Chronic Low Back Pain & Interventional Spine Procedures

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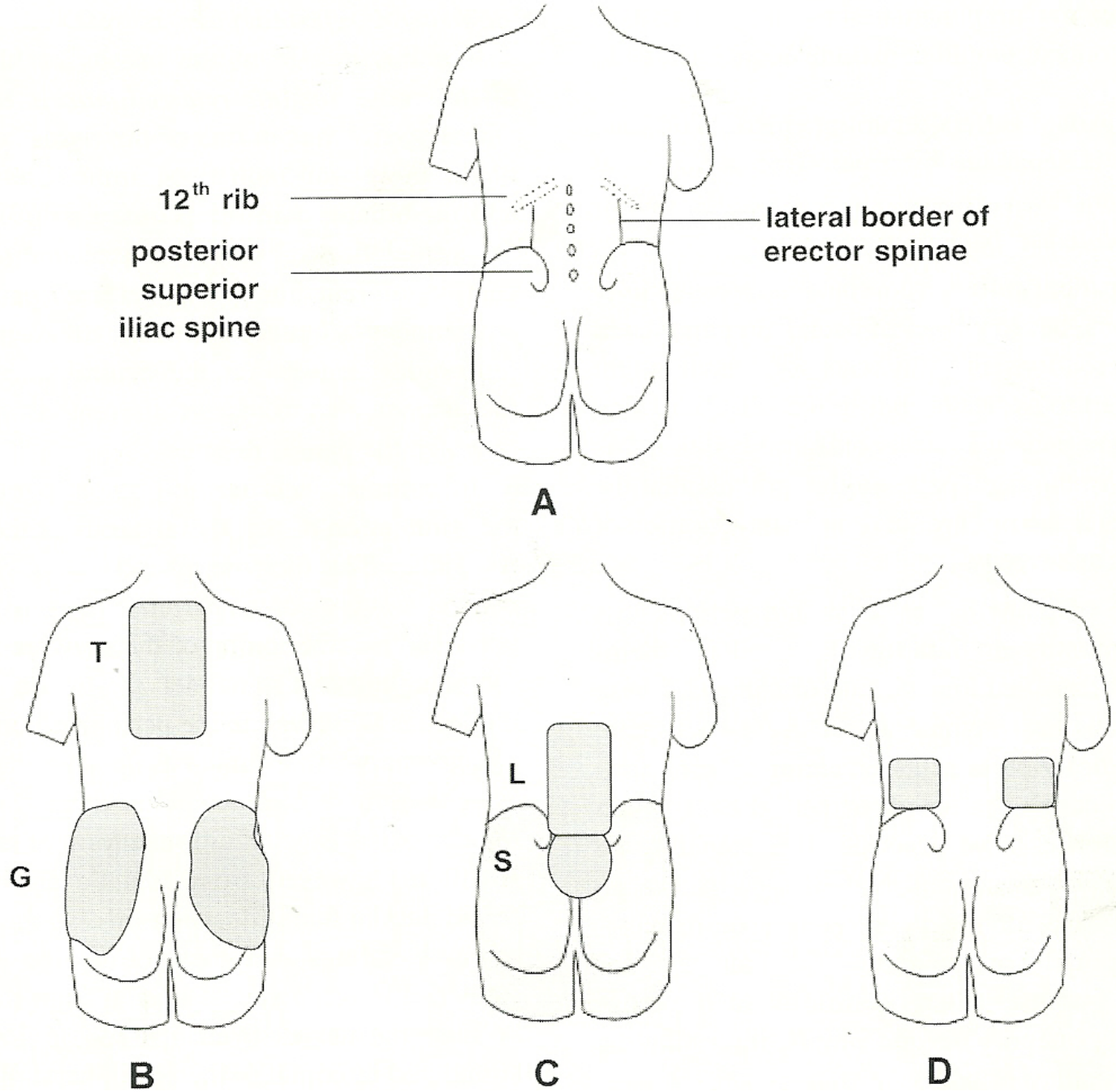
Epidemiology

- 80% lifetime prevalence
- Common reason for physician visits in the United States (2nd or 3rd leading cause)
- Most common cause of disability in patients < 45 years old

Definition

- Pain, muscle tension or stiffness localized below the costal margin and above the inferior gluteal folds, with or without leg pain
- International Association for the study of pain (IASP)
  - Low Back Pain
    - Lumbar spinal pain
    - Sacral spinal pain
    - Lumbosacral pain
  - Gluteal and Loin pain (not considered LBP)


12th rib
posterior superior iliac spine
lateral border of erector spinae
A
T
G
B
L
S
C
D

Classification

- **Mechanical** (HNP, OA, spinal stenosis, spondylolisthesis, compression fracture)
- **Nonmechanical**
  - Tumor (metastases, MM, lymphoma)
  - Infection (osteomyelitis, diskitis)
  - Inflammatory arthritis (RA, AS)
- **Visceral disease** (AAA, nephrolithiasis, pancreatitis, prostatitis, PID)

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Classification

- **Complicated** ("Red Flag" conditions)
- **Specific Diagnosis**
  - Lumbar Radiculopathy
  - Lumbar Spinal Stenosis
  - Others such as Ankylosing Spondylitis
- **Uncomplicated (Non-Specific)**
  - A diagnosis of exclusion

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“Red Flags”

1. **Metastatic CA** (**History of cancer***, Unexplained weight loss, Rest pain, Age >50)
2. **Infection** (**Unexplained fever***, Recent bacterial infection, Immunosuppression, IVDA)
3. **Fracture** (**Steroids***, Osteoporosis, Recent trauma, Age >70)
4. **Cauda Equina Syndrome** (Urinary retention or incontinence, Saddle anesthesia, Decreased rectal tone, Bilateral lower extremity weakness/numbness)
5. **Severe or progressive focal neurologic deficit**
6. **Failure to improve with therapy**
7. **Pain > 4 weeks**

(* Most important in the condition)

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“Red Flags”

1. **Compression Fracture (4%)**
2. Metastatic CA (0.7%)
3. Cauda Equina Syndrome (0.04%)
4. Infection (0.01%)

Compression Fracture

- Osteoporosis
- Location
  1. Thoracolumbar junction
  2. Midthoracic spine
- Pain may not be localized to the level of fracture, as thoracolumbar fractures may present with low back or lumbosacral pain.

Cancer

- **Past history of cancer** is by far the single strongest indicator of cancer related low back pain.
  - Metastatic (Prostate, Lung, Breast)
  - Multiple myeloma
  - Lymphoma
- Increases post test probability from 0.7% to 9%
- Not including nonmelanoma skin CA

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Cauda Equina Syndrome

- Large central disc herniation (L4-5)
- Urinary retention (Retention develops initially and leads to overflow incontinence later.)
- Normal post-void residual essentially rules it out.
- Surgical emergency

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Nonspinal LBP

1. AAA
2. Nephrolithiasis
3. Pancreatitis
4. Prostatitis
5. PID

* Most spinal cause of low back pain will be aggravated by spinal movement.

Lumbar Radiculopathy

- L4-5 or L5-S1 levels (90%)
- Inflammation > Mechanical compression
- Phospholipase A2, TNF-α
- Pain with sitting, bending and coughing
- Pain radiates below the knee in a narrow band.

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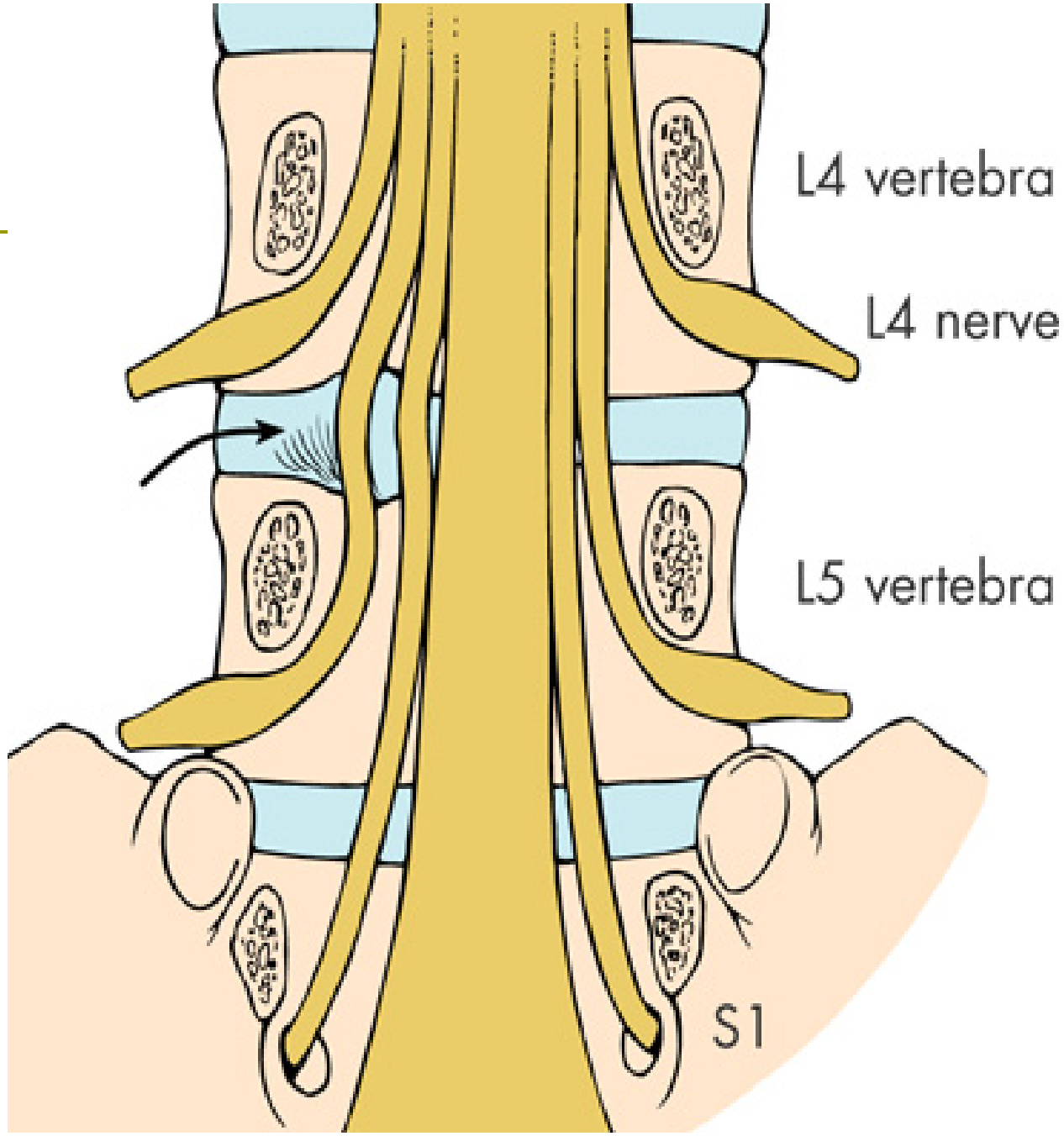
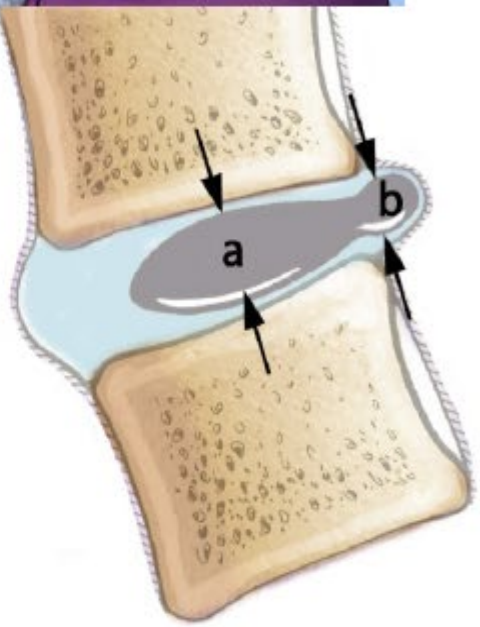
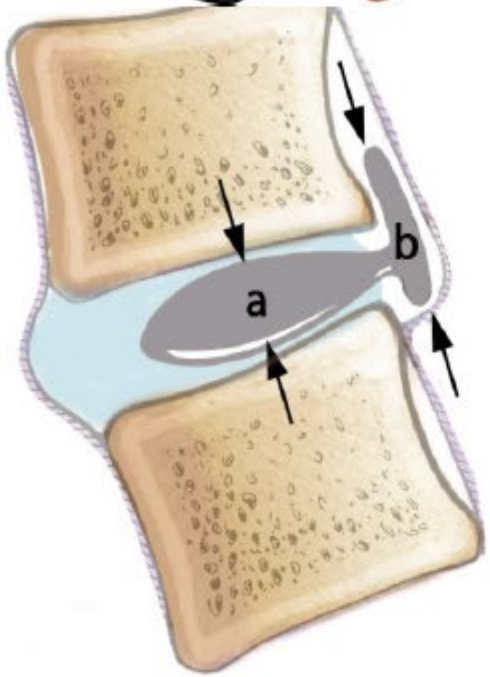
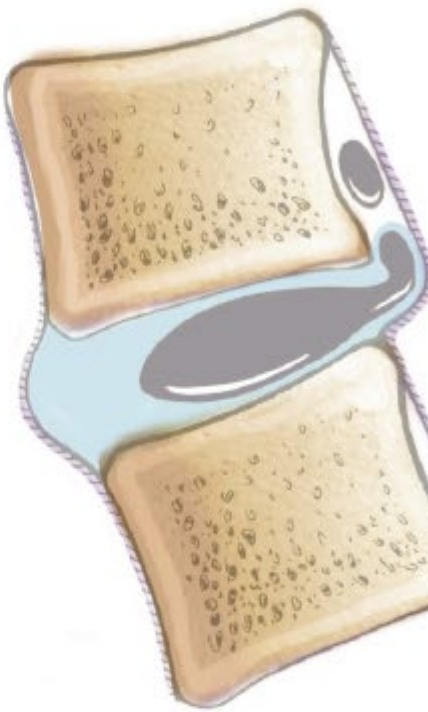

L4 vertebra
L4 nerve
L5 vertebra
S1







A. Bulge

B. Protrusion

a > b

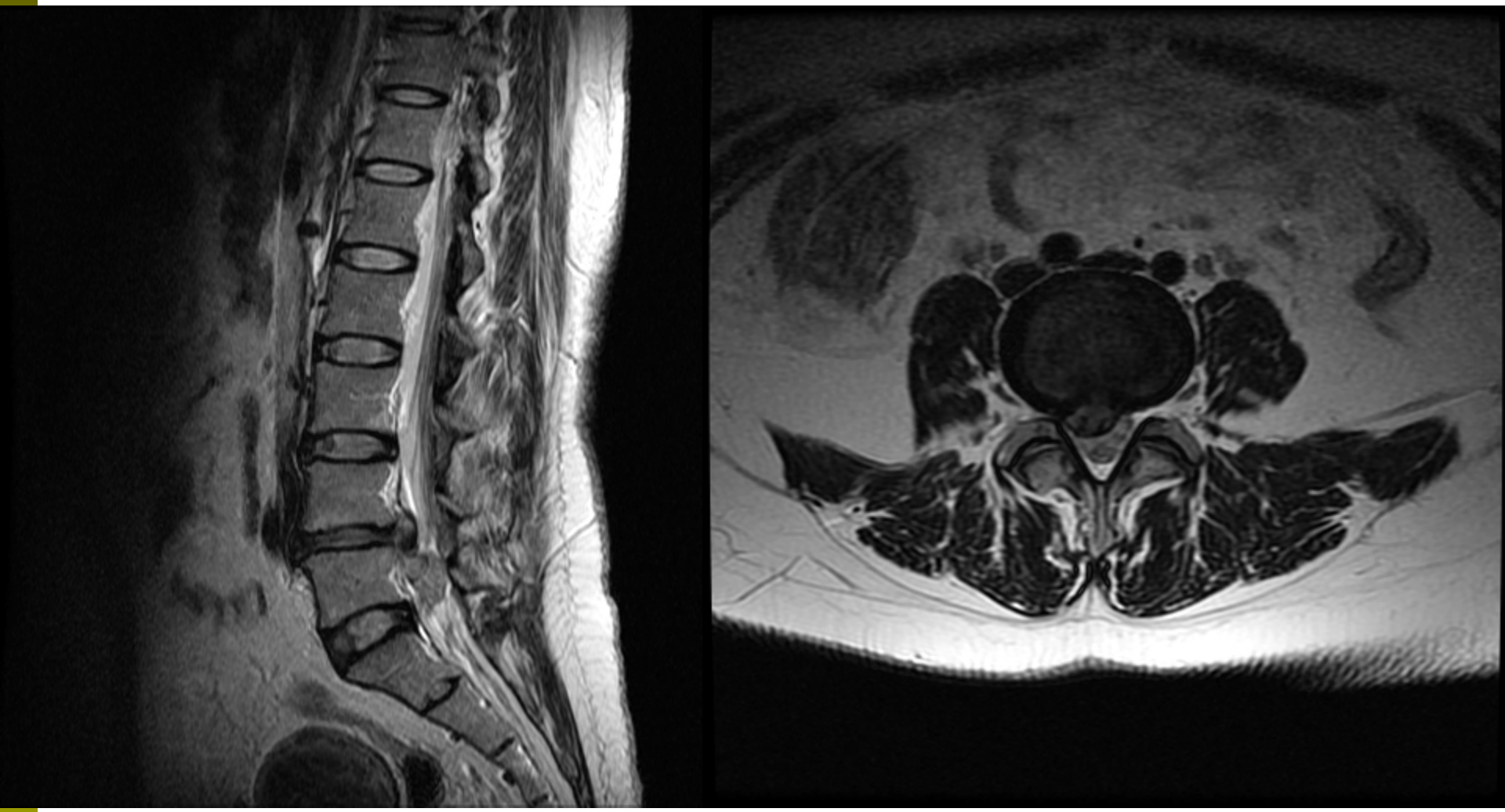
Max. diam. at base

C. Extrusion

b > a

Max. diam. exceeds base; migration from parent disc

D. Sequestratio



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Lumbar Radiculopathy

Nerve Root	Pain Referral	Motor	Sensory	DTR
L4	Medial leg	Ankle dorsiflexion	Medial ankle	Knee
L5	Lateral leg, dorsal foot	Great toe dorsiflexion	First web space between 1st and 2nd toe	No reliable reflex
S1	Posterior calf, lateral or sole of foot	Foot plantar flexion	Lateral aspect of the sole of foot	Ankle

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Not all leg pain is from sciatica.

- Uncomplicated low back pain is often referred to lower leg. (somatic referred pain)
- Ask “Where is the pain worst?” “Where do you feel the pain most consistently?”

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Radicular vs. Referred Pain

Radicular Pain	Somatic Referred Pain
Leg > Back	Back > Leg
Shooting, Lancinating, Cutaneous component	Dull, Pressure-like, Deep
Travels along the limb in a narrow band	Extends into limbs across a wide region
+/- neurologic deficit	- neurologic deficit

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Lumbar Radiculopathy

- Listing away from the side of disc herniation (paracentral herniation)
- Straight-leg-raise (SLR) for L5 or S1 root.
  - Reproduction of radicular pain between 30-70°
  - High sensitivity but low specificity
  - Crossed SLR is more specific but less sensitive.

Natural History

- Favorable
- Conservative and surgical treatments are both successful.
- Large extruded discs are more likely to decrease in size.

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Surgery vs. Prolonged Conservative Treatment for Sciatica – NEJM 2007

- Prospective randomized
- 283 patients with severe sciatica for 6 to 12 weeks
  - 141 → Early Microdiskectomy (2.2 weeks)
  - 142 → Conservative treatments
- Faster pain relief in surgery
- Same 1 year outcomes

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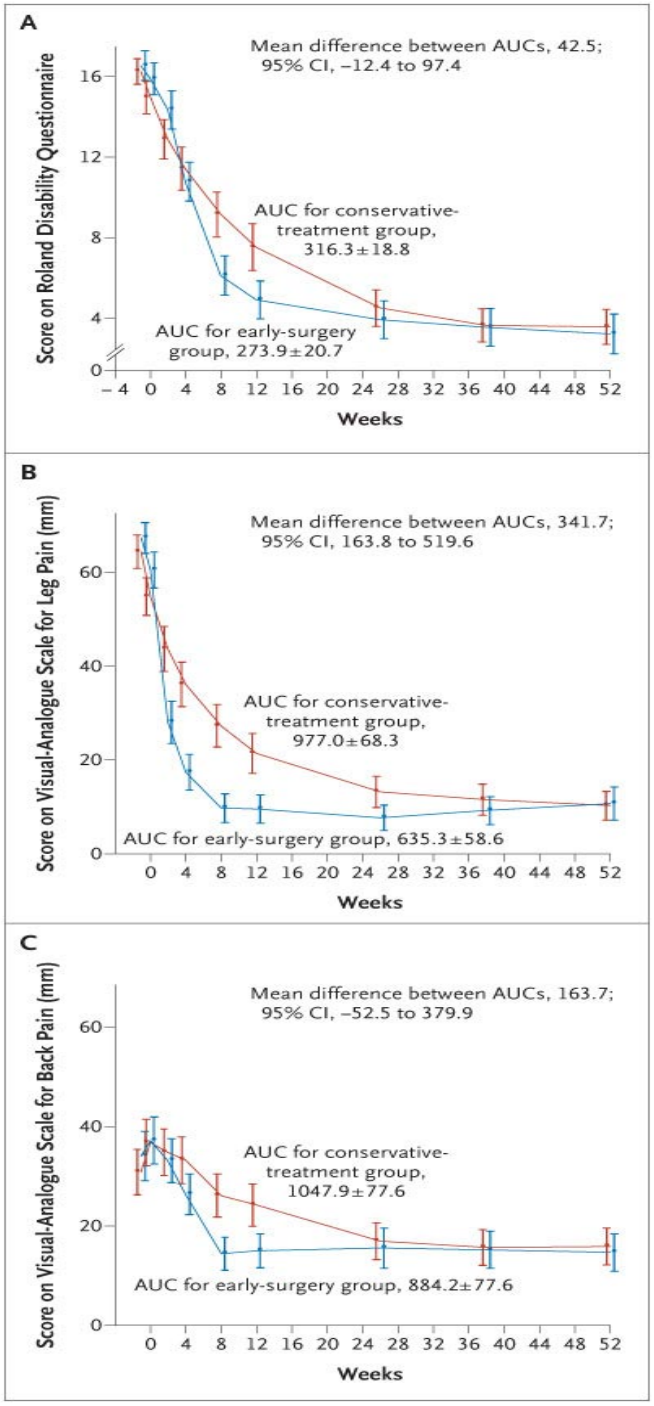
A
Mean difference between AUCs, 42.5;
95% CI, −12.4 to 97.4
Score on Roland Disability Questionnaire
AUC for conservative-treatment group, 316.3±18.8
AUC for early-surgery group, 273.9±20.7
Weeks
B
Mean difference between AUCs, 341.7;
95% CI, 163.8 to 519.6
Score on Visual-Analogue Scale for Leg Pain (mm)
AUC for conservative-treatment group, 977.0±68.3
AUC for early-surgery group, 635.3±58.6
Weeks
C
Mean difference between AUCs, 163.7;
95% CI, −52.5 to 379.9
Score on Visual-Analogue Scale for Back Pain (mm)
AUC for conservative-treatment group, 1047.9±77.6
AUC for early-surgery group, 884.2±77.6
Weeks

Lumbar Spinal Stenosis

- Congenital - Onset in 30s
- Degenerative
  - Most common
  - Onset in late 50s or early 60s
  - Most commonly involves L4-5 level followed by L3-4
- Mechanical Compression
  - Compression of microvasculature
  - Nerve root ischemia
  - Increased microvascular permeability and edema

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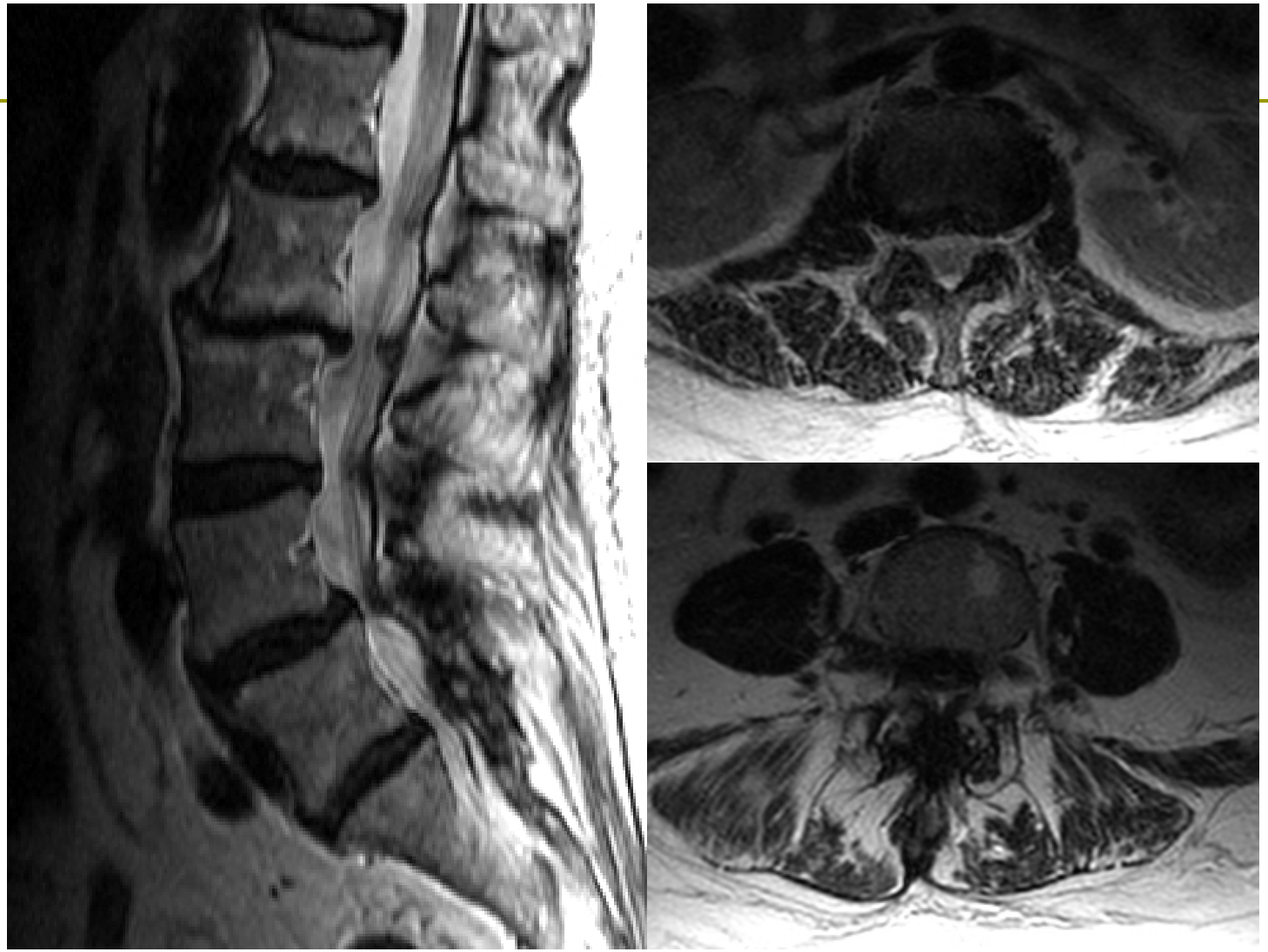

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Lumbar Spinal Stenosis

- Insidious onset
- Chronic low back pain that progresses to buttock, thigh and leg pain.
- Fatigue, heaviness or pain in the legs with ambulation (Neurogenic claudication)

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Neurogenic vs. Vascular Claudication

Symptoms	**Neurogenic**	**Vascular**
Back Pain	Common	Uncommon
Pain Relief	Sitting or flexed posture Standing and resting usually insufficient Often slow (>5 mins)	Not positional Pain relief while standing Almost immediate
Ambulatory tolerance	Variable	Fixed
Uphill vs. Downhill	Downhill more painful (extended posture)	Uphill more painful
Bicycle ride	No pain	Pain

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Lumbar Spinal Stenosis

Most common exam findings

- Loss of lumbar lordosis with limited extension
- Trunk is flexed forward in standing and walking. (“Simian Posture”)
- No significant tenderness to palpation
- Negative SLR
- Normal motor exam despite the report of weakness

Natural History

- At 4 years
  - 70% No change
  - 15% Improved
  - 15% Worsened
- 5-15% may have coexisting cervical spinal stenosis.

Ankylosing Spondylitis

- The earliest clinical features
  - Gradual onset in males < 30 years old
  - Morning stiffness
  - Improvement with exercise
  - Not relieved by bed rest
- Schober test
- Chest expansion < 2.5 cm (late stage)
- Plain films typically normal in early stages

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Classification

- **Complicated** ("Red Flag" conditions)
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Uncomplicated Low Back Pain

- A diagnosis based on exclusion of specific pathology
- Generally classified by the duration of the pain
  - Acute: < 1 month
  - Subacute: 1-3 months
  - Chronic: > 3 months

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Uncomplicated Low Back Pain

- Majority (> 85%) of low back pain in primary care
- Acute low back pain
  - Rapid improvement in the first month in most patients
  - High recurrence rate up to 1/3
  - **Chronic low back pain** (7-10%)

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What is the anatomic source of LBP?

- Controversial
- Possible sources
  - Discs
  - Facet (Zygapophysial) Joints
  - Sacroiliac Joints
  - Ligaments
  - Muscles

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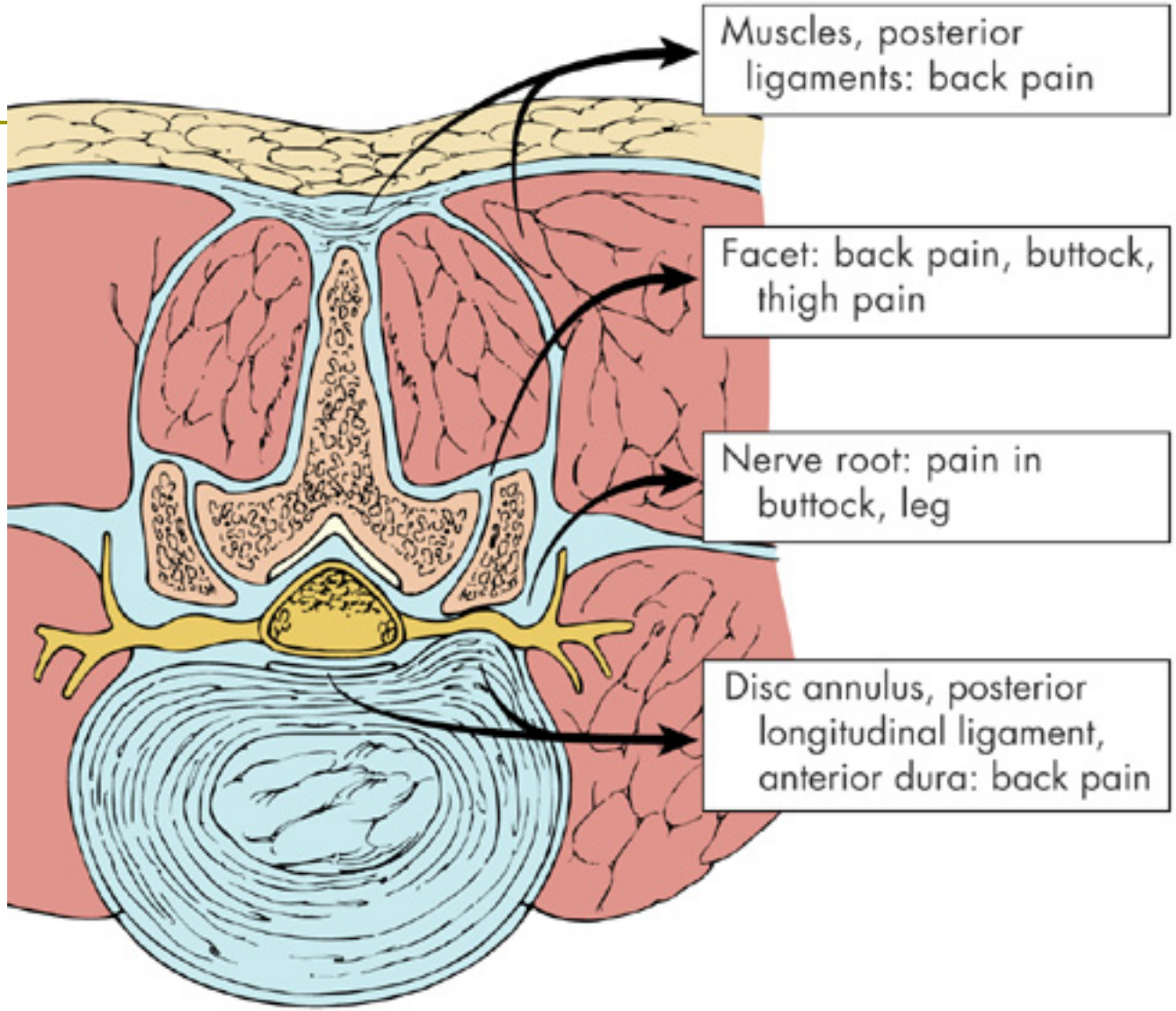
Muscles, posterior ligaments: back pain
Facet: back pain, buttock, thigh pain
Nerve root: pain in buttock, leg
Disc annulus, posterior longitudinal ligament, anterior dura: back pain

Uncomplicated Low Back Pain

- Cannot determine specific anatomic source based on history and exam alone.
- "Lumbar spinal pain of uncertain origin?"
- X ray?
- MRI ?
- Diagnostic Injections ?

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X ray

- Asymptomatic degenerative changes
- Finding of degenerative disc disease, spondylolisthesis or pars defect does not establish the cause of low back pain.

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MRI

- Recommended initial imaging study of choice in complicated low back pain
  - Cancer
  - Infection
  - Cauda equina syndrome
  - Severe or progressive neurologic deficit
- Lumbar disc herniation
- Lumbar spinal stenosis

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MRI

- MRI often shows abnormal findings in asymptomatic patients.
- At age 42, disc bulges in 52% and protrusion in 27% of asymptomatic adults
- After age 60, these findings are even more common.
- Spinal stenosis in 25% of asymptomatic adults over 60 years.

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MRI

- Indicated for complicated low back pain and specific diagnosis
- How about in uncomplicated LBP?
  - Controversial
  - Auto mechanic analogy? Opening up the hood?

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Diagnostic Injections

- Lumbar Transforaminal ESI (Selective Nerve Root Block)
- Lumbar Medial Branch Blocks
- Sacroiliac Joint Injections
- Lateral Branch Blocks

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Diagnostic Injections

- Identify the pain generator
- Plan long term treatment

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Treatment of Uncomplicated LBP

- Life Style Changes
  - Diet
  - Exercise
  - Weight control
  - No smoking
- Physical Therapy
- Medications? Opioids?
- Spinal Injections?
- Surgery?

“Yellow Flags”

1. Previous history of disability
2. Inconsistent findings
3. Abnormal pain behavior
4. Litigation
5. Work dissatisfaction
6. Attention seeking
7. Preference for prolonged bed rest
8. Depression
9. Chemical dependency
10. History of abuse
11. Family history of chronic pain

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Waddell's Signs

1. **Superficial tenderness**: Pain elicited from light touch on the skin
2. **Simulation**: Back pain is produced by maneuvers that should not be painful such as axial loading of the head (1-2 lb) or passive rotation of shoulders and pelvis in the same plane.
3. **Distraction**: A symptomatic response to a test, such as straight- leg-raise, changes when the test is repeated while the patient is distracted.
4. **Regionalization**: Ratchet like "givingway" weakness or non-neuroanatomic numbness
5. **Overreaction**: Disproportionate response to routine examination such as collapsing, grimacing, guarding, groans, tremors or any other type of overreaction.

(Behavioral response to examination, Not a proof of malingering, > 3 signs suggest the presence of non-organic factors)

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Prognosis

- **Psychosocial Risk Factors**
  - "Yellow Flags" and Waddell's signs are psychosocial risk factors of delayed recovery.
  - More predictive of outcome than severity of pain or any exam findings.
- **Duration of Symptoms**
  - The status of patients at 2 months may help predictor the outcome at 12 months.

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Summary – Low Back Pain

- Be aware of "Red Flags."
- Identify specific diagnosis. (LR, LSS, AS)
- Uncomplicated LBP is a diagnosis of exclusion.
- MRI for complicated and specific diagnosis.
- MRI for uncomplicated?
- Diagnostic Injections
- Don't forget the "Yellow Flags."

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Interventional Spine Procedures

- Epidural Steroid Injections
- Facet Interventions
- Sacroiliac Joint Interventions
- Sympathetic blocks (Stellate ganglion and lumbar paravertebral)
- Discography (Intradiscal Procedures)
- Spinal Cord Stimulation(Neuromodulation)
- Intrathecal Pain Pump

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Epidural Steroid Injections

- Anatomy
- Clinical Indications
- Complications
- Medical Evidence

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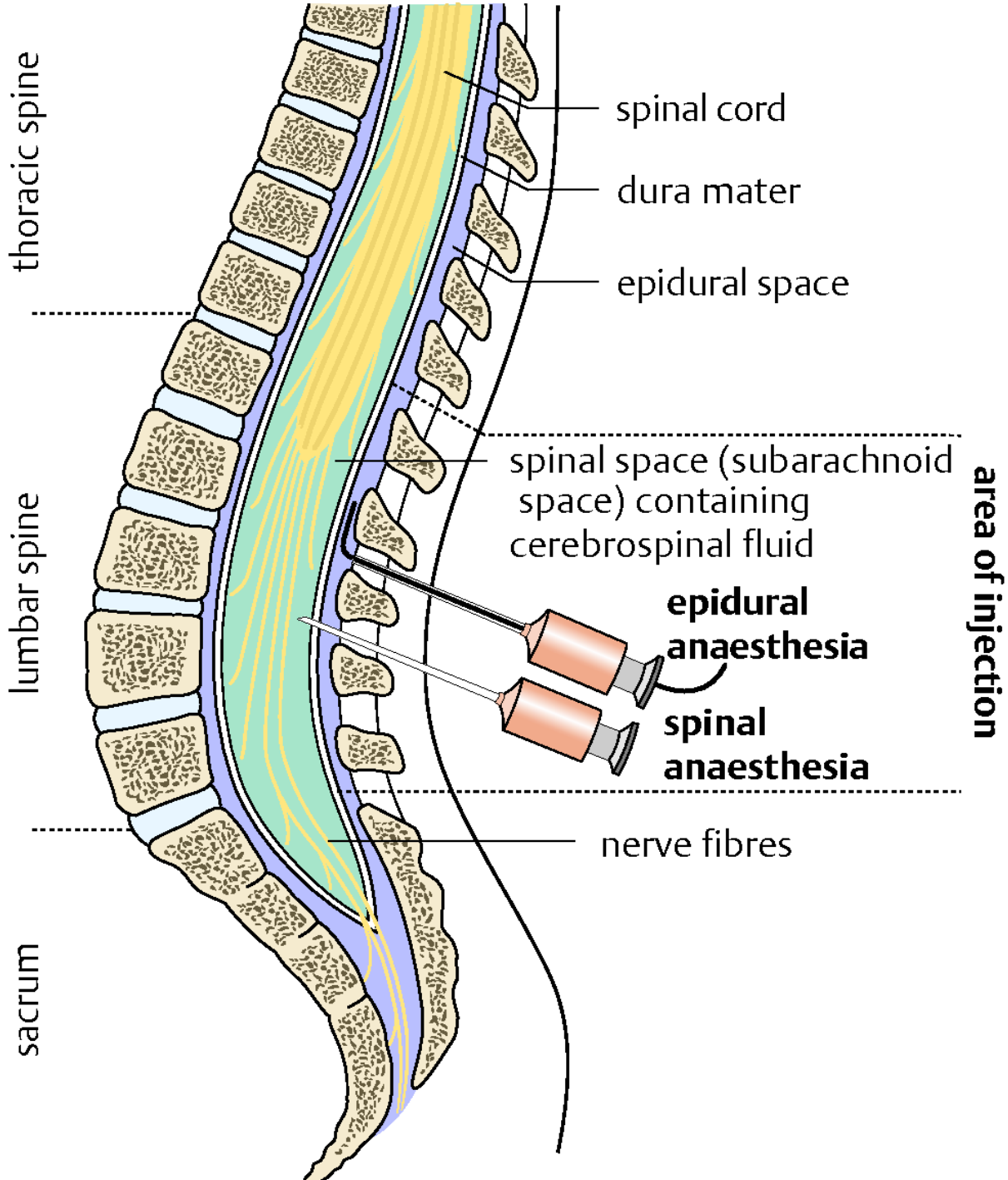
thoracic spine
lumbar spine
sacrum
spinal cord
dura mater
epidural space
spinal space (subarachnoid space) containing cerebrospinal fluid
epidural anaesthesia
spinal anaesthesia
nerve fibres
area of injection

Epidural Steroid Injection

- Interlaminar
- Transforaminal
- Caudal

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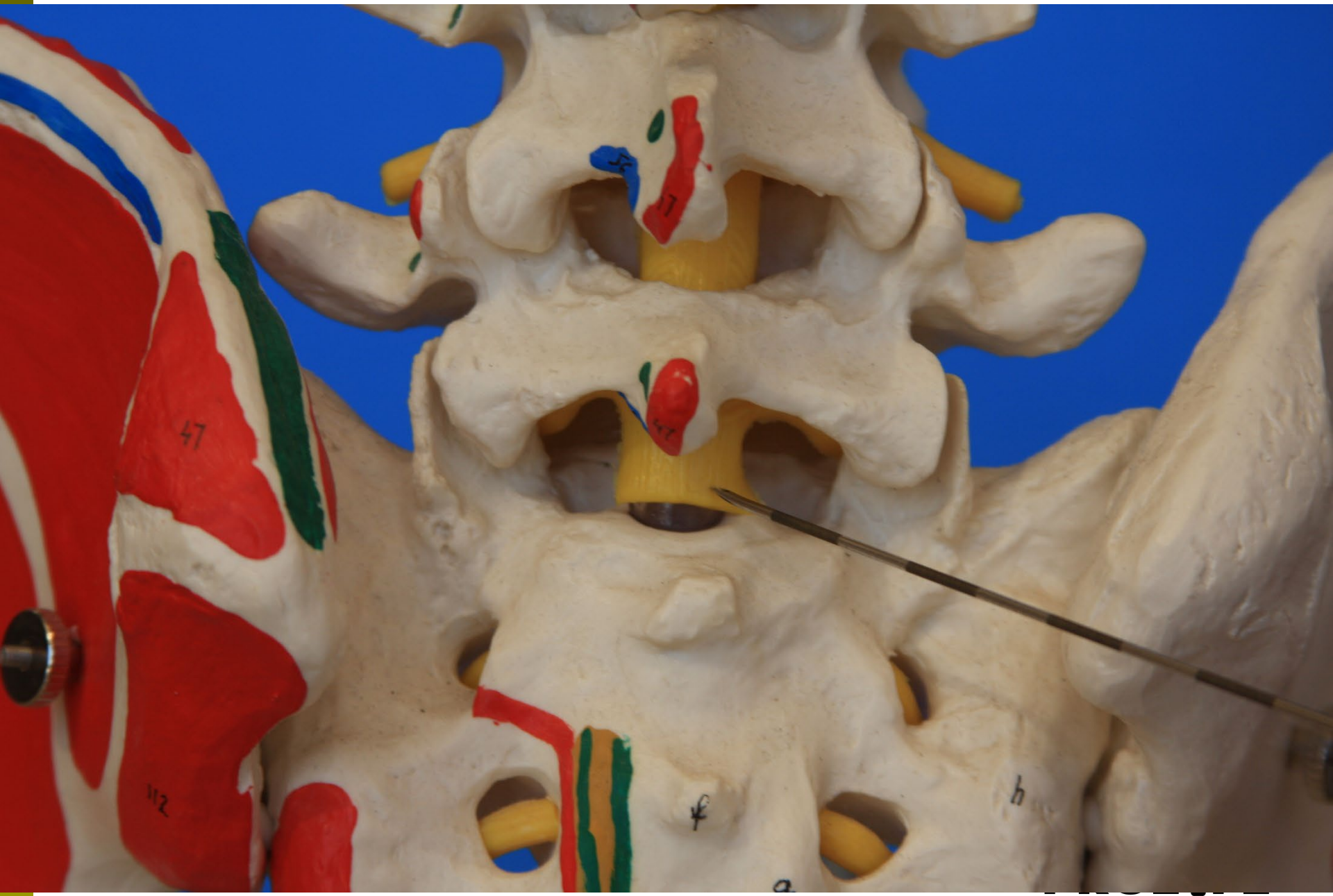
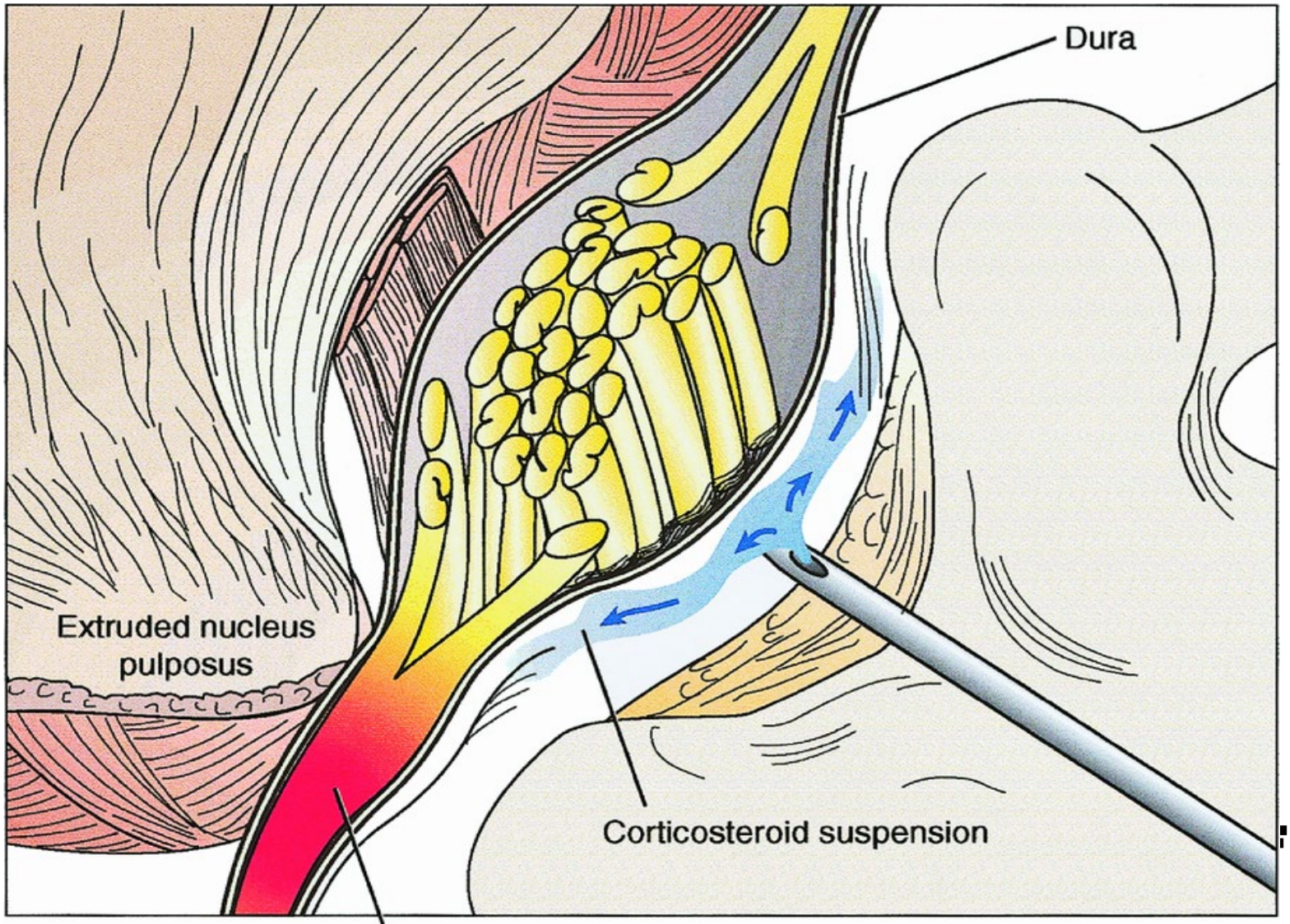
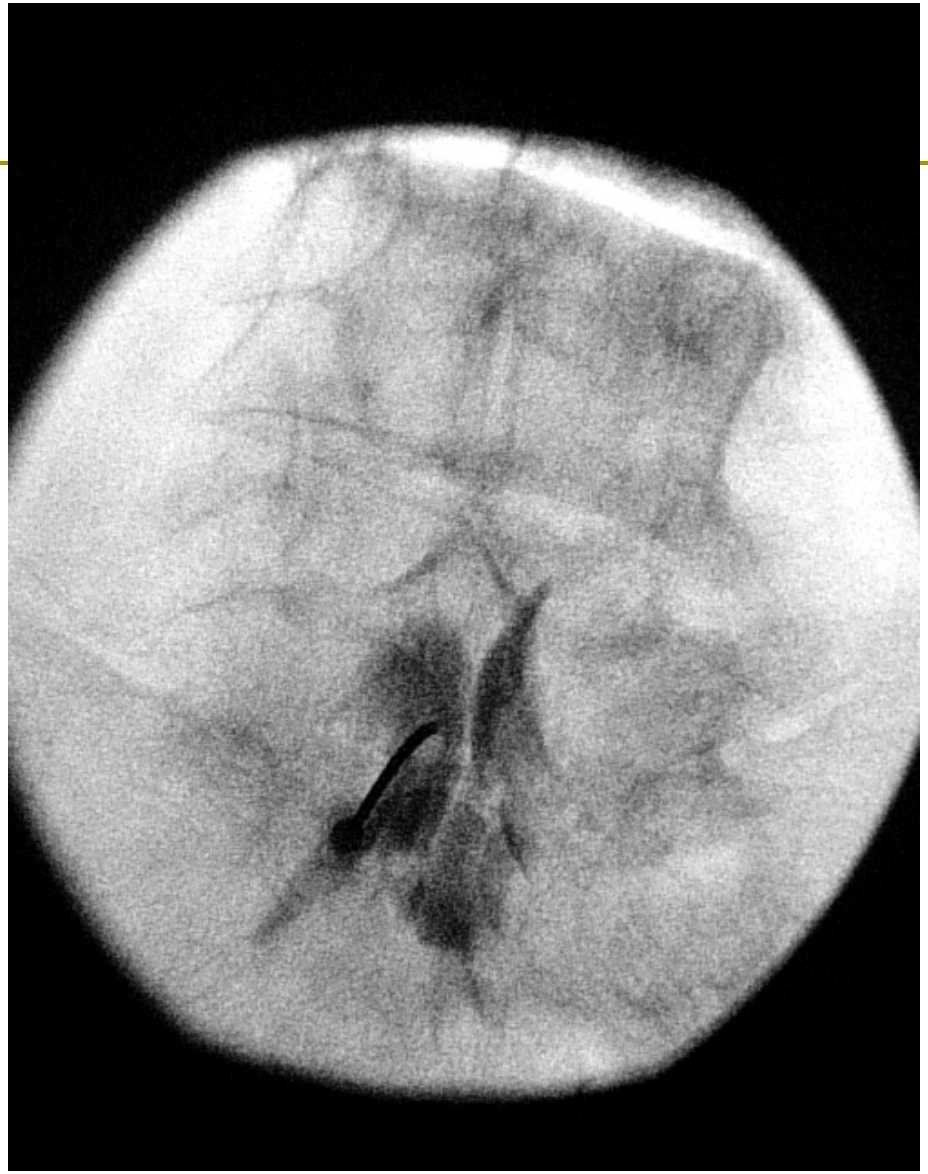



Dura
Extruded nucleus pulposus
Corticosteroid suspension



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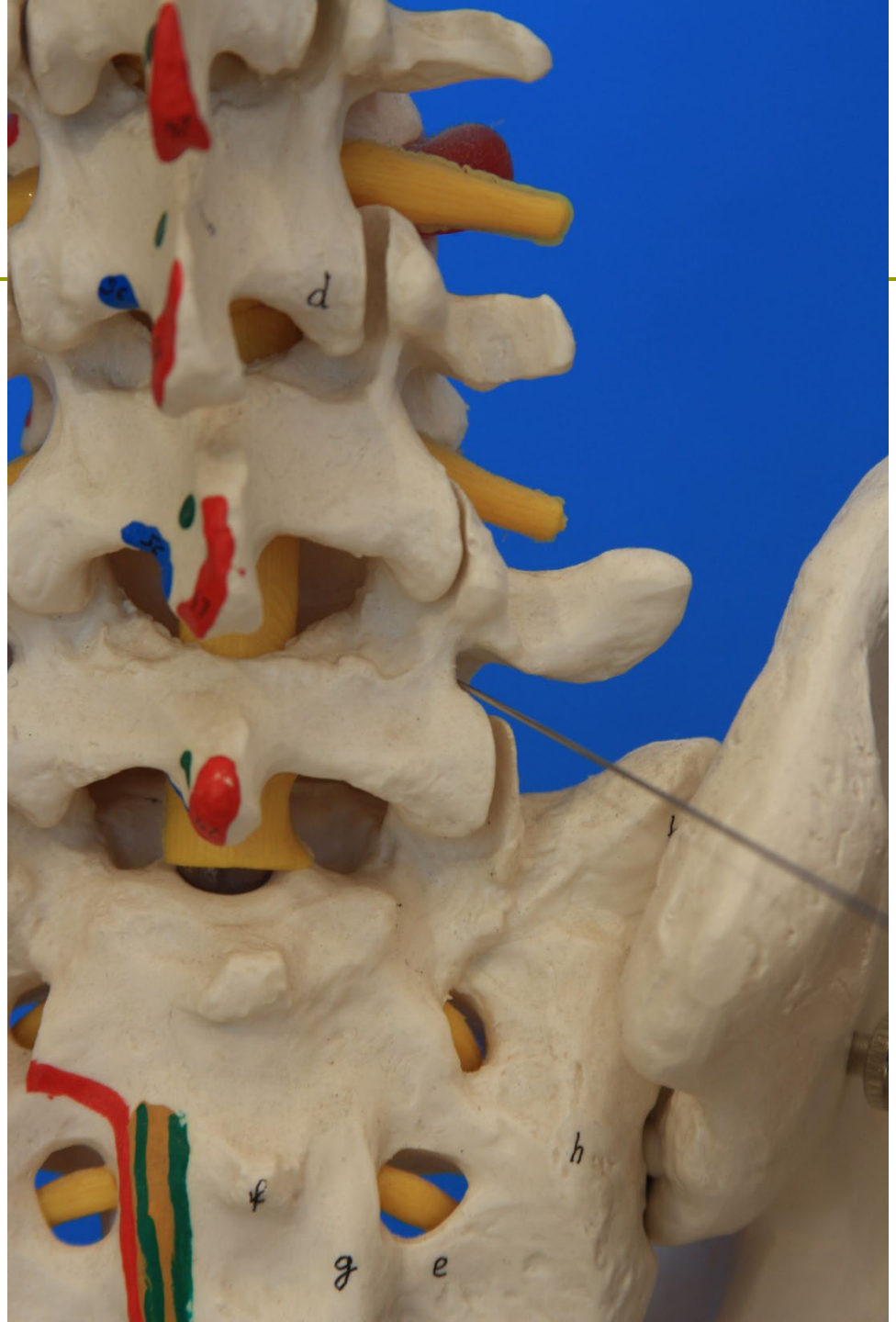
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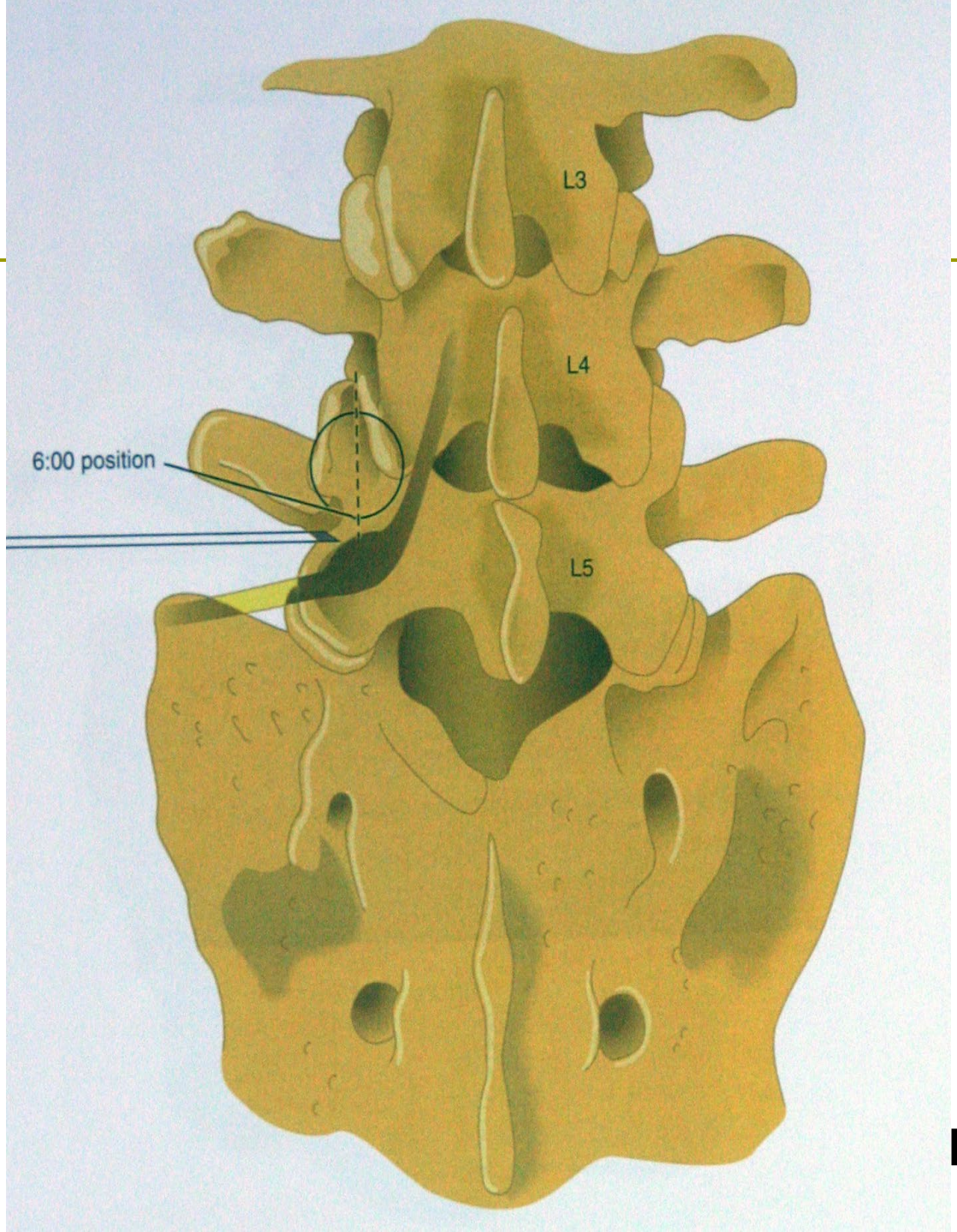
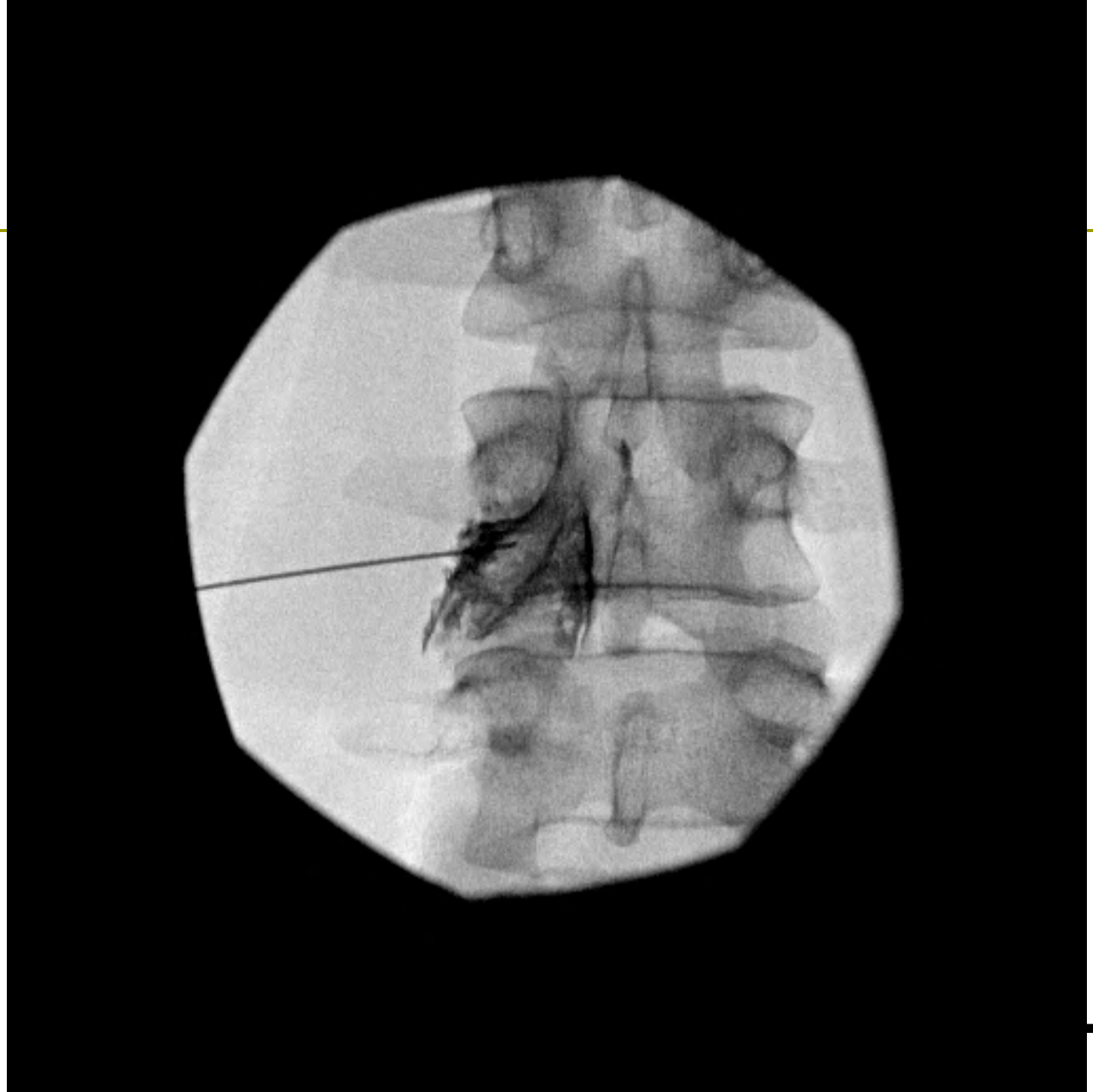
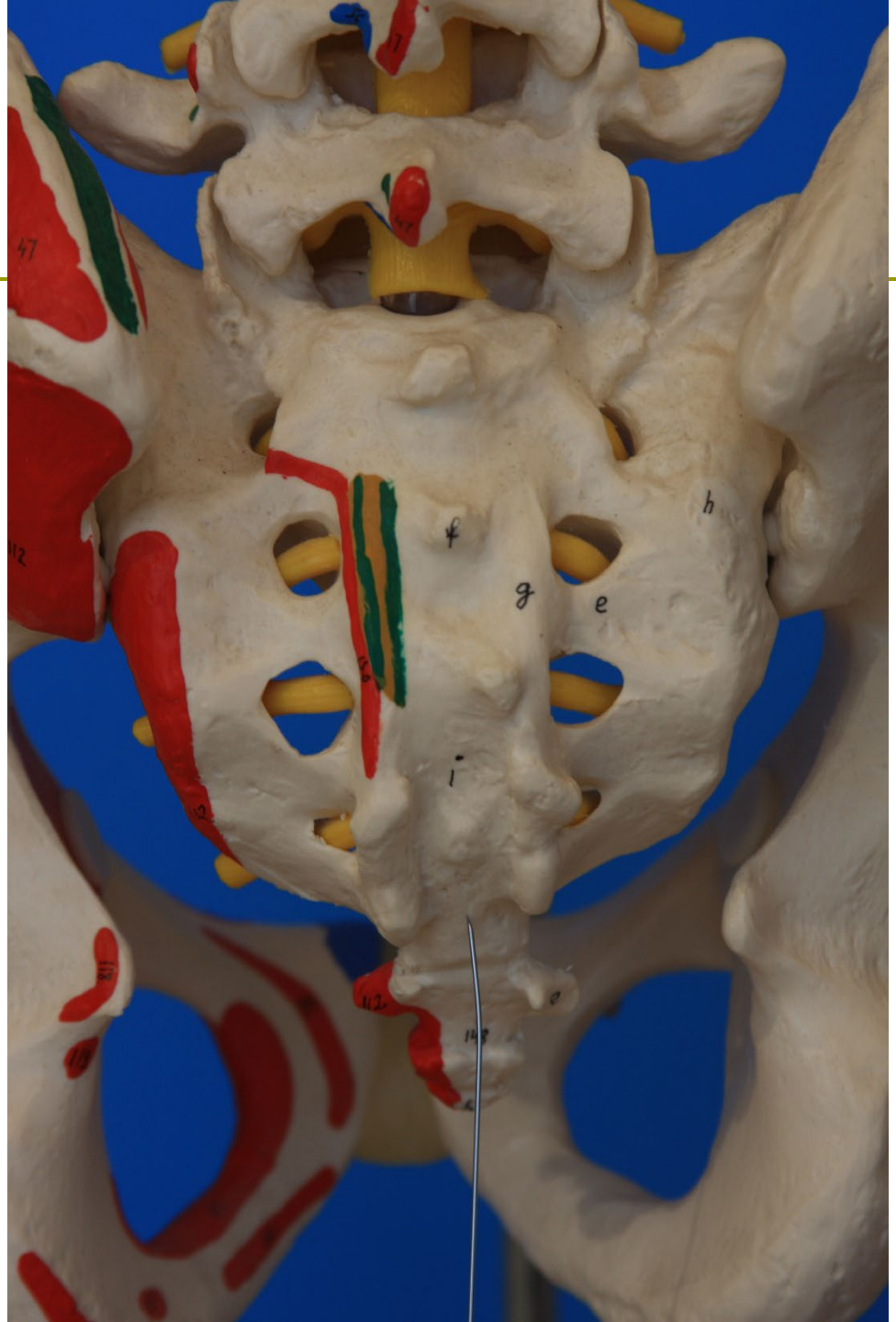

L3
L4
6:00 position
L5





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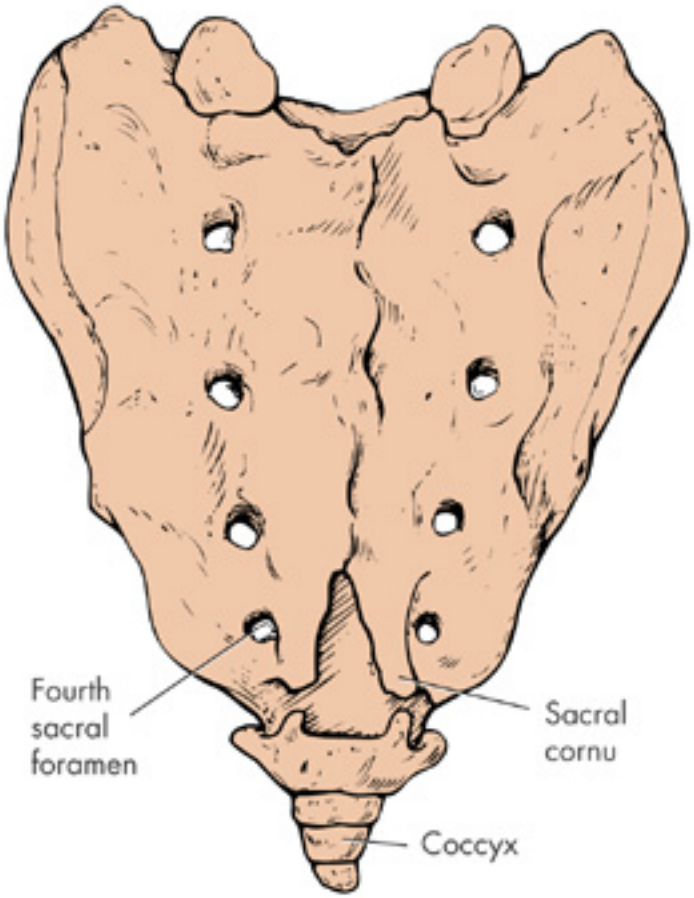
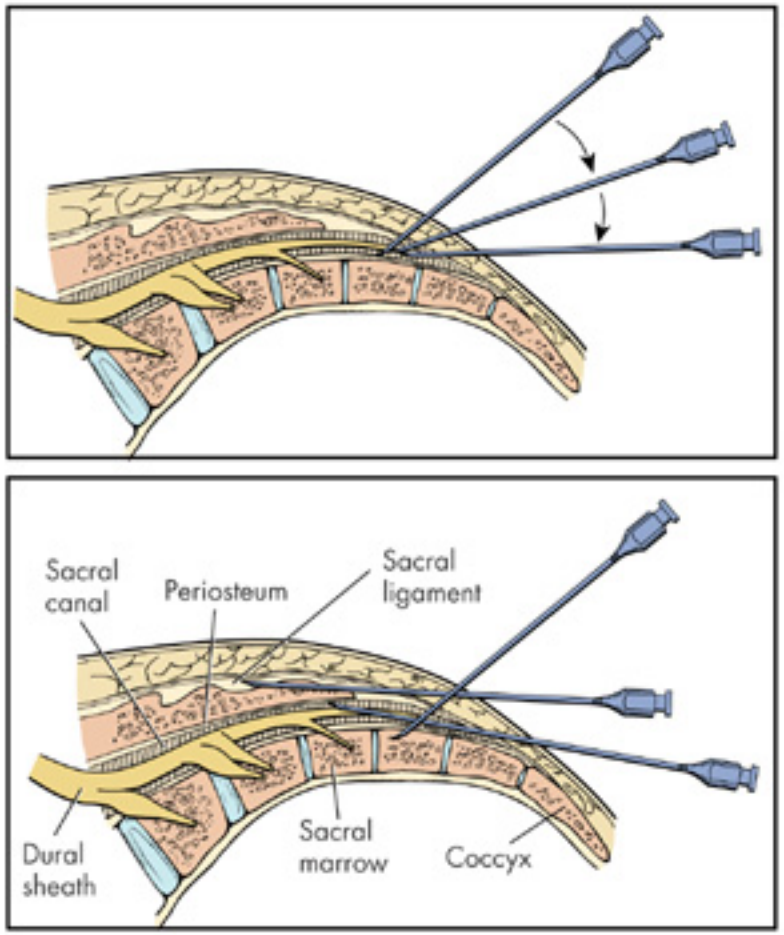
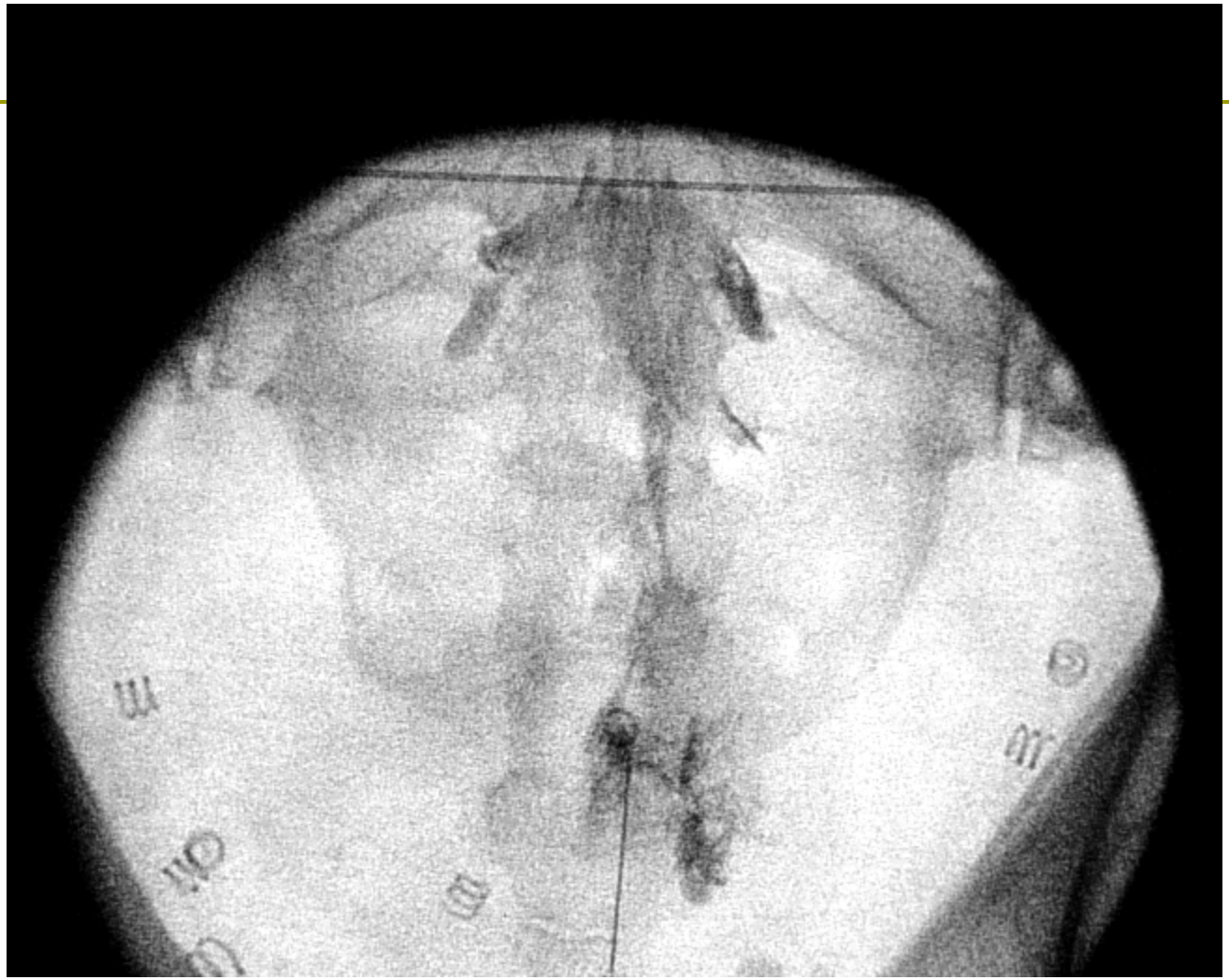

Fourth
sacral
foramen
Sacral
cornu
Coccyx


Sacral
canal
Periosteum
Sacral
ligament
Dural
sheath
Sacral
marrow
Coccyx



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Patient selection for ESI

- Positive Factors
  - Radicular pain
  - Radicular numbness
  - Short duration of pain
  - No significant psychological factors
- Negative Factors
  - Axial pain primarily
  - Work-related injury
  - Unemployed due to pain
  - High number of past treatments and drugs taken
  - Previous back surgeries
  - Smoking
  - Very high pain rating
  - Litigation

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Why not ESI for axial LBP?

- Different anatomical origin of pain– Facet arthropathy, Internal Disc Disruption (Annular tear), or Sacroiliac joint pain
- Epidural route of administration of steroid does not reach the target area any better than systemic administration.

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Complications

- Infection
- Bleeding
- Spinal Cord Infarct
- Increased vertebral fracture?

Multistate Outbreak of Fungal Meningitis and Other Infections

- CDC investigation in September 2012
- **Contaminated** steroid (methylprednisolone)
- New England Compounding Center in Framingham, MA
- Fungal meningitis and spinal abscess
- 751 cases across 20 states – 64 deaths
- Don't use contaminated steroids!

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Lumbar ESI Complications

- Multi-institutional study
  - 16,638 consecutive procedures
  - 14,956 TF ESIs and 1,682 IL ESIs
- Minor complications
  - Vasovagal reactions – 1.2%
  - Dural puncture – 0.04%
- **No** neurologic, bleeding or infectious complications

EI-Yahchouchi CA. Complication rates of transforaminal and interlaminar epidural steroid injections: a multi-institutional study

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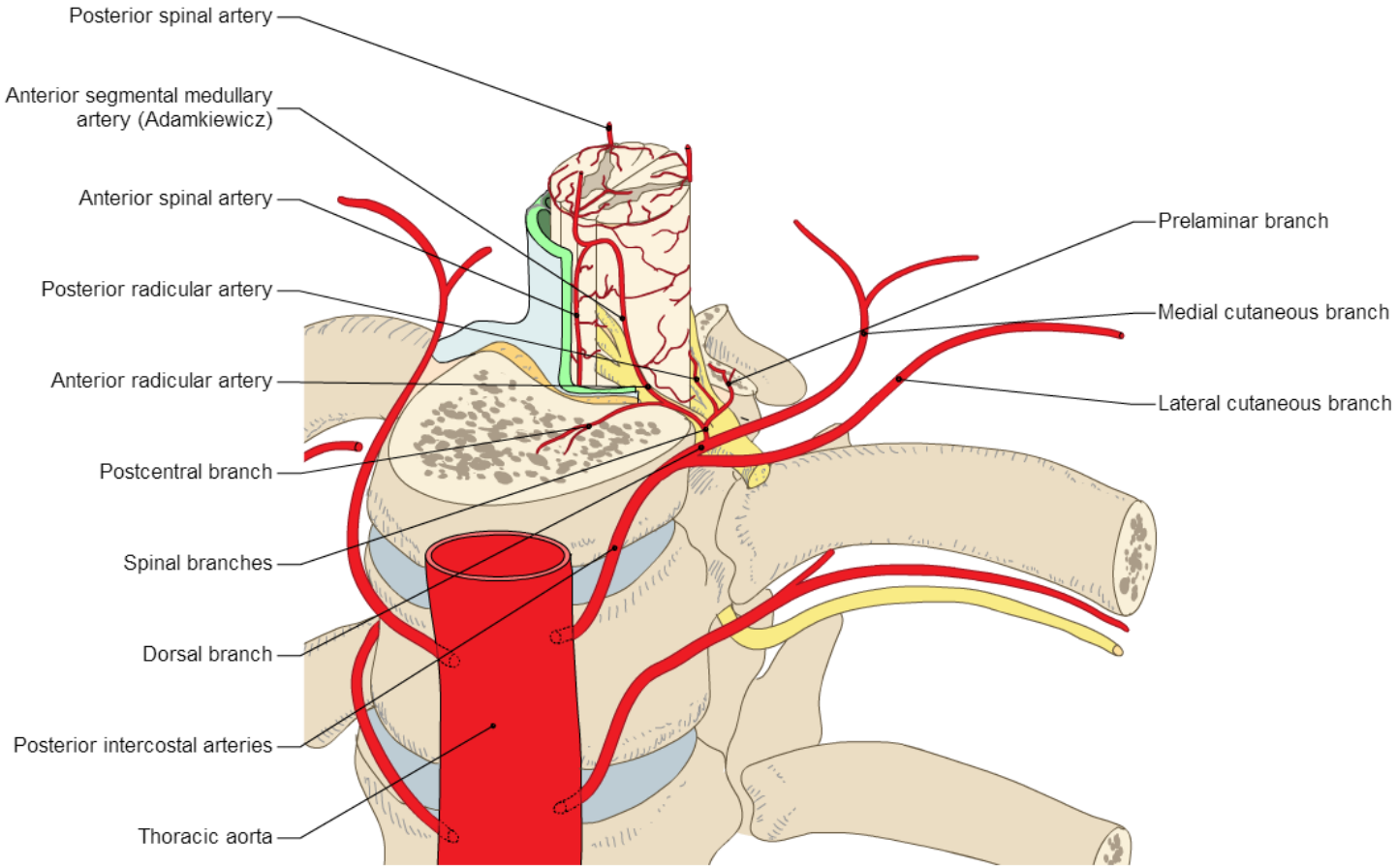
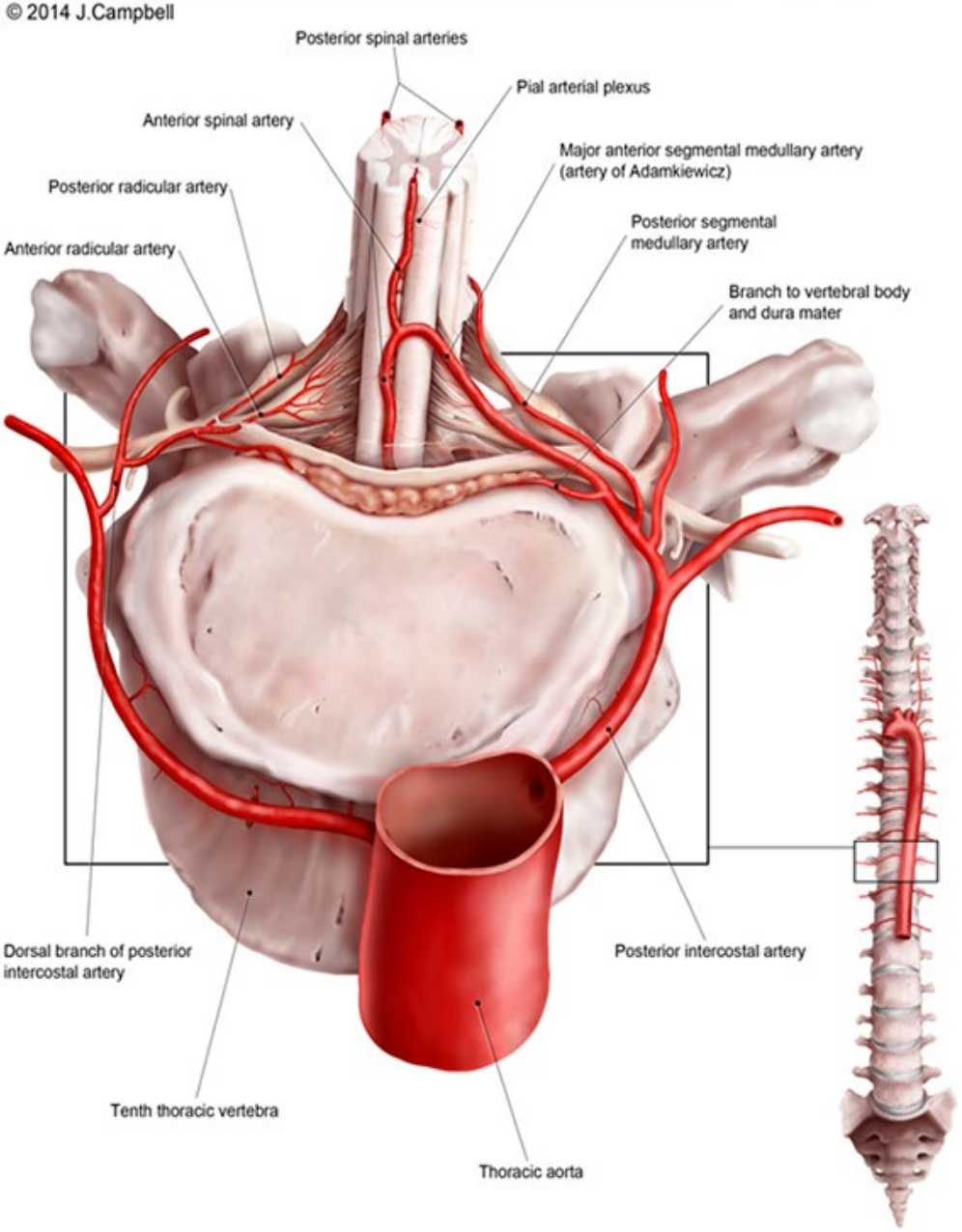
Spinal Cord Infarct



ARTERIAL SUPPLY OF THE LOWER SPINAL CORD



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Spinal Cord Infarct

- Extremely rare but devastating complication of lumbar transforaminal ESI
- Injection of particulate steroids into radicular artery
- Paraplegia
- Using non-particulate steroid and digital subtraction angiography mitigate the risk.

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Lumbar ESI

- Meta-analysis
- 39 publications on lumbar TF ESIs
- Disc herniation
  - 60% achieved at least 50% relief at between 1 and 2 months
  - 40% maintained this outcome for 12 months
  - Effective in reducing pain, restoring function and avoiding surgery

The Effectiveness of Lumbar Transforaminal Injection of Steroids: A Comprehensive Review with Systemic Analysis of the Published Data. Pain Medicine 2013;14:14-28

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Lumbar ESI

- Lumbar spinal stenosis
  - 50% achieved 50% relief of pain for 6 months but rigorous studies are lacking and no controlled studies have corroborated this outcome.
- Failed back surgery syndrome or Epidural lipomatosis
  - The literature on TF ESI is sorely limited.

The Effectiveness of Lumbar Transforaminal Injection of Steroids: A Comprehensive Review with Systemic Analysis of the Published Data. Pain Medicine 2013;14:14-28

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Lumbar Spinal Stenosis

- Multisite (16) randomized trial
- 400 patients
- Central lumbar spinal stenosis
- Buttock and/or leg pain > back pain
- Glucocorticoids + Lidocaine vs. Lidocaine alone
- No control group with sham injections

A Randomized Trial of Epidural Glucocorticoid Injections for Spinal Stenosis. NEJM 2014:371(1):11-21

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Lumbar Spinal Stenosis

- Primary outcomes:
  - Roland-Morris Disability Questionnaire (0-24) and the intensity of leg pain (0-10)
- Secondary outcomes:
  - >30% relief at 6 weeks
  - >50% relief at 6 weeks

A Randomized Trial of Epidural Glucocorticoid Injections for Spinal Stenosis. NEJM 2014:371(1):11-21

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Lumbar Spinal Stenosis

Steroid + Lidocaine (200)

- RMDQ – 14.4 to 12
- Intensity of 1week avg pain – 7.0 to 4.9
- >30% relief at 6wks – 49.2%
- >50% relief at 6wks – 38.3%

Lidocaine only (200)

- RMDQ – 14.8 to 12.1
- Intensity of 1 week avg pain – 7.0 to 4.9
- >30% relief at 6 wk – 49.7%
- >50% relief at 6 wks – 38.3%

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Lumbar Spinal Stenosis

- Both groups improved
- Subgroup analyses: Glucocorticoids-Lidocaine group reported better physical function on RMDQ (-2.5)and less leg pain (-0.9) at 3 weeks
- No statistically significant difference between the two groups at 6 weeks
- Negative Study?

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Medical Evidence for ESIs

- Lumbosacral radiculopathy secondary to disc herniation
  - Literature support – Yes
- Lumbar Spinal Stenosis with leg pain
  - Literature support – limited
- FBSS with leg pain
  - Literature support - Don't know
- Other causes of axial back pain
  - Literature support – No

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Summary Lumbar ESI

- ESIs may be an option for relief of severe radicular pain unresponsive to conservative treatments.
- Not for axial low back pain
- Safe procedure
- Good support for disc herniation
- Controversial support for lumbar spinal stenosis

Lumbar Facet Pain

- Clinical Symptoms
  - Predominantly axial pain
  - May have somatic referred pain to legs
  - Generally older patients
- Exam
  - Lumbar paraspinal tenderness
  - Positive facet loading
  - Negative nerve tension tests
  - No focal neurologic deficit

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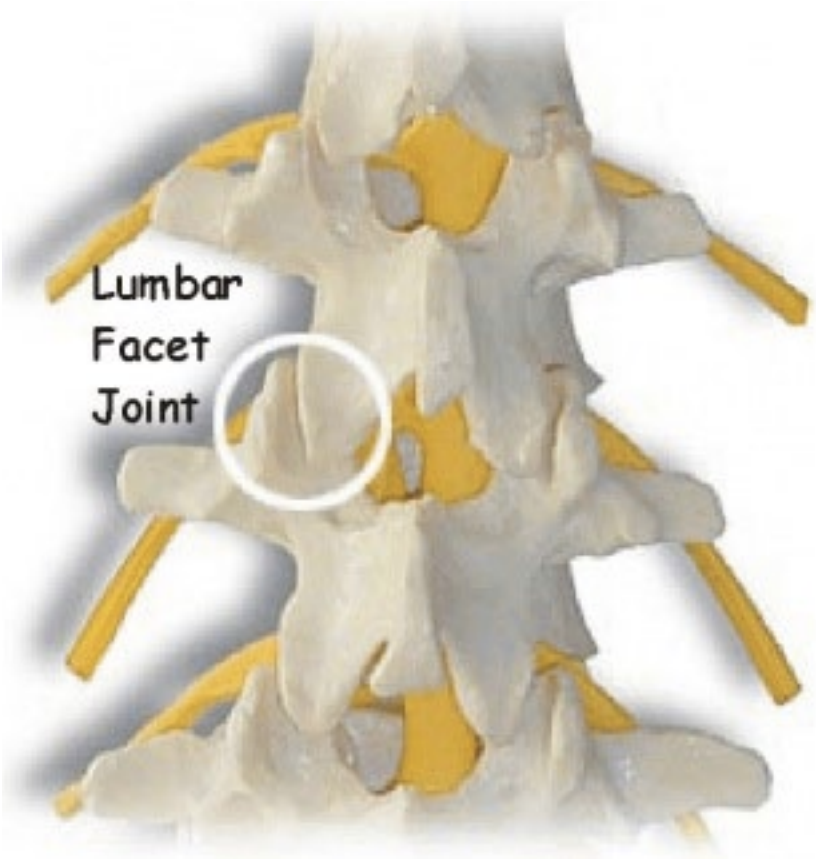
Anatomy

- Synovial joint
- Medial branches from dorsal rami innervate the facet joints.
- L4-5 and L5-S1 levels are most commonly affected.

PROLIFE

Anatomy



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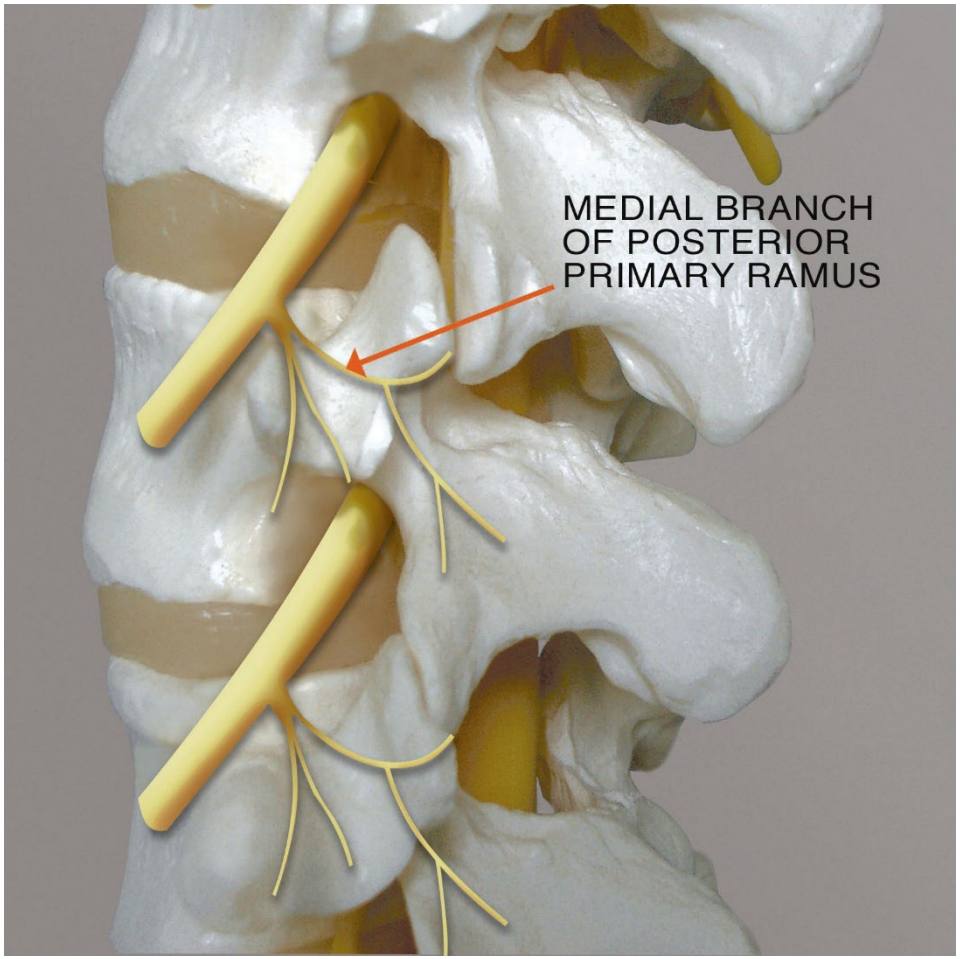
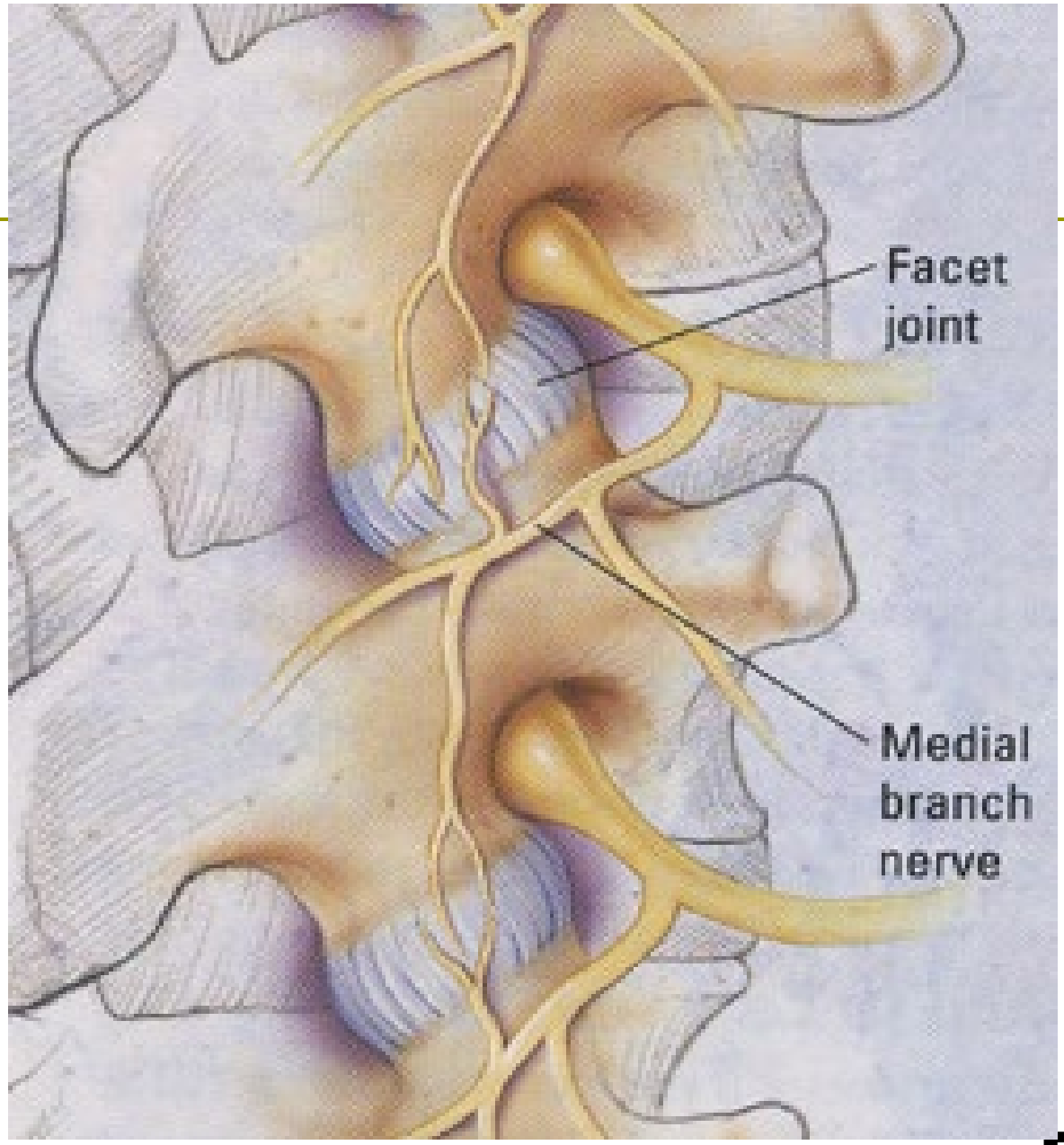
Anatomy




Facet joint
Medial branch nerve

Lumbar Facet Procedures

- Intra-articular Steroid Injection
- Medial Branch Block
- Percutaneous Radiofrequency Medial Branch Neurotomy

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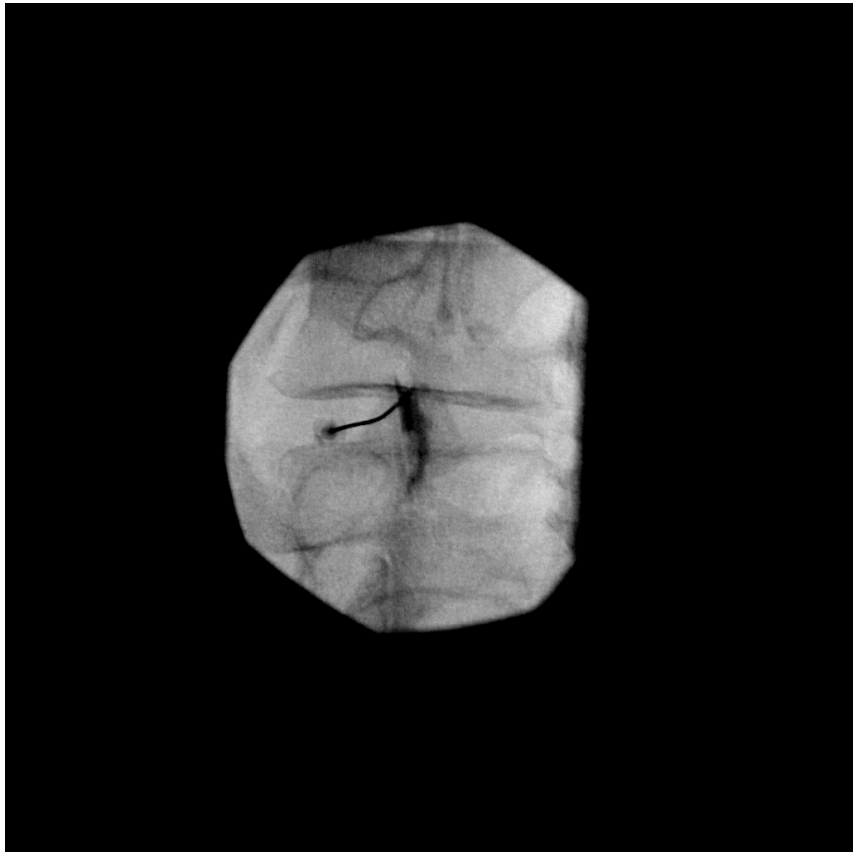
Intraarticular Injection



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Lumbar Medial Branch Block

- Diagnostic Test – No therapeutic benefit
- Placebo Injection of Normal Saline
  - Most rigorous control block
  - Impractical in most clinical settings
- Comparative Block
  - Lidocaine
  - Bupivacaine

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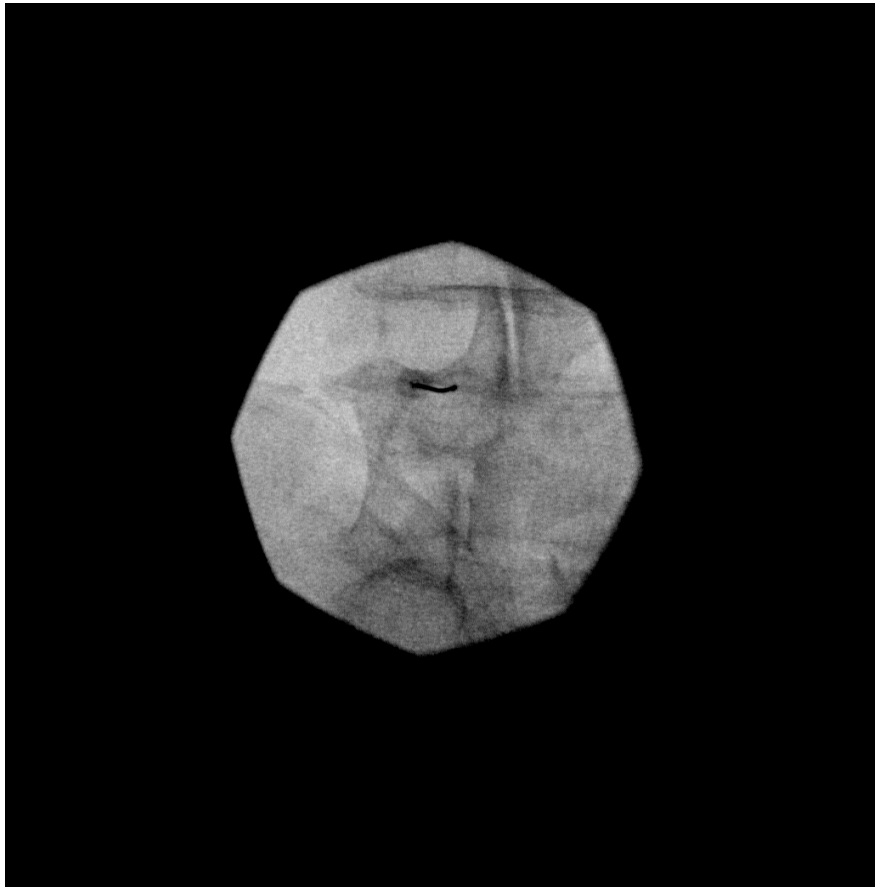
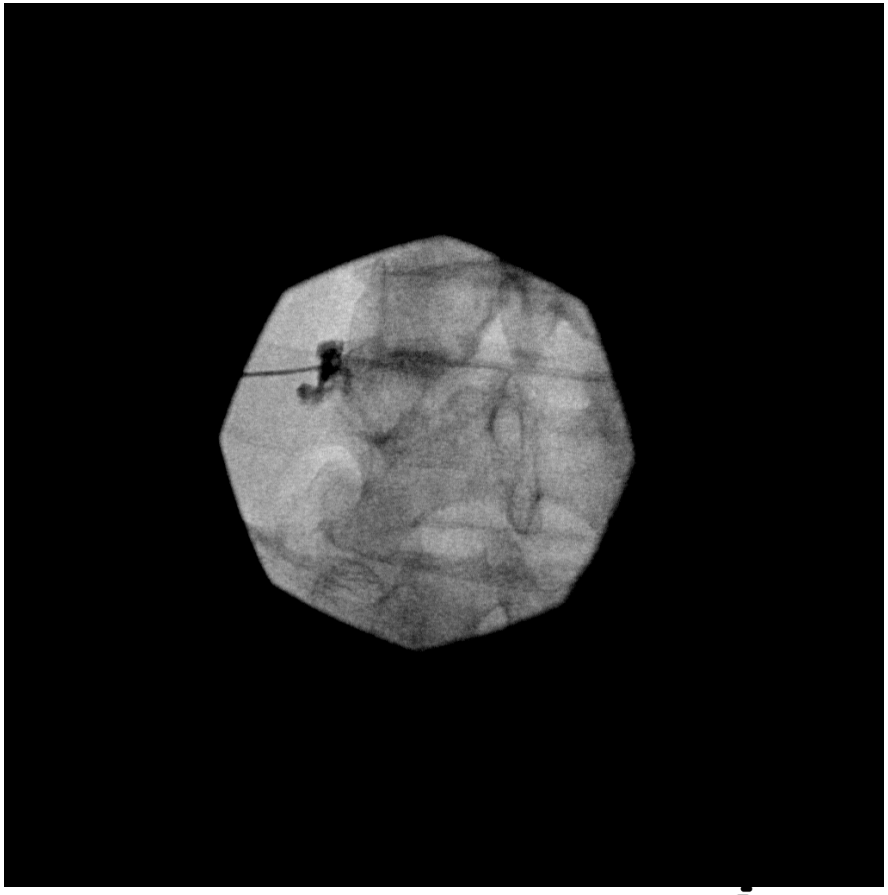
Medial Branch Blocks





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Radiofrequency Ablation

- Therapeutic procedure for lumbar and cervical facet pain
- Teflon-coated electrode with an exposed tip is inserted onto the target nerve.
- High frequency electrical current is concentrated around the exposed tip.
- The nerve is heated and coagulated.

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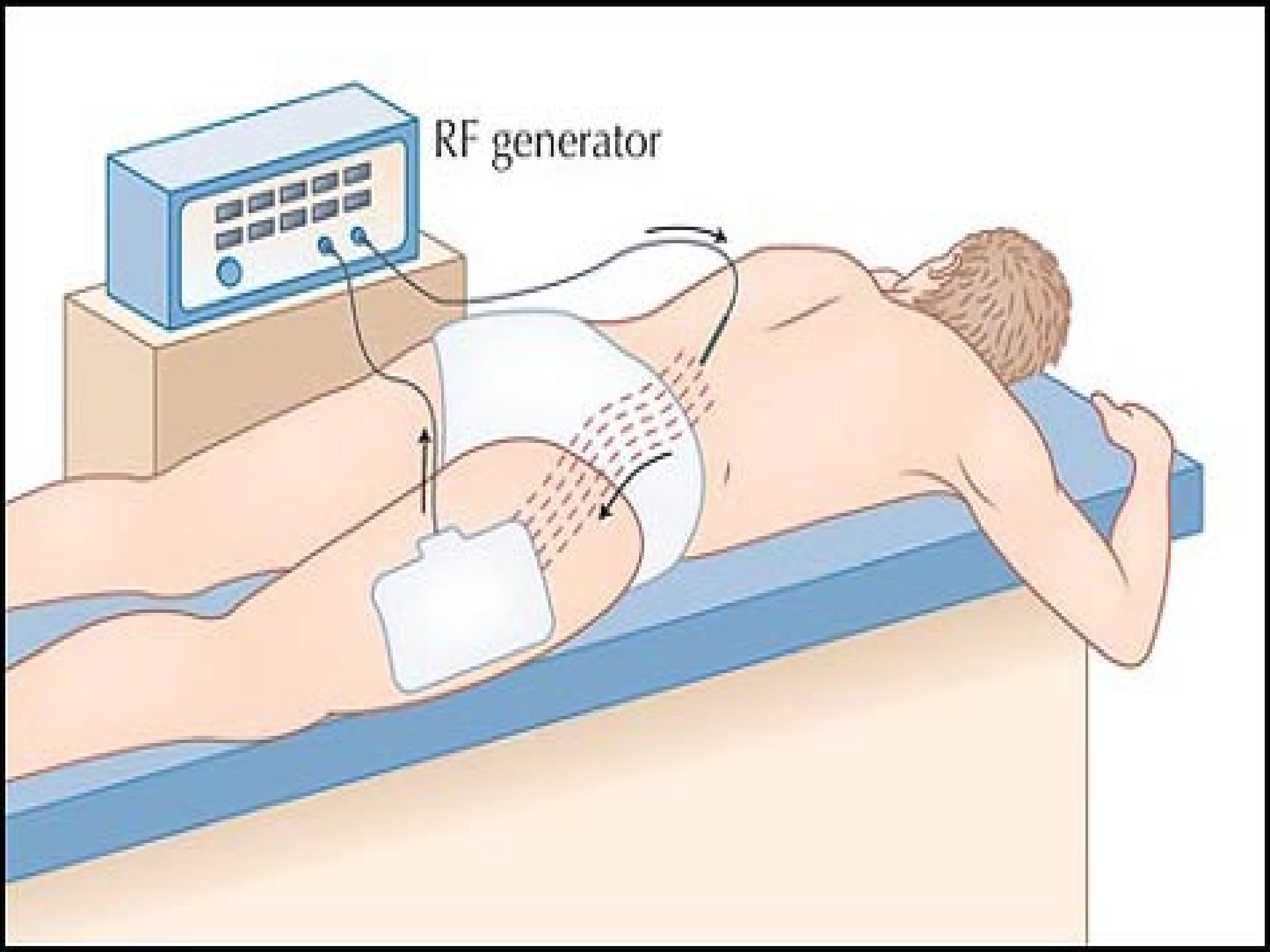
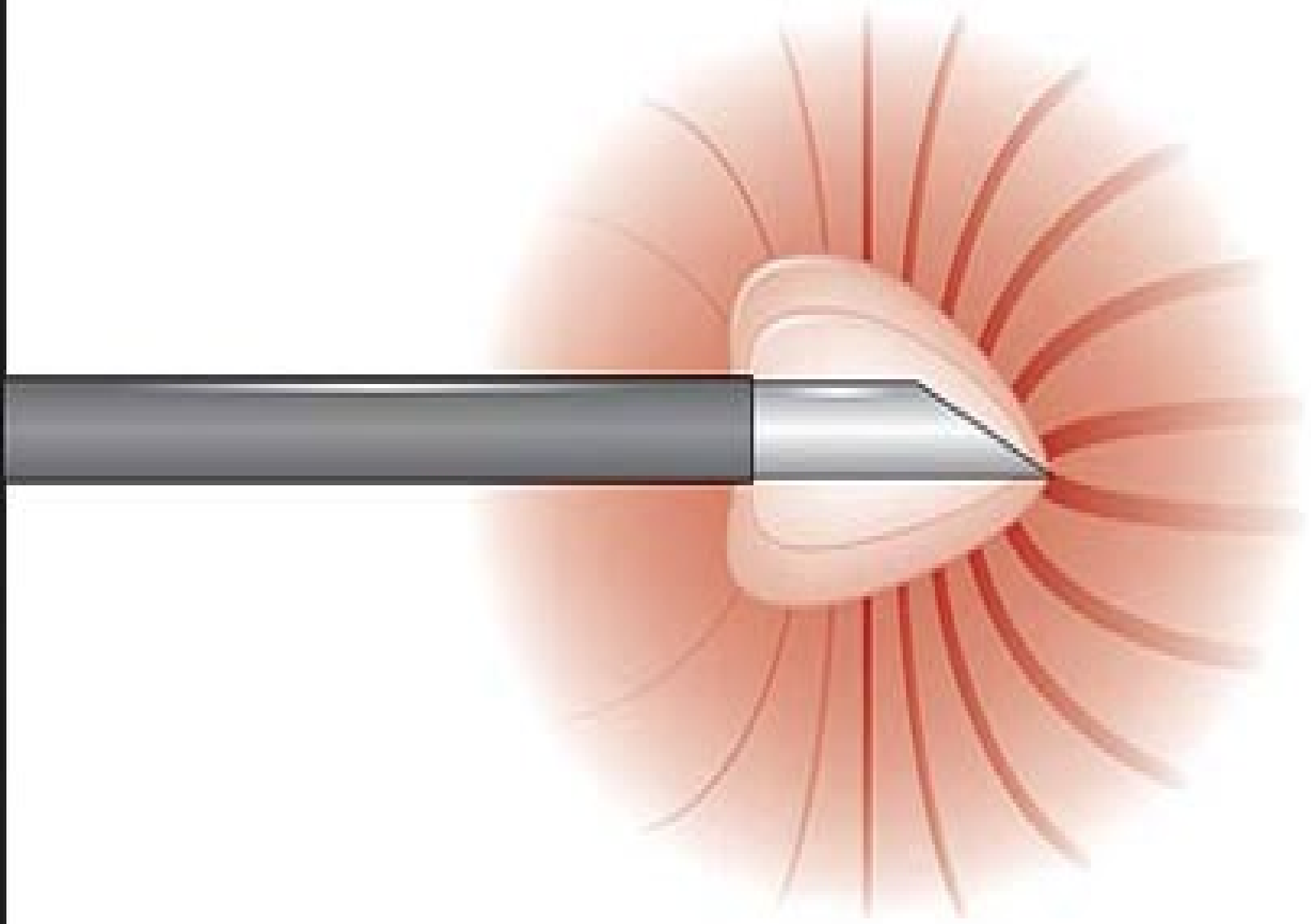
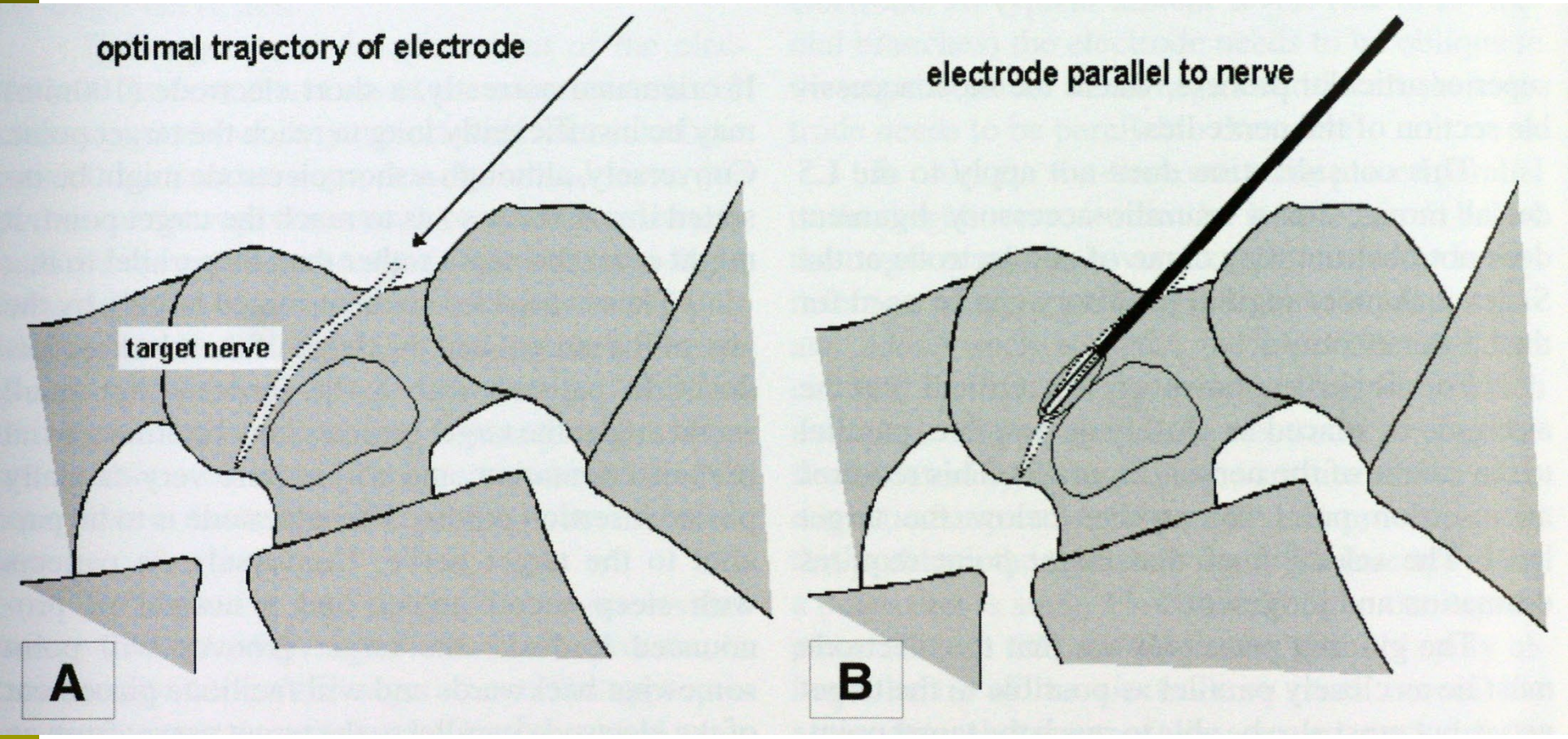
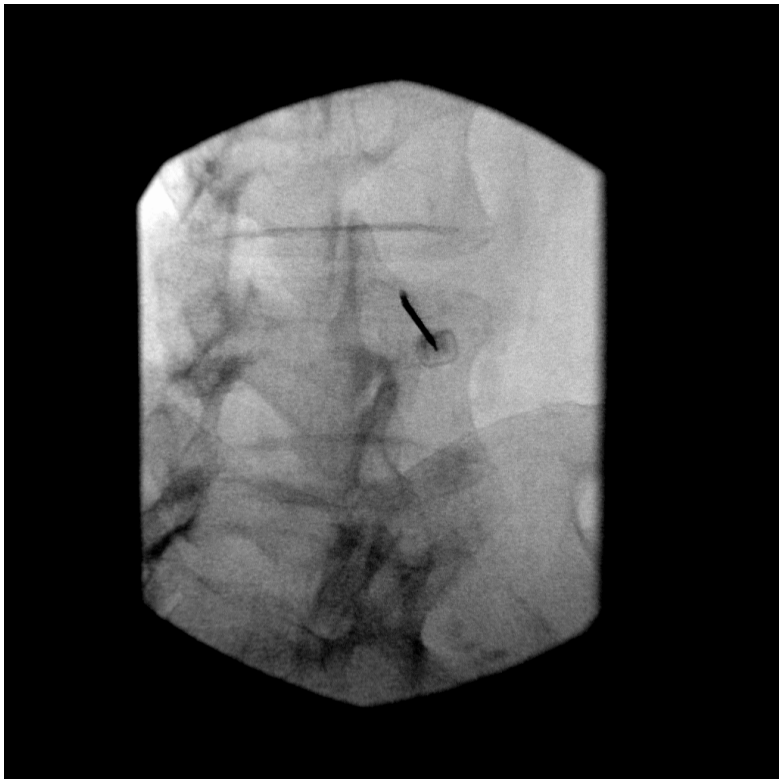
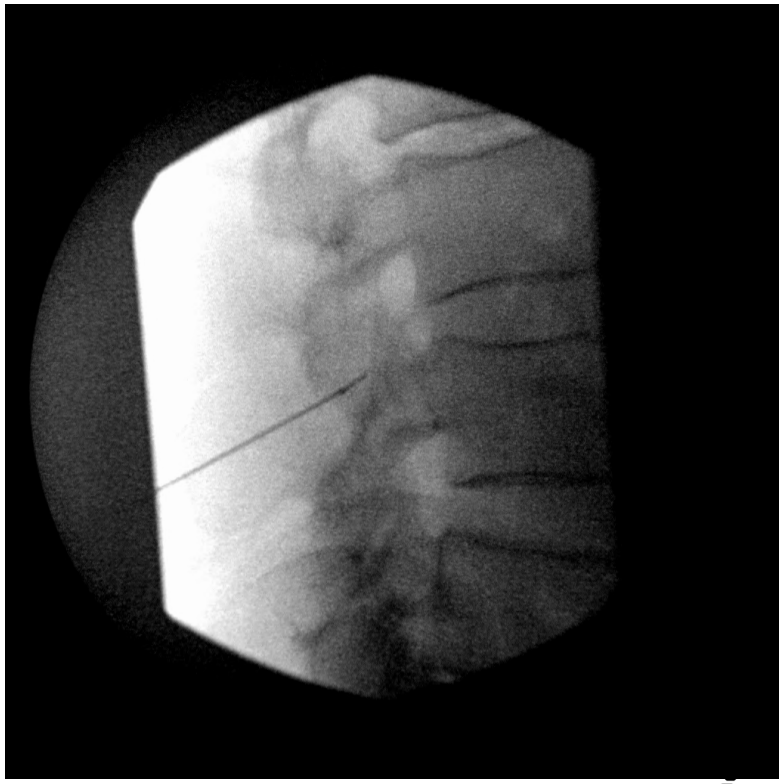

RF generator




optimal trajectory of electrode
target nerve
A
electrode parallel to nerve
B





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Gofeld – Pain Physician 2007

- 209 patients
- 10 year period
- 70% relief to diagnostic blocks
- 35% had 50% relief
- 22% had 100% relief
- Mean duration of relief 12 months

MacVicar – Pain Medicine 2012

- 106 patients
- 100% relief to diagnostic blocks
- 56% achieved complete relief
- Mean duration of relief 13 months
- Restoration of normal activities

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Summary -Lumbar Facet Procedures

- Predominantly axial low back pain
- Intra-articular Facet Injection
  - Primarily diagnostic
  - Long term relief?
- Radiofrequency Ablation
  - Select patients with diagnostic MBBs
  - Only helpful if facet mediated pain
  - About 50% chance of relief for about 12 months

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Sacroiliac Joint Pain

- Sacroilitis (Inflammatory Arthritis)
  - AS
  - RA
- Sacroiliac Joint Dysfunction
  - Abnormal gait pattern
  - Leg length discrepancy
  - Lumbar fusion
  - Trauma
  - Scoliosis
  - Pregnancy

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Anatomy

- Diathrodial Synovial Joint
  - Anterior: true synovial
  - Posterior: syndesmosis (ligaments and muscles – gluteal and piriformis)
- Innervation
  - Anterior: lumbosacral plexus
  - Posterior: primarily dorsal ramus L5 and lateral branches S1 to S4

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Sacroiliac Joint Dysfunction

- Clinical Symptoms
  - Pain near PSIS in gluteal area
  - Unilateral
  - Pain when rising from sitting
  - May have somatic referred pain down the leg
  - Does not pass above L4-5 level (iliac crest)
- Exam
  - Multiple clinical exams
  - Fortin Finger Test – simplest

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Sacroiliac Joint Interventions

- Intraarticular Injections
  - Primarily diagnostic
  - Long term relief?
- Radiofrequency Ablations
  - Select patients with LBBs
  - Designed for long term relief
  - Improving techniques
  - Emerging evidence

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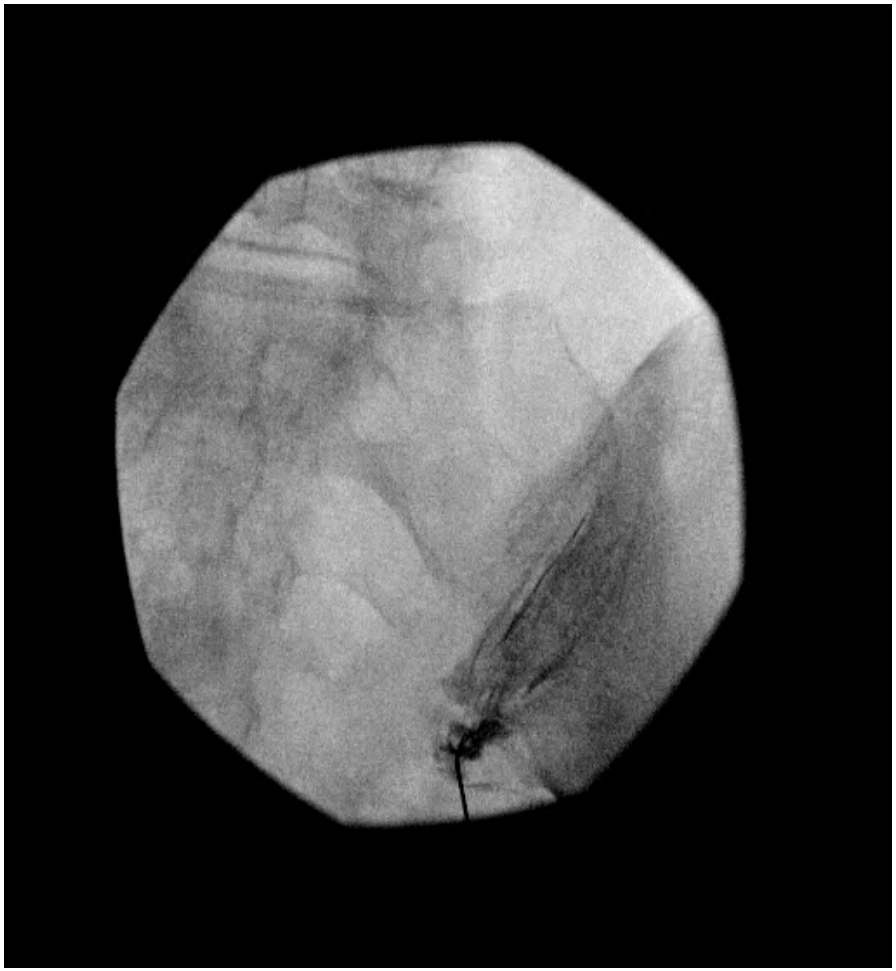
Intraarticular SI Joint Injection



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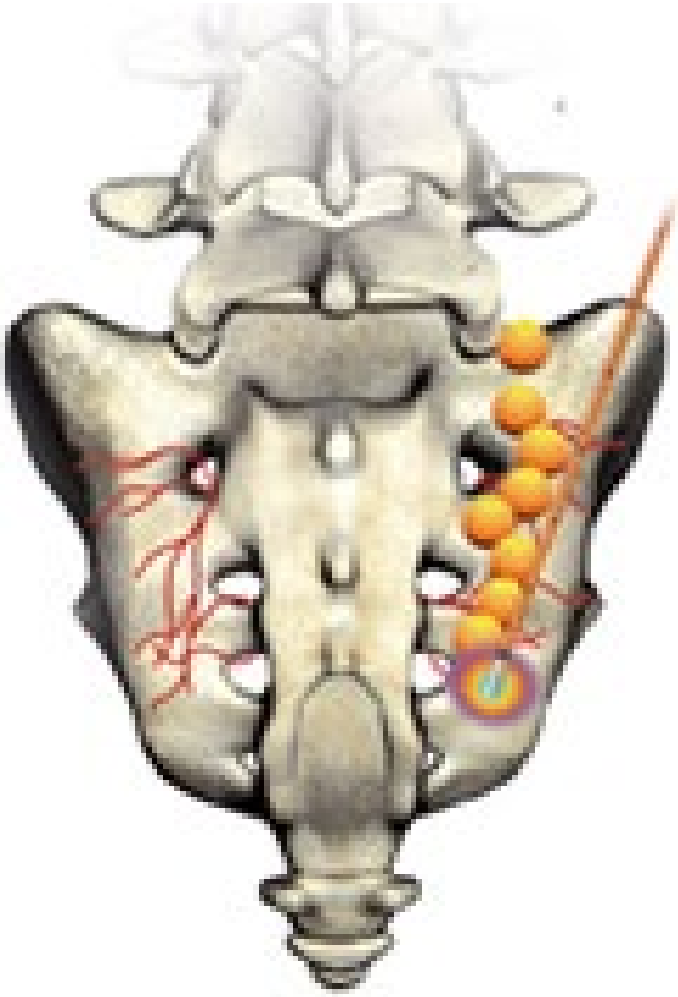
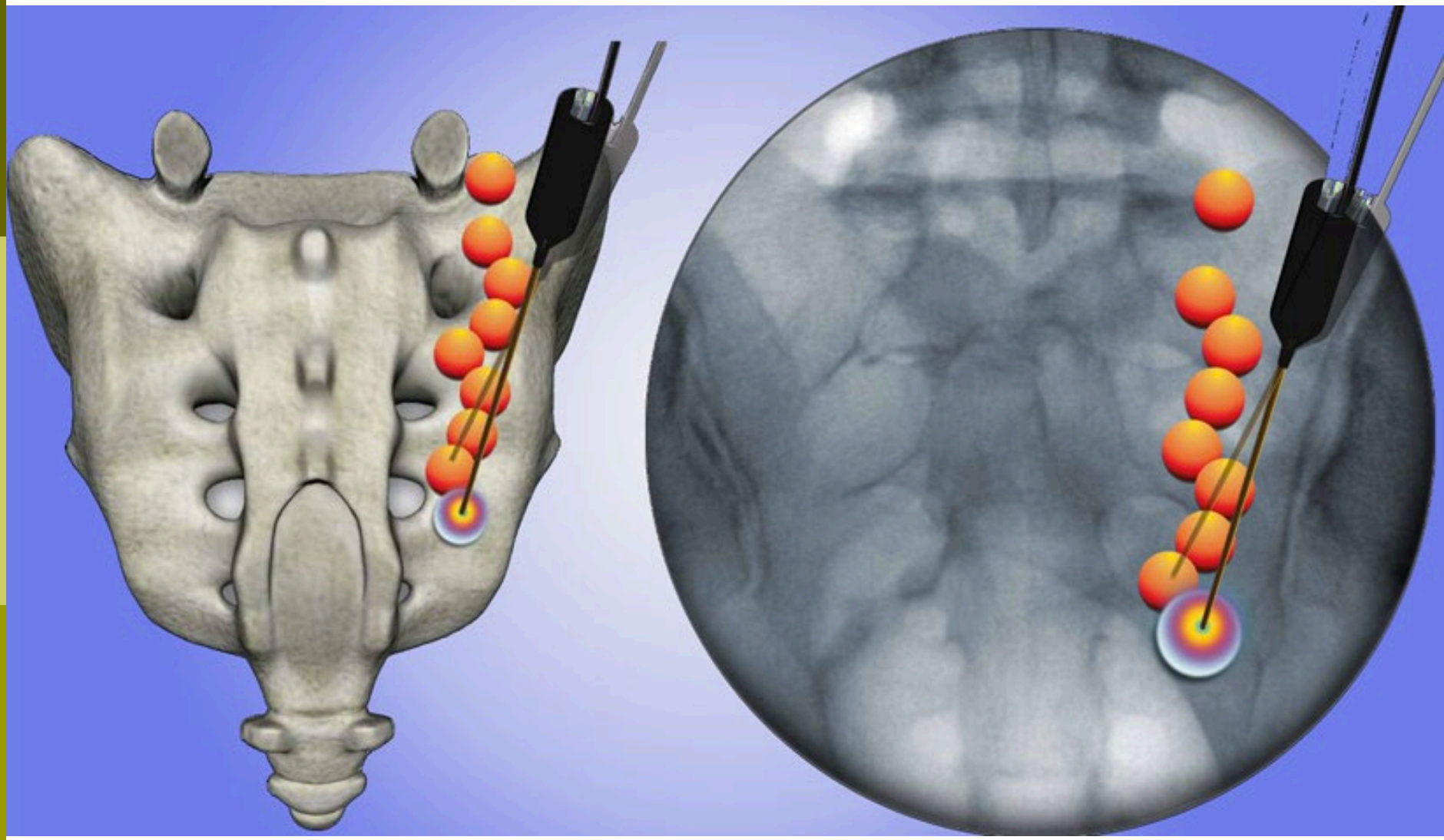
Radiofrequency Neurotomy





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Summary – SI Joint Procedures

- SI Joint Dysfunction
- Intra-Articular Injection
- Radiofrequency Ablation
  - Diagnostic LBBs for patient selection
  - Long term relief
  - Developing techniques

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