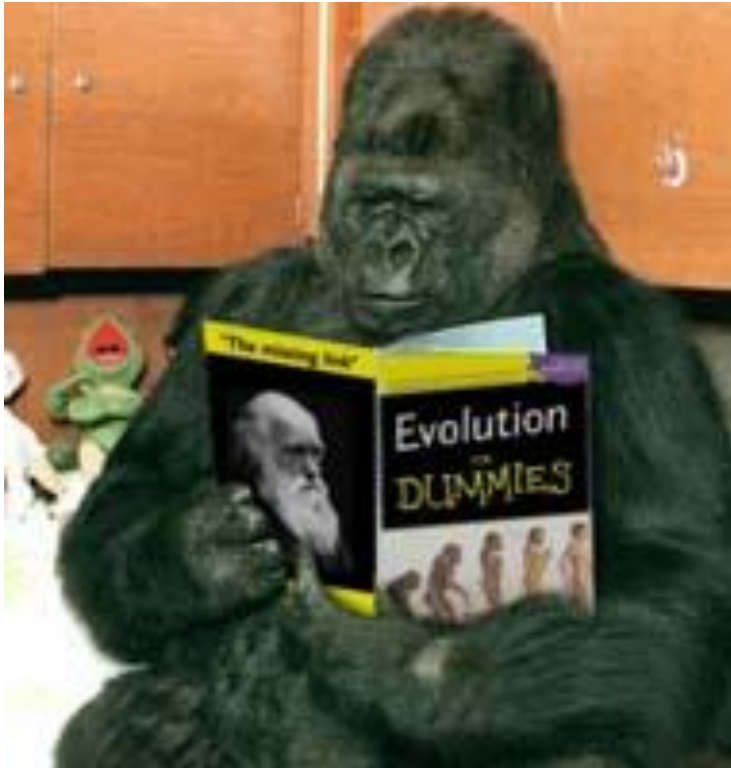
- Possible complications
  - Infection
  - Wound healing problems
  - Bleeding
  - Spinal fluid leak
  - Injury to major blood vessels
  - Prolonged muscle pain and dysfunction
- Even the small chance for these types of problems often deter patients from undertaking spinal surgery
- Many patients excluded as surgical candidates due to age or medical problems

# Minimally Invasive Techniques

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## ➤ Goals:

- Reduce approach-related complications
  - Reduce pain
  - Reduce blood loss
  - Reduce recovery time
- Achieve same surgical objectives



# Surgical Options

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- Traditional open surgery
  - 4-8 inch incision
  - Muscle is cut and spread open
  - Usually followed by considerable post-surgical pain

# Surgical Options

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- Minimally invasive surgery
  - Smaller incision
  - Dilators (or tubes) are used to spread the muscles under x-ray guidance
  - Surgeon works in a small surgical field with less tissue trauma
  - Easily includes fusion operations

# Minimally Invasive

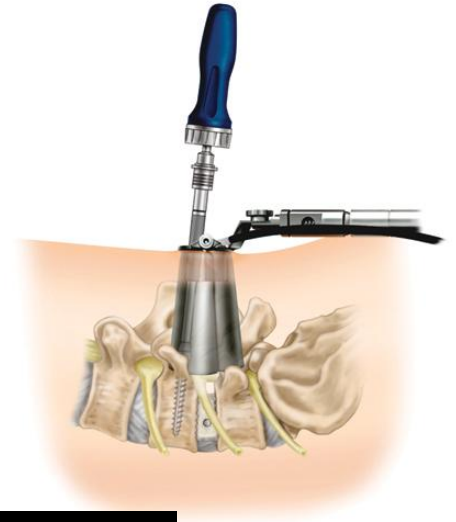
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# Minimally Invasive

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Example of scars from surgery using a minimally invasive technique:



# Minimally Invasive

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## Potential benefits include:

- Quicker return to normal activities
- Less post-operative pain
- Less damage to muscle and skin
- Less blood loss
- Easier rehabilitation
- Smaller scars
- Outpatient surgery for some

# Minimally Invasive

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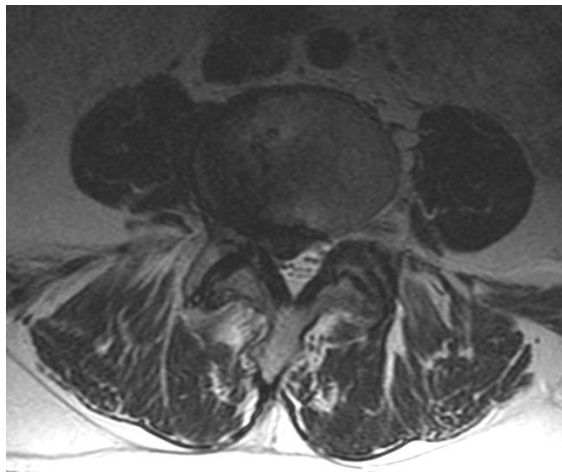
- Applicable to wide array of diseases
  - Herniated discs
  - Spinal stenosis
  - Spinal instability
  - Spinal tumors

# Lumbar Herniated Disc

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- One of the most common spinal ailments
- One of the most common elective surgeries in North America
  - Surgery provides more rapid effective pain relief and functional improvement than non-operative treatment
- Minimally Invasive technique offers modest gains over open technique



# Lumbar Spinal Stenosis

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- Very common problem with aging
- Reduced size of spinal canal due to:
  - Overgrowth of ligaments and bone
- Decreased ability to walk
- Commonly affects older patients
  - Reduction of activity level
  - Severe and debilitating pain

# Treatment

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- Surgery is an effective treatment for lumbar stenosis
- Surgery yields
  - Better outcomes as well as patient satisfaction at least 4 years after surgery than non-surgical management

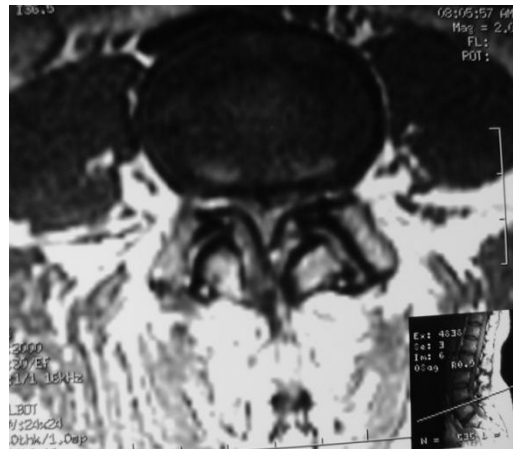
# Treatment

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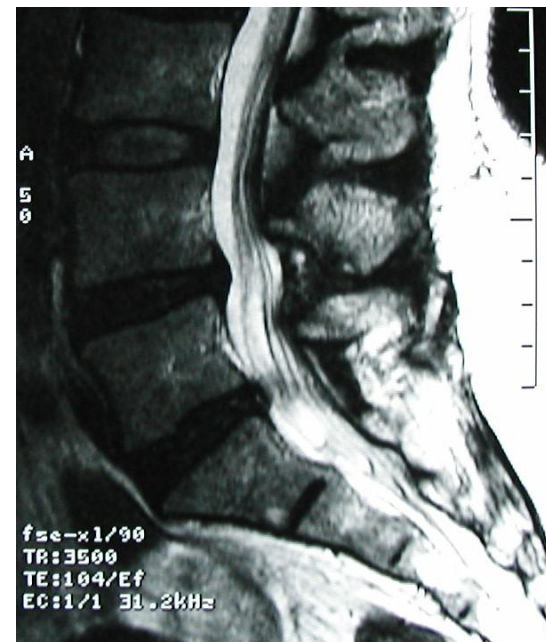
- Disadvantages of traditional surgery
  - Muscle injury
  - Blood loss
  - Postoperative pain & disability

# Minimally Invasive Stenosis Decompression

Pre-op



Post-op



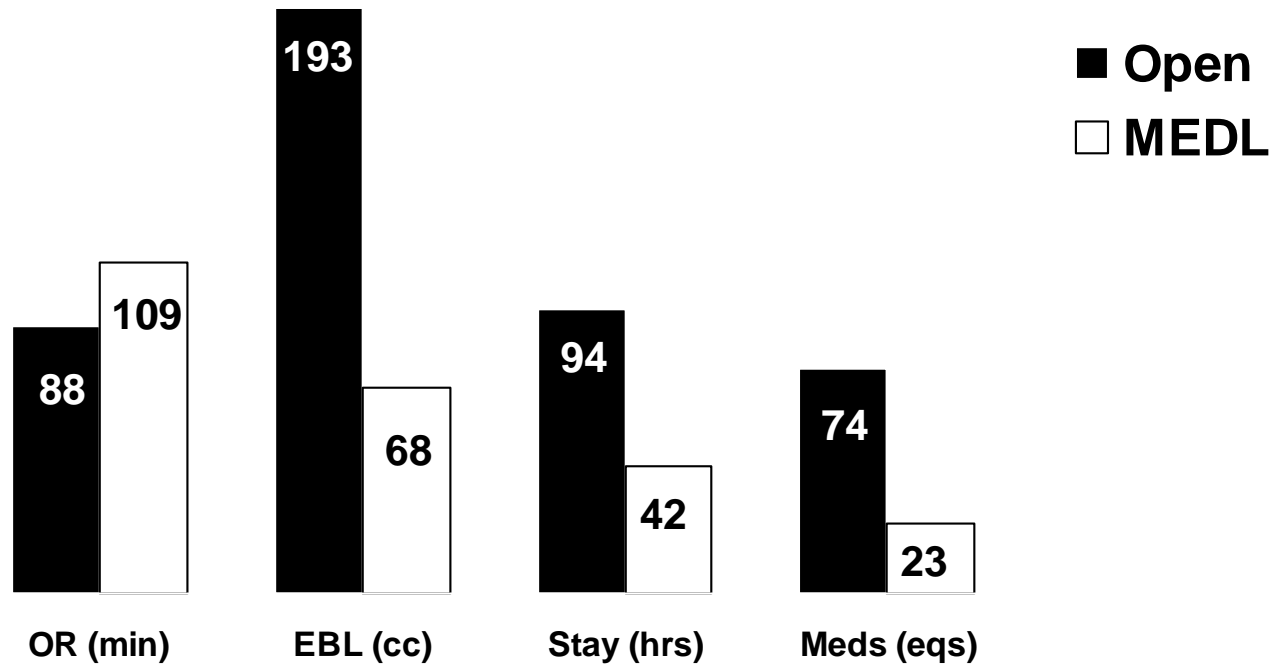
# Incision

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# Minimally Invasive Stenosis Decompression

## Clinical Results for Lumbar Stenosis



# Minimally Invasive Surgery

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- Highly Effective in Elderly Patients
  - 75-97 years old
  - Significant and durable pain relief and improvement in function
  - Very low complication rates and no mortality

# Lumbar Fusion for Spinal Instability

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- Lumbar fusion has been shown to be a successful surgical treatment for spinal instability and degenerative disc disease
- Traditional open surgical techniques can be associated with significant blood loss and post-operative pain and disability

# Minimally Invasive vs. Open Lumbar Fusion

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- Minimally invasive lumbar fusion
  - Is safe,
  - diminishes intraoperative blood loss,
  - Reduces postoperative pain and total narcotic use,
  - Almost eliminates the need for blood transfusion,
  - Effectively and durably leads to decreases in pain and improvement of function.

# Post-Operative Infections

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- After open spinal surgery
  - 1% to 15% of cases
  - May lead to:
    - Reoperations
    - Removal of hardware
    - Long-term antibiotics
    - Delayed wound healing
    - Poorer outcomes

# Post-Operative Infections

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- After minimally invasive surgery:
  - Only **0.2%**
  - Due to preservation of normal tissues

# Minimally Invasive Approaches

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- “Other” procedures:
  - Interspinous Devices
  - Vertebroplasty/Kyphoplasty
  - Spinal Cord Stimulation

# Interspinous Devices

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- Spinal Stenosis
  - Maintains spinal canal diameter
  - Reduces symptoms of leg pain
- Degenerative LBP
  - Prevents pressure on degenerated joints and disc



# Vertebral Body Compression Fractures

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- Causes:
  - Osteoporosis
  - Cancer
  - Trauma
- Osteoporotic fractures most common in elderly women
- Symptoms
  - Pain



# Compression Fractures: Management

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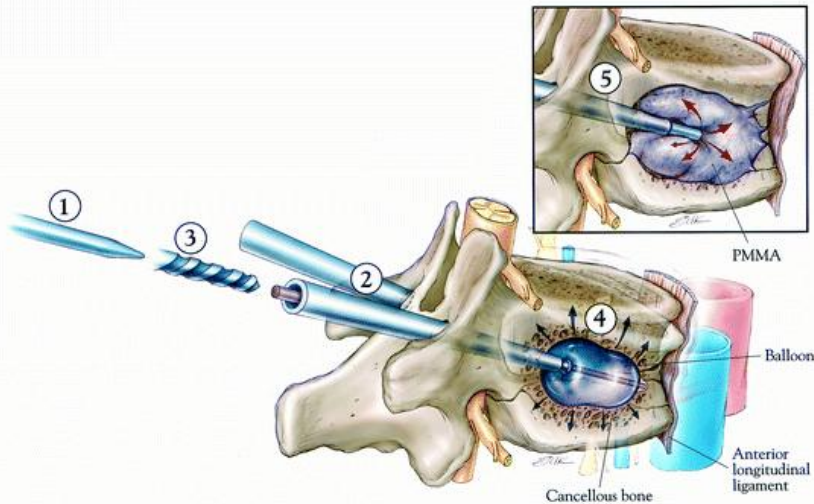
- Most common non-operative Rx:
  - Pain medications
  - Bracing
  - Physical Therapy
- No regimen uniformly effective for reliable pain relief

# Compression Fracture Management (cont)

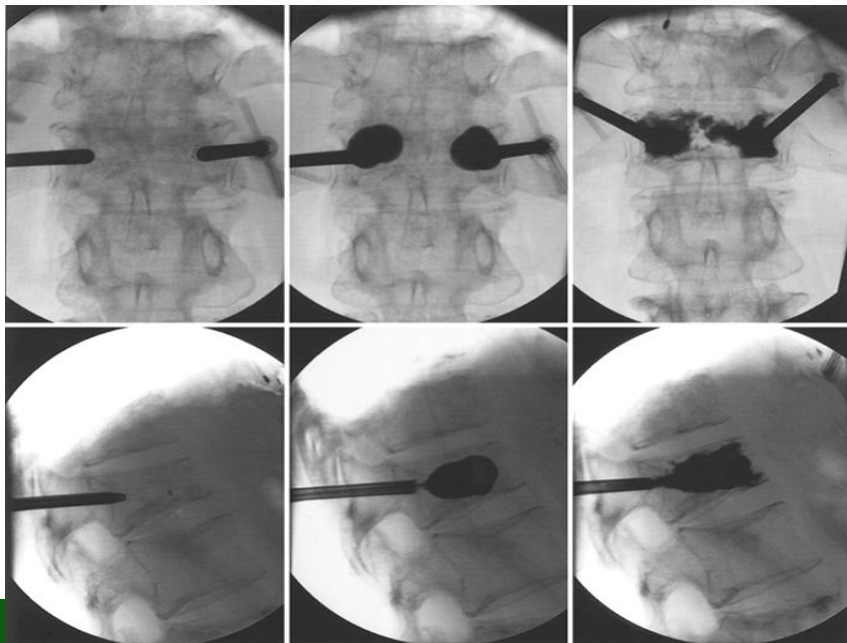
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- Interventions include:
  - Vertebral Augmentation
    - Kyphoplasty
  - Surgical reconstruction

# Kyphoplasty



- Needle placement through skin surface under x-ray guidance
- Inflatable balloons to restore vertebral height
- Bone cement is injected into vertebral body
- Stabilizes fracture and provides pain relief



# Outcomes

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- Osteoporotic fractures
  - Long-term pain improvement in 90-95%
  - Better than non-operative care
- Fractures due to tumors
  - Pain improvement in >75%
  - Better than non-operative care
- Rapid pain relief
  - Within 24-72 hours

# Spinal Cord Stimulation

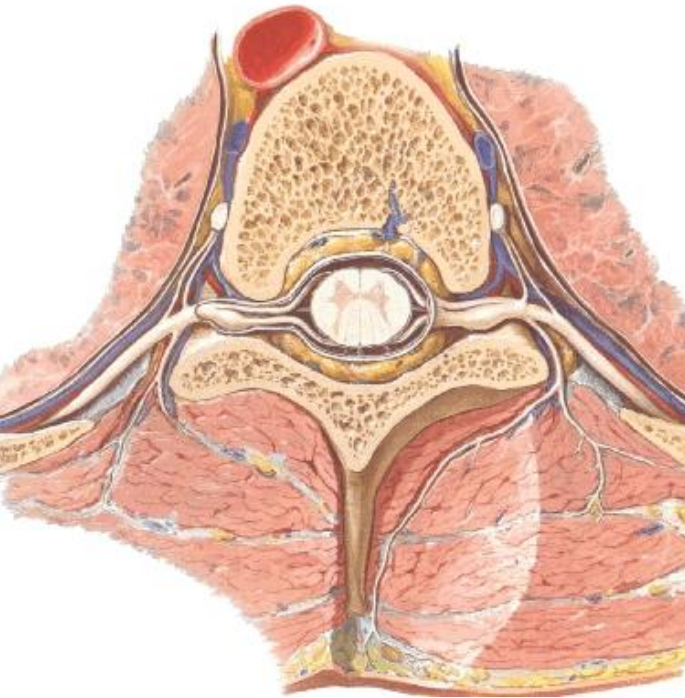
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- Mechanism of action unclear
- Best for radicular (leg) pain
- ~50% pain improvement in 50% of patients
- Modest results for back pain alone

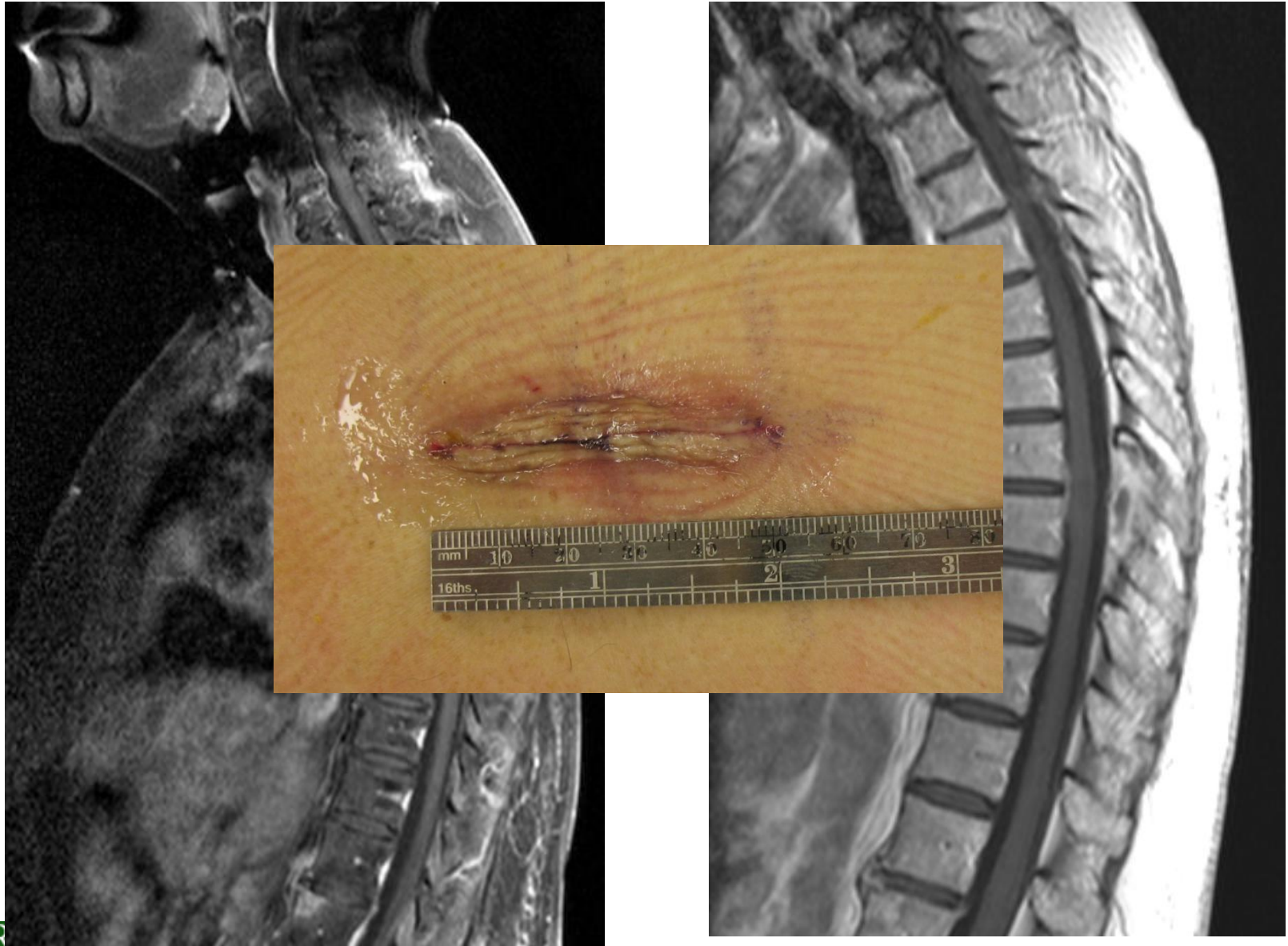
# Spinal Cord Tumors

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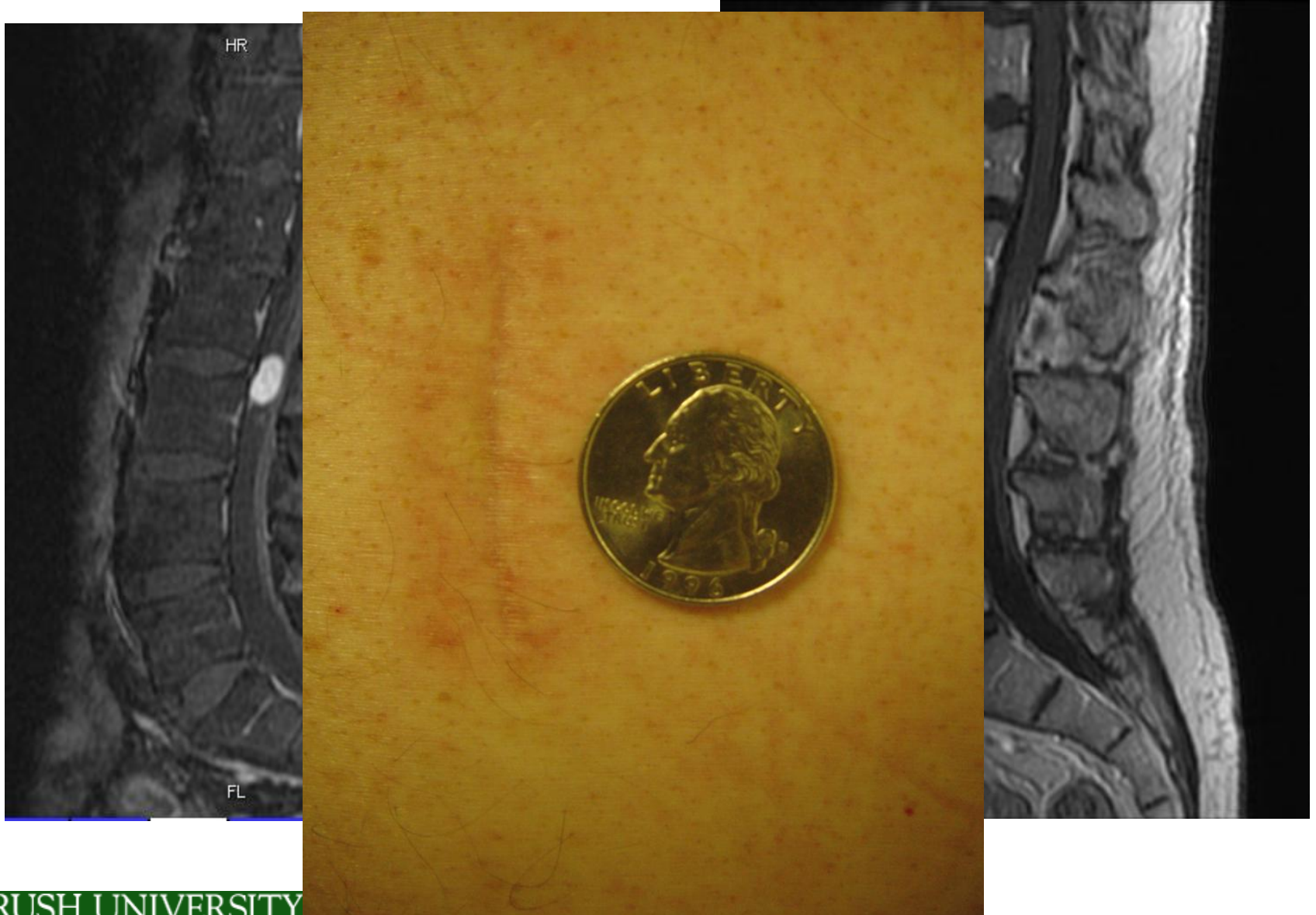


- May arise at any spinal level
- Vast majority are benign
- Often cause spinal cord compression

# Thoracic Meningioma



# Lumbar Schwannoma



# RESULTS—Intradural Tumors

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	Open Surgery*	Minimally Invasive‡
Mean OR time	3 hours	3.5 hours
Mean Blood loss	400 cc	75 cc
Days to ambulation	2.5	1
Length of hospital stay	5 days	2.3 days

\*Typical averages

‡ Tredway, *Neurosurg*, 2006  
O'Toole, *Neurosurg Clinics NA*, 2006

# OUTCOMES

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- >90% patients show improvement in neurological function
- Patients typically return to work/daily activities 2-3 weeks following surgery

# Conclusions

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- Minimally invasive spinal surgery
  - Available in the treatment of a wide array of lumbar spinal disorders
  - Reduces postoperative pain and blood loss
  - Leads to more rapid recovery and return to work and normal activities
  - Increases options for patients previously considered ineligible for surgical intervention