IBJI Workman's Compensation Seminar
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Low Back Pain

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Epidemiology

- Incidence of LBP
  - 5% annual incidence
  - 80-90% lifetime incidence
- Age & LBP
  - Leading cause of disability in pts < 45 yrs old
  - 3rd leading cause in pts > 45 yrs old
- Accounts for 15-25% of reported work injuries & up to 40% of costs of all workers' comp claims
- Direct and indirect cost of LBP as high as $85 billion in 2005

Natural History

- 90% of LBP resolves within the first 6-12 wks, however rate of recurrence is high
- 70-90% of pts have additional episodes of pain after there initial bout of pain
- Long-term studies have shown that 1/3 of pts continue to have persistent or intermittent LBP

Return to Work

- 50% if off work > 6 months
- 25% if off > 1 year
- Nearly 0% if off work > 2 years

Work Related Risk Factors

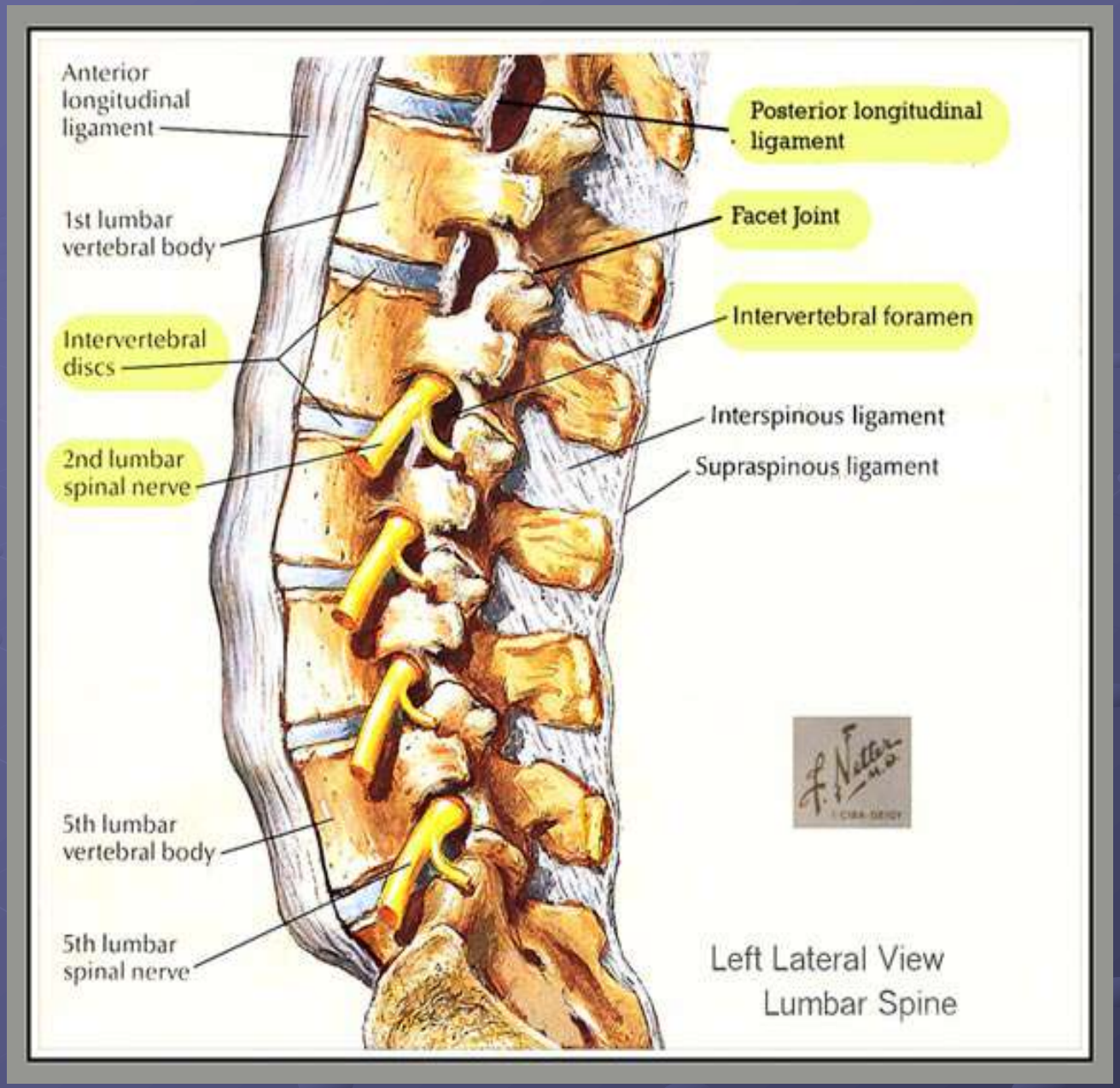
- Heavy physical/manual work
- Manual handling
  - utilization of poor technique and body mechanics, especially frequent lifting exceeding 25 lbs.
- Twisting and bending
- Whole body vibration
  - drivers, especially combined with taking loads to and from destination

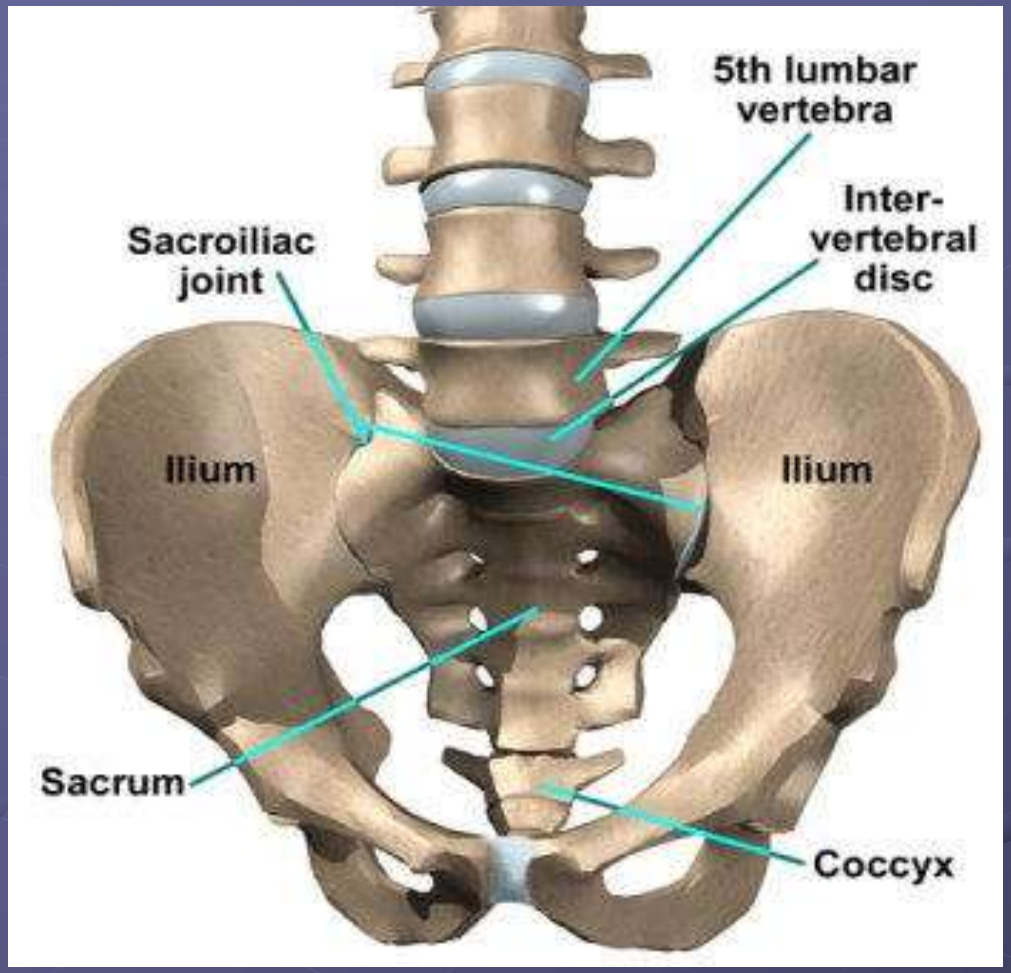
Work Related Risk Factors

- Previous back injury
  - most important risk factor for future problems on pre-employment screening history
- Psychosocial
  - Low job satisfaction
  - Monotonous or repetitious work
  - High workload
  - Adverse employer-employee relations
  - Educational level

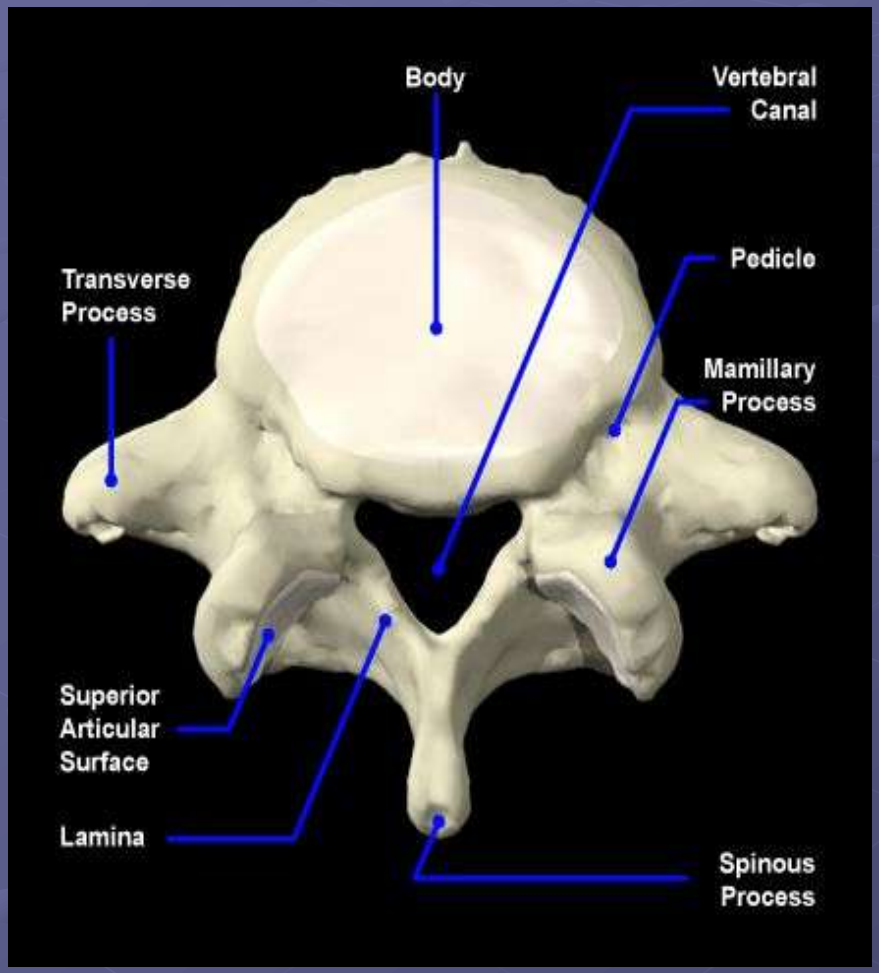
Pain Generators

- Periosteum
  - fibrous sheath that covers bones containing the blood vessels and nerves that provide nourishment and sensation to the bone
- Facet Joints
- SI joints
- Ligaments
  - interspinous ligament, supraspinous ligament, ALL, PLL and ligamentum flavum
- Muscles
- Intervertebral disc
  - outer 1/3 of the annulus, the remainder is aneural
- Spinal nerve roots


Anterior longitudinal ligament
1st lumbar vertebral body
Intervertebral discs
2nd lumbar spinal nerve
5th lumbar vertebral body
5th lumbar spinal nerve
Posterior longitudinal ligament
Facet Joint
Intervertebral foramen
Interspinous ligament
Supraspinous ligament
Left Lateral View
Lumbar Spine

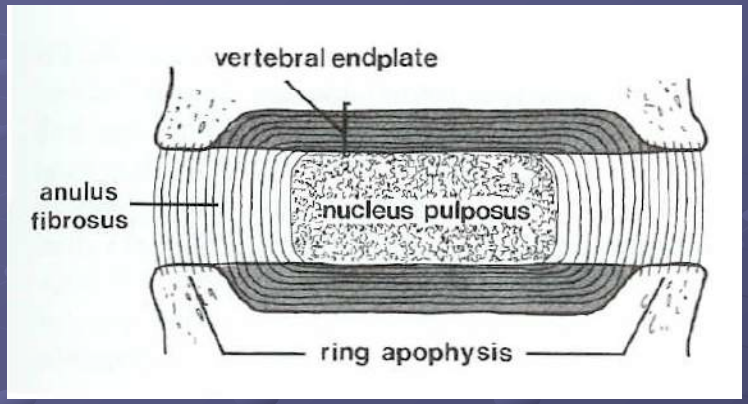

5th lumbar vertebra
Inter-vertebral disc
Sacroiliac joint
Ilium
Ilium
Sacrum
Coccyx

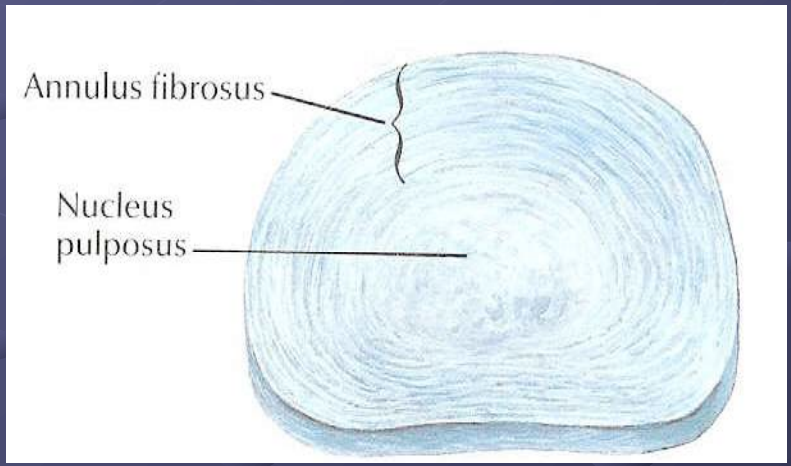
Lumbar Vertebrae



Invertebral disc

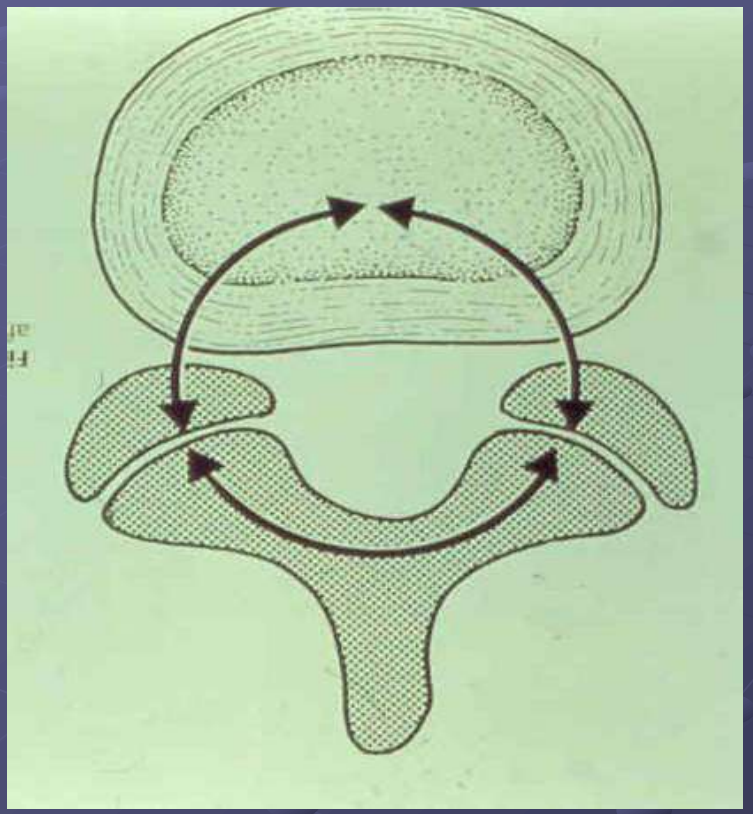
- Each disc is comprised of an inner nucleus pulposus, an outer annulus fibrosus, and limiting end-plates.
- Cartilage end-plates consist of 2 layers of cartilage – separates the disc form the adjacent vertebral bodies
- The nucleus pulposus is composed of glycosaminoglycans which helps retain fluid. Water content decreases with age and is replaced by fibrocartilage -> changes in mechanical behavior





3 Joint Complex

- Anteriorly the vertebrae are connected via the intervertebral discs
- Posteriorly they are connected by paired synovial joints, known as the zygapophyseal joints aka facet joints
- Injuring one component of the three joint complex affects its function and eventually always affects the other two components



History

- Mechanism of injury
- Time course: acute versus chronic
- Associated symptoms
  - Bladder / bowel function
  - Fevers / chills
  - Sleep disturbance
  - Weakness, numbness, tingling (especially into legs)
- Prior injuries: diagnostic studies, treatment & outcomes
- Medications: what helps and what does not
- Social history
  - Vocational
  - Tobacco / ETOH / Illicit drugs
  - Baseline and Current Function: ADLs & Mobility
- Litigation

Pain Specifics

- Quality: sharp, dull, shooting, burning, etc.
- Location / Distribution:
  - Radiating vs. Non-radiating
  - Dermatomal vs. Non-dermatomal
- Onset:
  - Gradual: degenerative disc and joint disease
  - Acute: Disc abnormality, strain, compression fractures
- Severity / Intensity
- Frequency: Constant vs. Intermittent
- Duration
- Exacerbating and Alleviating Factors

Red Flags

- Significant trauma history, or minor in older adults
- Nocturnal pain in supine position with history of cancer
- Bladder or bowel incontinence or dysfunction
- Constitutional symptoms
  - Fever / chills
  - Weight loss
  - Lymph node enlargement
- Risk factors for spinal infection
  - Recent infection
  - IV drug use
  - Immunosuppression
- Major motor weakness

Physical Exam

- Back/Musculoskeletal
  - Inspection
  - Posture
  - Palpation
  - ROM
  - Provocative maneuvers
  - Pelvic asymmetry/obliquity
  - Leg length

Physical Exam

- Neurological
  - Motor
  - Sensation
  - Muscle stretch reflexes
  - Neural tension
  - Gait

Thorough neuro exam is crucial in any patient presenting with back or limb pain

Extension Based Pain

- Spinal stenosis
  - narrowing of the lateral recesses or central canal
- Spondylolysis
  - Defect of the pars interarticularis which may be congenital or due to repetitive stress. Vulnerable with force applied while spine extended; stress fracture
- Spondylolisthesis
  - Subluxation of one vertebrae on another; most commonly occurs at lumbosacral junction
- Facet mediated pain
  - due to traumatic or degenerative causes
- Large central or far lateral disc herniation
- SI joint dysfunction

Flexion Based Pain

- Paramedian disc herniation
- Disc annular tears
- Discitis
- Compression fracture

Spondylolysis & Spondylolisthesis

Clinical Presentation

- Focal low back pain
  - May extend to the buttock or proximal lower extremity
- Onset is often insidious with acute worsening after a particular event
- Lumbar extension or rotation may exacerbate symptoms
- Vast majority occur at L5 (85-95%)
- L4 is the second most common level (5-15%)

Physical Exam

- Lumbar extension and rotation movements provoke pain
- Loss of lordosis with tight hamstrings
- Posterior pelvic tilt, flexed hip and knees
- Pelvic waddling, stiff short-legged gait
- Step-off deformity may be present with spondylolisthesis
- Neurologic exam is generally normal

Diagnostic Imaging: X-ray

- Lucency in the region of the pars interarticularis
- Oblique: Scotty dog with a collar
- Multiple angles may be needed to find the right orientation of the plane of the defect (AP, lateral, spot lateral of the L-S junction, oblique)
- Limitation: difficult to detect stress reactions in the pars interarticularis that have not progressed to complete fracture

Diagnostic Imaging: CT

- More sensitive than plain film x-ray
- Good for identifying other pathology
- May also be useful for staging and predicting outcome (early, progressive, terminal)

Diagnostic Imaging: MRI

- Lack of radiation exposure
- Very good for identifying other spinal pathology
- May be useful for identifying very early pars lesions
- May be useful for grading lesions and assessing prognosis based on edema pattern

Diagnostic Imaging: SPECT

- Single Photon Emission Computerized Tomography
- More sensitive than x-ray or planar bone scan
- Can stage a defect as acute or chronic
- Can help identify other pathology (infection, tumor)
- Detect stress reaction prior to actual fracture

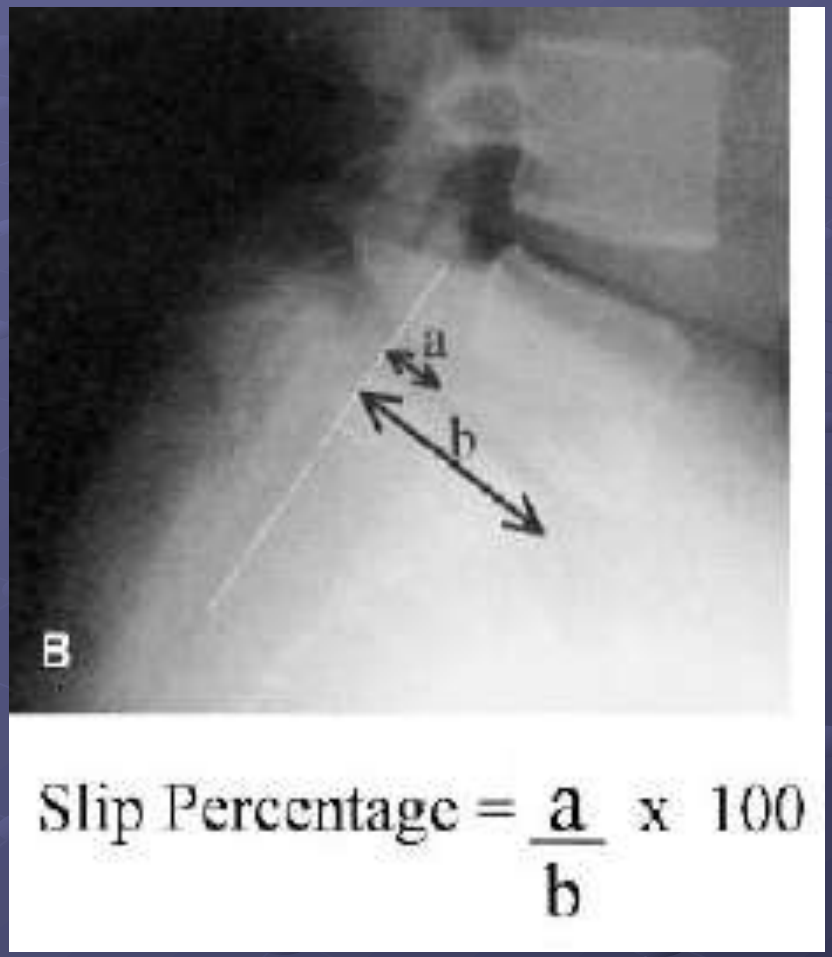
Spondylolysis

- Ear: Superior Articular Process
- Nose: Transverse Process
- Eye: Pedicle
- Front Leg: Inferior Articular Process
- Collar: Fracture

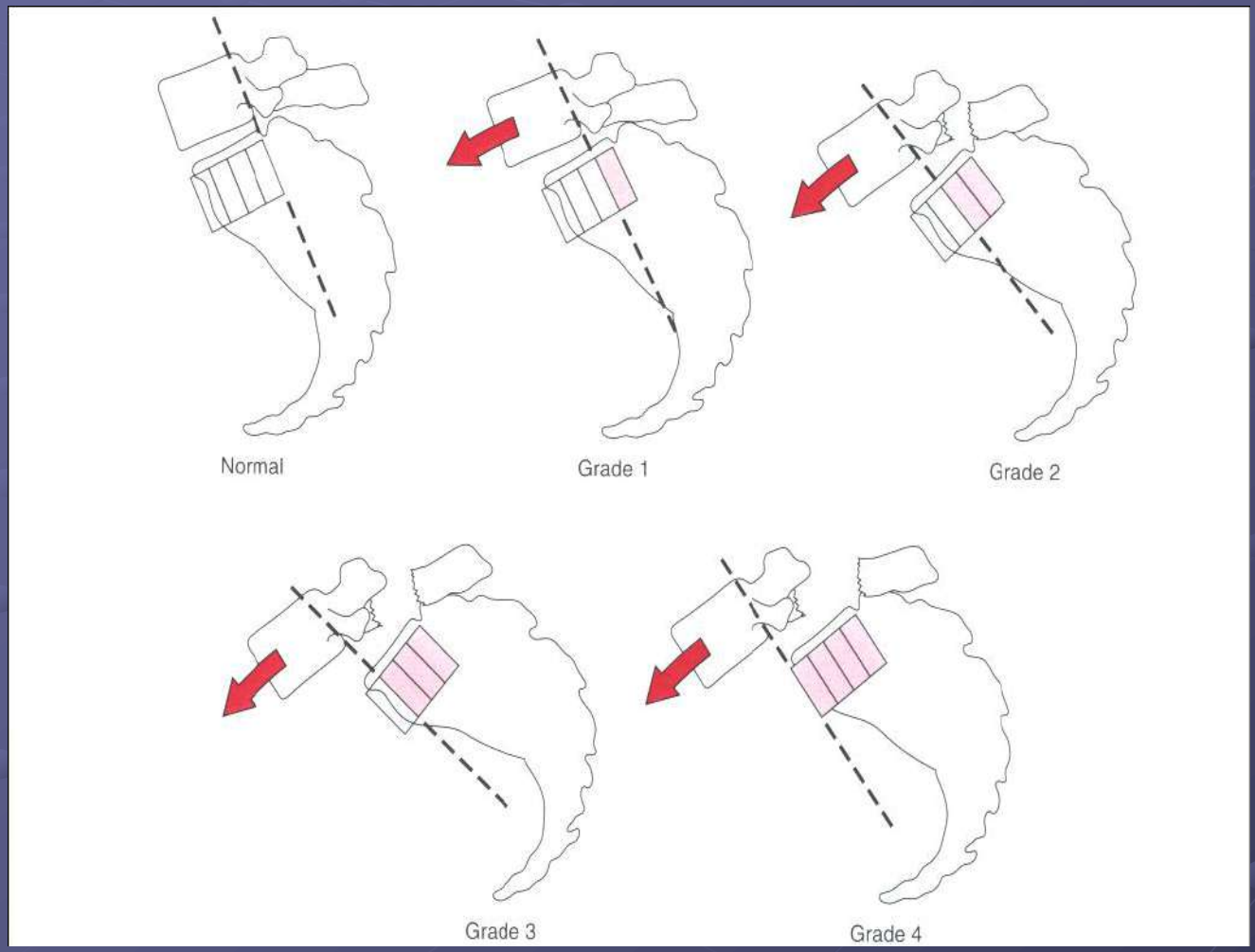
Spondylolysis

Spondylolisthesis

- Meyerding Grading Scale
  - Grade 0: 0%
  - Grade I: 1-25%
  - Grade II: 26-50%
  - Grade III: 51-75%
  - Grade IV: 76-100%
- Grade I and II: conservative management
- Grade III, IV: surgical management



Spondylolisthesis



Treatment

- Goals: Pain Relief and Functional Improvement
- Blanda: overall 97% success return to normal activity with minimal or no symptoms (14% of patients underwent surgery)
  - 52 patients had “excellent” outcomes, but only 21 patients demonstrated healing on x-ray
- Steiner: 78% success rate with conservative management

Treatment: Conservative Management

- Physical therapy
  - exercise with flexion bias most beneficial
  - core strengthening/stabilization
- Bracing/Orthosis
  - achieve bony healing, control pain, prevent/control progressive slip, provide proprioceptive feedback for proper body mechanics
  - Role unclear, no consensus: studies have shown improvement without the use of bracing
  - Jackson (Am J Sports Med 1981): 12 of 15 returned to unrestricted activity without the use of bracing

Treatment: Surgical

- 9-15% of patients undergo surgery
- Indications:
  - Progressive slip/ segmental instability
  - Intractable pain
  - Neurologic deficits
- Different approaches
  - lumbar fusion
  - bone graft and wires/screws to achieve union of the pars defect

Lumbar Disc Herniation & Radiculopathy

Lumbar Disc Herniation

- Incidence highest among adults 30-40 years old

- >95% of LDH occur at L4-L5 and L5-S1
  - With lumbar flexion:
    - 5-10 % stress occurs at L1-L4
    - 20-25% stress occurs at L4-L5
    - 60-75% stress occurs at L5-S1

Lumbar Disc Herniation

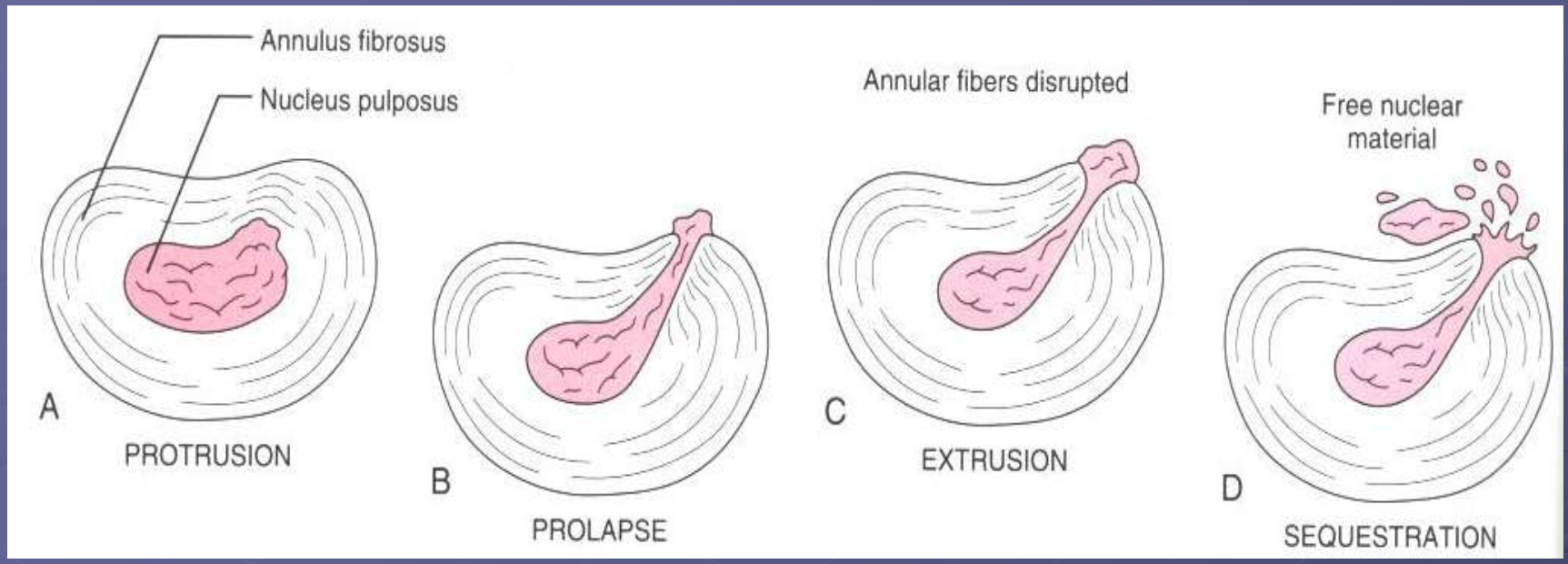
- Herniated nucleus pulposis occurs as a result of annular degeneration leading to weakening of the annulus fibrosis
- This leaves the annulus susceptible to annular fissuring and tearing
- Nuclear migration caused by annular disruption leads to the most common forms of clinically recognized LDH

Lumbar Disc Herniation

Classifications:

- Protrusion
  - Base is the widest part of displaced material in any plane
- Extrusion:
  - Base is narrower than width between edges of displaced material in at least one plane OR no continuity exists from disc space to outside material
- Sequestration:
  - Extruded disc segment that is detached from original with migration into the canal under the PLL or free floating in epidural space

Lumbar Disc Herniation



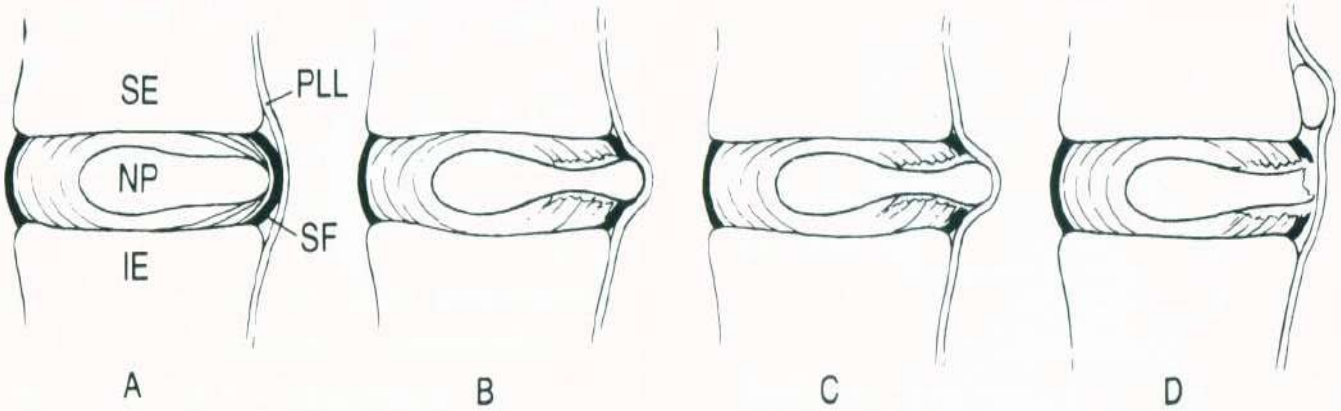


FIGURE 40–12. Classifications of disk herniation. *A.* Bulging annulus fibrosus. *B.* Prolapse. *C.* Extrusion. *D.* Sequestration. IE, inferior end-plate; NP, nucleus pulposus; PLL, posterior longitudinal ligament; SE, superior end-plate; SF, Sharpey's fibers. (From Vanderburgh DF, Kelly WM: Radiographic assessment of discogenic disease of the spine. Neurosurg Clin North Am 1993; 4:13.)

Lumbar Disc Herniation

- Spinal canal location of LDH will determine the type of neural compromise and the clinical pattern of pain and neurologic loss
- The degree of neural compromise cannot be accurately determined by size, type, or location of the disc material
- Pain production from types and locations of disc also varies considerably
- Small contained LDH may cause severe pain whereas larger extrusions & sequestrations can be painful or painless
- The factors that determine the pain producing capability of a LDH is unclear and may be related to the chemical potential of the HNP more than its anatomic characteristics

Lumbar Disc Herniation

- The mechanism of injury in radiculopathy has been shown to be more of a multifactorial process than mechanical compression alone
- In studies by Smythe and Wright(1958) as well as Kuslich
  - compression of normal nerve roots resulted in paresthesias, but not pain
  - radicular pain could only be produced through stimulation of a swollen or stretched nerve
- Radicular pain often improves clinically before the morphologic resolution of a disc lesion as seen on MRI
- This offers further support that nonmechanical factors contribute to the pathophysiology of radiculopathy

Radiculopathy

- Compression and/or chemical irritation of a spinal nerve root resulting in a demyelinating and/or axonal nerve injury
  - Commonly due to herniated disc herniation, spinal stenosis, spondylolisthesis, tumor
- Chemical radiculitis
  - inflammatory condition of the nerve root most often due to the rupture of the annulus fibrosus (annular tear) and dissemination of disc fluid along the nerve root sheath

Anatomy of Radiculopathy

- Each spinal nerve root is composed of a dorsal (somatic-sensory) root and a ventral (somatic-motor) root.
- These join in the intraspinal region just proximal to the neural (intervertebral) foramen.

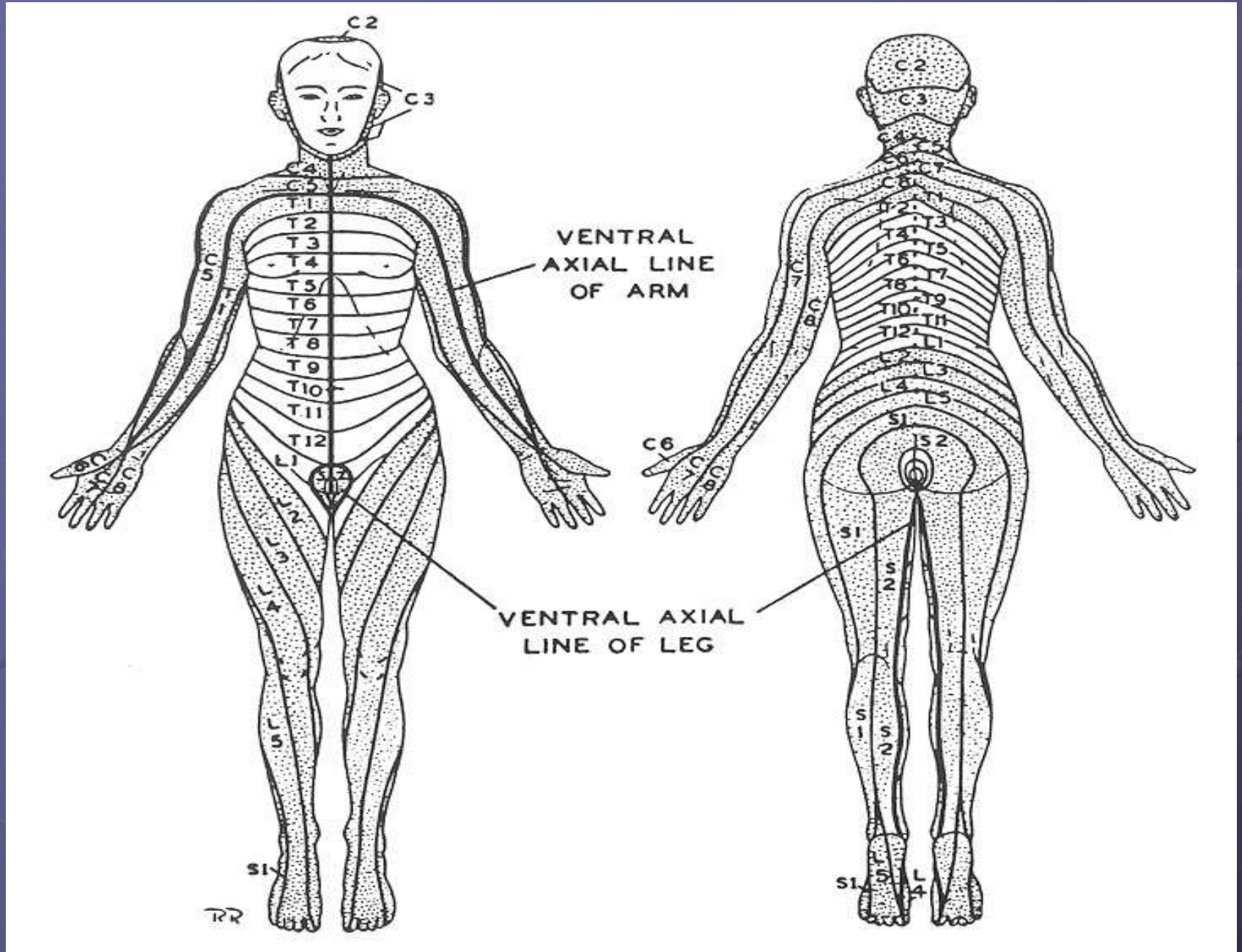
Anatomy of Radiculopathy

- Distal to the neural foramen, the nerve root divides into a dorsal primary ramus and an ventral primary ramus.
- The dorsal primary ramus innervates the paraspinal muscles and skin
- The ventral primary ramus innervates the limb and the trunk musculature

Dermatomal pain

- Dermatome
  - region of skin innervated by a dorsal root
- Pain in the distribution of a single nerve root that innervates a specific area of skin

Dermatomes


C2
C3
C4
C5
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
L1
L2
L3
L4
L5
S1
S2
C6
C7
C8
VENTRAL AXIAL LINE OF ARM
VENTRAL AXIAL LINE OF LEG

Myotomal pain

- Myotome
  - all muscles that share innervation from same ventral root
- Pain in the distribution of a group of muscles innervated by a single nerve root

Myotomes

Nerve Root	Test Action	Muscles
L1–L2	Hip flexion	Psoas, iliacus, sartorius, gracilis, pectineus, adductor longus, adductor brevis
L3	Knee extension	Quadriceps, adductor longus, magnus, and brevis
L4	Ankle dorsiflexion	Tibialis anterior, quadriceps, tensor fasciae latae, adductor magnus, obturator externus, tibialis posterior
L5	Toe extension	Extensor hallucis longus, extensor digitorum longus, gluteus medius and minimus, obturator internus, semimembranosus, semitendinosus, peroneus tertius, popliteus
S1	Ankle plantar flexion Ankle eversion Hip extension Knee flexion	Gastrocnemius, soleus, gluteus maximus, obturator internus, piriformis, biceps femoris, semitendinosus, popliteus, peroneus longus and brevis, extensor digitorum brevis
S2	Knee flexion	Biceps femoris, piriformis, soleus, gastrocnemius, flexor digitorum longus, flexor hallucis longus, intrinsic foot muscles
S3		Intrinsic foot muscles (except abductor hallucis), flexor hallucis brevis, flexor digitorum brevis, extensor digitorum brevis

Muscle Stretch Reflexes

- Patellar (L3–L4)
- Medial hamstring (L5–S1)
- Lateral hamstring (S1–S2)
- Posterior tibial (L4–L5)
- Achilles (S1–S2)

Clinical Presentation

- Symptoms usually begin abruptly
- Often acute injury with flexion/rotation of the lumbar spine
- Characteristic pain is sharp, traveling down the leg and sometimes into the foot
  - Variable degree LE radicular pain > back pain
- Muscle weakness, spasms, numbness, or tingling may be present
- Symptoms exacerbated by activities that increase intradiscal pressure:
  - Sitting, Standing, Walking, Bending, Valsalva, Cough

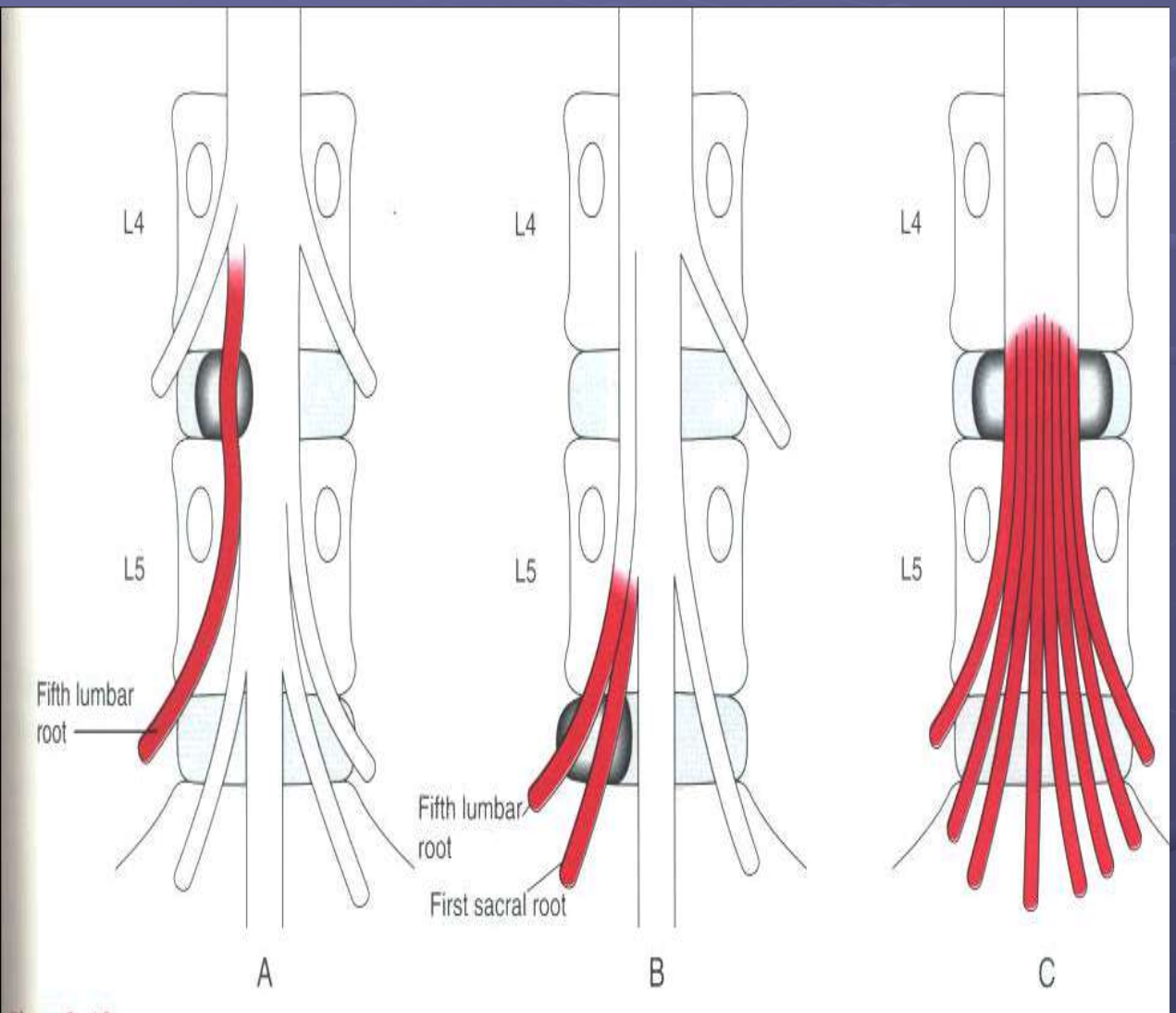
Clinical Presentation

- Paramedian LDH
  - Pain usually worse with sitting or lumbar flexion
  - Pain often centralizes with lumbar extension
- Far lateral, foraminal, and large central herniations
  - Pain usually worse with standing or lumbar extension
  - Pain often centralizes with lumbar flexion

Physical Exam

- Weakness – myotomal pattern
- Diminished sensation – dermatomal pattern
- Diminished reflexes
- Neural tension testing
  - SLR, Slump sit, Femoral stretch
- Lateral shift, directional preference
- Soft tissue inflexibility with decreased ROM due to muscle spasm

Which root is impinged?



- Paracentral herniations impinge level below.
- Far lateral herniations impinge level above
- large central - cauda equina

Diagnostic Studies

- Primarily clinically based
- Imaging can help delineate the cause of the radiculopathy
- Plain x-rays
  - useful for diagnosing degenerative changes, spondylolysis, spondylolisthesis, fractures
- MRI or CT should be considered for back pain failing conservative management
  - Except in cases of severe or progressive neurologic deficits (ie. saddle anesthesia, bladder or bowel incontinence, severe weakness) require immediate imaging (MRI/CT) and surgical referral

Diagnostic Studies

- MRI
  - Provides best detail of soft tissue
  - Disc herniations present in up to 30% of asymptomatic patients
  - Disc extrusions rarely present in asymptomatic patients
- CT scan
  - Provides more bony detail of pars defects, fractures, or tumor
  - Evaluate discs in those who cannot undergo MRI; addition of myelography for details of nerve root impingement
  - Abnormal findings (DDD, LDH, spinal stenosis) in up to 30-50% of asymptomatic patients

Diagnostic Studies

- Boden study 1990 JBJS
  - 21% of asymptomatic population less than 60 yrs old with disc herniation
  - 36% of asymptomatic population over age 60 yrs old with disc herniation
- Jensen study 1995 NEJM
  - 52% of asymptomatic patients with disc bulge at one or more levels
  - 27% of asymptomatic patients with disc protrusion
  - 1% of asymptomatic patients with disc extrusion

Diagnostic Studies

- Electrodiagnostic testing – EMG/NCS
- Nerve Conduction Studies
  - Sensory nerve studies usually normal
  - Motor nerve studies may show decreased amplitude indicating severe axonal loss
- Needle EMG
  - Single most useful electrodiagnostic procedure with highest diagnostic yield
  - Abnormal spontaneous activity in a myotomal distribution is accepted as the most reliable EMG evidence of a radiculopathy

Diagnostic Studies

- Advantages of EMG
  - Assesses physiologic integrity of nerves
  - Rarely false-positive (CT/MRI has ~30% false-positive rate)
  - Great for differentiating radiculopathy versus peripheral or entrapment neuropathy
- Limitations of EMG
  - Even when there is axon loss, it may not involve enough fibers to yield a positive study
  - Demyelinating lesions not picked up because axon is preserved
  - A positive EMG does not reveal etiology
  - Timing of the study is crucial; best results if done in 3-6 week window, exams can normalize in LS radics >12-18 months
  - EMG 57-94% sensitive when using surgically proven nerve involvement as gold standard, but probably on the lower end

Treatment

- Most studies show over 65% of people with LBP from herniated disc improve over time without surgical intervention
- Relative rest and activity modification
  - metanalysis of 10 randomized controlled trials, bed rest was not show to be an effective treatment in the management of LBP
- Medication
  - NSAIDs or pulse dose oral steroid to achieve anti-inflammatory and analgesic effects
  - Muscle relaxants can be useful for muscle spasm and sleep aid
  - Oral opioids for short term, acute, breakthrough pain.

Treatment

- Physical therapy
  - Early passive modalities as necessary to help reduce muscle spasm and for pain relief
  - Manual therapy
  - Lumbar spine stabilization - exercises with directional preference in attempt to centralize pain with progression to triplanar core stabilization exercises as tolerated
  - Functional lower extremity stretching
  - Body mechanics and postural training
- No data exists to support the use of manipulation for patients with LDH and radiculopathy, only acute(nonspecific) low back pain

Treatment

- If the patient fails initial conservative management, consider referral for fluoroscopic guided ESI
- In cases not related to radiculopathy, SI joint or facet injections may be beneficial depending on diagnosis
- Numerous studies have found ESI to be beneficial for patients with radiculopathy caused by LDH
  - Vad(2001) performed the first prospective, randomized study of TFESI in patients with lumbar radiculopathy due to LDH.
  - Examined therapeutic value of TFESI vs. saline trigger-point injections.
  - 84% vs. 48% showed significant improvement in patient satisfaction score, Roland-Morris score, lumbar ROM, and VAS score over an average f/u period of 1.4 years

Treatment

- Surgical intervention
  - Considering the positive natural history of radiculopathy due to LDH, surgery is rarely indicated before 6-12 weeks
  - A patient with profound neurologic loss who does not demonstrate an improvement trend in 6-12 weeks is a better candidate for surgical intervention
- Surgery vs. non-operative approach otherwise is still controversial
- SPORT Randomized Trial *JAMA.* 2006
  - Showed no significant difference in long term outcome in improvement in pain and function between surgical and non-operative groups at 2 yrs

Treatment

- Definite surgical indications:
  - Cauda equina syndrome
  - Intractable pain unresponsive to aggressive, active conservative care
  - Progressive neurological deficit
  - Significant functional limitations
- Surgical Techniques
  - Microdiscectomy
  - Laminectomy
  - Fusion