Cervical and Lumbar Radiculopathy

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What is Radiculopathy?

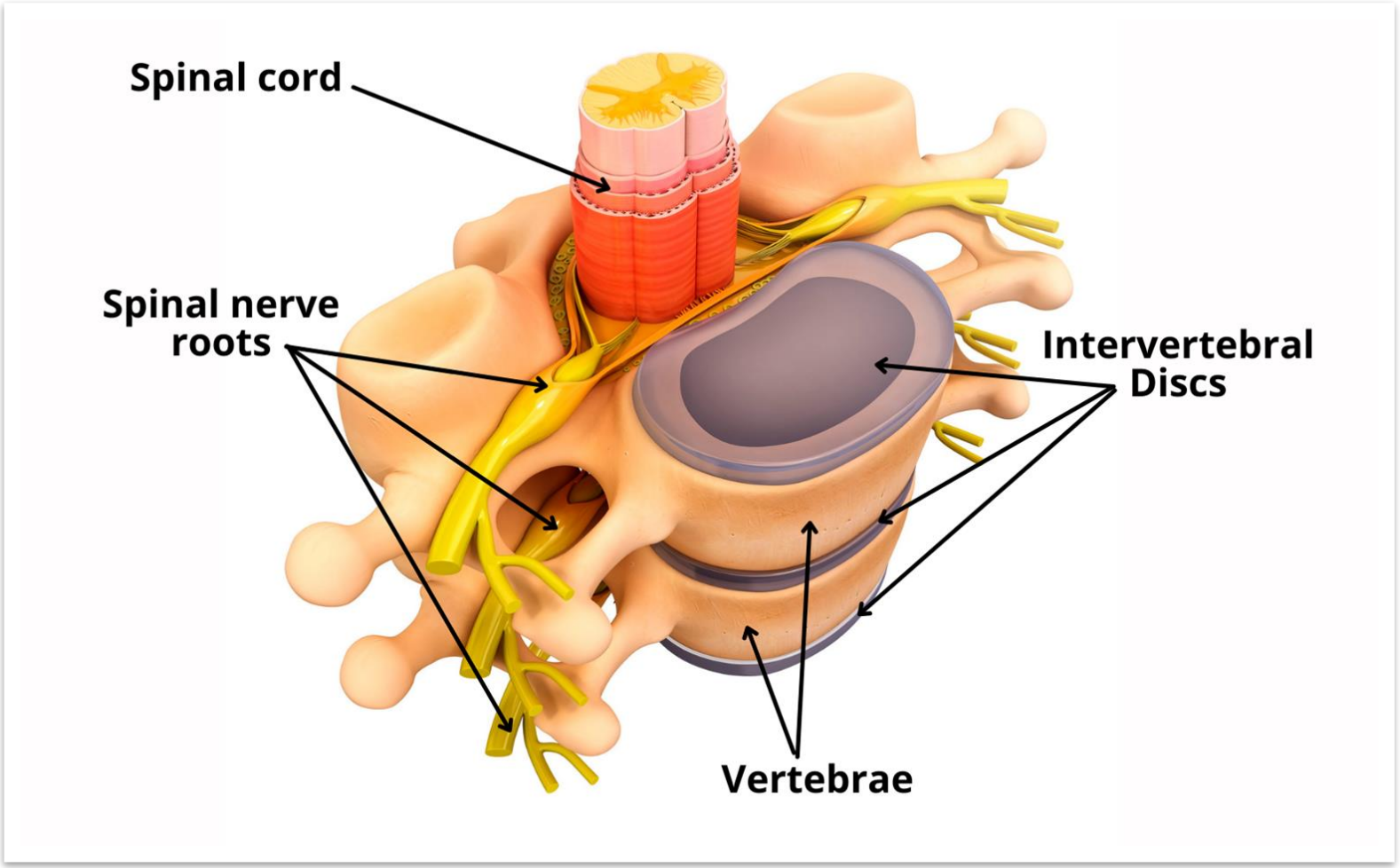
Pathologic term: spine nerve root dysfunction

Practical terms: spinal nerve-related symptoms such as pain, paresthesia, weakness, etc.

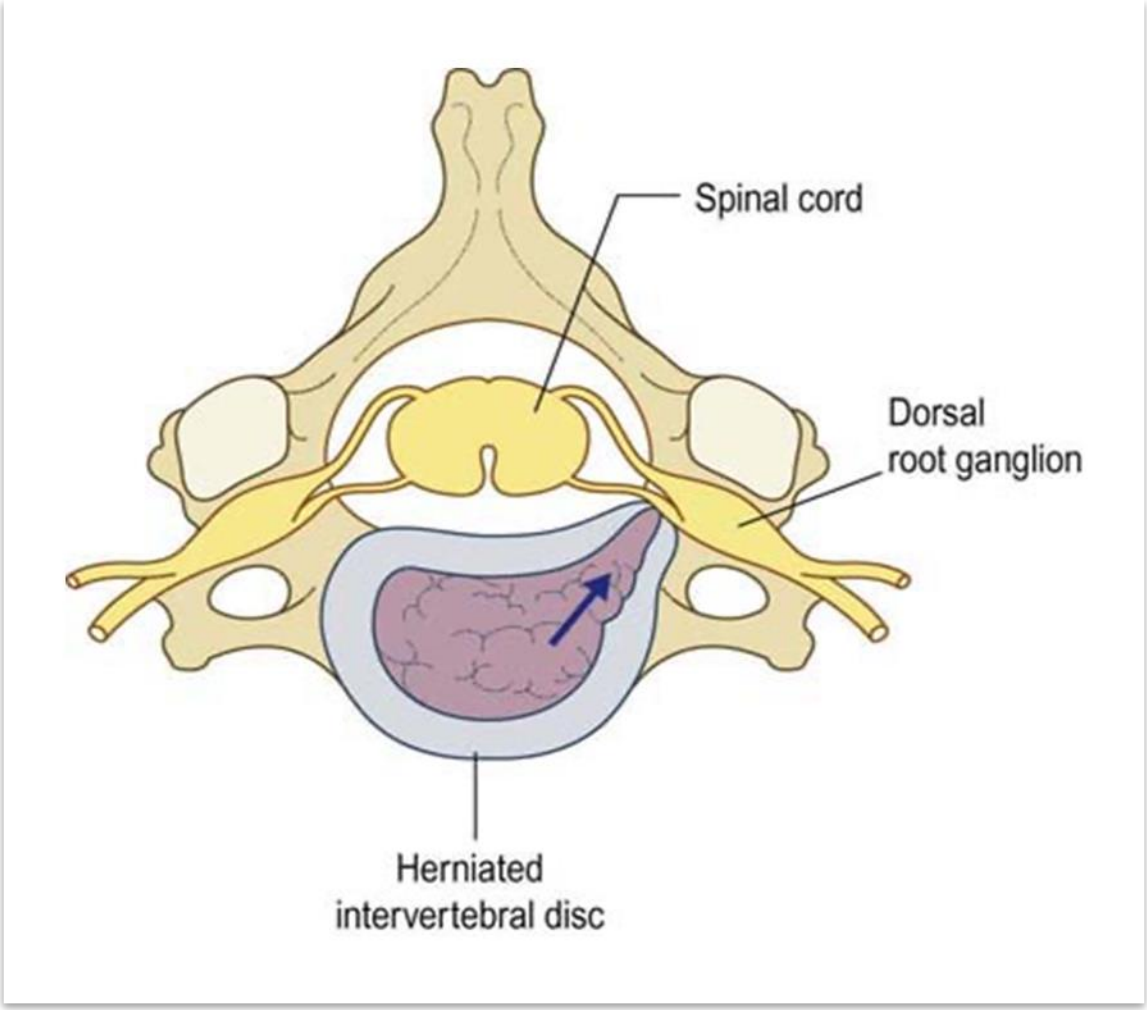
ICD 10 Codes

- M54.1 Radiculopathy
- M54.12 Radiculopathy, cervical region
- M54.16 Radiculopathy, lumbar region
- M54.17 radiculopathy, lumbosacral region

Nerve Roots


Spinal cord
Spinal nerve roots
Intervertebral Discs
Vertebrae

Nerve Root Impingement



Differentiation (“pathy”)

Myelopathy: spinal cord compression

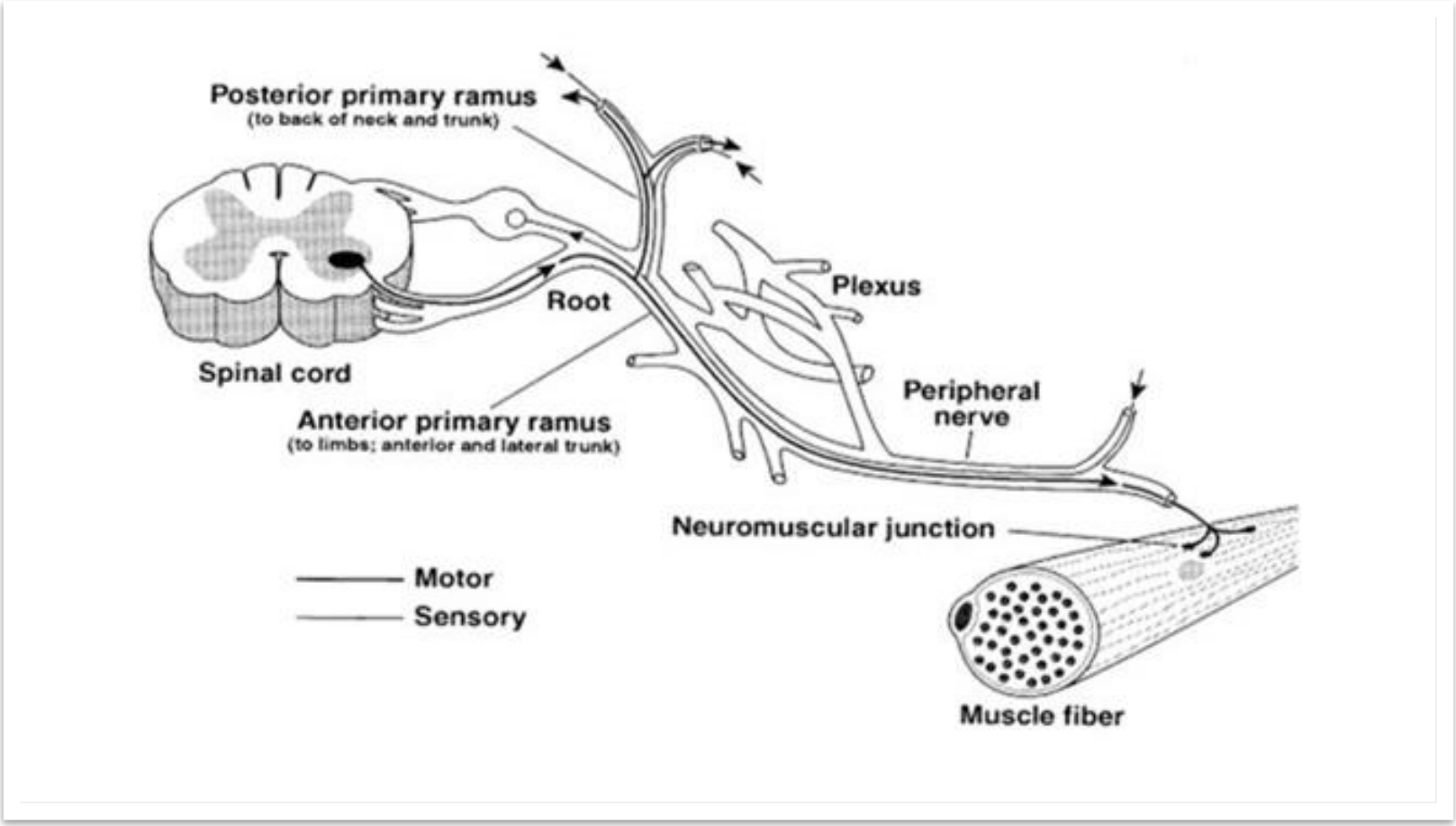
Radiculopathy: spinal nerve roots

Plexopathy : proximal nerves: brachial and lumbosacral plexus

Neuropathy: peripheral nerves

“Myopathy”: muscle disorders such as polymyositis

Peripheral Nervous System



“Pathys”

“Neuropathy”

Disease of Peripheral Nerve

“Radiculopathy”

Disease of Spinal Nerve Root

“Myelopathy”

Disease of Spinal Cord

Possible Symptoms:

Weakness
Numbness

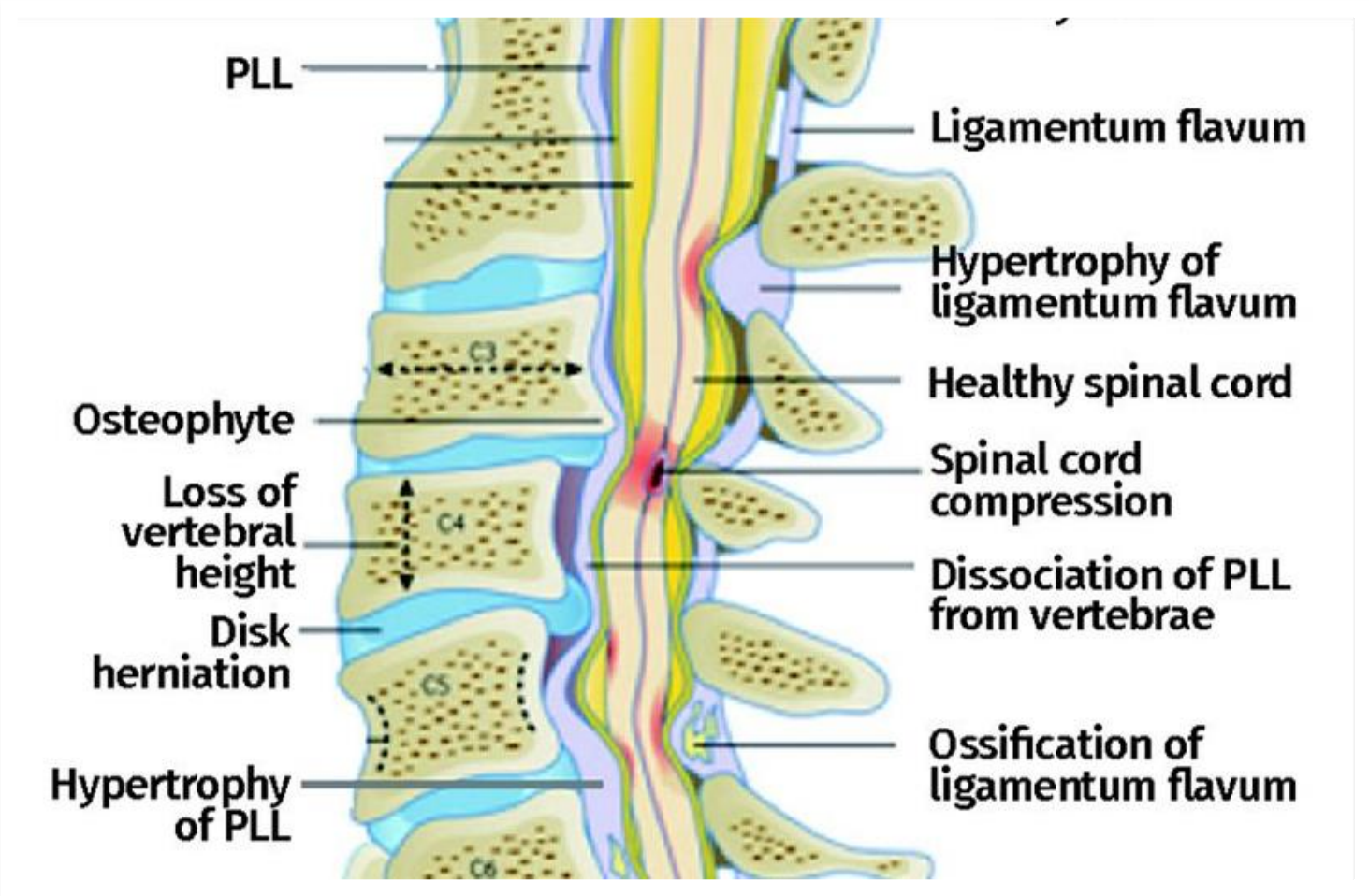
Possible Symptoms:

Weakness
Numbness

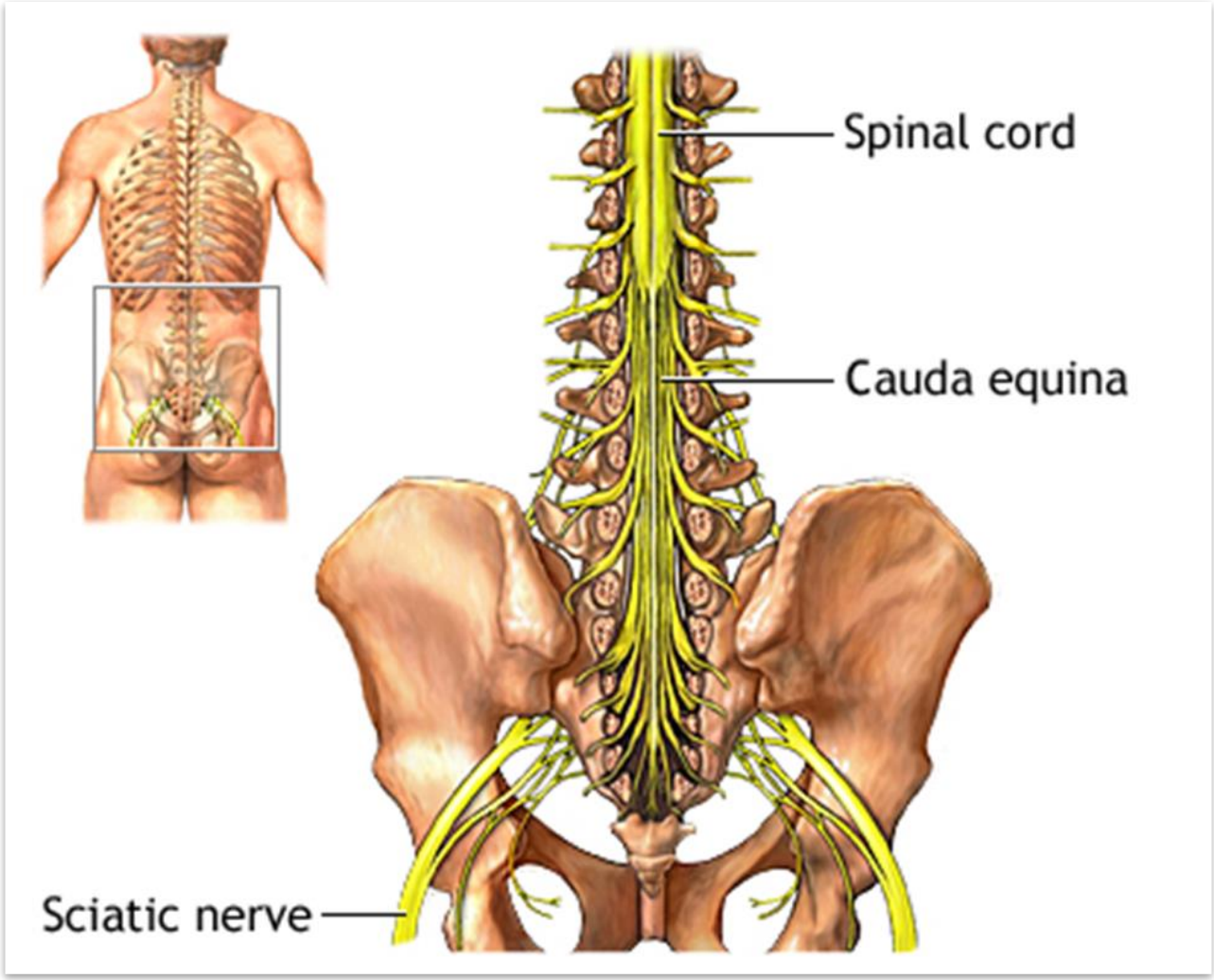
Possible Symptoms:

Stiffness
Incoordination
Weakness
Numbness

Myelopathy


PLL
Ligamentum flavum
Hypertrophy of ligamentum flavum
Healthy spinal cord
Osteophyte
Spinal cord compression
Loss of vertebral height
Dissociation of PLL from vertebrae
Disk herniation
Ossification of ligamentum flavum
Hypertrophy of PLL
C3
C4
C5
C6

Cauda Equina



Etiology

External Causes:

- Compression: disc herniation, neuroforaminal narrowing, tumor, fibroproliferation, hematomas, trauma
- Irritation: inflammatory mediators such as acute disc rupture

Internal Causes:

- Nerve tumor, inflammation

Spine Disorders (“spondys”)

Spondylosis with/without radiculopathy/myelopathy: osteoarthritis of spine

Spondylolysis: a stress fracture through pars interarticularis of vertebrae

Spondylolisthesis: a vertebrae slips forward and out of place

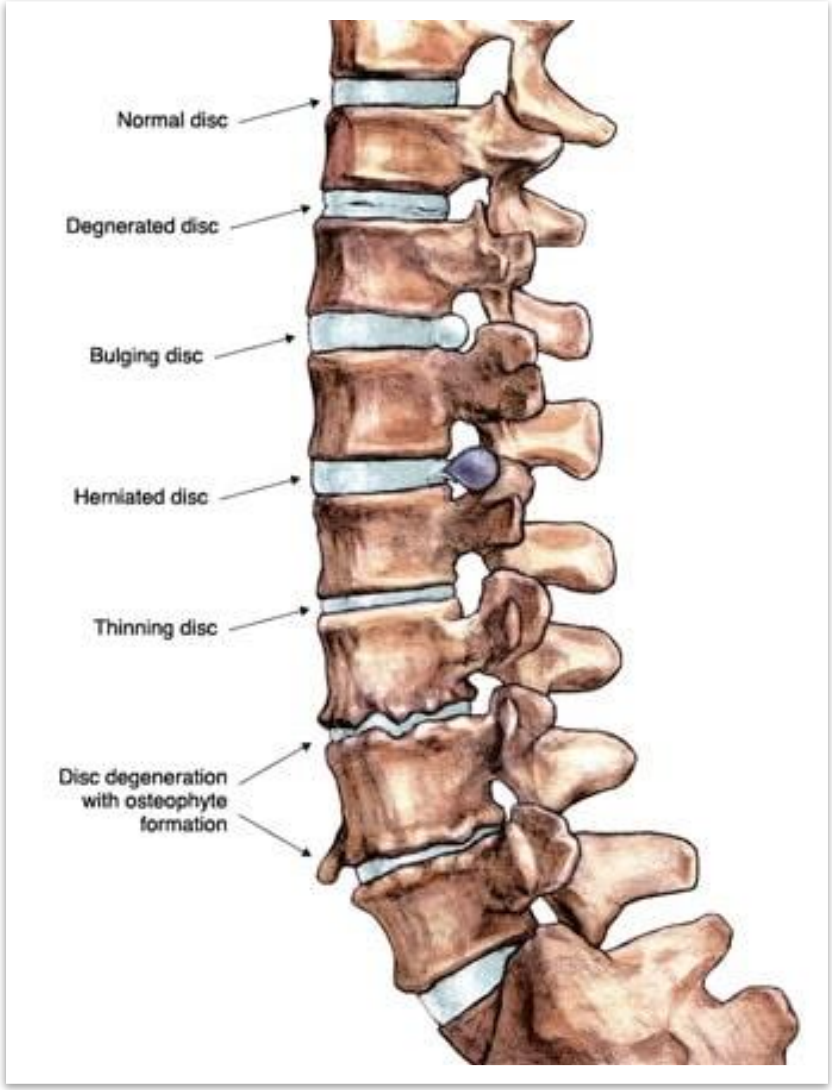
Stenosis: canal and foramen

Disc herniation: bulging, protrusion, extrusion

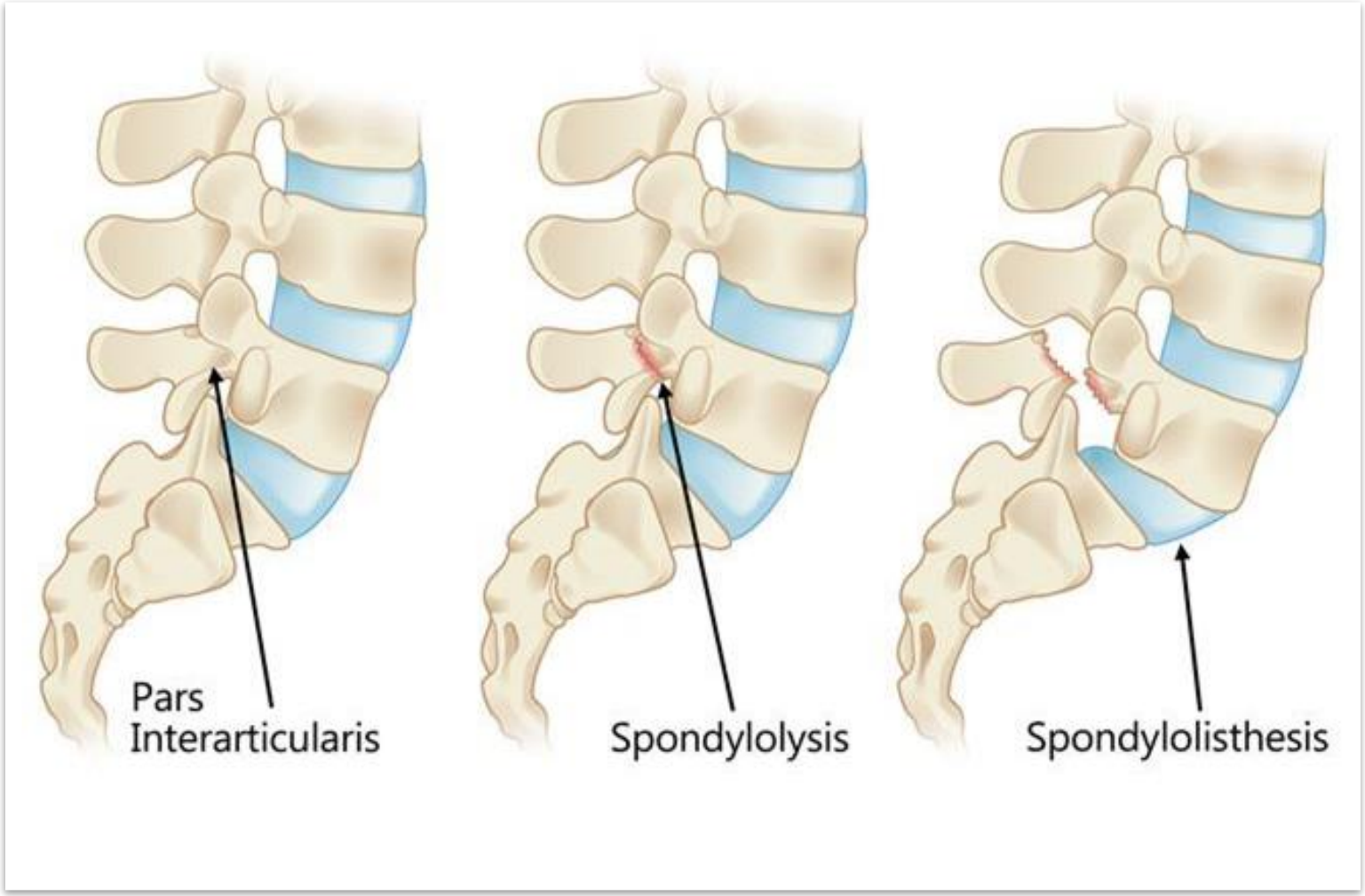
Facet (zygapophyseal) joint arthropathy:

"Ankylosing spondylitis": HLA-B27

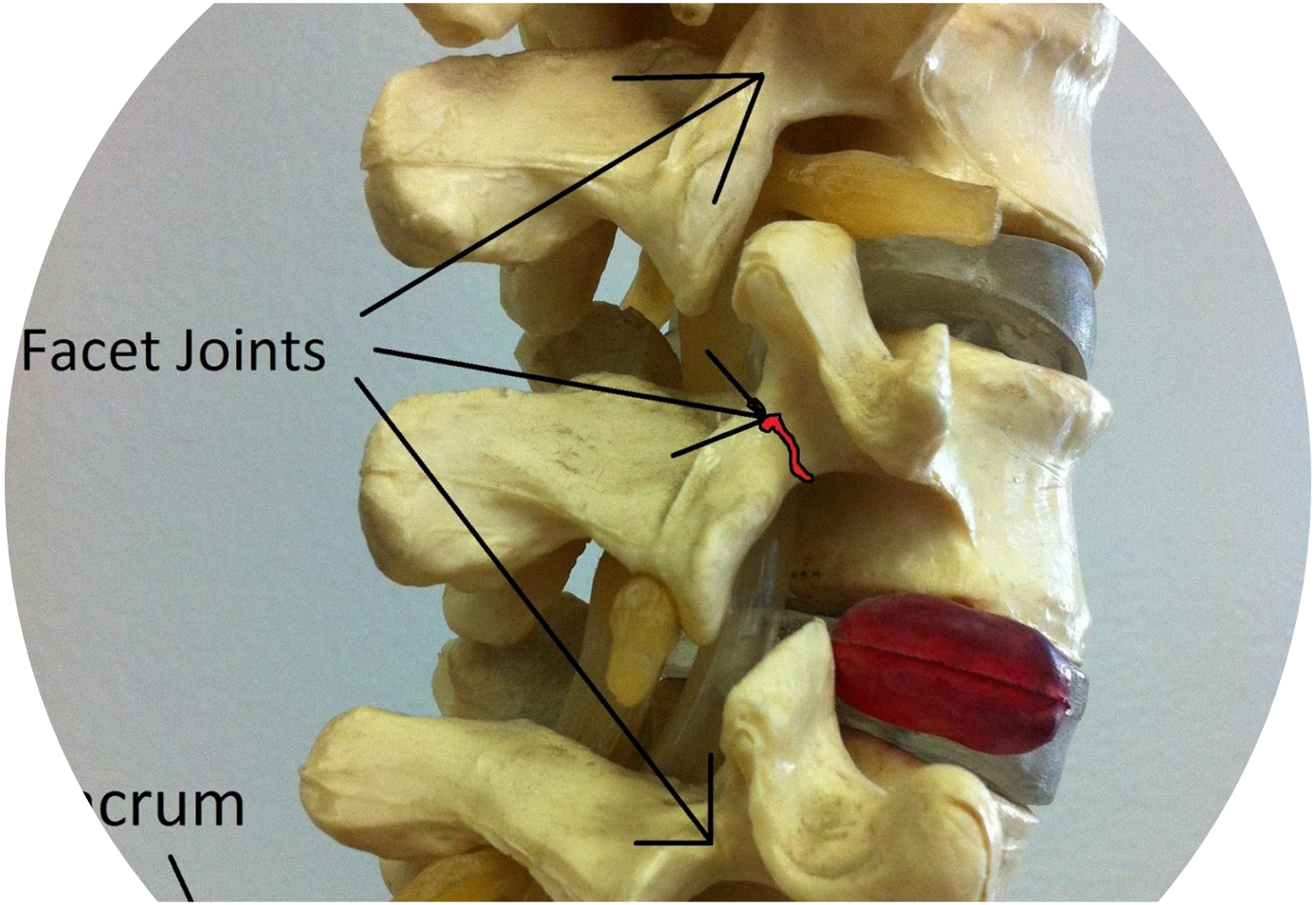
Spondylosis



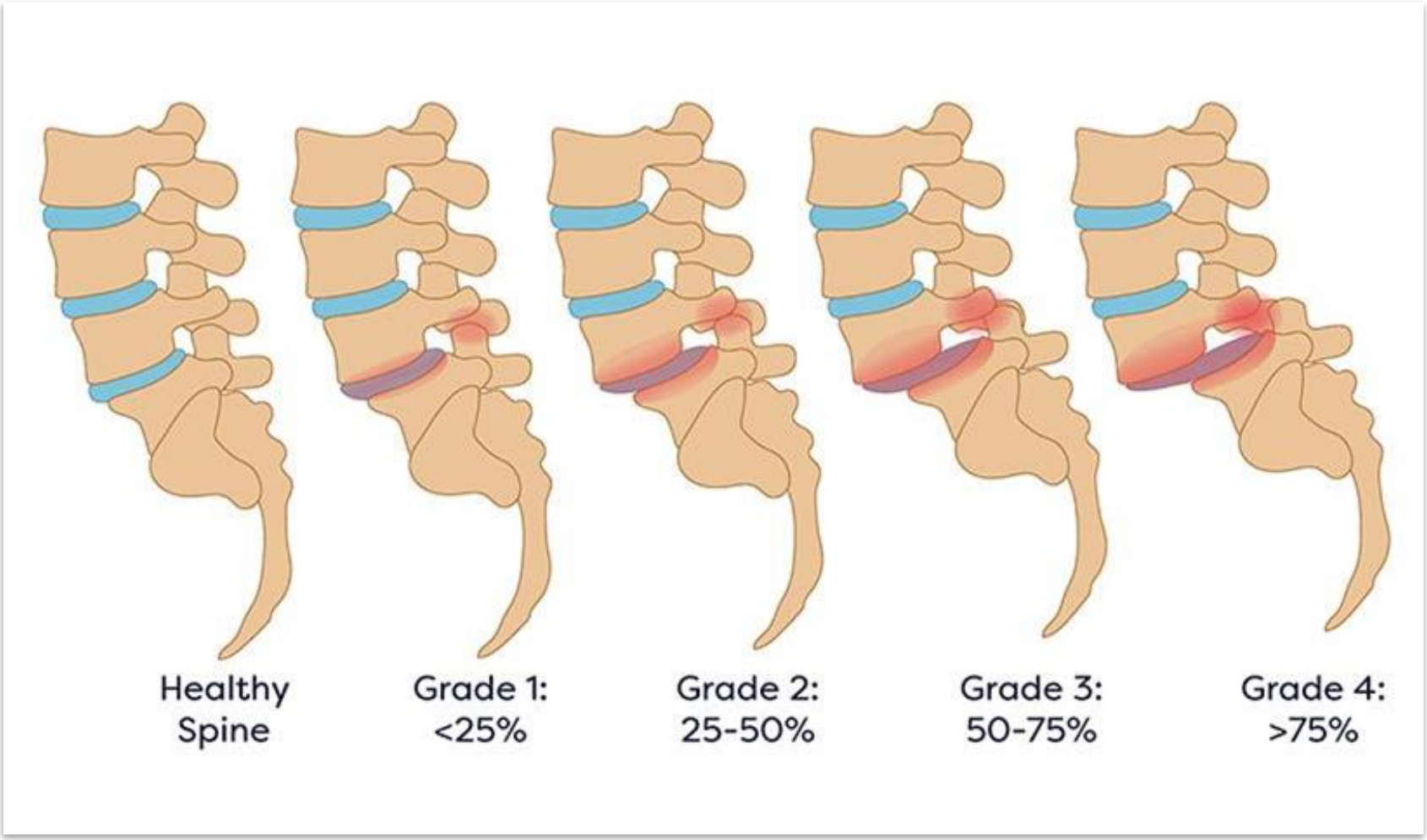
Spondylolysis and Spondylolisthesis



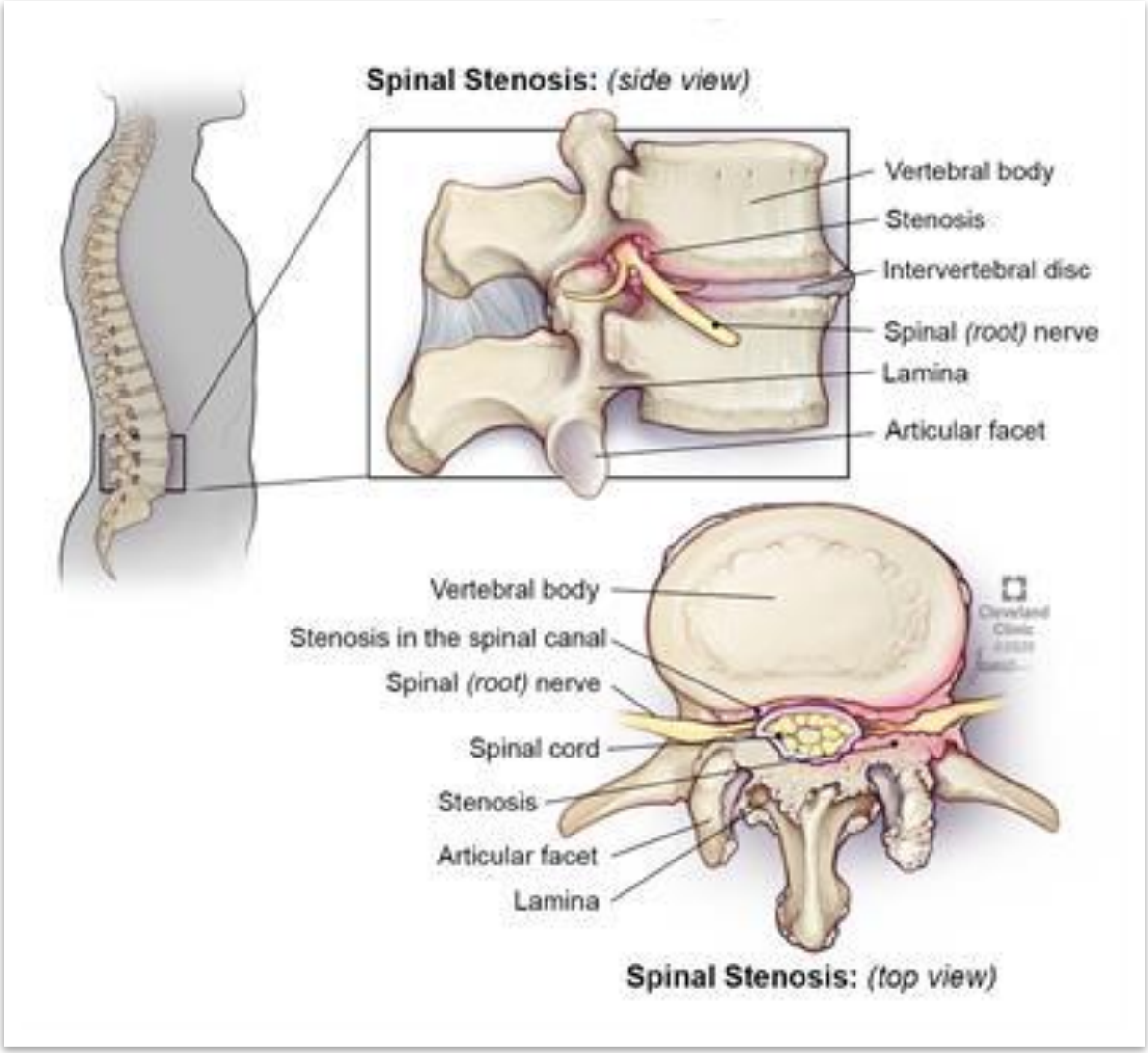
“Scottie Dog”



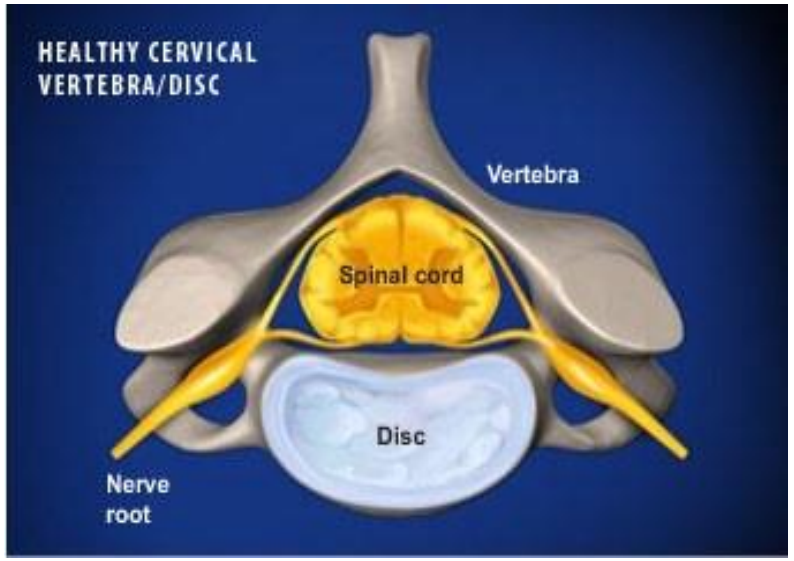
Spondylolisthesis Stages

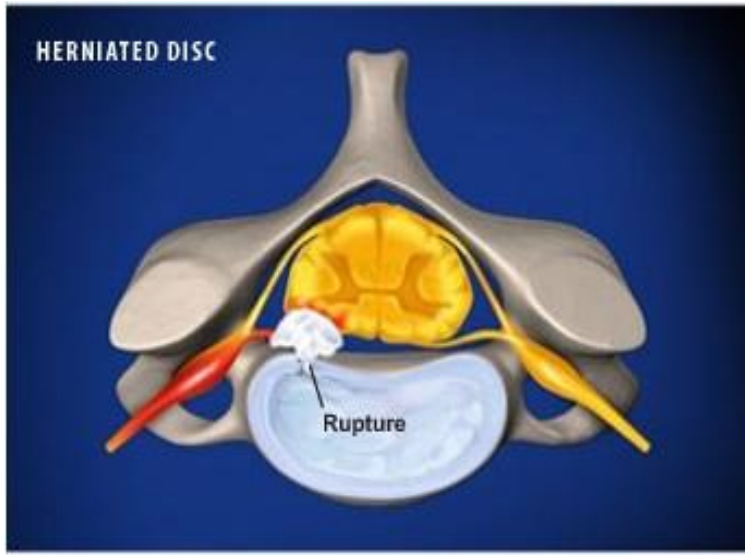


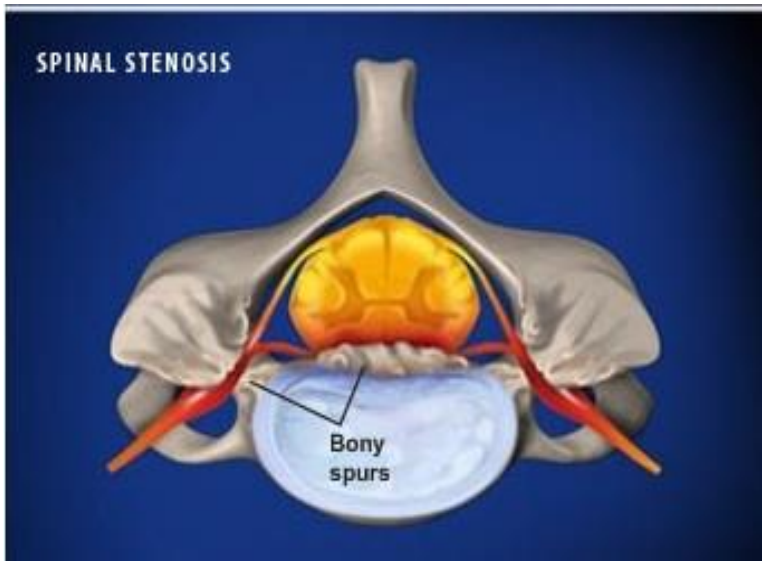
Spinal Stenosis



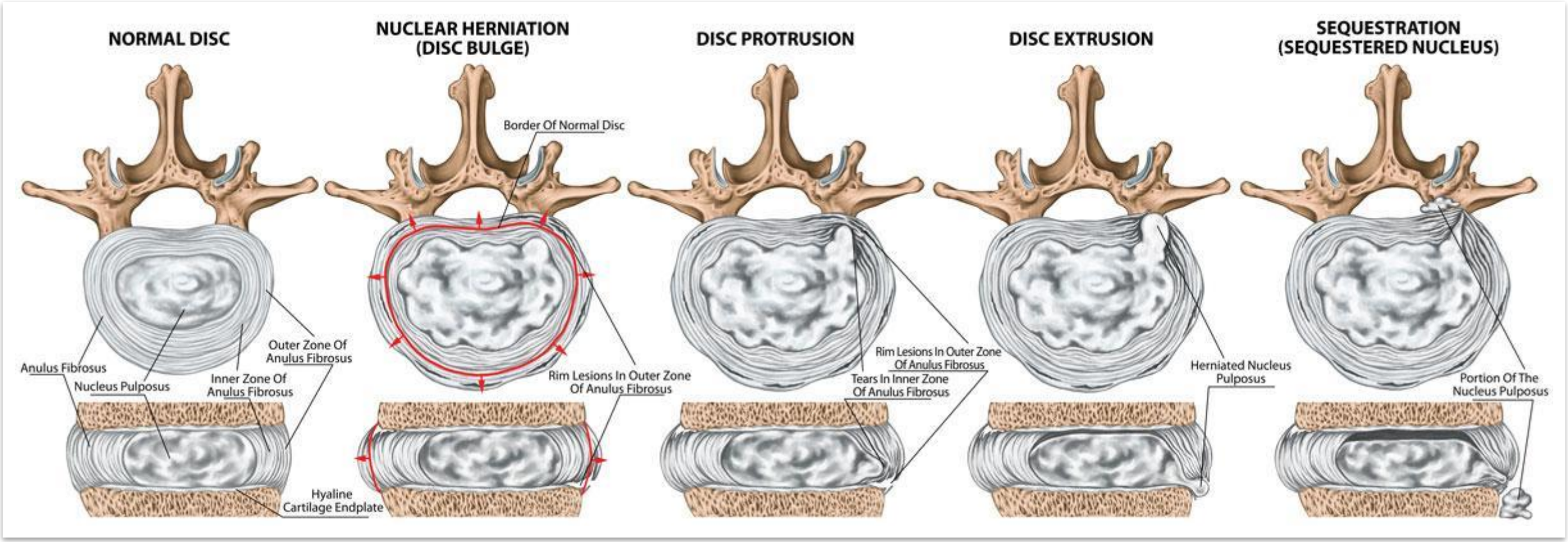
Nerve Root Impingement and Spinal Cord compression







Disc Herniations



Epidemiology

Prevalence:

- **Cervical:** 0.35% with 70% C7 and 20% C6 nerve roots
- **Lumbar:** 3-5% with 90% affecting the L5 and S1 nerve roots

Risk factors:

- Heavy industrial work, driving, previous injuries, smoking, sedentary lifestyle overweight, etc.

Pathy-anatomy/physiology

Mechanical compression:

- Malfunction of nerve such as conduction block, demyelination or axonal loss
- Volume changes of intervertebral foramen: increase with flexion and decrease with extension

Inflammatory substances: phospholipaseA2 from nucleus pulposus, prostaglandinE2, leukotrienes, cytokines, tumor necrosis, etc.

Essentials of Assessment

History

- Onset, distribution, exacerbating, and alleviating factors
- Specific pattern of compromised nerve roots, dermatome/myotome
- Symptoms of myelopathy: bowel and bladder, balance, increased muscle tone, etc.
- Cauda Equina Syndrome
- Joint history: shoulder, sacroiliac joint, hips
- Social history: pending litigation, substance use, etc.

Neurological Evaluation of Cervical Spine

Cervical radiculopathy

- **C5:** Pain in the medial scapular border and lateral upper arm; weakness of the deltoid, supraspinatus, and infraspinatus; sensory loss in lateral upper arm; changes in supinator reflex.

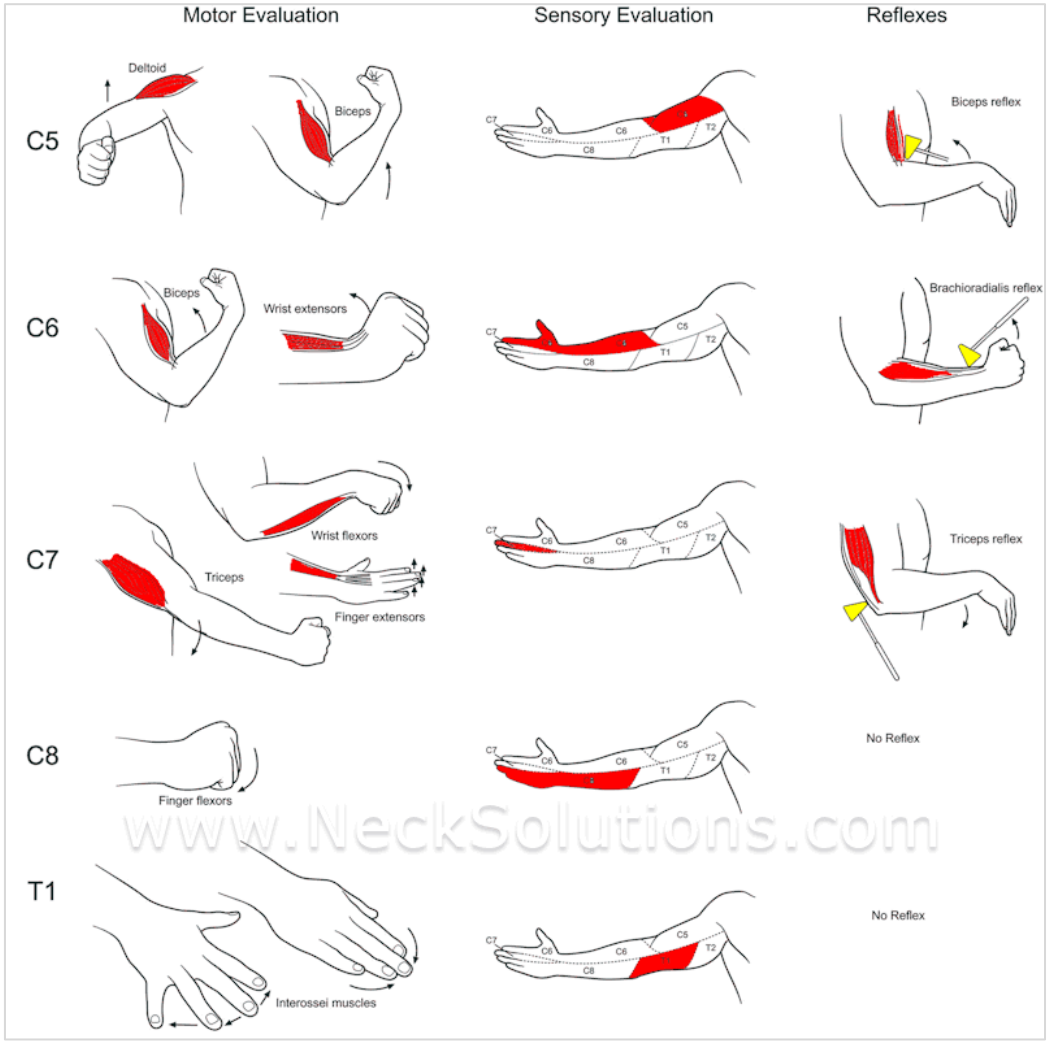
- **C6:** Pain in the lateral forearm, thumb and index finger; weakness of the biceps, brachioradialis, infraspinatus, and wrist extensors; sensory loss in thumb and index finger; and changes in the biceps/or brachioradialis reflexes.

- **C7:** Pain in the medial scapula, posterior arm, forum of forearm and third finger; weakness of the triceps, wrist flexors, and finger extensors; sensory loss in the posterior forearm and third finger; and changes in the triceps reflex.

- **C8/T1:** Pain in the ulnar side of the forearm and fifth finger; weakness of thumb flexors; abductors, and hand intrinsic; and sensory loss isn't fifth finger.

Nerve root	Extremity pain pattern	Weakness	Deficient reflex
C5	Shoulder, lateral arm	Deltoid and biceps	Biceps
C6	Thumb, index finger	Brachioradialis and wrist extension	Brachioradialis
C7	Long finger	Triceps and wrist flexion weakness	Triceps
C8	Medial forearm, fourth and fifth fingers	Finger flexion	None

Myotome and Dermatome of Cervical Spine Nerve Roots



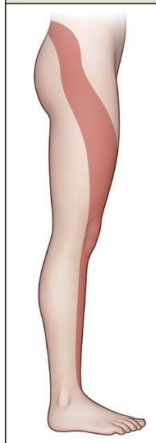
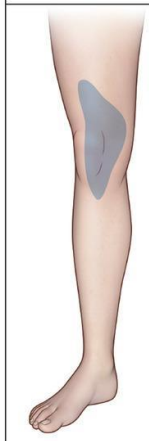
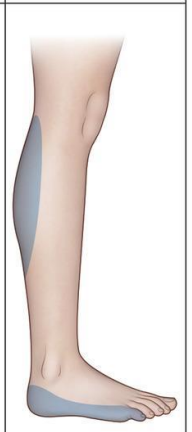
Neurological Evaluation of Lumbar Spine

Lumbosacral radiculopathy

- L2: Pain in anterior thigh; weakness of hip flexion; sensory loss in upper anterior thigh; no reflex to test
- L3: Pain in anterior knee; weakness of hip flexion, knee extension, and hip abduction; sensory loss in anterior knee; changes in patella reflex.
- L4: Pain in medial calf; weakness of knee extension and some ankle dorsiflexion; sensory loss in medial calf; changes in patella reflex.
- L5: Pain in lateral calf, dorsomedial foot, and buttock/posterior thigh; weakness of ankle inversion, dorsiflexion, and large-toe extension; sensory loss in formal and medial foot, and lateral calf; no reflex to test.
- S1: Pain in plantar and lateral boot, and buttock/posterior thigh; weakness of ankle plantarflexion, hip extension, and knee flexion; sensory loss in plantar and lateral foot; changes in Achilles reflex

 **L3-4 disc; 4th lumbar nerve root**	 Lower back, hip, posterolateral thigh, anterior leg	 Anteromedial thigh and knee	 Quadriceps	 Quadriceps	 Knee jerk diminished
 **L4-5 disc; 5th lumbar nerve root**	Over sacro-iliac joint, hip, lateral thigh and leg 	 Lateral leg, web of great toe	 Dorsifexion of great toe and foot; difficulty walking on heels; foot drop may occur	Minor	Changes uncommon absent or diminished posterior tibial reflex
 **L5-S1 disc; 1st sacral nerve root**	Over sacro-iliac joint, hip, postero-lateral thigh and leg to heel 	 Back of calf; lateral heel, foot and toe	Plantar flexion of foot and great toe may be affected; difficulty walking on toes	 Gastrocnemius and soleus	 Ankle jerk diminished or absent

Myotome and Dermatome of Lumbar Spine

	Nerve Root		
	L4	L5	S1
Pain			
Numbness			
Motor weakness	Extension of quadriceps	Dorsiflexion of great toe and foot	Plantar flexion of great toe and foot
Screening examination	Squatting and rising	Walking on heels	Walking on toes
Reflexes	Knee jerk diminished	None reliable	Ankle jerk diminished

Special Testes

Cervical radiculopathy: Spurling's Maneuver and upper limb tension test (ULTT). The post-test probability of cervical radiculopathy is 90%.

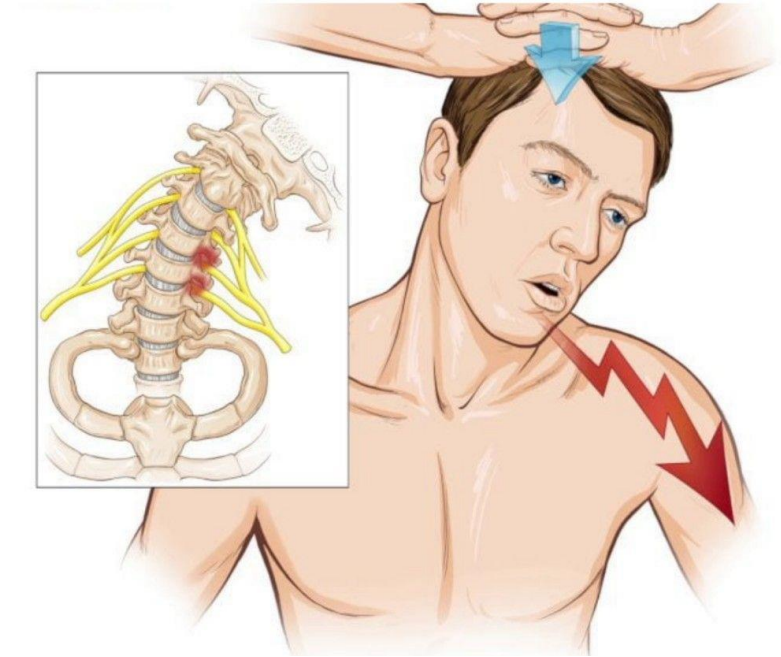
Lumbosacral radiculopathy:

- **Functional strength tests:** toe walking (S1), Heel walking (L5), single leg sit to stand or squat/rise (L3, L4)
- **Root tension signs:** supine straight leg raise (SLR more sensitive, less specific), slump test, crossed SLR (low sensitive, high specific), femoral nerve stretch test (upper lumbar)
- **Sacroiliac joint maneuvers:** Gaenslen's and FABER, nonspecific and not sensitive

Spurling Test

Special Tests

- Spurling Test (Foraminal Compression):
  - *Patient position:*
    - Seated
  - *ATC position:*
    - Standing behind the athlete with hands interlocked over crown of patient's head
  - *Procedure:*
    - Patient laterally flexes the head while a compressive force is placed along patient's cervical spine
  - *Positive test:*
    - Radiating pain down patient's arm
    - Implication:
      - Nerve root impingement



Upper Limb Tension Testing A

- Scapular Depression
- Shoulder Abduction
- Shoulder ER
- Elbow Extension
- Forearm Sup
- Wrist and Finger Extension

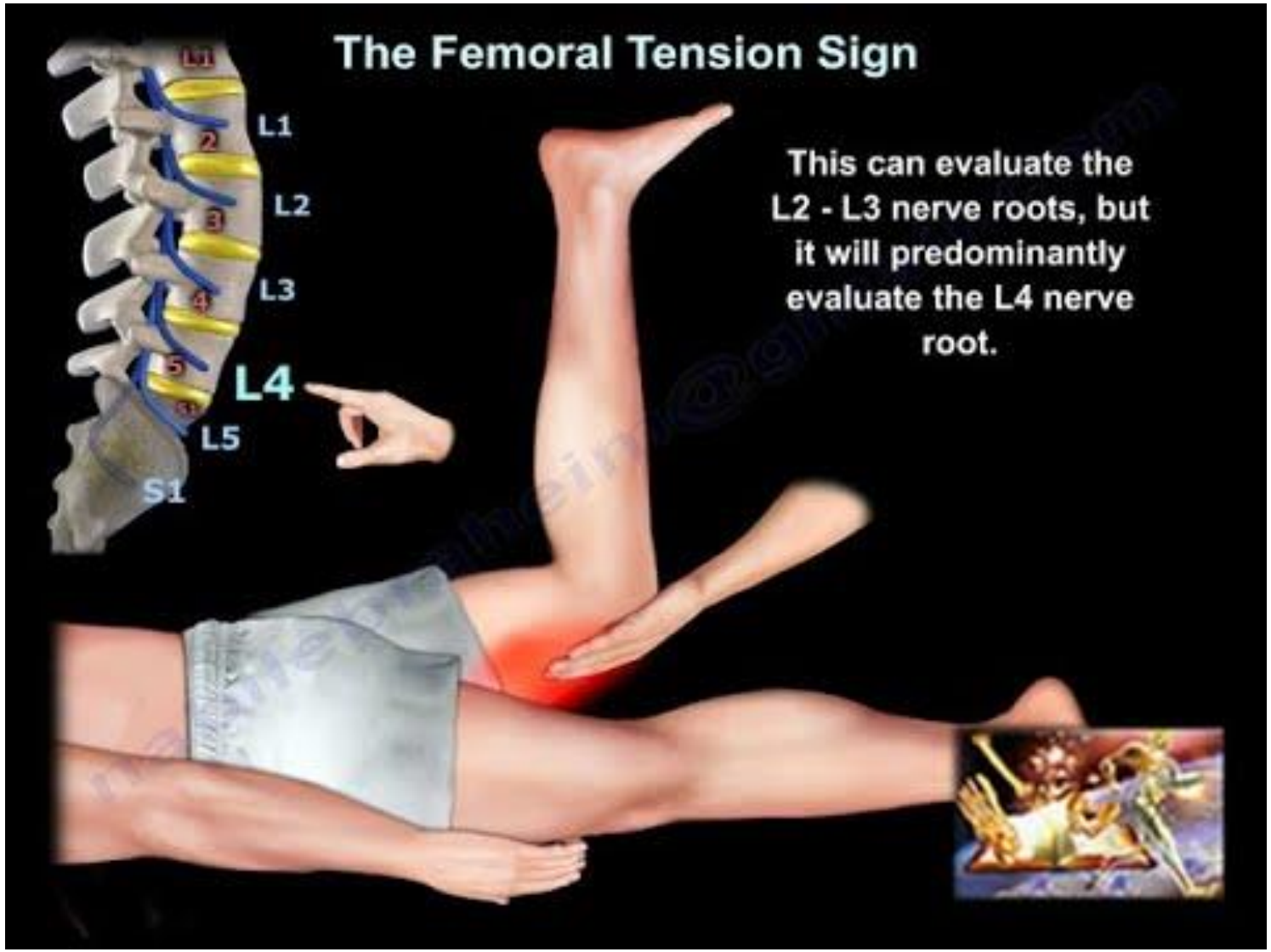
University of Delaware

Straight Leg Raise

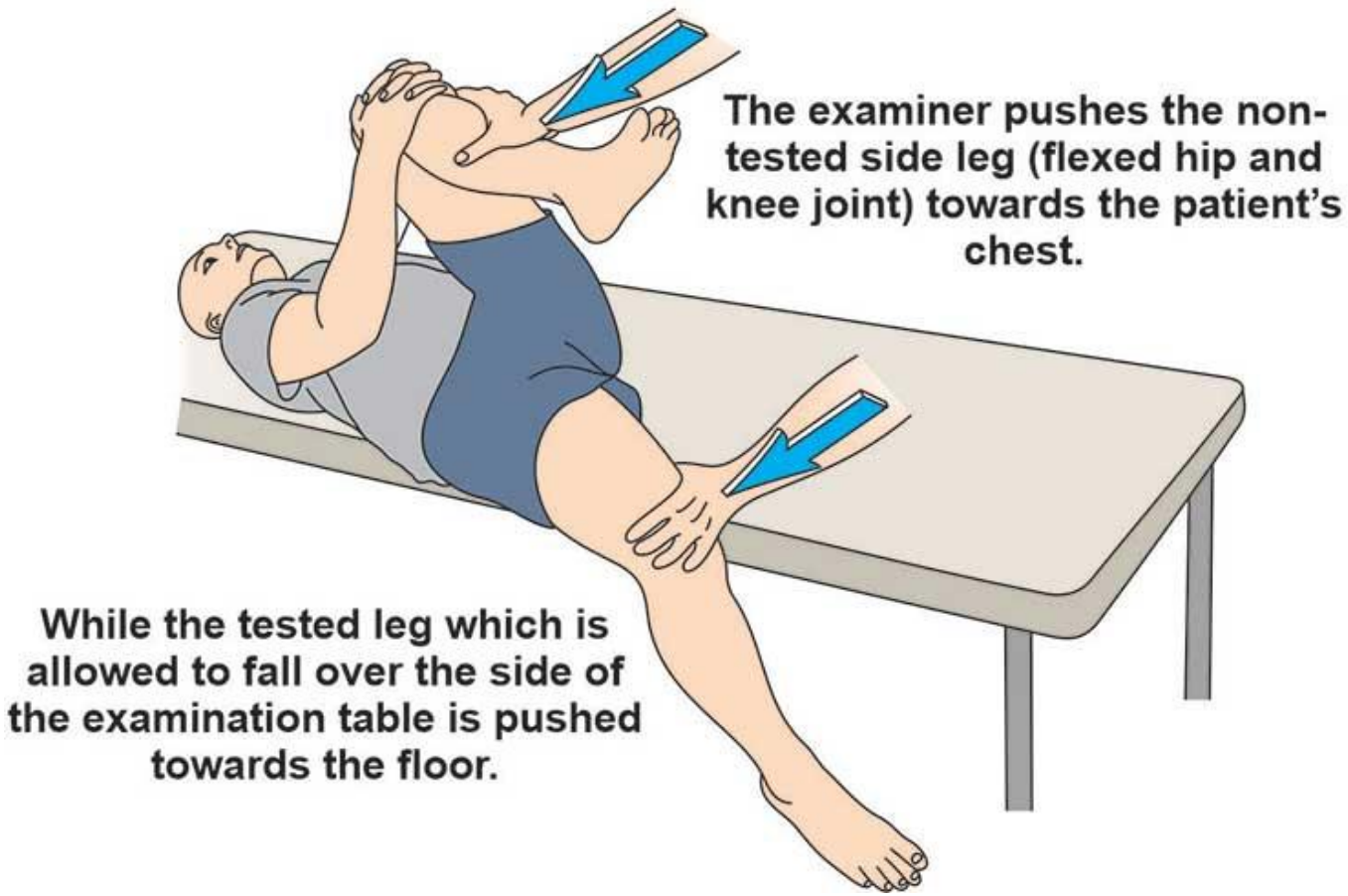
Assessment

Test Slump

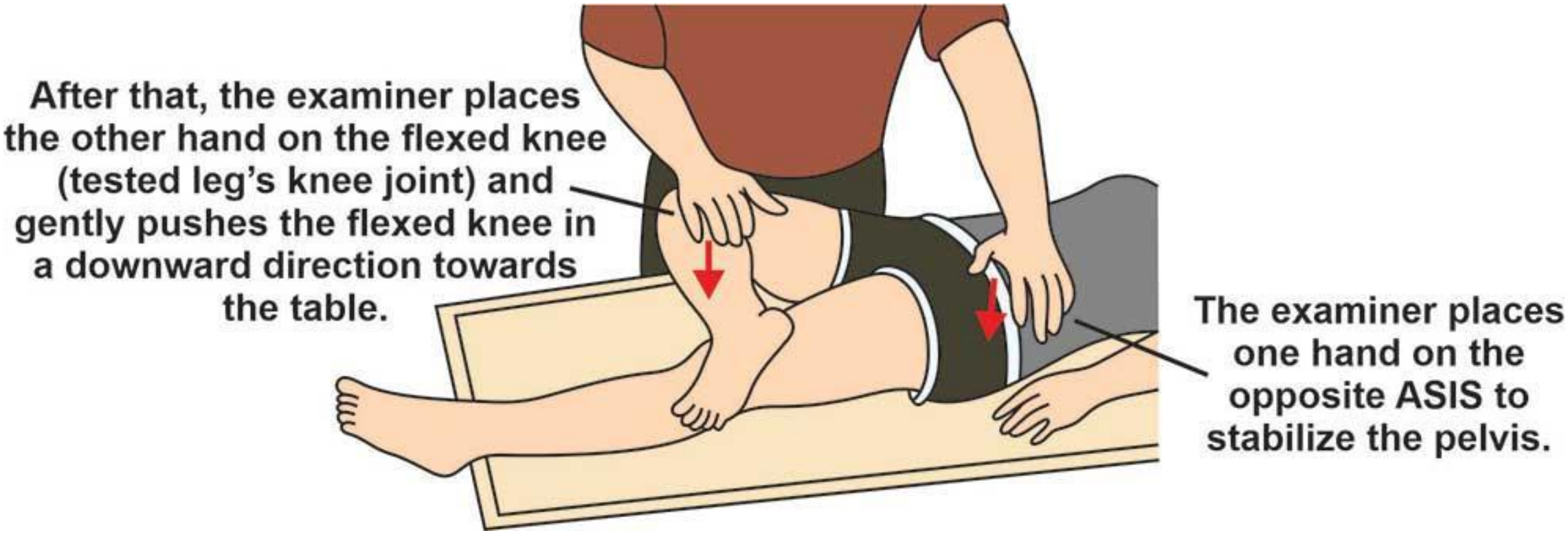
Femoral Nerve Stretching Test



Gaenslen's Test



FABER (Patrick's Test)



Imaging

X-ray: " first line", but not as effective for patients older than 55

MRI:

- Preferred imaging modality
- A confirmatory test of the clinic impression
- Highest sensitivity 89% and specificity 83%

CT with or without myelography if MRI is contraindicated:

- Better bony detail
- Sensitivity 82% and specificity 78%

Electromyography (EMG)/Nerve Conduction Study (NCS)

- Confirm clinical suspicions
- Identify root level
- Evaluated severity and acuity
- Differentiation: Nerve root vs. Plexus vs. Peripheral nerve

EMG Abnormality

1 week: abnormal spontaneous activity in paraspinals

2 weeks: abnormal spontaneous activity in the limbs

3 weeks: abnormal activity in the paraspinals and limbs

5 - 6 weeks: reinnervation

6 months - 1 year: large MUAP amplitude

Therapeutic Diagnosis

- Fluoroscopically guided transformational epidural injection can confirm the root level

- Hip, sacroiliac joint, facet joint injection to add diagnostic information

Disease Progression

- Radiculopathy caused by disc herniation had around 80% significant improvement in pain and disability in 4-6 weeks (disc shrink/regress over time)
- Around 30% had persistent pain and physical restriction at one year
- 1 - 10% of patients will go to surgery
- Surgical treatment consideration: myelopathy symptoms, progressive neurological deficits (especially single root radicular symptoms), Cauda equina syndrome

Rehabilitation Management and Treatment

New onset/acute management:

- Short rest period
- Activity modification with emphasis on staying as active as possible
- Modalities: ice, heat, TENS
- PT with general stretching program, McKenzie mechanical diagnosis and treatment
- Medications: NSAIDs, acetaminophen, muscle relaxers, anti-neuropathic drugs and opioid like tramadol; oral steroid taper are often used,75% improvement in cervical radiculopathy pain compared to 30% in placebo, but has not been shown superior pain relief compared to placebo in lumbar radiculopathy

Rehabilitation Management and Treatment

Subacute managements:

- Continue and advance acute care
- Repeat neurological evaluation
- PT with dynamic spinal stabilization and strength training
- Interventional pain procedures
- Decompression: cervical al traction; Interspinous Processor Decompression (IPD), a lumbar interspinous spacer, minimally invasive procedure
- If no improvement by 4 - 6 weeks, surgical consultation
- A randomized prospective study of 60 patients with cervical radiculopathy who underwent surgery had 87% reduction in neck pain vs. 62% in nonsurgical group at 1 year, but statistically insignificant at 2 years
- Many studies comparing surgery to conservative management for lumbar radiculopathy favor surgery. there were some bias in those trials

Rehabilitation Management and Treatment

Chronic/Stable Management

- Complementary treatments: acupuncture, massage therapy, chiropractic manipulations
- Spinal stimulator
- Chronic pain medication
- Comprehensive multidisciplinary cognitive-behavior pain management

Case Study

- 60-year-old male with past medical history of chronic low back pain off and on for years. Patient presents with increased low back pain after moving a furniture at home 2 months ago.
- He reports that pain is in left lower back, which radiates down to left buttock, posterior aspect of left thigh, cross left knee down to left leg laterally and top of left foot. He can't stand and walk very long. He drags his toes and traps easily.
- During exam, he has Steppage gait on left side, weakness of left ankle Dorsiflexion and left great toe extension, decreases light touch sensation on lateral aspect of left shin and top of left foot, and straight left raise positive for pain at 30–70-degree range.

Case Study (cont.)

- Clinic suspicious of left L5 radiculopathy
- MRI study without contrast
- EMG/NCS
- Surgical consultation

Practice Pearls

- Do not assume radiculopathy is the diagnosis in anyone presenting with neck and back radicular pain along with radiological evidence, without a full neurological evaluation and correlation

- Radiculopathy may be the diagnosis clinically when patient presents with classical dermatome and myotome distribution, you probably know which nerve root is involved (MRI and EMG/NCS to confirm)

- Differential diagnosis: myofascial pain, joint pain (shoulder, hip, sacroiliac joint), plexopathy, peripheral neuropathy

Questions?

Thank you!