Spine Care Today: Surgical Decisions, Spasticity, and Recovery

Virginia Mason Franciscan Health™

Center for Neurosciences & Spine

Understanding Spasticity: Pathophysiology, Assessment, and Treatment Strategies

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Disclosures

Nothing to disclose

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Objectives

- Causes of spasticity
- Identification of spasticity
- Treatment options

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Case 1

- 61 year old RHD male with a PMH of ischemic right corona radiata stroke, HTN, HLD, DM with initial presentation of right hand incoordination, abnormal gait and R foot numbness
- Independent prior to stroke. Working in finance for a large tech company
- Complaints of RUE and RLE weakness, utilizing a cane for longer distances, right shoulder pain

Exam

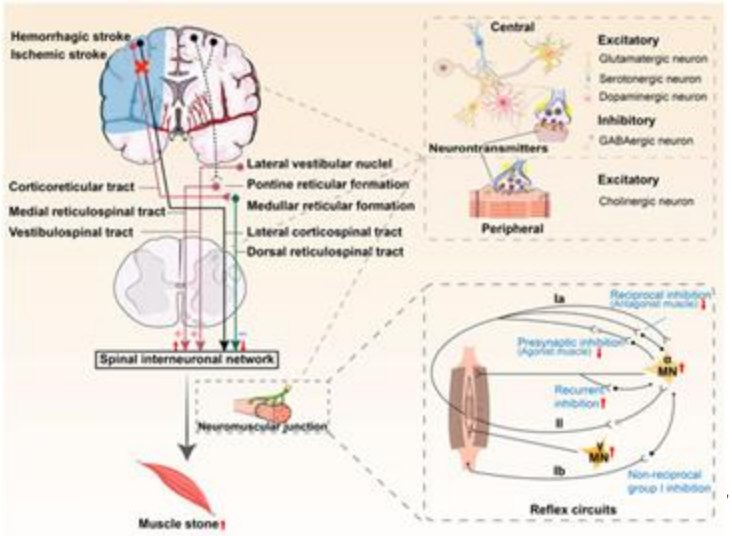
- Upper extremities: 5/5, except 4/5 in right finger flexion
- Lower extremities: 4+/5 in R HF, KF, DF; 4/5 in R PF

- Reflexes: 3+ in R hemibody, 5 beats of clonus

- Spasticity: MAS of 1 at right shoulder, elbow, wrist, fingers, knee and ankle
- Gait: Mild right foot drag

What is spasticity?

- Upper motor neuron syndrome
- Velocity dependent resistance to stretch
- Can vary based on time of day, position, and increases with noxious stimuli



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Causes of Spasticity

Condition	Estimated patients in US	Prevalence of Spasticity
Stroke	6.5 million	1.5 million (23%)
Traumatic brain injury	5.3 million	Estimates of up to 30%
Cerebral Palsy	765,000	650,000 (85%)
Multiple sclerosis	400,000	268,000 (67%)
Spinal cord injury	260,000	172,000 (68%)

Stroke Spasticity Patterns

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Identification

Modified Ashworth Scale

0	No increase in muscle tone
1	Slight increase in muscle tone with catch and release
1+	Slight increase in muscle tone with catch followed by resistance
2	Marked increase in tone throughout range of motion, easy ROM
3	Marked increase in tone throughout range of motion, difficult ROM
4	Fixed joint

When do we decide to treat?

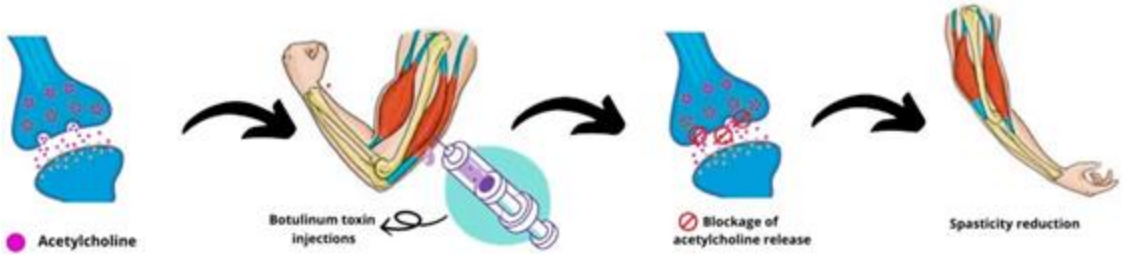
- Interferes with daily function
- Limits independence
- Causes pain
- Interferes with caregiver support

Treatment

- Oral Medications
  - Baclofen
  - Tizanidine
  - Dantrolene
  - Diazepam

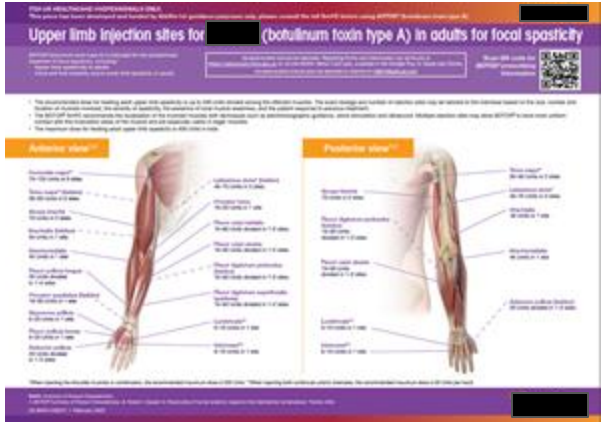
Treatment

- Botulinum toxin injections
  - Onabotulinum toxin A
  - Incobotulinum toxin A
  - Abobotulinum toxin A



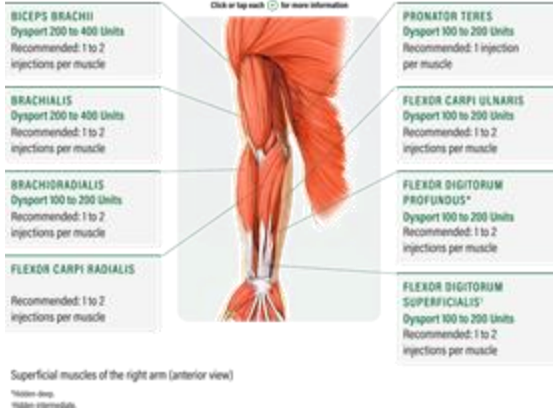
- Inhibits the release of acetylcholine from presynaptic nerve terminal

Onabotulinum toxin A



Approved Muscles Involved in Common Postures

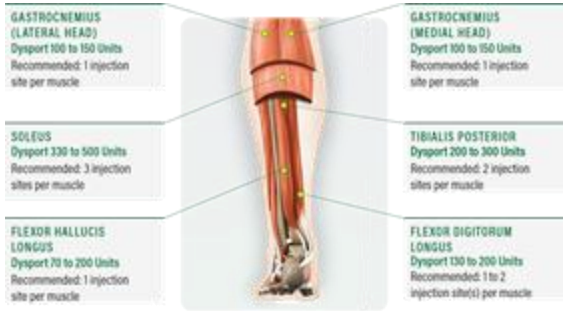
Abobotulinum toxin A



Superficial muscles of the right arm (anterior view)

*Hidden deep.
†Hidden intermediate.

Incobotulinum toxin A



Superficial and deep muscles of the left lower leg (posterior view).

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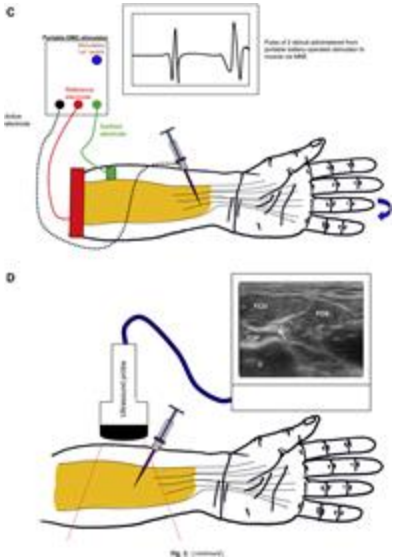
Botulinum toxin injections



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Back to the case

- 6 sets of botulinum toxin injections to RUE (pectoralis, latissimus, brachialis, FCR, FDS) and RLE (hamstrings, gastrocnemius, soleus)
- 5/5 strength throughout
- MAS of 0 in R hemibody

Case 2

- 22 yo M admitted to HMC after multiple GSW to abdomen and flank with a T11 ballistic fracture and resultant T10 incomplete SCI.
- 3 weeks of IPR with improvement in neurologic level of injury (T9 ASIA B T10 ASIA C)
- 1st clinic visit was 5 mo later – utilizing a manual wheelchair, limited by pain and spasticity. Household ambulator with a 2 wheeled walker

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Exam

- Lower extremities:
  R Hip flexion: 4/5, KE: 5/5, KF5/5, DF 5/5 PF 5/5

  L Hip flexion: 3+/5, KE 4/5, KF 5/5, DF 0/5, PF 5/5

- Reflexes:
  3+ in BLE

  3 beats of clonus on R

  Sustained clonus on L

- Spasticity:
  MAS of 2 at bilateral hips, adductors

  MAS of 3 at bilateral knees

  MAS of 2 at right ankle, 4 at left ankle

Treatment

- Baclofen 20mg BID
- Botulinum toxin A 400 units into BLE

WHAT ELSE???

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Intrathecal Baclofen

- Delivery of baclofen directly into the CSF
- Reduce adverse systemic drug effects
- Patient selection importance

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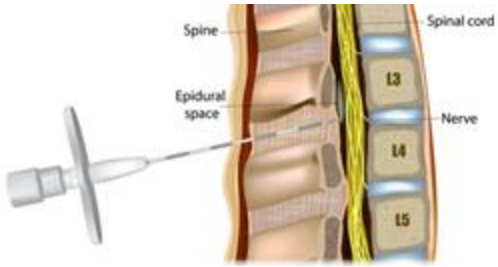
Intrathecal Baclofen

- Trial
- Implantation
- Titration
- Maintenance



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MAS of 0 in BLE
Strength improved to 4/4 in HF, 4+/5 KE

No longer taking oral spasticity or pain medications

66 mcg/day of ITB

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- Get Dysport® Spasticity Dosing & Administration Data – https://www.dysport.com/en-us/hcp/adult-spasticity/dosing-and-administration

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Thank you

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Low Back Pain in the Elderly

A 70-Year-Old Patient: Comprehensive Clinical Approach

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577M
people affected globally (GBD 2017)

80%
lifetime prevalence in the general population

1st
cause of disability in 160 countries

$90B+
annual US healthcare cost for LBP

Why It Matters at Age 70

- LBP prevalence peaks between ages 60–80 — this patient is in the highest-risk window
- ~40% of adults over 65 report chronic low back pain lasting more than 3 months
- 30–50% of elderly patients with LBP have underlying facet joint arthropathy as a contributor
- Degenerative disc disease is present on imaging in >90% of adults by age 70 — but symptoms and imaging must correlate
- LBP is the 2nd most common reason for doctor visits in the United States

Occurrence & Recurrence

INCIDENCE

- 7.5% of population has new LBP each year
- Most common in adults 40–80 yrs
- Peak disability: ages 60–80
- Men = Women overall prevalence
- Women >65: higher fracture risk
- 2.5% of all ED visits due to LBP

CHRONICITY

- Acute LBP: 80–90% resolve in 6 wks
- ~10–15% become chronic (>3 months)
- Elderly have higher chronicity rates
- Psychosocial factors predict chronicity
- Depression doubles disability risk
- Fear-avoidance → prolonged course

RECURRENCE

- ~70% recurrence within 1 year
- Each episode tends to be worse
- Previous LBP = #1 risk factor
- Structural changes persist on imaging
- Functional loss accumulates over time
- Multidisciplinary care reduces recurrence

Case Vignette

Patient Profile

A 70-year-old male presents with a 6-month history of progressive low back pain radiating to the right buttock and posterior thigh. Pain is rated 6/10 at rest, worsening to 9/10 with prolonged standing or lumbar extension. He reports morning stiffness lasting approximately 30 minutes. He had a prior L4–L5 disc herniation 15 years ago that resolved with conservative management. PMH: hypertension, type 2 diabetes mellitus. Medications: lisinopril, metformin.

Age	Duration	Pain Score	Radiation	PMH
70 years	6 months	6–9 / 10	Buttock / Post. Thigh	HTN, DM2, Prior disc herniation

Clinical Question: What is causing this patient's LBP — and how should we approach it?

History of Present Illness: Pain Profile

ONSET & DURATION

- Gradual onset — no acute precipitant
- Progressive worsening over 6 months
- Prior episode 15 years ago (L4–L5 disc)
- No history of significant trauma
- Worsening trend over the last 8 weeks
- Morning stiffness: ~30 minutes

PAIN CHARACTER

- Dull, aching quality — axial low back
- Radiation: right buttock, posterior thigh
- Does NOT radiate below the knee
- No associated tingling or numbness initially
- VAS 6/10 at rest → 9/10 with activity
- Pain worsens with lumbar extension

History of Present Illness: Aggravating & Relieving

▲ AGGRAVATING FACTORS

- Prolonged standing or walking
- Lumbar extension (facet loading)
- Rising from a seated position
- Twisting or rotating the spine
- Morning stiffness after rest
- Carrying heavy objects
- Cold or damp weather
- Climbing stairs

▼ RELIEVING FACTORS

- Lying down / recumbency
- Leaning forward (lumbar flexion)
- Heat application / warm bath
- Short periods of rest
- Over-the-counter analgesics
- Gentle stretching
- Supportive seating
- Short walks (temporarily)

History of Present Illness: Associated Symptoms

Symptoms PRESENT (Important Positives)

- Persistent morning stiffness (~30 min) — suggests inflammatory or degenerative component
- Fatigue and reduced mobility — impacting activities of daily living
- Intermittent right leg heaviness with prolonged walking — possible early claudication

Red Flags: Cancer & Infection

CANCER WARNING SIGNS

- History of any malignancy
- Unexplained weight loss > 10 lbs
- Night sweats / persistent fever
- Pain unrelieved by rest
- Pain waking patient from sleep
- Age >50 with new-onset severe LBP
- Failure to improve after 6 weeks of treatment

INFECTION WARNING SIGNS

- Recent systemic infection (UTI, skin, respiratory)
- IV drug use or immunosuppression
- Fever + localized spinal tenderness
- Elevated ESR, CRP, or WBC
- Diabetes (increased infection risk)
- Recent spinal procedure or surgery
- Persistent nocturnal pain without relief

Red Flags: Fracture Risk & Neurological Emergency

FRACTURE RISK (Elderly)

- Osteoporosis or low bone density
- Prolonged corticosteroid use
- Even minor trauma in age 70+
- Severe, sudden-onset localized pain
- Progressive thoracic kyphosis
- Post-menopausal female with acute pain
- Paget's disease history

NEUROLOGICAL EMERGENCY

- CAUDA EQUINA — CALL SURGEON NOW
- Saddle anesthesia (perianal numbness)
- Acute urinary retention or incontinence
- Fecal incontinence
- Bilateral leg weakness or paralysis
- Rapidly progressive motor deficits
- Myelopathy: hyperreflexia, clonus,

CAUDA EQUINA SYNDROME = SURGICAL EMERGENCY — Do not delay. Immediate MRI + neurosurgery consult.

Physical Examination: Inspection, Palpation & ROM

INSPECTION

- Overall posture: kyphosis, lordosis loss
- Antalgic lean — away from pain side
- Gait: antalgic or Trendelenburg pattern
- Paraspinal muscle bulk / asymmetry
- Skin: café-au-lait spots, surgical scars
- Leg length discrepancy
- Scoliosis / rib hump

PALPATION

- Midline spinous process tenderness
- Step-off deformity (spondylolisthesis)
- Paraspinal muscle spasm or tenderness
- SI joint tenderness (PSIS region)
- Greater trochanter tenderness (bursitis)
- Costovertebral angle tenderness (renal)
- Pulsatile abdominal mass (AAA screen)

RANGE OF MOTION

- Flexion (normal 90°) — usually limited
- Extension (normal 30°) — pain ↑ with facet
- Lateral bending (normal 30° each side)
- Rotation (normal 30° each side)
- Schober test: measures true lumbar flexion
- Document painful arcs / end-range pain
- Compare to prior exams if available

Physical Examination: Neurological & Special Tests

🧠 NEUROLOGICAL EXAM

- Motor: L4/L5 = dorsiflexion, L5 = EHL,

S1 = plantarflexion

- Dermatomal sensation mapping (L1–S1)
- Patellar reflex (L3–L4)
- Achilles reflex (S1) — often reduced in elderly
- Clonus — upper motor neuron screen
- Babinski — myelopathy screen
- Rectal tone if cauda equina concern

🦿 SPECIAL TESTS

- SLR: leg pain 30–70° → disc herniation L4–S1
- Crossed SLR: large central disc herniation
- FABER Test: SI joint pathology or hip OA
- Facet Loading: extension + rotation

reproduces LBP

- Femoral Stretch: anterior thigh pain → L2–L4
- Waddell's Signs: ≥3 of 5 → psychosocial contributor
- Hip ROM: exclude hip OA as pain source

Imaging: X-Ray — Facet Joint Assessment

First-line screening. Ordered for new LBP in age >50. Cannot confirm facet as pain source — use as structural screen only.

FINDINGS SUPPORTING FACET ARTHROPATHY

- Facet joint space narrowing at L4–L5, L5–S1
- Subchondral sclerosis of articular surfaces
- Osteophyte formation at facet joint margins
- Degenerative spondylolisthesis (facet failure)
- Oblique views: best direct view of facet joints
- Flexion-extension: dynamic instability at facet level
- Vacuum phenomenon in facet joint space

LIMITATIONS — CANNOT CONFIRM FACET AS PAIN SOURCE

- Cannot visualize cartilage, synovium, or nerves
- >90% of adults age 70+ show DDD on plain films
- Structural degeneration ≠ symptomatic pain generator
- High false-positive rate — correlate clinically
- Diagnostic injection (MBB) needed to confirm facet origin
- MRI or SPECT-CT required for definitive assessment
- Use as screening tool; not sufficient alone for diagnosis

Imaging: MRI — Gold Standard for Facet Assessment

No radiation. Best for soft tissue and nerve root. Always correlate with clinical symptoms — normal MRI does not rule out facet pain.

MRI CONFIRMING FACET JOINT AS PAIN GENERATOR

- Facet joint hypertrophy: enlarged arthritic joints
- Joint effusion: fluid in facet capsule (active synovitis)
- Bone marrow edema in articular processes (STIR sequence)
- Ligamentum flavum hypertrophy — secondary to facet OA
- Foraminal narrowing from facet osteophytes
- Gadolinium contrast: enhancing synovitis = active facet OA
- SPECT-CT correlation confirms metabolically active level

MRI RULING OUT OTHER PAIN GENERATORS

- Disc herniation: nerve root compression — not facet
- Central canal stenosis: cauda equina involvement
- Vertebral compression fracture: STIR bone marrow edema
- Metastatic lesion: T1 hypointense vertebral body signal
- Epidural abscess or discitis: gadolinium enhancement
- Normal MRI does NOT rule out facet pain
- Over-reading common: treat the patient, not the scan

Imaging: CT & Nuclear Medicine — Facet Assessment

CT provides superior bony detail. SPECT-CT is the most specific non-invasive tool for confirming the facet joint as the active pain generator.

CT SCAN — BONY FACET DETAIL

- Superior bony detail vs. MRI for arthrosis severity
- Subchondral cysts, joint space loss, vacuum sign
- Osteophyte direction and canal encroachment detail
- CT-guided facet injection: precise needle placement
- Facet fracture detection (trauma / stress fracture)
- Use when MRI contraindicated (pacemaker, metal)
- Radiation: ~6 mSv — limit repeat exposure in elderly

SPECT-CT / NUCLEAR MEDICINE — CONFIRMS ACTIVE FACET PAIN

- SPECT-CT: identifies metabolically active facet level
- Hot facet on SPECT = active bone remodeling inflammation
- Strong predictor of positive response to facet block or RFA
- Most specific non-invasive test for facet pain generator
- Bone scan alone: high sensitivity, poor facet specificity
- PET-CT: rules out malignancy mimicking facet pain
- DEXA scan: bone mineral density / fracture risk

Differential Diagnosis — Part 1: Musculoskeletal

Facet Joint Arthropathy	Extension-worsened axial LBP, buttock referral, paraspinal tenderness	Pain relief with medial branch block
Lumbar Spinal Stenosis	Neurogenic claudication, bilateral leg pain, flexion relief, age >60	Relief leaning on cart; MRI shows canal narrowing
Degenerative Disc Disease	Discogenic pain, worsened with flexion, disc space narrowing on X-ray	MRI: disc dehydration (black disc), endplat changes
Vertebral Compression Fx	Acute-onset point tenderness, osteoporosis, minimal trauma history	MRI STIR: bone marrow edema at fracture site
Disc Herniation	Radicular leg pain, positive SLR, dermatomal numbness or weakness	MRI: nerve root compression at disc level

Differential Diagnosis — Part 2: Serious & Referred

Degenerative Spondylolisthesis	Step-off deformity, extension pain, stenosis symptoms, L4–L5 common	Lateral X-ray: vertebral forward slip
Sacroiliac Joint Dysfunction	Buttock pain, FABER positive, PSIS tenderness, no radiation below knee	SI joint injection diagnostic & therapeutic
Metastatic Malignancy	Night pain, unrelenting ache, weight loss, prior cancer history	Bone scan / MRI contrast: multiple lesions
Abdominal Aortic Aneurysm	Pulsatile mass, vascular risk factors, tearing back or flank pain	URGENT: ultrasound or CT abdomen
Osteoporotic Compression Fx	Post-menopausal, steroid use, sudden severe pain, kyphosis onset	MRI STIR: acute fracture edema pattern

Facet Joint Pain: Anatomy & Pathophysiology

1	**Anatomy:**	Paired synovial joints (zygapophyseal) at each vertebral level. Contain articular cartilage, synovium, and a highly innervated fibrous joint capsule.
2	**Degenerative Changes:**	Aging causes cartilage loss, subchondral bone sclerosis, and osteophyte formation — identical process to peripheral osteoarthritis.
3	**Pain Sensitization:**	Joint capsule stretch and inflammation activate nociceptors (Aδ and C-fibers). Pro-inflammatory mediators released: IL-1β, TNF-α, Substance P, CGRP.
4	**Neural Innervation:**	Each facet joint is innervated by the medial branch of the dorsal ramus at the same level AND one level above — dual innervation (key for RFA planning).
5	**Referred Pain Pattern:**	Axial LBP → buttock → posterior thigh (rarely below knee). No true dermatomal distribution. Extension + rotation loads and compresses the joint.

Facet Joint Pain: Clinical Features & Diagnosis

CLINICAL FEATURES

- Axial low back pain — worse with extension
- Bilateral or unilateral paraspinal tenderness
- Pain worse with rotation toward affected side
- Referred pain: buttock and posterior thigh
- No neurological deficit (if uncomplicated)
- Morning stiffness lasting 20–45 minutes
- Temporary relief with lumbar flexion
- Most common at L4–L5 and L5–S1 levels

CONFIRMING DIAGNOSIS

- No single clinical test is definitive
- Prevalence: 15–40% of chronic LBP
- MRI may show facet hypertrophy + joint effusion
- CT shows facet arthrosis (sclerosis, osteophytes)
- Diagnostic medial branch block (MBB): gold standard
- Positive MBB: ≥80% pain relief after injection
- Two confirmatory blocks required before RFA
- SPECT-CT can identify active facet pathology

Conservative Treatment: Physical Therapy & Education

PHYSICAL THERAPY

- Structured program: 6–12 weeks minimum
- Core stabilization (transversus abdominis, multifidus)
- McKenzie Method — directional preference exercises
- Aquatic therapy: low-impact, buoyancy-assisted
- Manual therapy / joint mobilization
- TENS, therapeutic ultrasound, heat/ice
- Postural correction and body mechanics
- Home exercise program maintenance

EDUCATION & LIFESTYLE

- Pain neuroscience education (PNE)
- Ergonomics: workstation, sleeping position
- Activity pacing — avoid boom-bust cycle
- Weight management (reduces spinal load)
- Smoking cessation (improves disc healing)
- Sleep hygiene optimization
- Graded return to activity — avoid bed rest
- Walking program: 20–30 min daily if tolerated

Conservative Treatment: Pharmacological Approach

Acetaminophen	First-line for mild–moderate pain in elderly. Safer GI profile. Max 2–3g/day (1.5g if liver disease).	⚠ Avoid in liver disease / alcohol use
NSAIDs (Topical)	Topical diclofenac / ibuprofen gel: effective with minimal systemic absorption. Preferred in elderly.	⚠ Check skin integrity before use
NSAIDs (Oral)	Effective for inflammatory component. Use lowest dose for shortest time. Risk: GI bleed, renal impairment, CVD.	⚠ Add PPI; avoid if CKD, CHF, anticoagulation
Duloxetine (SNRI)	Moderate evidence for chronic LBP, especially with neuropathic features or depression comorbidity. 60mg/day.	⚠ Monitor BP; taper on discontinuation
Gabapentin/Pregabalin	For radicular / neuropathic pain component. Start low in elderly (fall risk, sedation, cognitive effects).	⚠ Monitor for sedation and falls
Opioids	Avoid as first-line. Short-term only for severe acute exacerbations. High risk: falls, constipation, dependence.	⚠ Last resort; use lowest dose; monitor closely

Interventional Treatment: Facet Joint Pain

FACET JOINT INJECTIONS

- Intra-articular corticosteroid + local anesthetic
- Fluoroscopic or CT-guided technique
- Diagnostic AND therapeutic in one procedure
- Pain relief: typically 4–12 weeks
- Limit: max 3–4 injections per year
- Suitable if joint effusion present on MRI
- Outpatient; minimal recovery time
- Evidence: moderate — good short-term relief

MEDIAL BRANCH BLOCKS (MBB)

- Targets medial branch of the dorsal ramus
- Anesthetizes nerve supplying the facet joint
- Primary role: DIAGNOSTIC — predicts RFA response
- Positive result: ≥80% pain relief after injection
- Two separate diagnostic blocks required
- Low risk: outpatient, minimal recovery
- Imaging guidance mandatory (fluoroscopy/CT)
- Guides patient selection for RFA

RADIOFREQUENCY ABLATION (RFA)

- Thermal neurotomy of medial branch nerves
- Indicated after 2 positive medial branch blocks
- Duration of relief: 6–18 months
- Nerve regenerates → procedure can be repeated
- Strong evidence — supported by NICE guidelines
- Gold standard for facet-mediated chronic LBP
- Temperature: 80°C for 90 seconds per lesion
- Complication: temporary localized burning sensation

Surgery for Facet Joint Pain

Surgery is rarely indicated for isolated facet joint pain. Considered only after failure of conservative therapy AND interventional procedures (MBB → RFA), with confirmed structural pathology on imaging.

LUMBAR FUSION (ARTHRODESIS) — Indirect Facet Decompression

- Stabilizes motion at the degenerated facet level — eliminates painful micro-motion
- Indicated when facet pain coexists with spondylolisthesis, spinal instability, or severe DDD at the same level
- Also considered after failure of multiple RFA treatments with confirmed structural instability
- Surgical approaches: TLIF (transforaminal), PLIF (posterior), ALIF (anterior), XLIF / MIS lateral
- Hardware: pedicle screws + connecting rods + interbody fusion cage + bone graft or BMP
- Minimally invasive fusion (MISS): preferred in elderly — reduced blood loss, shorter recovery
- Recovery: 6–12 months for full functional recovery; bony fusion confirmed at 3–6 months on CT
- Key risk: adjacent segment disease — ~2.5% per year above/below fusion level
- Pre-operative optimization: osteoporosis treatment, glycemic control, cardiac clearance

SUMMARY

Screen Every Patient for Red Flags

Malignancy, cauda equina, infection, and fracture cannot be missed — always ask about weight loss, night pain, bowel/bladder, and bilateral weakness.

Facet Arthropathy: #1 Cause in Elderly

Extension-worsened axial pain with buttock referral in a 70-year-old. Present in 15–40% of cases. Confirmed by medial branch block → RFA.

Correlate Imaging with Clinical Exam

DDD and facet arthrosis are nearly universal at age 70. Do not treat the scan — treat the patient and their functional limitations.

Conservative First — Step Up Methodically

PT + analgesia for 6–12 weeks. If facet-mediated: medial branch blocks → radiofrequency ablation. Reserve epidurals for radicular pain.

Surgery Has Specific Indications

Reserve for progressive neuro deficits, cauda equina, or failed conservative + interventional therapy with confirmed structural pathology.

LBP Is a Major Public Health Challenge

577M affected globally; 38% of elderly develop chronic LBP. Early multimodal treatment prevents chronicity and preserves function.

A question of risk

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May 9, 2026

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How do we measure Risk?

- How do we define risk?
- What do patients care about when evaluating risk?
- How can we use risk for decision-making?

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Who is the risk-taker in the audience?

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Who always plays it safe?

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Our biases

Action Bias

We favor action over inaction, even when inaction may have a better result

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Loss Aversion

The pain of losing is far greater than the pleasure of winning

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Sunken Cost (scenario 1)

Your Wallet

Buy a $20 ticket

Lose the ticket

Do you buy another ticket?
Will it feel like the game “cost” you $40?
You started with $40 and now have none…

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Sunken Cost (scenario 2)

Your Wallet

Lose $20

Arrive at game

Do you buy the ticket?
You'll have no money…

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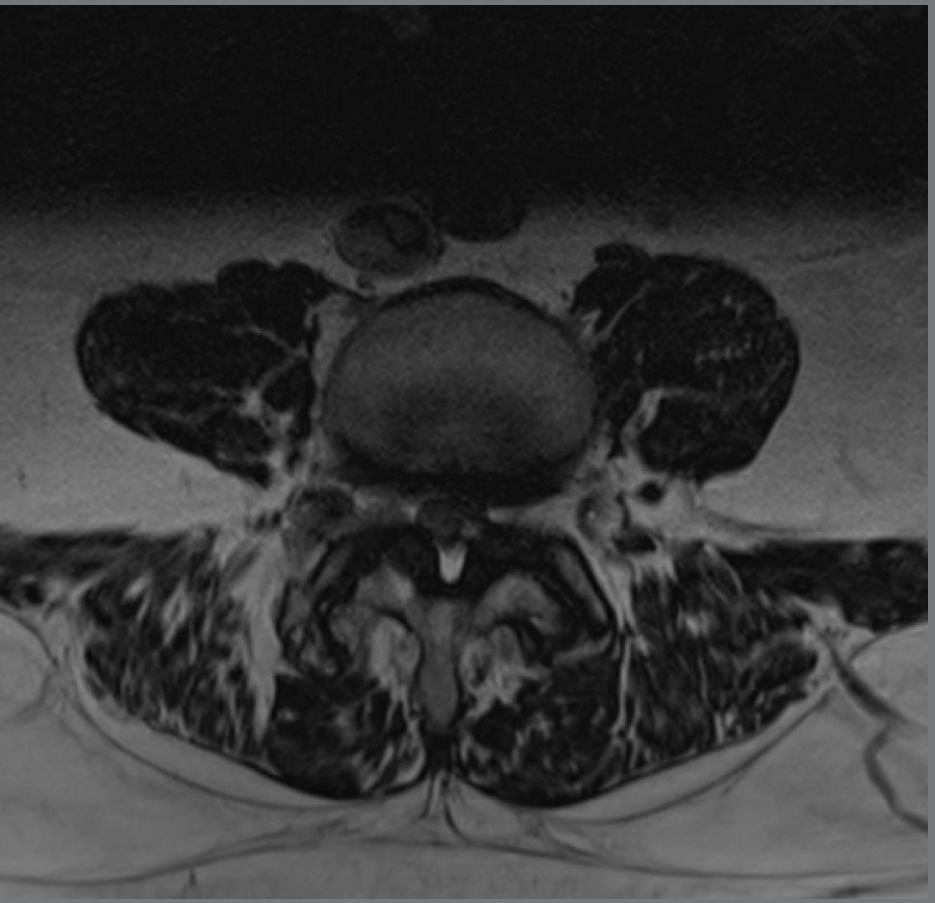
The case

Moderate back pain

Severe leg pain

Worsened with standing

Better supine



Fusion

Better ODI/VAS
More durable outcome
Less chance of short-term failure
Higher reimbursement

More invasive
Higher risk of complications

Decompression

Less improvement in ODI/VAS
Only short-term improvement?
Will it need a fusion?
Lower reimbursement

Less invasive
Lower risk of complications

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So do you want the decompression or the fusion?

Which is the riskier procedure?

The surgeon’s perspective

So what’s the risk?

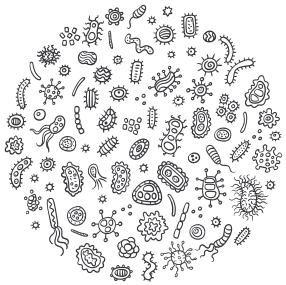
The risks

Failed spine surgery
(2023 AI-generated image!)

Failed spine surgery
(2026 AI-generated image!)

Nerve injury

Infection



…and others

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The Influence of Surgeon Personality Factors on Risk Tolerance: A Pilot Study

Jack Contessa, PhD, Luis Suarez, MD,* Tassos Kyriakides, PhD,† and Geoffrey Nadzam, MD**

DESIGN: Instrument assessing surgeon personality profile (MBTI) and 2 questionnaires measuring surgeon risk tolerance and risk aversion (PRU and PRA).

TABLE 2. Physician Risk Attitudes Measured on the Physician Risk Attitude Scale

1	I enjoy taking risks
2	I try to avoid situations that have uncertain outcomes*
3	Taking risks does not bother me if the gains involved are high
4	I consider security an important element in every aspect of my life*
5	People have told me that I seem to enjoy taking chances
6	I rarely, if ever, take risks when there is another alternative*

(a) Surgeons with the personality factor Thinking (vs Feeling) were more risk tolerant on the scale "Concern about Bad Outcomes."

(b) Surgeons with the personality factor Extravert (vs Introvert) displayed greater risk tolerance on the scale "Reluctance to Disclose Mistakes to Physicians."

(c) Surgeons with the personality factor Perception (vs Judgment) were more risk tolerant on the PRA scale.

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Risk preferences and attitudes to surgery in decision making

A survey of Swedish orthopedic surgeons

To cite this article: Andreas Meunier, Kinga Posadzy, Gustav Tinghög & Per Aspenberg (2017) Risk preferences and attitudes to surgery in decision making, Acta Orthopaedica, 88:5, 466-471, DOI: 10.1080/17453674.2017.1298353

946 Swedish orthopedic surgeons

1. Radiograph with 5 scenarios
2. Economic risk-preference test
3. Hazardous attitude to surgery assessment

Table 1. Treatment choices of the 354 surgeons included in the final analysis. The cases are presented in order of age. In the survey, the order was different

	Osteo-synthesis	Hemi-arthroplasty	Reverse shoulder prosthesis	Non-operative treatment
64-year-old man. Married. Works as an organizational consultant. Goes to the gym now and then. Plays tennis every week. Healthy.	76%	3%	3%	18%
69-year-old married lady. Former history teacher. Likes picking mushrooms and travelling. Orally treated diabetes.	51%	10%	5%	34%
73-year-old man. Married. Plays golf. Hobby carpenter. Hunting. Smokes. Drinks some alcohol. Slight hypertension.	39%	12%	4%	45%
80-years-old woman. Lives alone without home help. Likes walking. Plays bridge. Healthy.	17%	12%	9%	62%
83-year-old woman. Lives alone without home help. Slight disability of the other arm after stroke.	13%	13%	9%	65%

Figure 1. The radiograph shown in the survey; the same for all 5 patient descriptions.

Risk preferences and attitudes to surgery in decision making

A survey of Swedish orthopedic surgeons

Supplement: translation of the Hazardous Attitude Scale—aviation

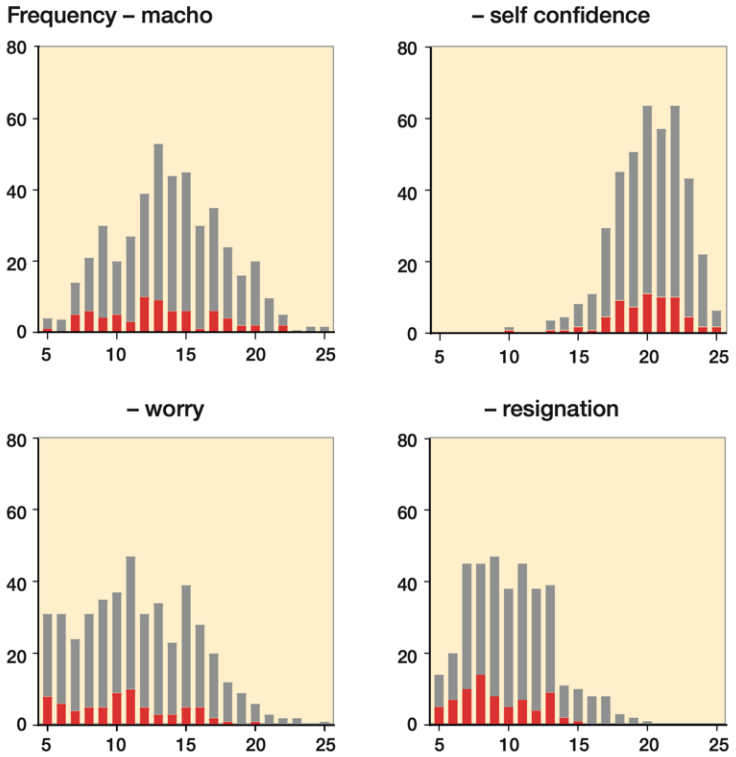
	Attitude	Aviation	Orthopedic surgeon English [b]
1	Self-confidence	I am a pilot due entirely to my hard work and ability	I am a surgeon due entirely to my own hard work and ability
2	Worry/ anxiety	While flying at night, I worry about not seeing navigation landmarks and getting lost	When operating on high-energy injuries, I worry about not being able to identify landmarks and getting lost
3	Worry/ anxiety	If I fly over water, I worry about having to ditch if the engine quits	If my operation is dependent on a specific instrument functioning, I worry about having to complete the operation if that instrument fails
4	Self-confidence	I can learn any flying skill if I put my mind to it	I can learn any surgical skill if I put my mind to it
5	Macho	I like to practice stalls	I like to do challenging procedures
6	Impulsive	I really hate being delayed when I fly on a trip	I really hate having my cases delayed
7	Macho	I like to practice unusual aircraft attitudes	I like to do challenging operations
8	Worry/ anxiety	I really worry about having to make an emergency landing	I really worry about having to abort a surgical procedure
9	Impulsive	If the weather is marginal, I don't mind waiting at the airport until it clears up	If the patient's medical condition is questionable, I don't mind waiting for anesthesia to "line up" the patient
10	Worry/ anxiety	I always worry about an accident when I am flying	I always worry about technical errors and complications when operating

Hazardous Attitude Scale converted to "orthopedic-ese"

(that means no big words)

Risk preferences and attitudes to surgery in decision making

A survey of Swedish orthopedic surgeons



Distribution of hazardous attitudes. Possible values range from 5 (lowest Likert score for all questions) to 25 (highest score for all questions). Number of respondents who recommended nonoperative treatment for all cases is shown in red

Risk preferences and attitudes to surgery in decision making

A survey of Swedish orthopedic surgeons

4	Self-confidence	I can learn any flying skill if I put my mind to it	I can learn any surgical skill if I put my mind to it
5	Macho	I like to practice stalls	I like to do challenging procedures
6	Impulsive	I really hate being delayed when I fly on a trip	I really hate having my cases delayed
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10	Worry/ anxiety	I always worry about an accident when I am flying	I always worry about technical errors and complications when operating
11	Impulsive	I am basically an impatient pilot	I am basically an impatient surgeon
12	Macho	I like to practice spins	I like high-risk operations
13	Anti-authority	The FAA is more concerned with restricting access to aviation than providing the services aviation needs	The OR administration is more concerned with restricting access to the OR than providing the services when needed
14	Resignation/ [a]	Sometimes I feel that I have very little control over what happens to the aircraft	Sometimes I feel that I have very ittle control over what happens to the patient
15	Resignation/ [a]	In a tight situation, I trust to fate	In a tight situation, I trust to fate
16	Worry/ anxiety	I really worry about mid-air collisions	I really worry about needlestick injuries

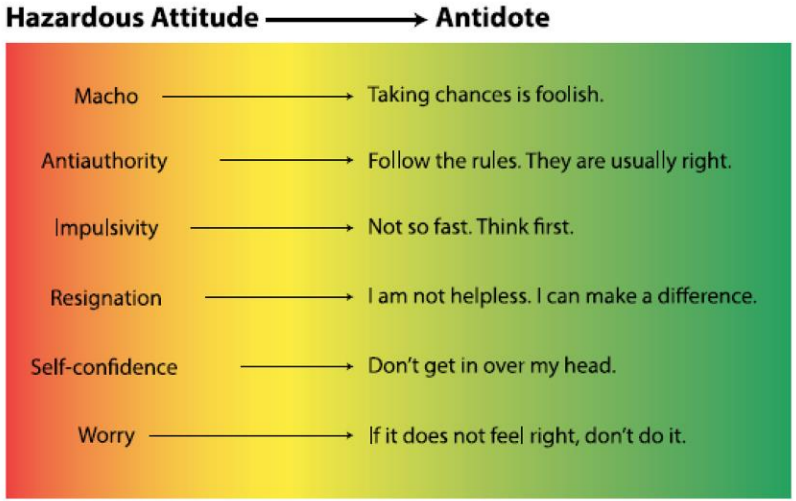
Results

1. No association between risk aversion and tendency to avoid surgery (for surgeons)
2. Those with a "macho" or "resigned" attitude were more likely to recommend surgery
3. Choice of nonoperative treatment was associated with long experience as a surgeon

Surgeons' Attitudes Are Associated With Reoperation and Readmission Rates

John Kadzielski MD, Frank McCormick MD,
James H. Herndon MD, MBA, Harry Rubash MD,
David Ring MD, PhD

Clin Orthop Relat Res (2015) 473:1544–1551
DOI 10.1007/s11999-014-3687-6



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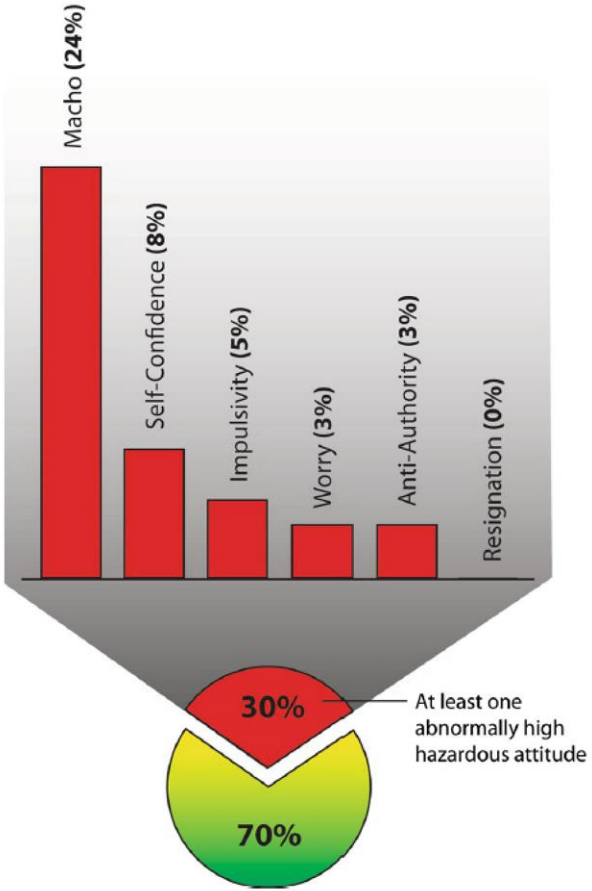

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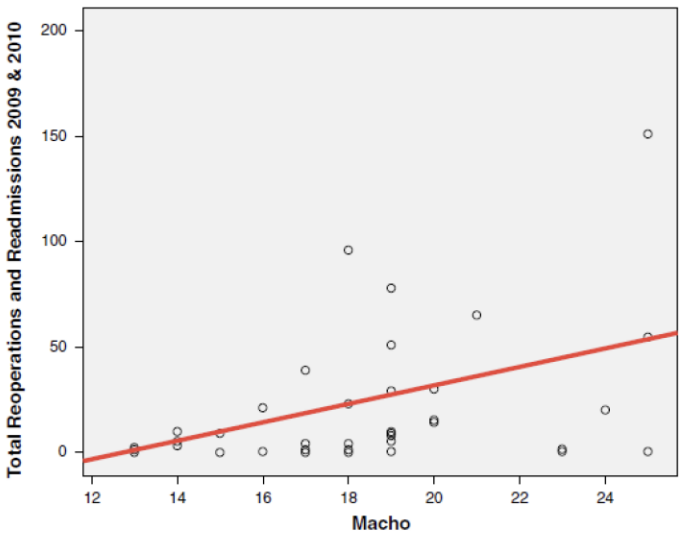

Fig. 3 This graph depicts the linear relationship between reoperation and readmission rates and macho attitude. The regression showed that macho, as an independent variable, accounted for 19% of the variance in reoperation and readmission rates. Reprinted with permission from Nicole Wolf.

Table 2. The top 10 safety climate issues with the highest levels of problematic responses

	Safety climate: top 10 items with the highest problematic response rates	Percentage of problematic responses*
1	Senior management reacts well to unexpected changes to its plan	60.0
2	Loss of experienced personnel has negatively affected my ability to provide high-quality patient care	51.4
3	Senior management does not hesitate to temporarily restrict clinicians who are under high personal stress	37.1
4	I am provided adequate resources (personnel, budget, and equipment) to provide safe patient care	25.7
5	In my department, there is significant peer pressure to discourage unsafe patient care	20.0
6	Individuals in my program are willing to report behavior that is unsafe for patient care	20.0
7	People in leadership positions set the example for compliance with policies and procedures that promote safe patient care	17.1
8	My program uniformly prescribes performance standards to ensure patient safety	14.3
9	My program follows a specific process to review performance standards to ensure patient safety	14.3
10	Patient safety decisions are made at the proper levels by the most qualified people	14.3

* Overall mean problematic response rate for residents in the same program who worked with these surgeons was 12.6% [27]. Overall mean problematic response rate for naval aviators was 5.6% [28].

So do you want the decompression or the fusion?

The patient’s perspective

What do I value?

FinaMetrica Questionnaire

Name :

10. What degree of risk are you currently prepared to take with your financial decisions?
    - ◯ Very small.
    - ◯ Small.
    - ◯ Medium.
    - ◯ Large.
    - ◯ Very large.
11. Have you ever borrowed money to make an investment (other than for your home)?
    - ◯ No.
    - ◯ Yes.
12. How much confidence do you have in your ability to make good financial decisions?
    - ◯ None.
    - ◯ A little.
    - ◯ A reasonable amount.
    - ◯ A great deal.
    - ◯ Complete.
13. Suppose that 5 years ago you bought stock in a highly regarded company. That same year the company experienced a severe decline in sales due to poor management. The price of the stock dropped drastically and you sold at a substantial loss.

    The company has been restructured under new management, and most experts now expect it to produce better than average returns. Given your bad past experience with this company, would you buy stock now?
    - ◯ Definitely not.
    - ◯ Probably not.
    - ◯ Not sure.
    - ◯ Probably.
    - ◯ Definitely.
14. Investments can go up or down in value, and experts often say you should be prepared to weather a downturn. By how much could the total value of all your investments go down before you would begin to feel uncomfortable?
    - ◯ Any fall would make me feel uncomfortable.
    - ◯ 10%.
    - ◯ 20%.
    - ◯ 33%.
    - ◯ 50%.
    - ◯ More than 50%.
15. Assume that a long-lost relative dies and leaves you a house which is in poor condition but is located in a suburb that's becoming popular.

    As is, the house would probably sell for $300,000, but if you were to spend about $100,000 on renovations, the selling price would be around $600,000. However, there is some talk of constructing a major highway next to the house, and this would lower its value considerably.

    Which of the following options would you take?
    - ◯ Sell it as is.
    - ◯ Keep it as is, but rent it out.
    - ◯ Take out a $100,000 mortgage and do the renovations.

Tolerance
Capacity
Need

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Tolerance

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Capacity

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Need

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I’ll take any risk if it means that I get to keep playing – it’s my only shot

Willing to accept all-or-none outcome

High need and high tolerance

I’ll tolerate some residual pain, but don’t mess with my singing voice

Willing to accept partial outcome

Lower need and lower tolerance

Where do we meet?

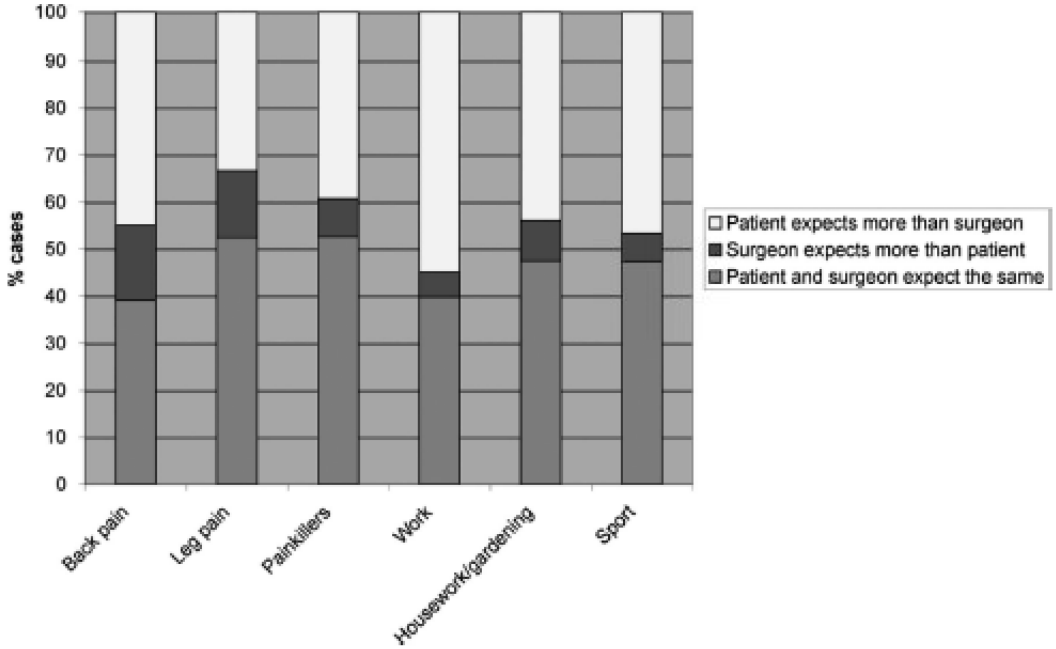
A Comparison of Patient and Surgeon Preoperative Expectations of Spinal Surgery

Friederike Lattig, MD,*† Tamás Fülöp Fekete, MD,* David O'Riordan, BSc,* Frank S. Kleinstück, MD,* Dezsö Jeszenszky, MD,* François Porchet, MD,* Urs Mutter, MD,* and Anne F. Mannion, PhD*

SPINE Volume 38, Number 12, pp 1040–1048

225 patients and 7 treating surgeons

Survey on baseline status and expectations



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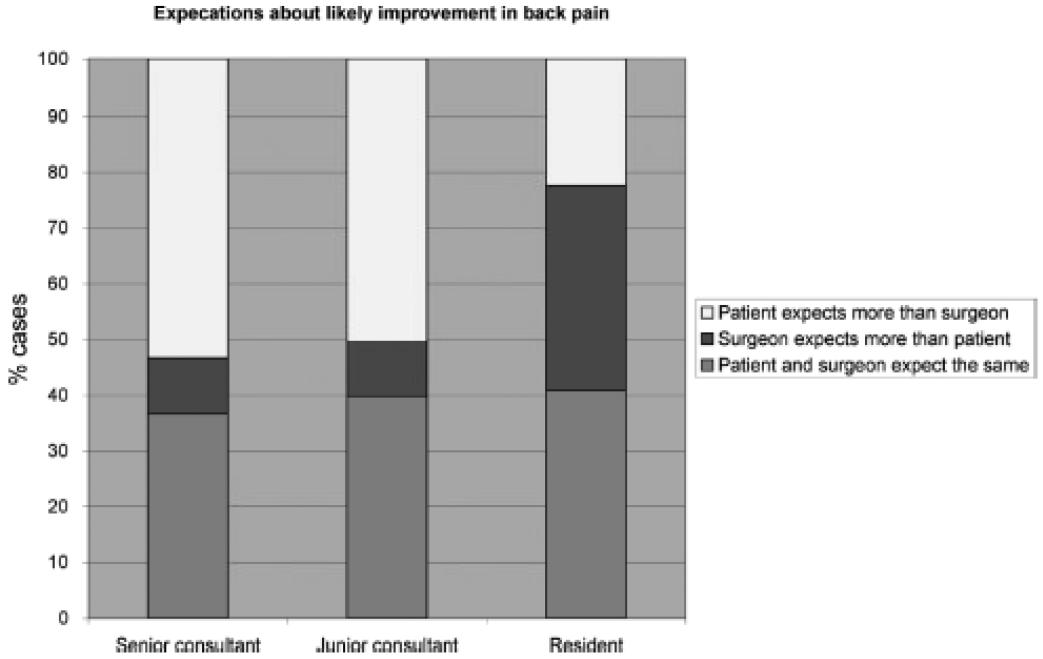

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Risk taking propensity: Nurse, surgeon and patient preferences for diverting ileostomy

Ian Mackay[1] | David A. Clark[1,2,3,4,5] | James Nicholson[6] | Aleks Edmundson[1,4] | Daniel Steffens[2,3] | Michael Solomon[2,3]

Colorectal Disease. 2022;24:1073–1079.

Three groups:
Colorectal nurses on wards
Colorectal surgeons
Patients attending colorectal clinic

Three scenarios

1. Preference to avoid a stoma
2. Avoid a stoma in a high-risk anastomosis
3. Avoid a stoma in a low-risk anastomosis

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Risk taking propensity: Nurse, surgeon and patient preferences for diverting ileostomy

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Colorectal Disease. 2022;24:1073–1079.

Assessed risk-taking index as well as preferences for temporary diverting ileostomy

Deliberate Risk-Taking (DRT)	Item-factor loading
I deliberately put myself in danger	.77
It's like gambling, you can't win unless you try it	.60
I actively seek out dangerous situations	.83
Precautionary Behaviors (PB)	
I take time to check conditions (e.g., weather)	.60
I check any gear/equipment that I borrow	.45
I am aware of the nearest help and first aid	.66
I take time to check for potential hazards	.73

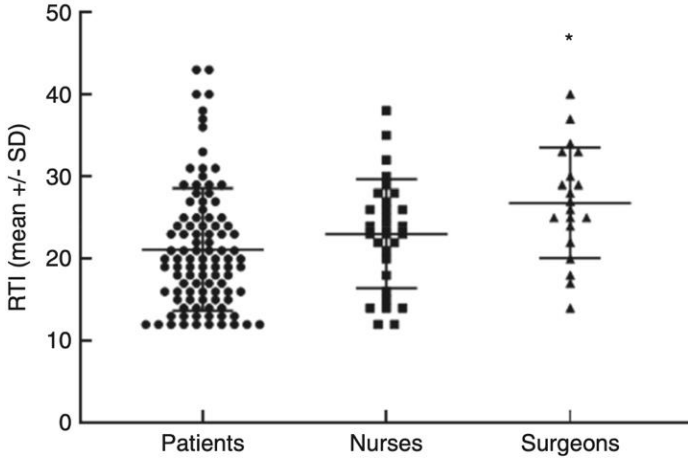
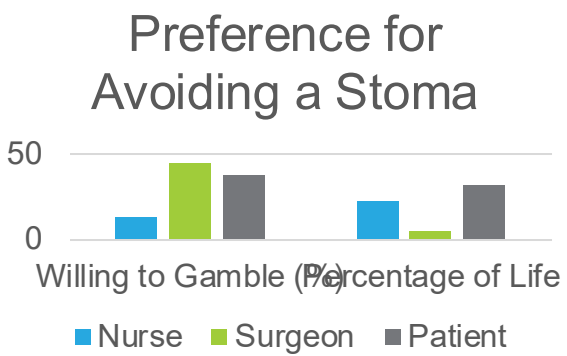
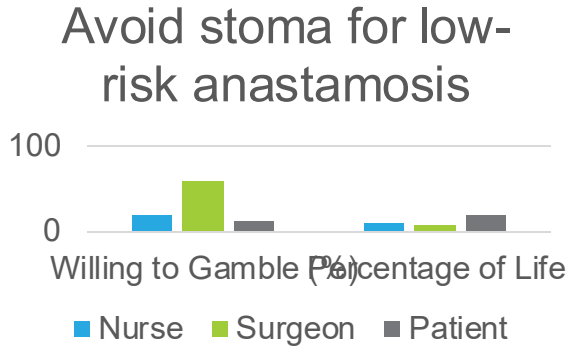


FIGURE 1 Risk taking index for patients, nurses and surgeons. RTI, risk taking index; RTI ranges from 12 to a maximum of 60, with higher scores indicating a greater risk taking propensity; SD, standard deviation; *$p = 0.0002$.

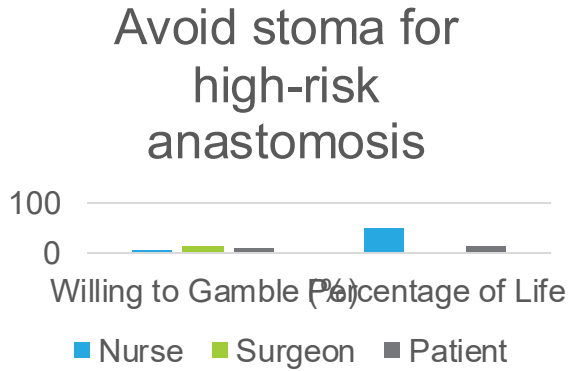




Surgeons are the most willing to gamble, but gamble the least percentage of life

Patients are always willing to gamble more percentage of life than surgeons in both high- and low-risk situations

Differing levels of information and bias lead to different preferences



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Exploring the expectation-actuality discrepancy: a systematic review of the impact of preoperative expectations on satisfaction and patient reported outcomes in spinal surgery

Christopher D. Witiw[1,2] · Alireza Mansouri[2] · Francois Mathieu[2] · Farshad Nassiri[2] · Jetan H. Badhiwala[2] · Richard G. Fessler[1]

Neurosurg Rev (2018) 41:19–30
DOI 10.1007/s10143-016-0720-0

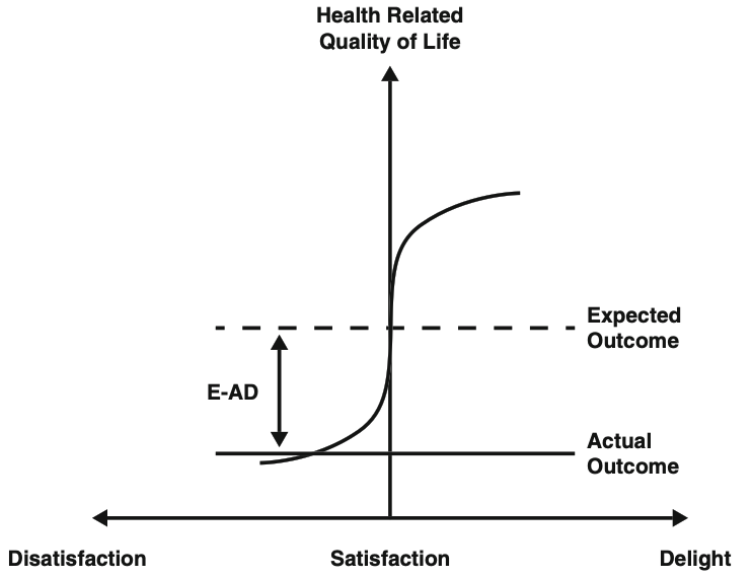


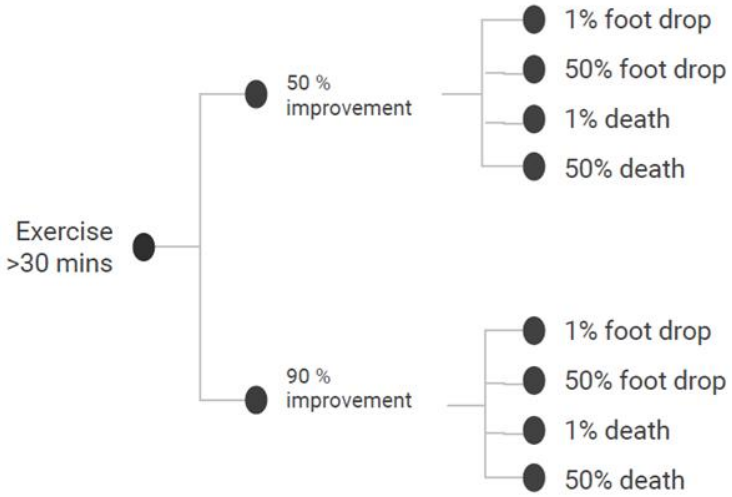
Fig. 3 Conceptual model of the relationship between the magnitude of the expectation-actuality discrepancy (E-AD) and patient satisfaction. As the difference between what a patient expects from surgery and what they actually experience widens, they become less satisfied. This relationship is thought to be non-linear. Small differences are generally tolerated through the assimilation effect; conversely, larger differences are exaggerated through the contrast effect

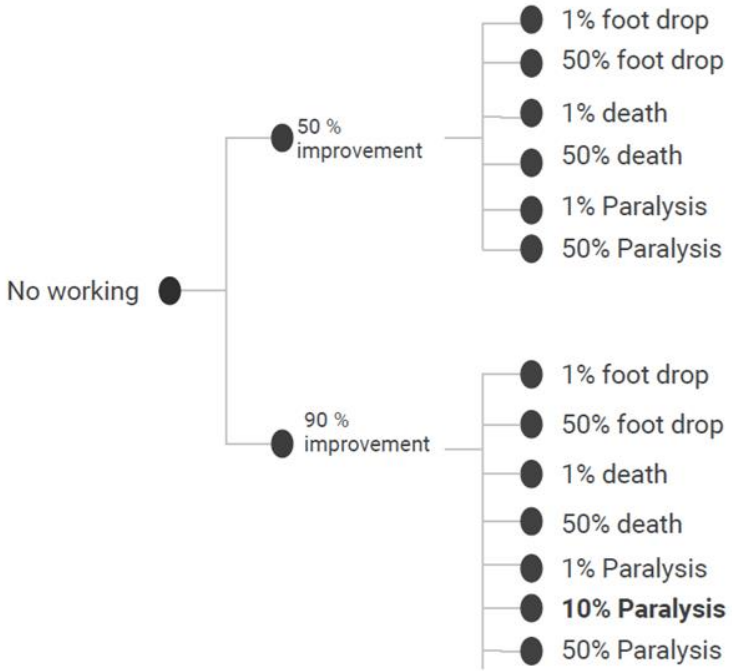
Our initial foray

Amazon Mechanical Turk

Access a global, on-demand, 24x7 workforce

Surgical scenarios design





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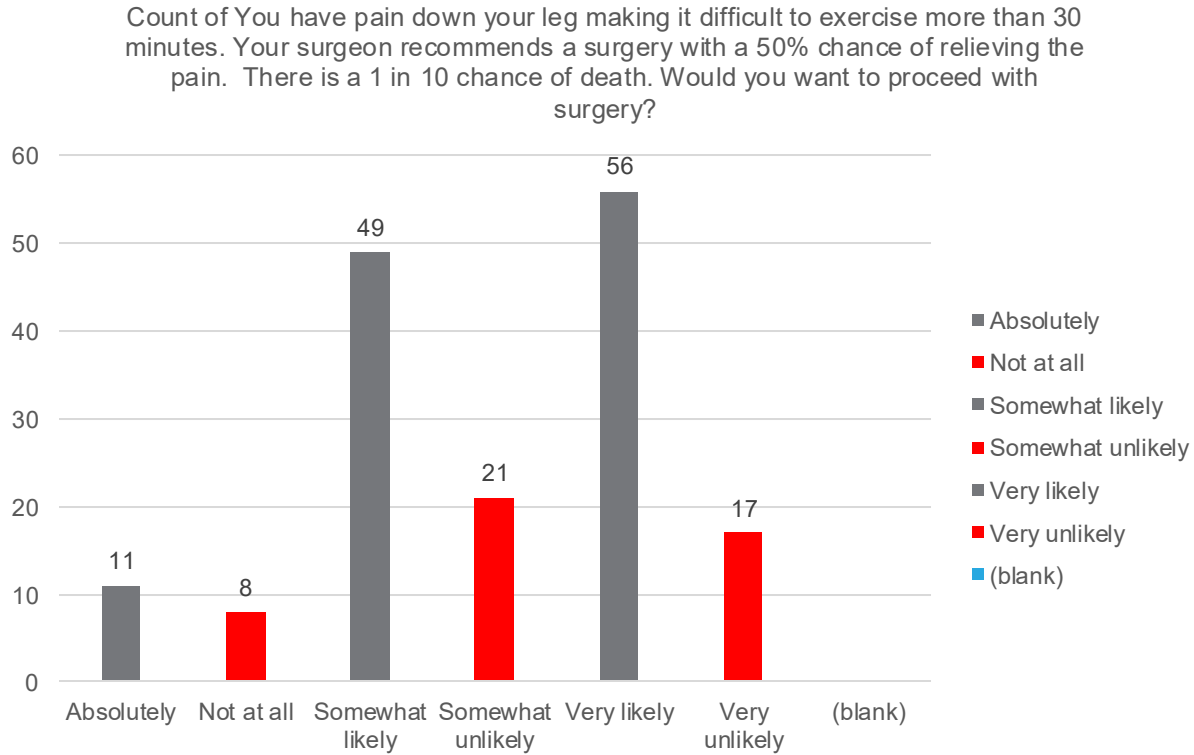
You have pain down your leg making it difficult to sleep.
Your surgeon recommends a surgery with a **90%** chance of improvement.
There is a **1 in 10 chance risk of lifelong numbness** in your leg.
Would you want to proceed with surgery?

Out of 161 subjects, 129 said ”yes” and 32 said “no”

You have pain down your leg making it difficult to exercise more than 30 minutes.
Your surgeon recommends a surgery with a **50%** chance of relieving the pain.
There is a **1 in 10 chance of death**.
Would you want to proceed with surgery?



Yes: 116

No: 46

For half the chance of improvement and risk of death vs leg numbness, only 13 people changed their minds

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People don’t understand statistics

Although surgeons are ”risk-takers” we abhor complications

Are there demographic differences in surgery-yes vs surgery-no

What are the odds of success/failure that lead to surgery-yes vs surgery-no?

Methods

- Used CloudResearch, crowdsourcing platform for US representative sampling.
- Created a 84-question survey with various hypothetical surgical scenarios.
  - **Chance of improvement** (**50% or 90%)** and **complication risks** (**1%, 10%, 50%**).
  - **Choice of surgery** on a 6-point Likert scale (Very unlikely to Very likely)
- Demographics (age, sex, race)
- Socioeconomics (income, education, religion, zipcode Area Deprivation Index or ADI)
- 10-item Oswestry Disability Index (ODI).
- 30-item DOSPERT (validated personality survey) includes 5 domains – financial, recreational, ethical, health, and social

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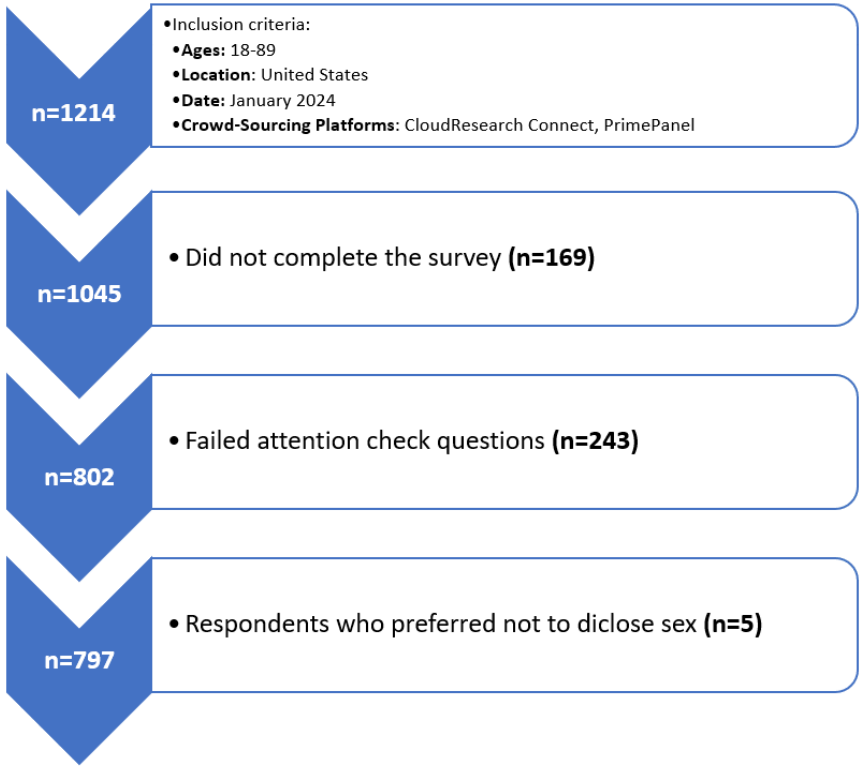
- **797 participants, 386 (48.1%) males and 411 (51.5%) females**
- **Captured ~100 from each age ten-year age group (18 to 89 years).**
- **Distribution is representative of US Census**



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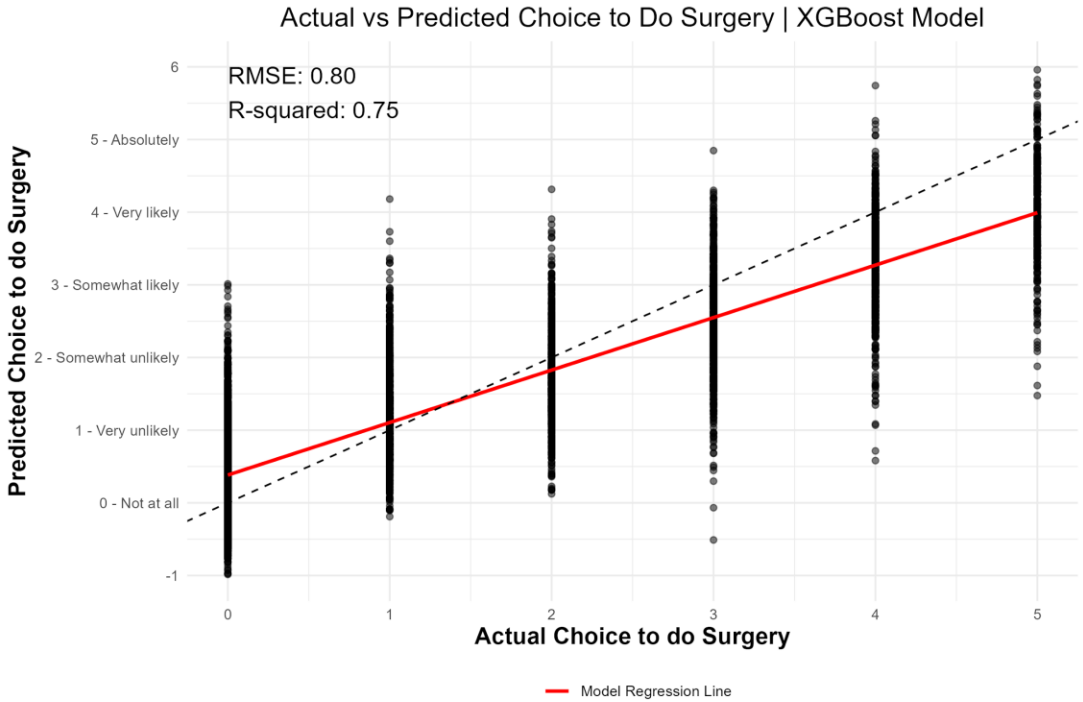
Model Performance

- **RMSE=0.80, R-squared=0.75**



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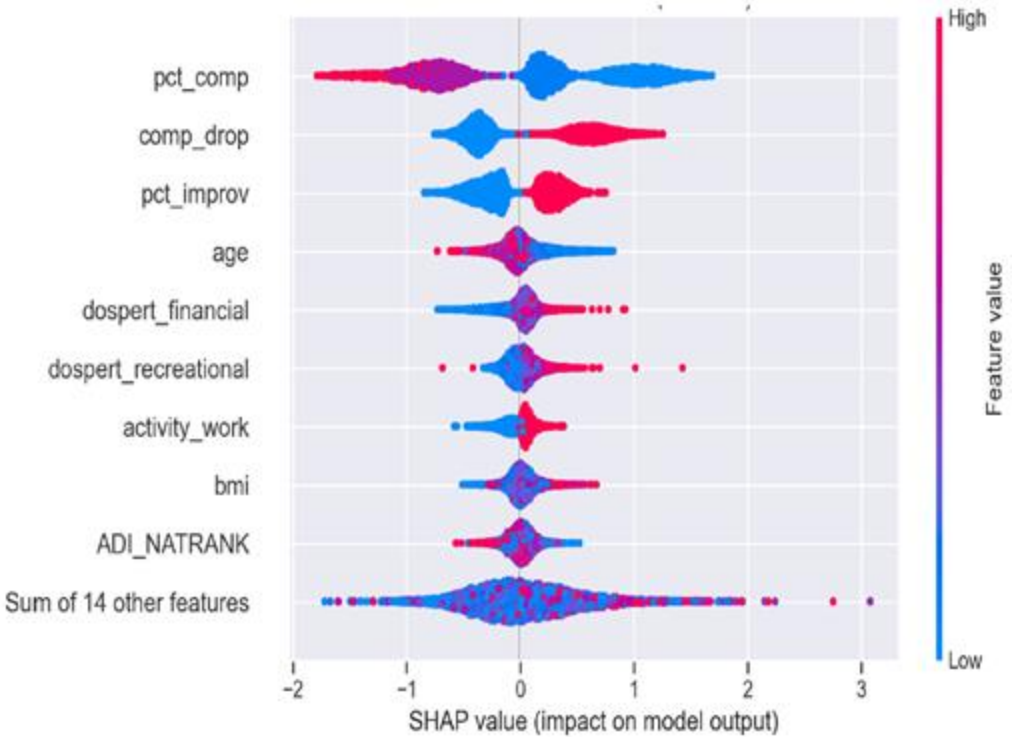
Feature Importance

Top 5 features:

- Higher the *chance of complication* = lower the likelihood of choosing surgery.
- *Type of complication* is foot drop = higher the likelihood of choosing surgery.
- Higher the *chance of improvement* = higher the likelihood of choosing surgery.
- Younger = higher the *likelihood of choosing surgery*.
- More financial risk taker = higher the *likelihood of choosing surgery*.



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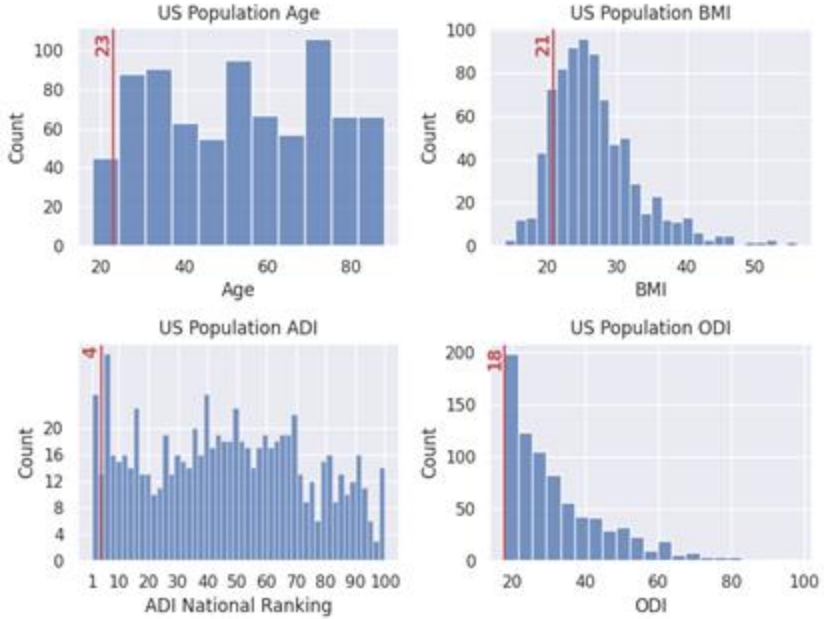
Model Results:

For a surgical scenario that has **50%** chance of improvement from work and a **90%** chance of death, this **23**-year old Asian or Pacific Islander Male with an ODI of **18**, BMI of **20.80**, ADI National Rank of **4**, an annual salary of **$100,000-$124,999**, DOSPERT ethical **5.56%**, DOSPERT financial **13.89%**, DOSPERT health/safety **11.11%**, DOSPERT recreational **55.56%**, DOSPERT social **58.33%**, and a risk score of **0.18** out of **1**, the likelihood of choosing surgery is **1.11%**.



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The goal

Risk Calculators

A Validated Predictive Model for the Safety of Spine Surgery: SpineSage.com

Michael J. Lee, MD, Amy M. Cizik, MPH, and Jens R. Chapman, MD

Healthcare Delivery

Procedure-based postoperative risk prediction using NSQIP data

David E. Clark MD, FACS [a, b], Timothy L. Fitzgerald MD, FACS [a], Albert W. Dibbins MD, FACS [a]

Development of ethnicity-adjusted global alignment and proportion score to predict the risk of mechanical complications following corrective surgery for adult spinal deformity

Abdukahar Kirem PhD [a, †], Zongshan Hu PhD [a, †], Hongru Ma PhD [a], Jie Li PhD [a], Xing Sun PhD [b], Yonjie Xu PhD [a], Chen Ling PhD [b], Hui Xu PhD [a], Zezhong Zhu PhD [a], Yong Qiu PhD [a], Zhen Liu PhD [a, b]

Predicting complication risk in spine surgery: a prospective analysis of a novel risk assessment tool

Anand Veeravagu MD, Amy Li BA, Christian Swinney BA, Lu Tian ScD, Adrienne Moraff ... View More +

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Advanced Rehab & Medical/ Back Pain Relief Clinic/ 45 Urgent Care

New Patient Information

Name_____ ☐ Female ☐ Male Date _____

What you prefer to be called_____Age_____Date of birth _____

Preferred Language ☐ English ☐ Other_____Race: ☐ White ☐ African American ☐ Other _____

Address_____City_____State_____Zip_____

Home Phone_____Cell Phone _____

Email Address_____SS#_____

Employer_____Occupation_____Work Phone_____

Emergency Contact_____Relation_____Phone_____

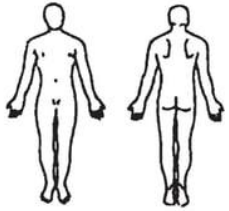
How did you hear about our office? _____

When did your condition begin?_____

Other Doctors seen for this condition? _____

Have you had the same or similar symptoms before? ☐ Yes ☐ No Date of prior condition_____

Mark Areas of Pain on Figures Below



List chief symptoms in order of severity:

(1) _____

(2) _____

(3)_____

Have you had chiropractic care before? ☐ Yes ☐ No

Family Physician/ PCP_____

May we forward our findings to your doctor? ☐ Yes ☐ No

Allergies (Medicine, Food, Environment)

_____

_____

Previous Surgeries _____

Other serious illnesses_____

MEDICAL/FAMILY HISTORY S = Self M = Mother F = Father

(Please indicate which PAST conditions have been experienced prior to present complaint by marking appropriate boxes).

S	M	F		S	M	F		S	M	F	
☐	☐	☐	Heart Disease	☐	☐	☐	polio	☐	☐	☐	hepatitis
☐	☐	☐	anemia	☐	☐	☐	epilepsy	☐	☐	☐	cancer
☐	☐	☐	arthritis	☐	☐	☐	tuberculosis	☐	☐	☐	kidney disorder
☐	☐	☐	asthma	☐	☐	☐	headaches	☐	☐	☐	rheumatic fever
☐	☐	☐	diabetes	☐	☐	☐	rheumatism	☐	☐	☐	HIV/ARC
☐	☐	☐	scarlet fever	☐	☐	☐	multiple sclerosis				
☐	☐	☐	Stroke	☐	☐	☐	high blood pressure				
☐	☐	☐	muscular dystrophy	Other serious illness: _____							

What do you value?

Rank your outcomes

Which risks matter to you?

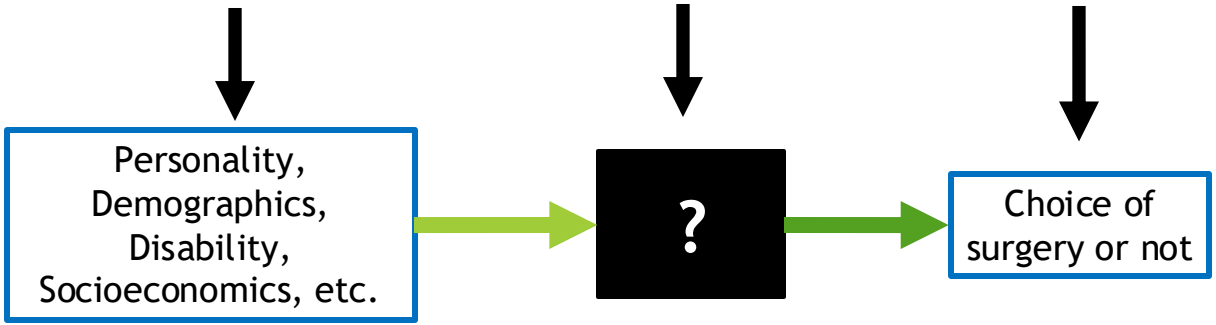
Which risks don’t?

What is your risk aversion or tolerance?

Rather than “here is what patients with your MRI tend to do”, perhaps we need to ask:

What decision do other patients who have the same risk attitudes as you make?

“people like you are more likely to choose this treatment option”



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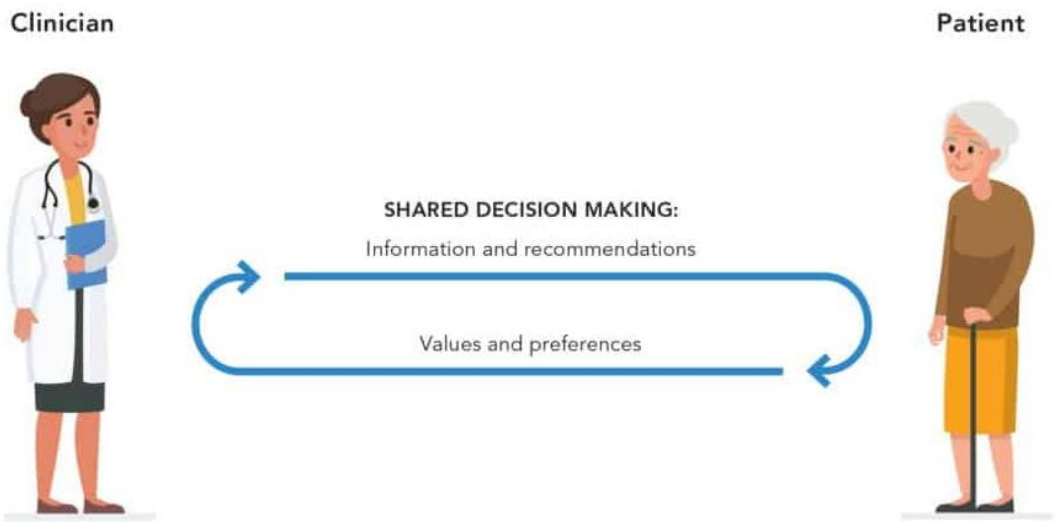
- **Prospective study design**
- **What is a real patient's perspective on risk?**
  - How does the feature importance change?
- **What is a surgeon's perspective on risk?**
  - Can the surgeon's choice of treatment influence the final decision?



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Thank you

Why are all my Patients Getting Fusions? The Bone Health Crisis Behind Spine Fusion Surgery

Neurosciences & Spine Symposium 2026 | Bellevue, WA | May 9, 2026

Eric S. Varley, DO

Center for Neurosciences and Spine
Virginia Mason Medical Center

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Disclosures

- None relevant to this presentation

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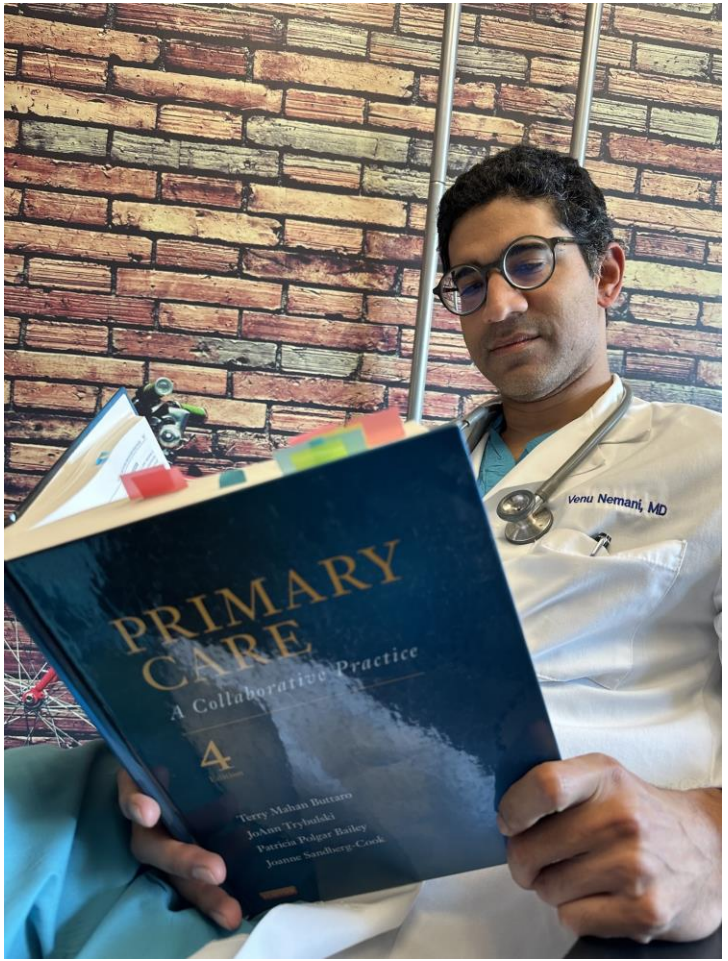
Special Thank You
Dr. Venu Nemani



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BONE HEALTH AND SPINE SURGERY

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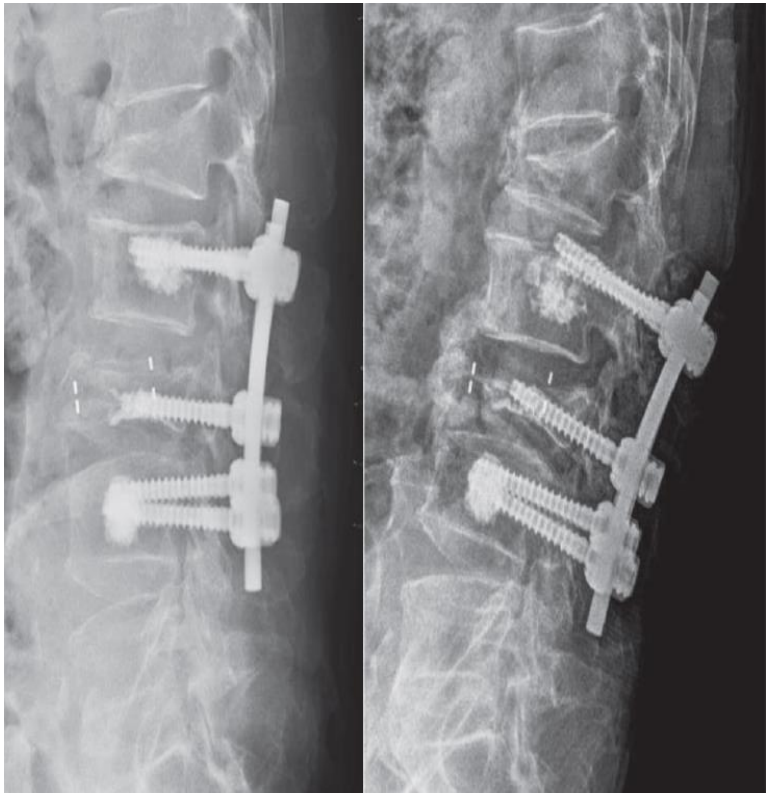
Why Are Fusion Rates Rising?

- Lumbar spinal fusion rates increased >150% over last two decades [1,2]
- Fusion can be a result of a failed prior fusion — but WHY do patients fail?
- One missing piece: underlying bone fragility
  - Progressive deformity, instability, and implant failure



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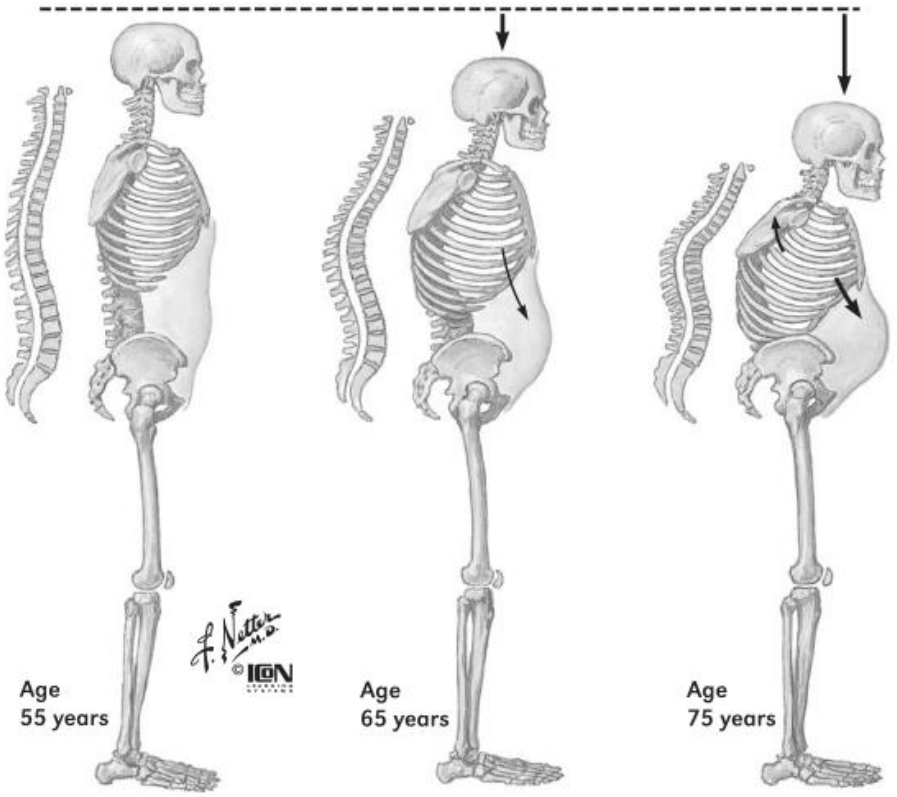
1. Weinstein et al. JAMA. 2006;294:2441-2450
2. Singh et al. World Neurosurg. 2022: 165:e191-196

The Bone Health–Fusion Connection

- Poor bone quality accelerates the conditions that lead to spine surgery:
  - Vertebral compression fractures → progressive kyphosis and deformity
  - Loss of disc height and endplate integrity → segmental instability
  - Screw pullout and hardware failure after fusion → revision surgery



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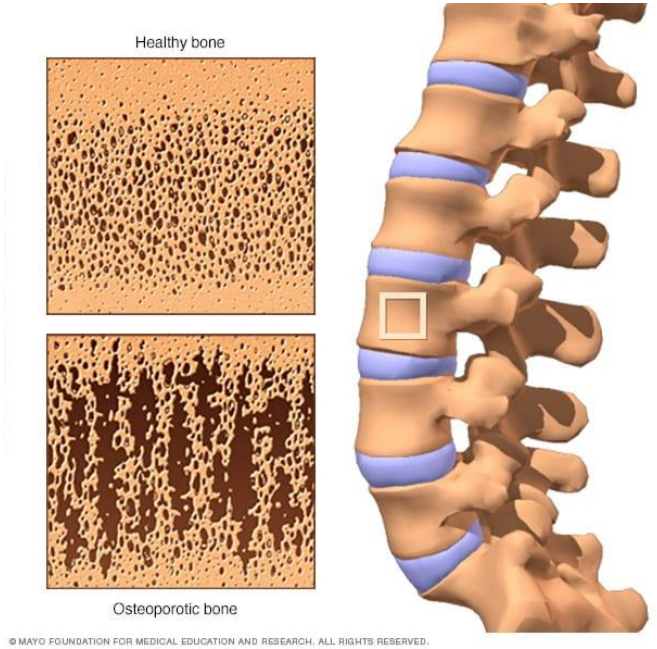
Bone Health & Osteoporosis. Surgeon's Generals Report 2004

The Bone Health–Fusion Connection

- **Osteoporosis** -up to 40% elective spine surgery patients [1]
- **Osteopenia** – additional 40% elective spine surgery patients [1]
- **Untreated** – up to 50% osteoporosis untreated at time surgery [2]
- **Revision** – Untreated osteoporosis ***3X Revision*** rate for single level fusion -vs- normal BMD [3]



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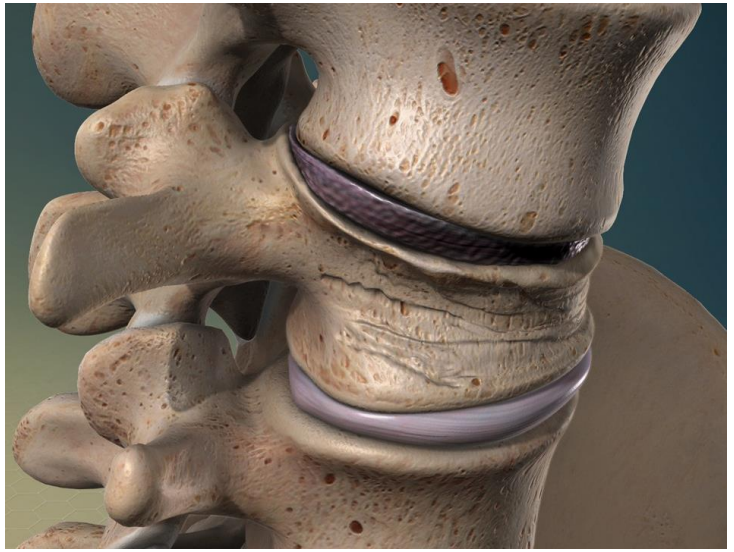
1. Fan. PLOS One. 2023;18(5):e0286110
2. Kohli. Spine. 2025:50(6):420-428
3. Khalid. Neurosurg Focus. 2020;49(2)E6

Osteoporosis by the Numbers

- 10.2 million Americans have osteoporosis; 43.4 million have low bone mass (osteopenia) [1]
- 1 in 2 women and 1 in 4 men over age 50 will suffer an osteoporotic fracture in their lifetime [2]
- Most patients are undiagnosed: only ~20% of women with osteoporosis receive treatment [3]
- Only 50% with osteoporotic fracture persist with treatment >6 months [4]



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1. Wright. J Bone Miner Res. 2014:29(11):2520-6.
2. NOF Guide to Prevention & Treatment of Osteoporosis. 2022
3. Siris. Arch Intern Med. 2004:164(18):2013-21
4. Everhart. J Clin Endrinol Meteb. 2025;110(9):2520-2529.

Why Bone Quality Matters in Spine Surgery

- The spine is the most common site of osteoporotic fracture
- Vertebral fractures occur silently — 2/3 never diagnosed [1]
- Vertebral fracture -> 5X risk of subsequent fracture [2]
- Consequences of untreated fracture cascade:
  - Progressive thoracic kyphosis, respiratory compromise, chronic pain, disability
  - Each fracture level reduces FVC by ~9%
- 40% of adult spinal deformity patients develop bone-related mechanical complications at 8 years [3]

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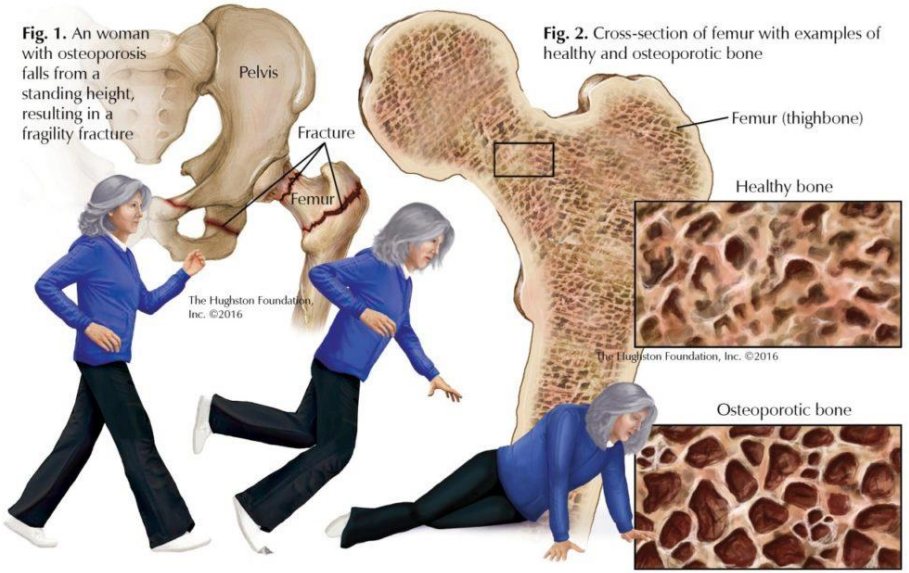
1. Alsoof. Am J Med. 2022:135(9):1107-114.
2. Lindsey. JAMA. 2001:285(3):320-3.
3. Compagnone. Global Spine J. 2025:15(8):3664-3678

Hip Fracture: A Mortality Event in Disguise

- Hip fracture is among the most devastating consequences of osteoporosis
- 24% mortality rate 1 year after hip fracture[1]
- 50% of survivors never regain prior function; up to 25% require long-term care placement
- Hip fracture carries a higher 1-year mortality than many common cancers — yet is largely preventable



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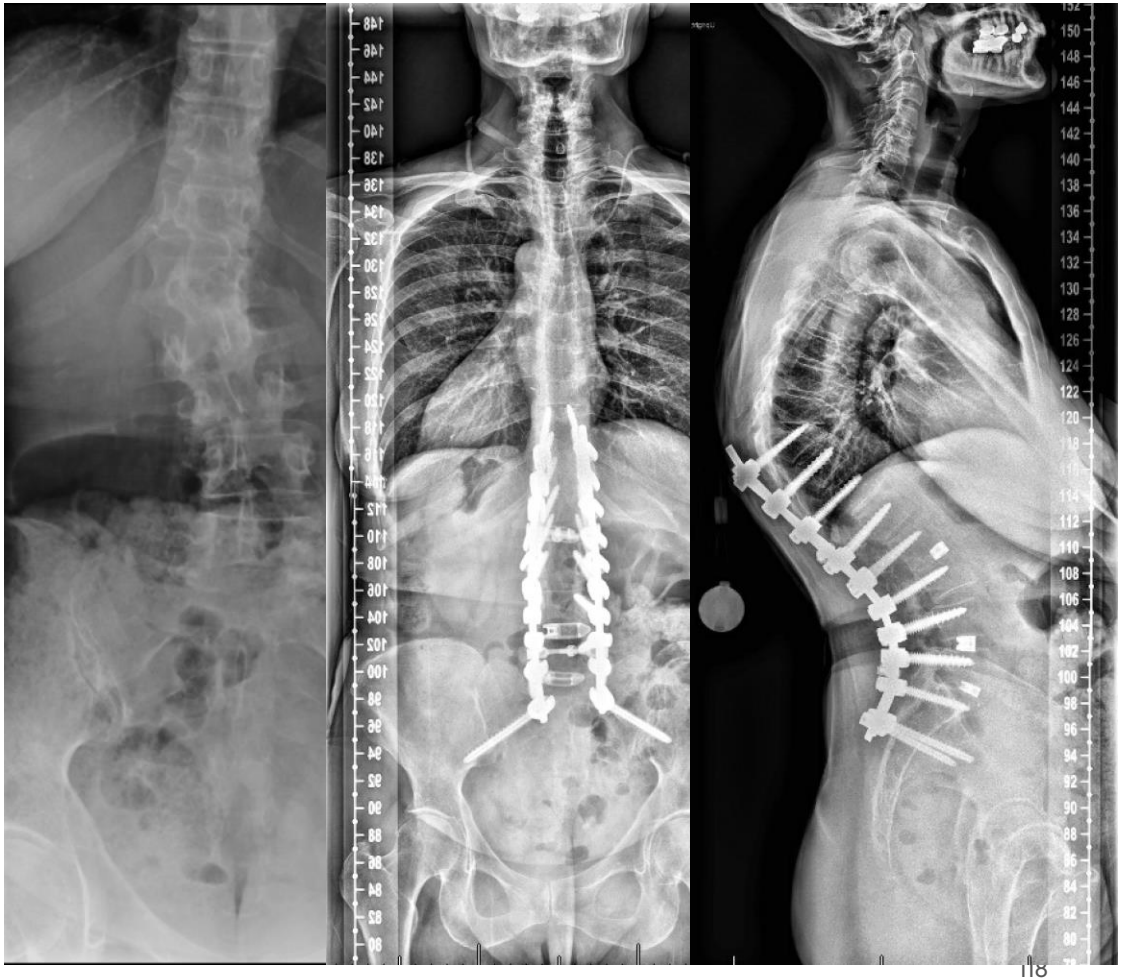
1. Holvik. BMG Geriatrics. 2023:23(1):201
2. Magaziner. J Gerontol. 1990:435(3)

Case Example

- 72-year-old female presented to another surgeon with back pain
- Original presenting X-rays showed a minor scoliosis
- Underwent PSF T10-pelvis within 1 month of initial visit — no optimization performed
- Immediate prominence of instrumentation noted prior to discharge



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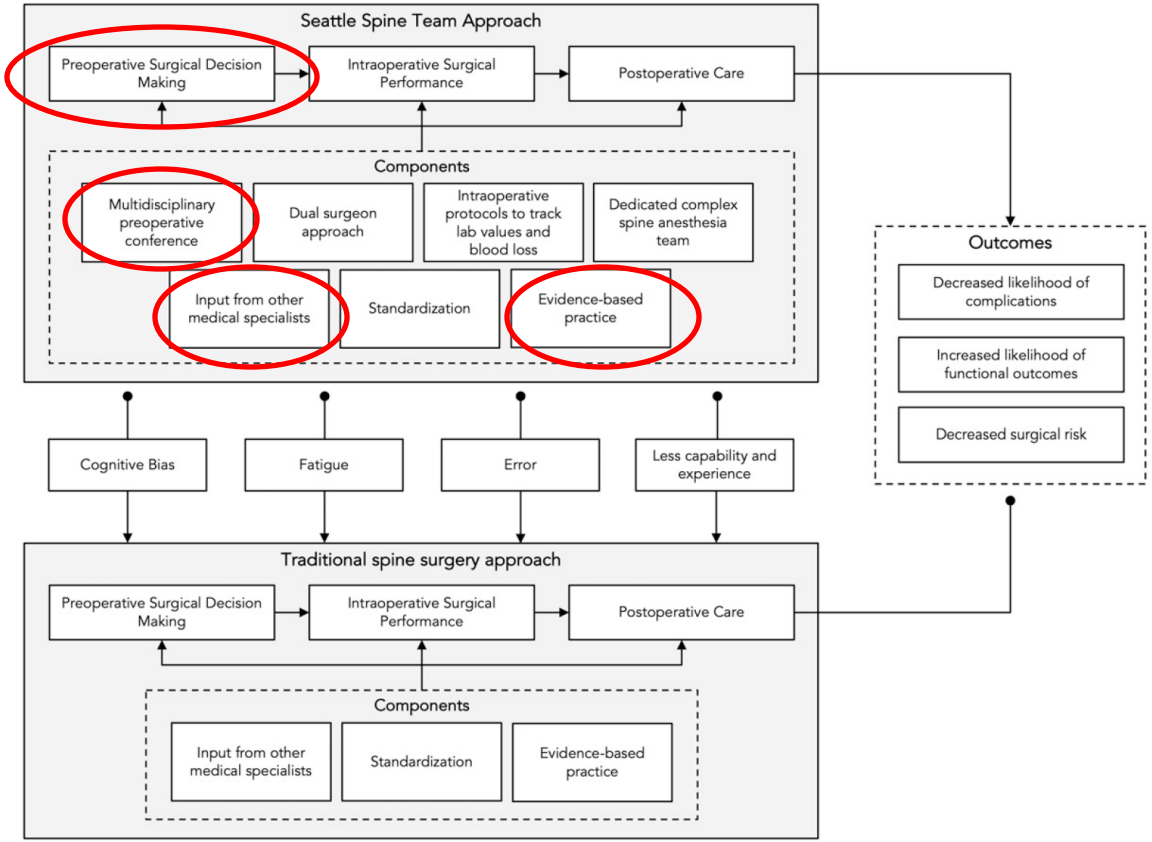
Team Approach: Safety and Value in the Practice of Complex Adult Spinal Surgery



Bone Health Screening and Optimization

Rajiv K. Sethi, MD

Anna K. Wright, PhD

Venu M. Nemani, MD, PhD

Helen A. Bean, MD

Andrew S. Friedman, MD

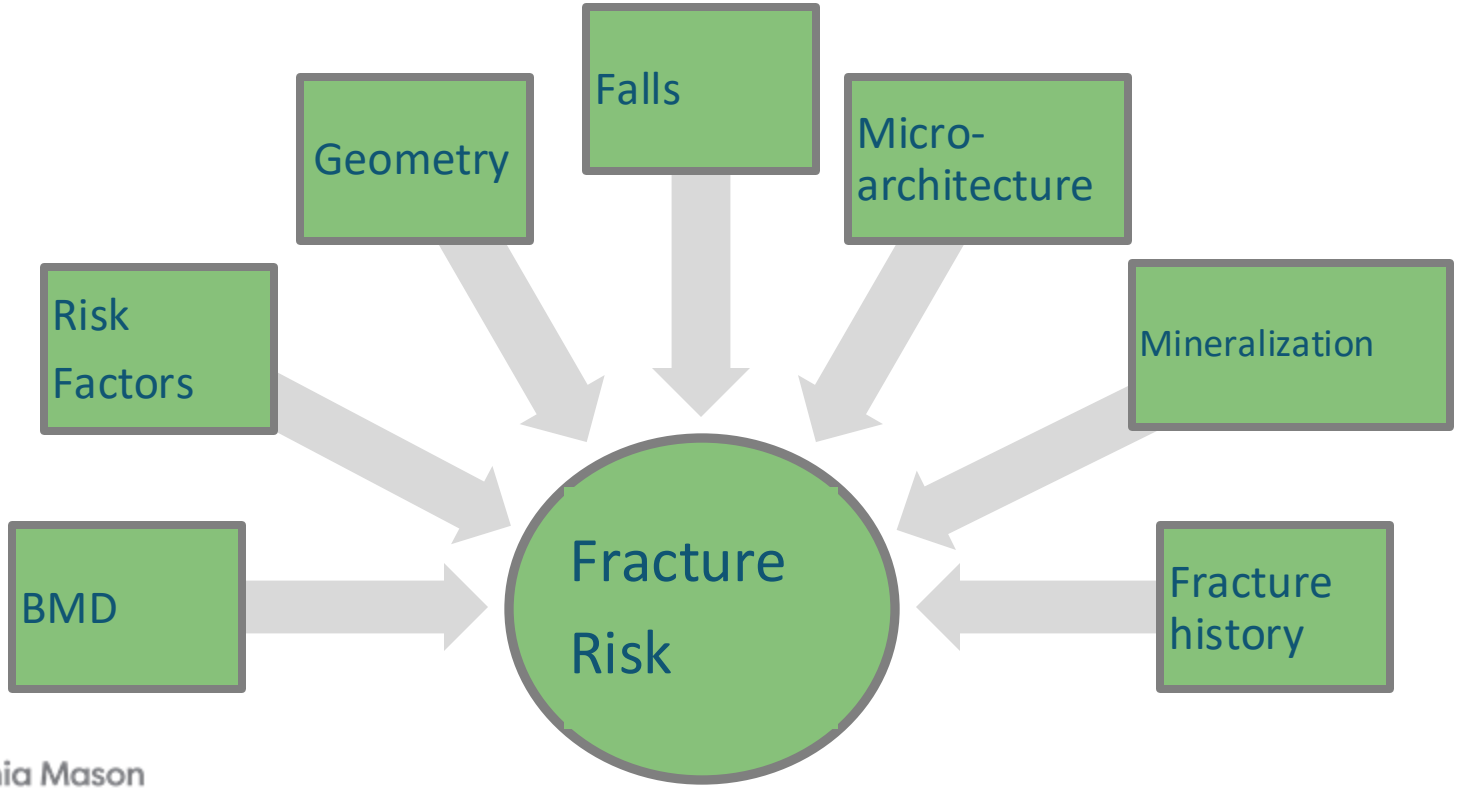
Jean-Christophe A. Leveque, MD

Quinlan D. Buchlak, MBBS

Christopher I. Shaffrey, MD

David W. Polly, MD

Who to Screen for Poor Bone Health?



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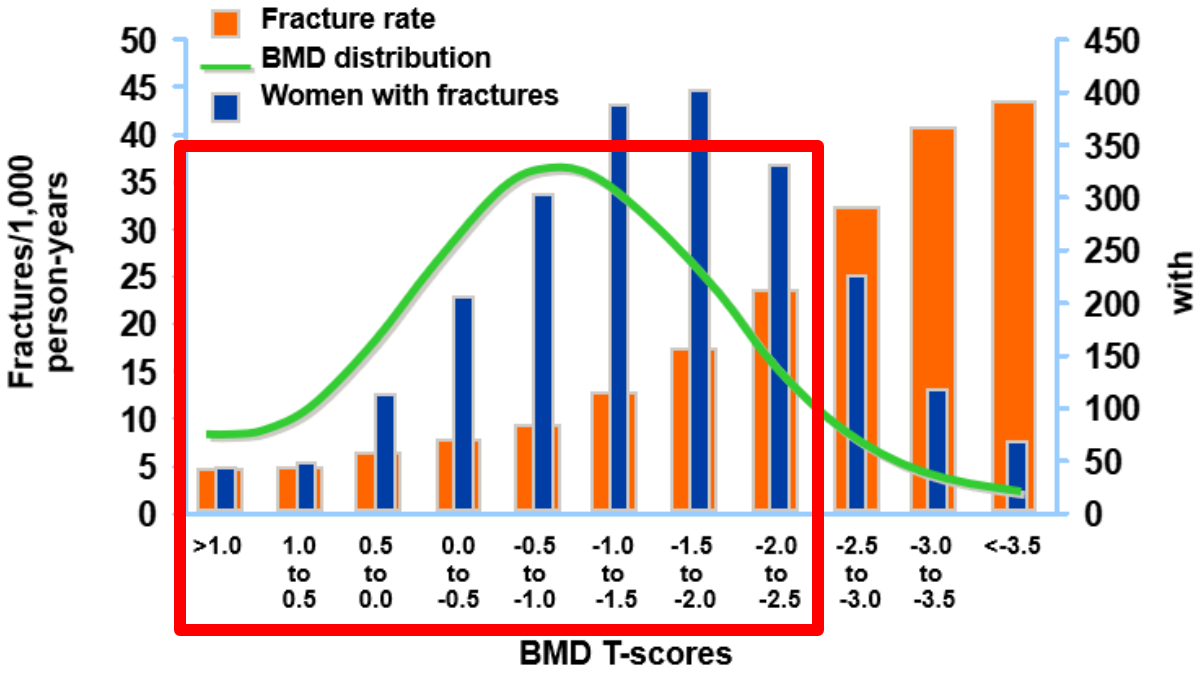
Slide courtesy of Paul Anderson

Fracture Risk Is What We Care About

- Over 50% of fractures occur in patients with T score > –2.5
- BMD alone does not capture full fracture risk



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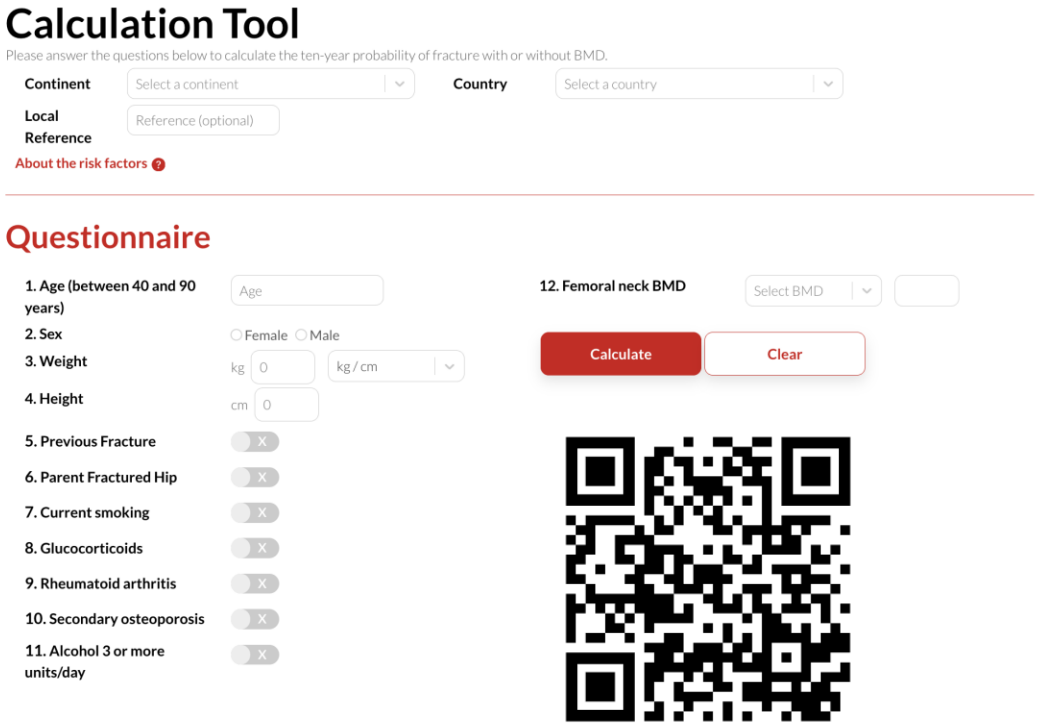
1. Siris. Osteoporosis Int. 2006. 17(4):565-74

FRAX Score

- TOOL: estimates 10-year fracture risk
- CLINCAL OSTEOPOROSIS: 10-year hip fracture risk > 3% - **OR** - major osteoporotic fracture (MOF) risk > 20%
- DOCUMENTATION: Insurance accepts this as a diagnostic criterion
- GOAL: ID patients with high fracture risk -- NOT just low BMD



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FRAX Score

Calculation Tool

Please answer the questions below to calculate the ten-year probability of fracture with or without BMD.

Continent North America | **Country** US (Caucasian)

Local Reference Reference (optional)

About the risk factors

Individuals with fracture risk assessed since 1st June 2011 : 11,445,388

Questionnaire

1. Age (between 40 and 90 years)	72
2. Sex	Female / Male
3. Weight	kg 52 (kg / cm)
4. Height	cm 160
5. Previous Fracture	✓
6. Parent Fractured Hip	X
7. Current smoking	X
8. Glucocorticoids	X
9. Rheumatoid arthritis	X
10. Secondary osteoporosis	X
11. Alcohol 3 or more units/day	X
12. Femoral neck BMD	T-score -2.3

Calculate | Clear

Age : 72 BMI : 20.3 with BMD

THE TEN-YEAR PROBABILITY OF FRACTURE

Major osteoporotic	19 %
Hip Fracture	5.0 %

Adjust your results, try FRAXplus®

What does FRAXplus® do ? Click here

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● DIAGNOSIS: Osteoporosis

So, once You've Diagnosed Increased Fracture Risk...

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So, once You've Diagnosed Increased Fracture Risk... Now What???

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Next Step — Bone Health Assessment

Table 4 – History Questions and Laboratory Evaluation for Secondary Osteoporosis

History Questions:

- Ca and Vit D intake
- Active smoking or nicotine use
- Alcohol intake > 2 drinks per day
- Parental history of hip fracture
- History of bone radiation or bone tumors
- Medication history (e.g. proton pump inhibitors, anti-seizure, long-term steroids)
- Rheumatoid arthritis
- Celiac disease / inflammatory bowel disease / malabsorption / bariatric surgery
- Chronic kidney disease
- Liver disease

Laboratory Evaluation:

Routine

- CBC with differential
- CMP (calcium, phosphate, total protein, albumin, ALT, AST, ALP, creatinine, electrolytes)
- 25-OH vitamin D
- PTH

Additional Tests in Select Patients

- TSH
- Free T4
- SPEP, serum immunofixation, serum light chains
- 24 hour urine calcium and creatinine
- Tissue transglutaminase IgA antibody
- Total testosterone (males)

- **GOAL: 25-OH Vit D Level >30 ng/ml**
  - Calcium supplementation: 1,500 mg/day
  - Vitamin D3: 1,000 IU/day

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Next Step — Bone Health Assessment

Table 4 – History Questions and Laboratory Evaluation for Secondary Osteoporosis

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- **GOAL: 25-OH Vit D Level >30 ng/ml**
  - Calcium supplementation: 1,500 mg/day
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OPTIMIZE MODIFIABLERISK FACTORS ASAP

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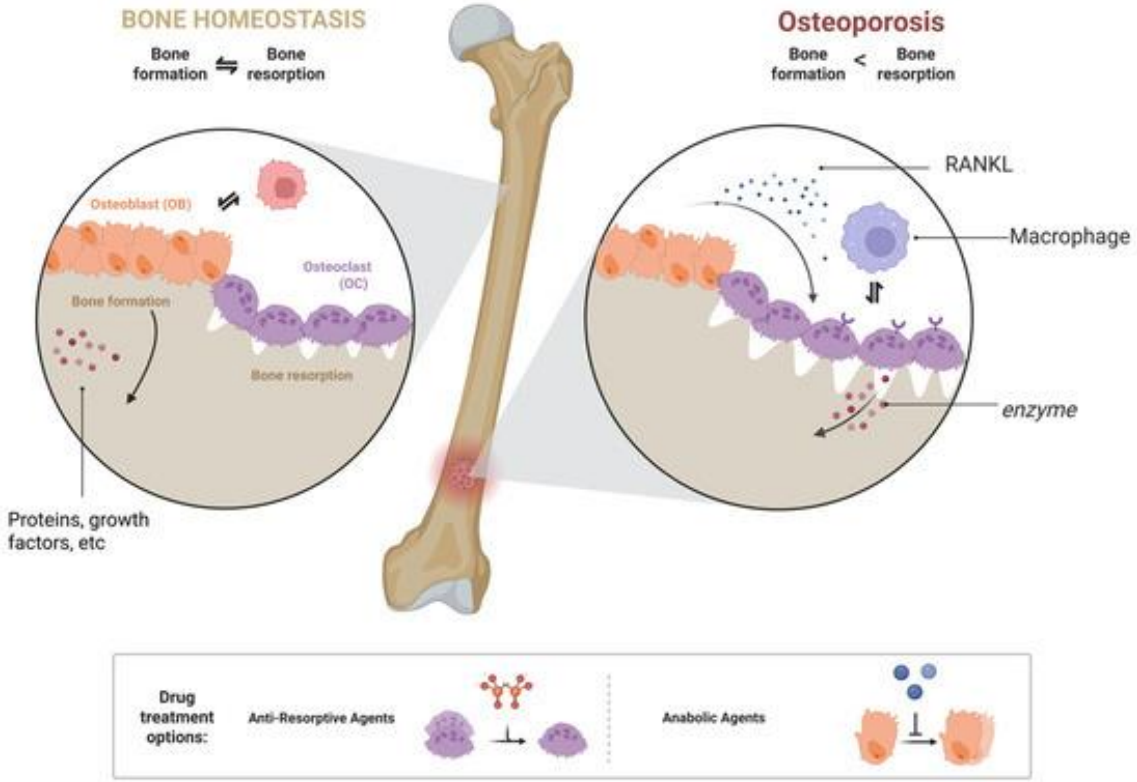
Pharmacological Treatment Overview

Two main categories of agents

- **Anti-Resorptives** — inhibit osteoclast function:
  - Bisphosphonates, SERMs, Denosumab, Romosozumab, Calcitonin
- **Anabolics** — stimulate osteoblast function:
  - Teriparatide, Abaloparatide, Romosozumab



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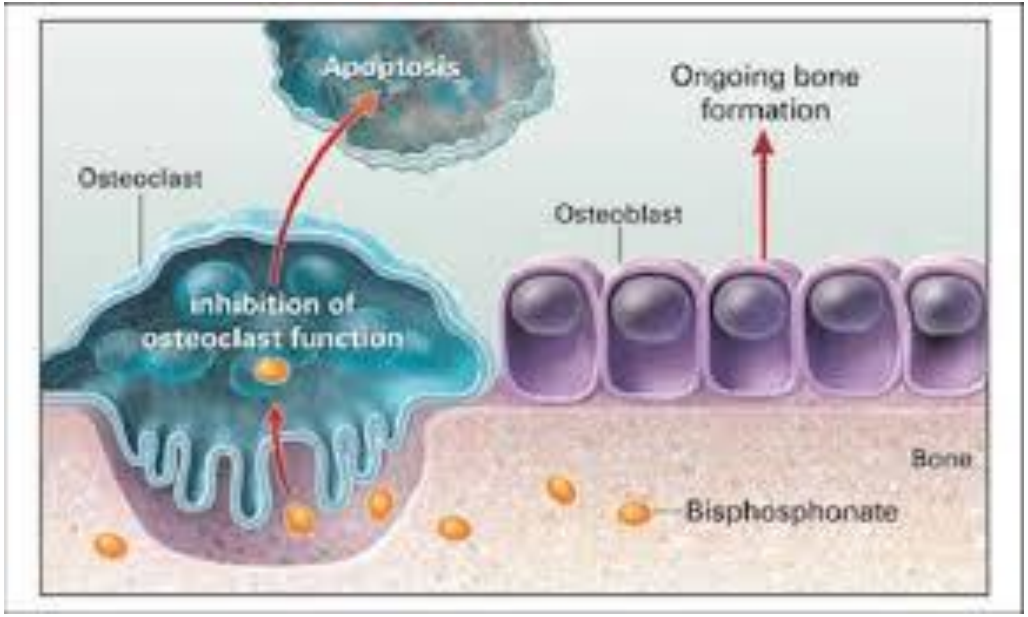
Lin. Pharmaceuticals 2025, 12(12)

Bisphosphonates

- Common meds: Fosamax, Actonel, Boniva
- Mechanism: limit osteoclast activity
- First-line treatment for osteoporosis; favorable long-term safety data
- Costs less than anabolic agents
- Reduce vertebral fracture risk: 40% [1]
- Risks:
  - Osteonecrosis of the jaw
  - Atypical femur fracture: 1.8 → 113/100,000 per person-year
  - 162 fractures prevented per atypical femur fracture



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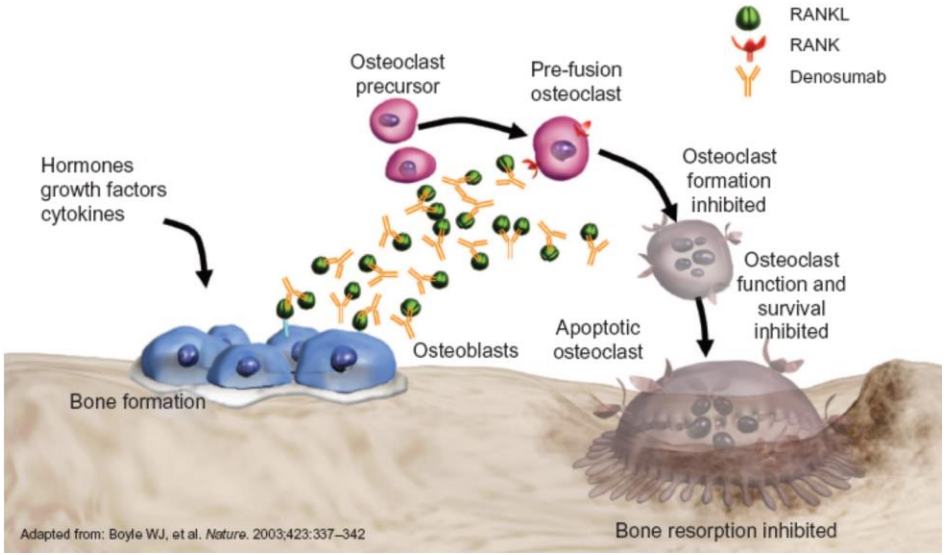
1. Black. N Engl J Med. 2007:356:1809-22

Denosumab

- Mechanism: monoclonal Ab to RANKL; inhibits preosteoclast differentiation
- Safe in mild-to-moderate kidney disease; costs less than anabolics
- Risks:
  - Discontinue; Rapid bone loss and rebound fractures
  - Must transition to another agent
  - ***NOTABLE***: even a 1-month delay in due dose can cause fractures



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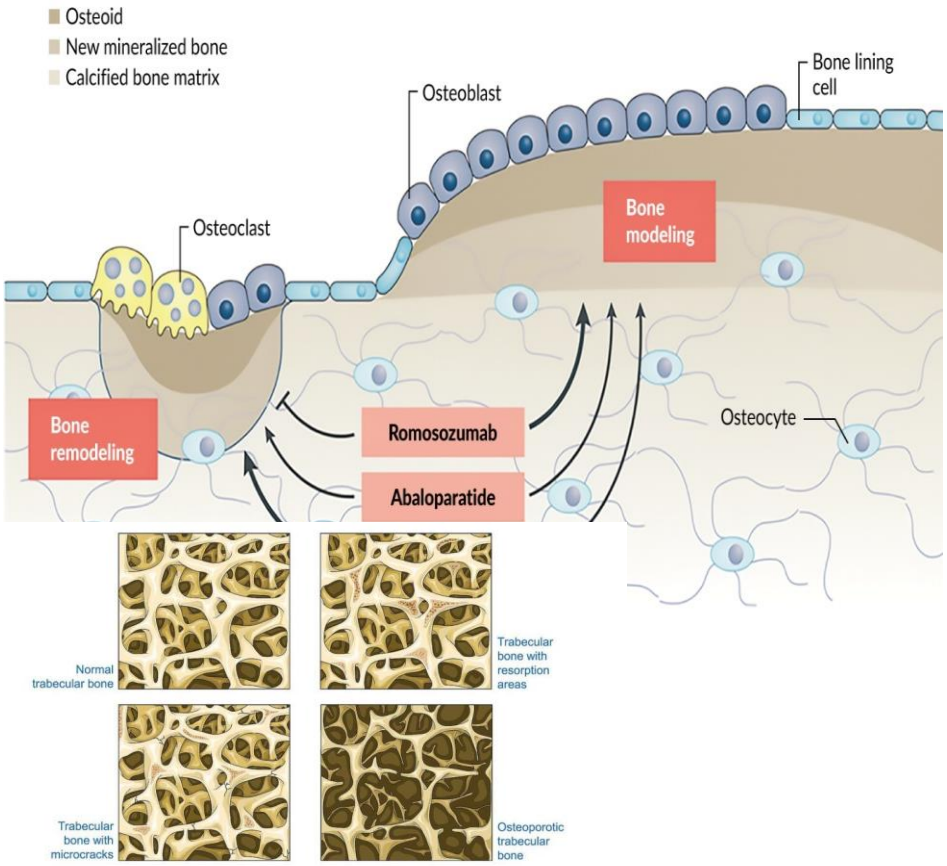
Anabolic Agents



- Indicated in patients with VERY HIGH fracture risk
- Available agents:
  - Teriparatide— PTH analogue
  - Abaloparatide— PTHrP analogue
  - Romosozumab — anti-sclerostin mAb (dual mechanism)
- Increase both bone density - AND - bone quality (trabeculae thickness, number, connectivity)
- Romosozumab also directly inhibits osteoclastic bone resorption
- Reduce vertebral fracture risk: 65%[1]

1. Neer. N Engl J Med. 2001:344(19):1434-41

OK, but does treatment make a difference in outcomes?

Clinical Trial > Eur Spine J. 2017 Aug;26(8):2121-2127. doi: 10.1007/s00586-017-4959-0.

Epub 2017 Jan 23.

Teriparatide versus low-dose bisphosphonates before and after surgery for adult spinal deformity in fem

Shoji S
Kayo S

Bisphosphonate and Teriparatide Use in Tho

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Perioperative teriparatide for preventing proximal junctional kyphosis and failure in patients with osteoporosis after adult thoracolumbar spinal deformity surgery: a prospective randomized controlled trial

Jin-Ho Par

Impact of Frailty and Other Factors as Estimated by HU to Predict Response to Anabolic Bone Medications †

Abdelrahman M. Hamouda [1,‡],
Derrick Obiri-Yeboah [1], Maria A
William E. Krauss [1], Ahmad N. N
Kurt A. Kennel [3], Jeremy L. Fo

The Spine Journal 25 (2025) 1218–1228

Clinical Study

Effect of romosozumab administration on proximal junctional kyphosis in corrective spinal fusion surgery

Yuta Sawada, MD[a], Shinji Takahashi, MD[a,*], Hiroyuki Yasuda, MD[b], Masaki Terakawa, MD[b], Sadahiko Konishi, MD[b], Minori Kato, MD[a], Hiromitsu Toyoda, MD[a], Akinobu Suzuki, MD[a], Koji Tamai, MD[a], Masayoshi Iwamae, MD[a], Yuki Okamura, MD[a], Yuto Kobayashi, MD[a], Hiroaki Nakamura, MD[a], Hidetomi Terai, MD[a]

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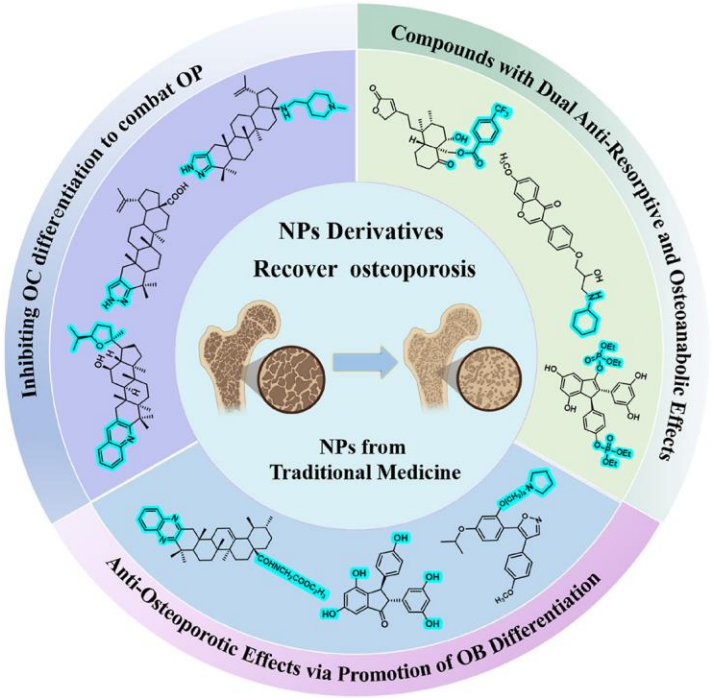
Evidence: Anti-Osteoporotic Medications in Spine Surgery



- Multiple studies evaluate impact of bone health treatment on spine surgery outcomes
- Data encompasses bisphosphonates, denosumab, and anabolic agents
- Outcome measures include: fusion rates, implant failure, mechanical complications, PJF
- Overall trend: treated patients outperform untreated controls
- Anabolics demonstrate superior outcomes compared to anti-resorptives in most studies

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Impact of Teriparatide on Complications and Patient-Reported Outcomes of Patients Undergoing Long Spinal Fusion According to Bone Density

Mohanty, Sarthak BS[1]; Sardar, Zeeshan M. MD, MSc[1]; Hassan, Fthimnir M. MPH[1,a]; Lombardi, Joseph M. MD[1]; Lehman, Ronald A. MD[1]; Lenke, Lawrence G. MD[1]

Author Information

The Journal of Bone and Joint Surgery 106(3):p 206-217, February 7, 2024. | **DOI:** 10.2106/JBJS.23.00272

- 542 patients, >7 level posterior fusion, propensity-score matched, 2 year follow up
- Osteoporotic patients treated with perioperative teriparatide
  - *50% reduction in 2-year reop rate | 70% reduction in symptomatic pseudarthrosis*
- Teriparatide - minimum of 6 months preop and 1 year postop — timing of initiation is critical
- Osteoporotic patients on teriparatide had statistically identical outcomes to patients with normal bone density — treatment effectively eliminated the bone quality disadvantage

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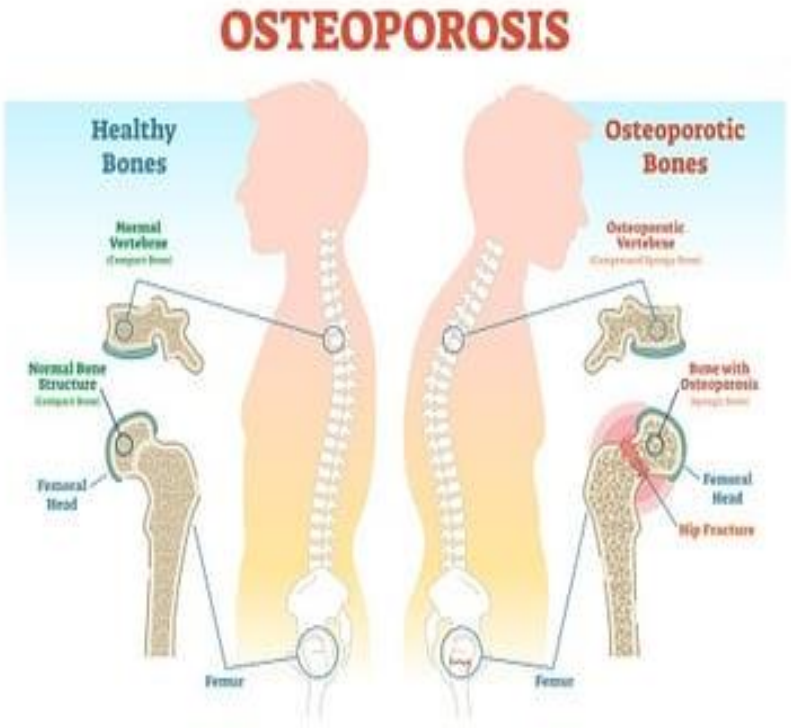
Summary of Evidence

- Bisphosphonates, denosumab, and anabolics all improve bone density
- Anabolics show preferential effect on axial skeleton > appendicular skeleton
- Lower rate of mechanical complications after ASD surgery with anabolics
- Early data suggests romosozumab works fastest among available agents



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How do I get my patient treated?

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Medicare Part D Coverage: What Qualifies

- Teriparatide and romosozumab require prior authorization — ONE qualifies:
  - DEXA: T-score ≤ −2.5
  - Any fragility (low-trauma) fracture
  - FRAX: 10-yr MOF ≥ 20% or hip fracture ≥ 3%
- Planned spine surgery is NOT a qualifying criterion
- Romosozumab: bisphosphonate step therapy required on most plans

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Getting Your Patient Approved: Practical Steps

- Refer to Bone Health Specialist (Rheumatology or Endocrinology)
- Document T-score ≤ –2.5 explicitly — bypasses step therapy on most plans
- Any prior fragility fracture in the chart? Document it — qualifies immediately
- CT Hounsfield units < 110 supports osteoporosis diagnosis without DEXA
- Step therapy required? Zoledronic acid IV 5 mg (single infusion) satisfies it within days
- Letter of medical necessity — cite Mohanty et al. JBJS 2024: teriparatide cut reoperation 23% → 12%; pseudarthrosis 22% → 6%

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And back to our case example

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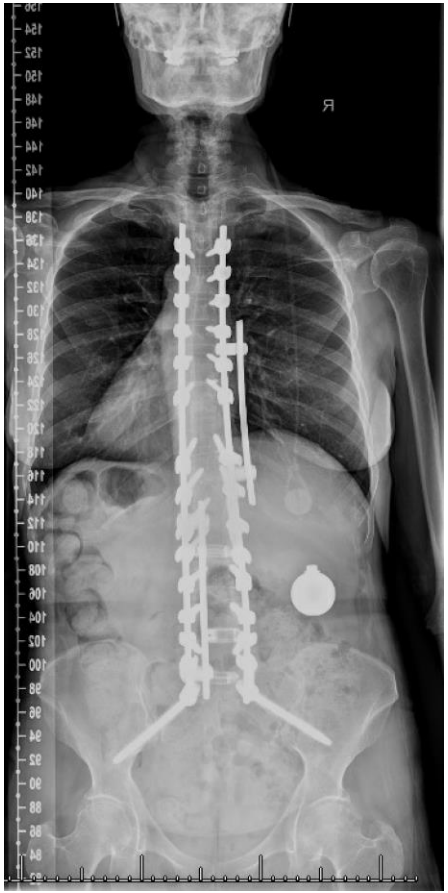

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- 3 months of preop romosozumab prior to complex revision surgery
- Procedure: Revision PSF T4-pelvis, VCR T10, reverse PCO L3-4

Take Home Points

- Osteoporosis/penia often is undiagnosed with potential for devastating outcomes
- Can lead to spine fusion and/or failure of spine fusion
- Work up is critical: Imaging, labs, FRAX score
- Start calcium and vitamin D supplementation early
- Submit appropriate documentation to Medicare for treatment
- Treatment results in substantial improvement in functional outcomes

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Thank you

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The New ”Minimally Invasive Spine Surgery”

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Medical Director of Research and Academics
Center for Neurosciences and Spine
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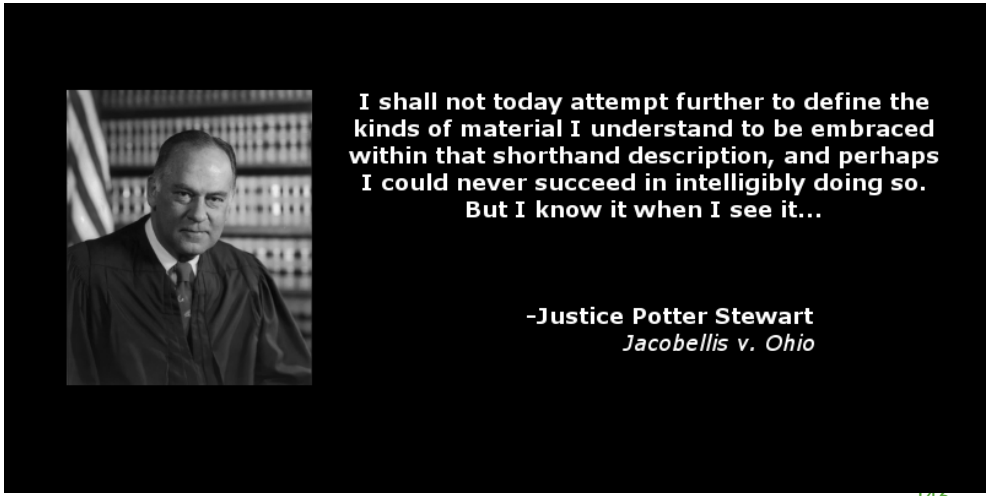
Seattle Spine Team

What is “minimally invasive” spine surgery?

Well… that’s a tricky question…

The definition varies widely depending on who you ask.

Perhaps, Supreme Court Justice Potter Stewart said it best when trying to formally define pornography.



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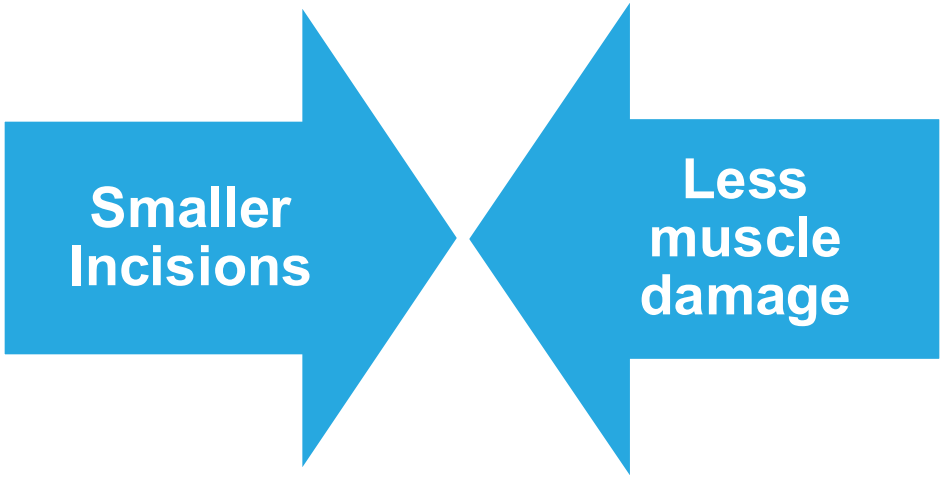
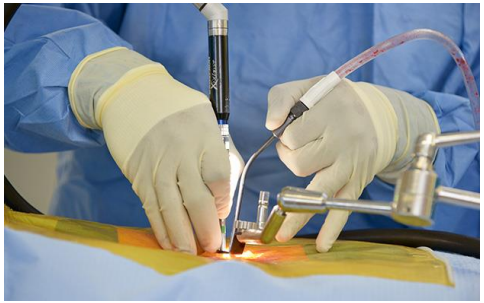
What is “minimally invasive” spine surgery?

2 major principles (and they are very broad)





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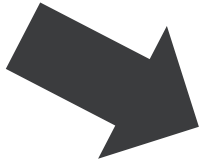
A basic tenet of surgery is to effectively treat pathology with **minimal disturbance of normal anatomy**:
leaving "the smallest footprint."

Most surgical specialties
have embraced this minimalist concept



SMALLER INCISIONS
LESS SOFT-TISSUE DISRUPTION
LIMITED SURGICAL CORRIDORS

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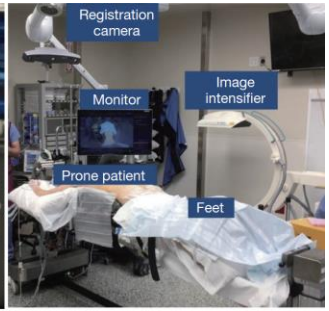
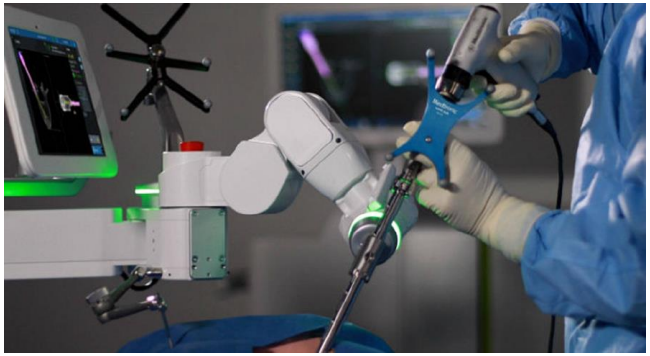
The Role of **Enabling Technologies**

- 3D printing
- Navigation
- Robotics
- Augmented Reality
- Intra-operative Cameras
- Endoscopy





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Augmented Reality

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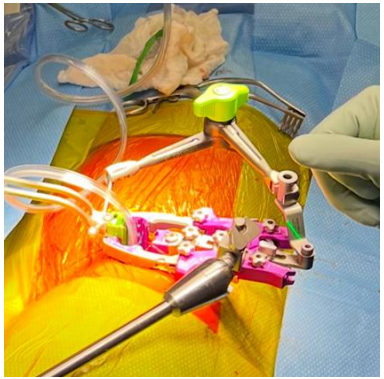
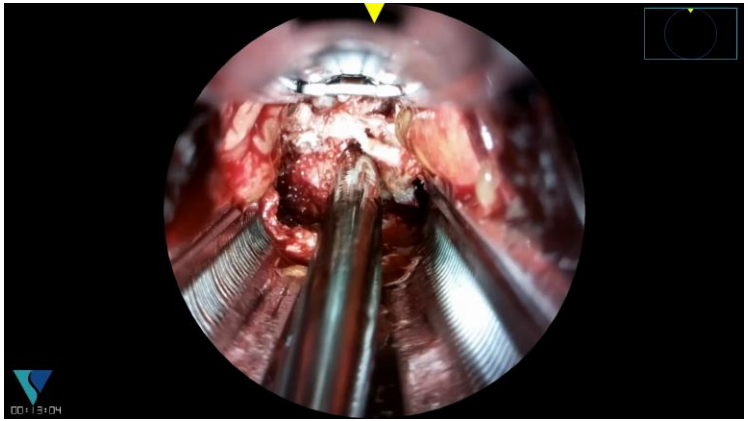
Small Cameras on Tubes and Retractors





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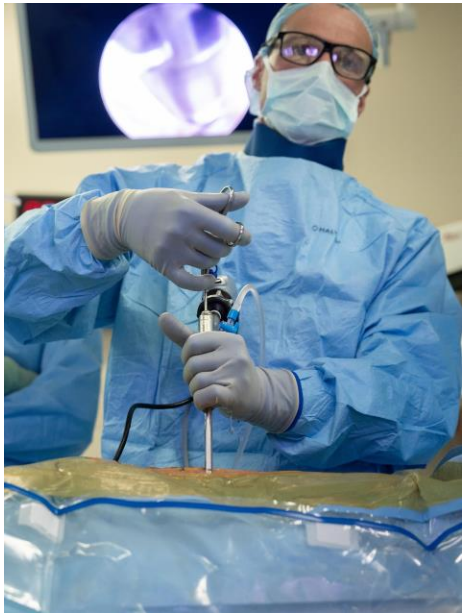
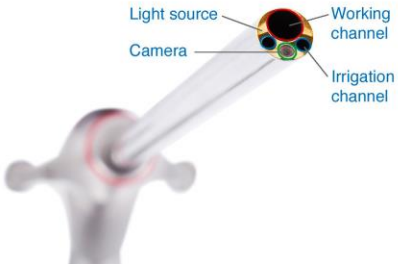
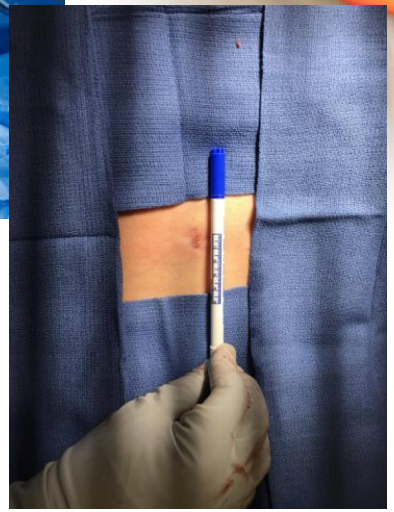
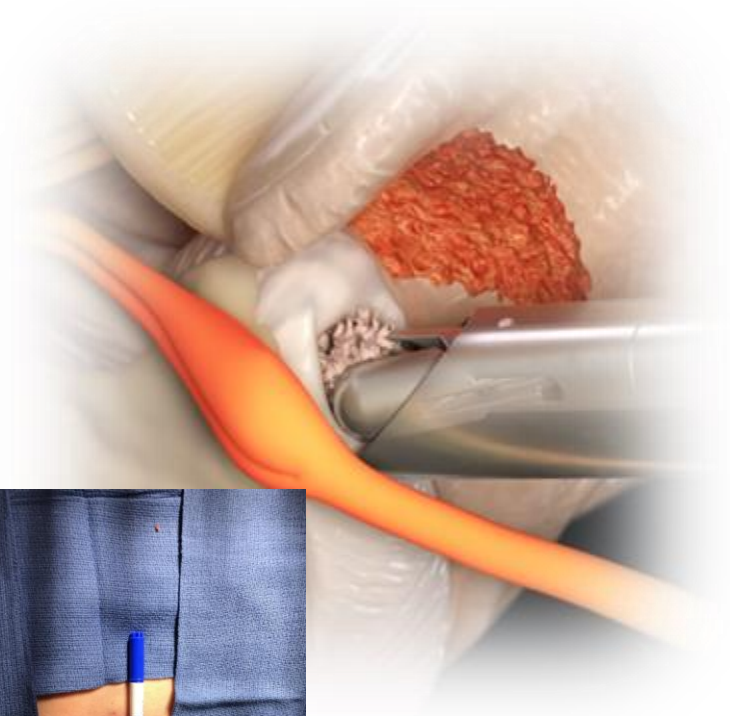
Endoscopy









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The Role of **Enabling Technologies**

Innovation that allows us to **improve the way we care for patients**, and ultimately, **drives meaningful change in how we practice**!

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Its more than just fancy toys and equipment --- it's the little advancements and opportunities that allows to make BIG changes in providing excellent patient care in a cost-effective manner.

"Imagination is more important than knowledge. For knowledge is limited, whereas imagination embraces the entire world, stimulating progress, giving birth to evolution." - Albert Einstein

The Drive to **Ambulatory Surgery Centers** has accelerated the movement towards MIS techniques

- Lower Costs
- Lower infection rates
- More efficient (for everything)
- Higher patient satisfaction
- (Physician Ownership)
- Greater autonomy
- More predictable scheduling
- Convenience and accessibility

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The **Responsible Adoption** of Enabling Technologies

Technology must **serve the patient** … not the surgeon's curiosity, the industry's pitch, or the institution's marketing engine.

- **Smaller incisions are not the goal.** Better outcomes are the goal. MIS is the route, not the destination.
- **Innovation earns its place.** Adopt deliberately, measure honestly, and abandon what doesn't deliver.
- **The surgeon owns the decision.** Tools augment judgment; they do not replace it.

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Five Questions to **Ask Before We Adopt**

1. **Does it improve outcomes that matter to the patient?**

   Pain, function, return to life; not just radiographic elegance.

2. **Does it reduce the morbidity of the approach?**

   Less blood loss, less soft-tissue disruption, faster recovery; with no compromise to the goals of the operation.

3. **Is the evidence honest?**

   Independent data, real comparators, real follow-up; not industry case series.

4. **Does the value justify the cost?**

   Capital, disposables, OR time, learning curve; the patient and the system both pay.

5. **Can I still operate without it?**

   Fluency comes first. Master the fundamentals; the technology should extend the surgeon, never define one.

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Thank you

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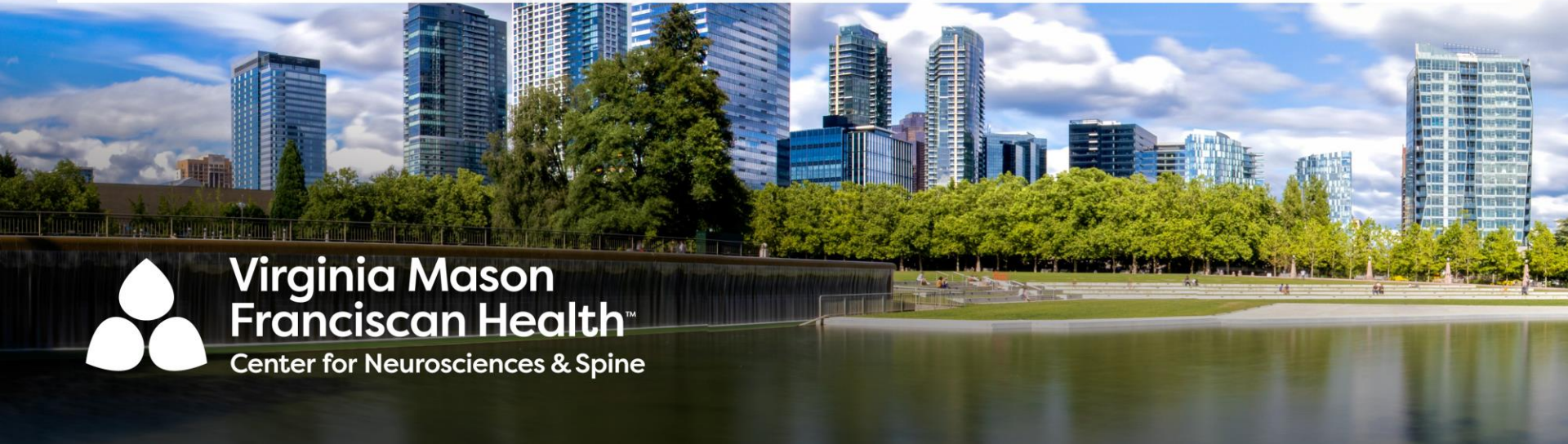
Question & Answer

Audience - please raise hand for roaming mic

Virtual Attendees - please click on Q&A button



Lunch and Exhibits