Objectives

- Discuss concepts relevant to pathophysiology and differential diagnosis for lumbar radiculopathy
- Discuss concepts relevant to pathophysiology and differential diagnosis for lumbar disc and joint disorders
- Discuss concepts relevant to pathophysiology and differential diagnosis for lumbar instability
RADICULOPATHY
Pathophysiology of Radiculopathy

- Tension event associated with protrusion, prolapse, extrusion
- Compression event associated with degenerative disc changes
- Sizer et al, Pain Practice, 2001
Protrusion $\rightarrow$ Prolapse

- Increasing degree of annular damage
- Increasing presence of neurological signs
- Increasing potential for rapid and complete eradication
  - In-growth of vascular supply into fissure

- Winkel et al 1997
Locations of Protrusion and Prolapse

- **Shoulder lesion**
  - Lateral to nerve root
  - Typically shift laterally away from pain
  - Pain with ipsilateral sidebending
  - Best treated with traction
Locations of Protrusion and Prolapse

- Axillary lesion
  - Medial to nerve root
  - Lateral shift variable
  - Pain with contralateral sidebending
  - Traction may worsen condition
  - Cyriax 1989
Degenerative Disc Disease

- L4-5 and L5-S1
  - Decreased nuclear hydrostatic pressure and disc height with aging
  - Opposite effects at L3-4 and above
  - Leads to lower lumbar accelerated degeneration
    - Sizer et al 2001
Differential Diagnosis of Radiculopathy

- Herniated disc
  - Pain with sagittal plane movements, typically flexion
  - Most common at L4/5 and L5/S1 levels
    - Oblique orientation of L5-S1 articular surfaces
    - Allows for more transverse plane motion
  - L4/5 posterolateral herniation affects L5 root
Differential Diagnosis of Radiculopathy

- Degenerative disc disease
  - Pain with foraminal closing
  - Most common at L4/5 to L5/S1 levels
    - Site of degenerative changes
    - Long and narrow IVF (L5-S1)
    - Thickest lumbar root (L5)
    - Sizer et al 2001
  - L5/S1 stenosis affects L5 root
LOCAL LUMBAR PAIN
Pathophysiology of Local Lumbar Pain

- **Disc disorders**
  - Disc herniation L4/5 and L5/S1
  - Degenerative disc disease
- **Joint disorders**
  - Zygapophyseal joint
- **Symbiotic relationship evident in biomechanics**
Differential Diagnosis of Disc Disorders

- Disc herniation L4/5 and L5/S1
  - May present with acute lateral shift positional fault
  - Pain with sagittal plane motions
  - No increased provocation with 3-D rotation
  - Change with repeated movements
  - Dural tension testing positive or negative
    - Testing specific, not sensitive

- Degenerative disc disease
  - Biggest predictor is age, greater than 45
  - No consistent distinguishing pattern of ROM loss or provocation
Repeated Movements

- Centralization occurs in 80-100% of persons with a positive discogram.
- 35-40% of those failing to centralize still had positive discogram.
- Competent annulus found in 91% centralizers and 54% peripheralizers.
  - Laslett et al, 2005
  - Donelson et al, Spine 1997
Repeated Movements

- Non-centralizers more likely at one year post-treatment to
  - Not return to work
  - Continue to report pain
  - Report increased disability
  - Use healthcare resources
    - Werneke and Hart, Spine 2001

- Centralizers have good prognosis for recovery with conservative care
  - Aina et al, Man Ther 2004
Differential Diagnosis of Joint Disorders

- Zygapophyseal joint
  - Pain with 3-D motion testing
  - Extension and sidebending with ipsi/contra-lateral rotation
  - Pain relieved with flexion
INSTABILITY
Pathophysiology of Instability

- Multisegmented spinal motion
  - Greatest degree of motion occurs at most flexible segment
  - Dysfunction occurs more readily at flexible segments than inflexible segments
Pathophysiology of Instability

- Deep muscles control intersegmental motion and stability
  - TRA/Deep multifidus fires in advance of arm movement, independent of direction
- Delayed firing in deep system with arm movements in patients with a history of LBP
  - Hodges and Richardson, Spine 1996; Moseley et al, Spine 2002
Pathophysiology of Instability

- Multifidus fat infiltration and atrophy strongly associated with LBP
  - Kjaer et al, BMC Med 2007
- Recovery not automatic after first time episode of LBP
  - Significantly higher recurrence rates of LBP in a control group versus stabilization group at 2-3 year followup
    - Hides et al, Spine 2001
Differential Diagnosis Instability

- Directional Susceptibility to Movement (DSM)
  - Uni-planar motion
    - Extension
    - Flexion
    - Rotation
  - Combined motion
    - Extension-Rotation
      - >50% of patients (Van Dillen et al, PT 2002)
    - Flexion-Rotation

Sahrmann 2002
Forward Bending Rhythm and Range

- **Flexion**
  - Posterior sway with hip flexion
  - Lumbar flexion
  - Hip flexion

- **Return**
  - Hip extension
  - Hip and spine extension

- **Ranges**
  - Lumbar flexion mean 56deg
  - 75-80deg hip flexion
Extension Syndrome

- Patient > 55
- Relief with lumbar flexion
- Hypertrophied back extensors
- Lumbopelvic rhythm impaired
  - Return from flexion initiated with back extension
  - Symptoms decrease when cued to lead with hip extension
- Active straight leg raise (prone and supine)
  - Anterior pelvic tilt and LBP
- Passive knee flexion (prone) or hip extension increases anterior pelvic tilt and LBP
Impairments

- **Tight**
  - Back extensors
  - Hip flexors

- **Weak**
  - Abdominals
    - Rectus
    - External oblique
    - Internal oblique
  - Gluteals
Flexion Syndrome

- Patient 18-45
- Impaired LP rhythm and range
  - Leads motion with lumbar flexion
  - Limited hip flexion and increased lumbar flexion
  - Symptoms decrease when cued to only allow hip flexion
- Passive hip flexion leads to spine flexion/pain before 120deg
Impairments

- **Tight**
  - Hamstring
  - Gluteus maximus
  - Abdominals (recruited more than hip flexors for leaning forward while sitting)

- **Weak**
  - Back extensors
  - Abdominals (if not present above)
Rotation Syndrome

- Key Findings
  - Paraspinal fullness of greater than ½ inch on one side
  - Pain and limitation with sidebending toward side of paraspinal fullness
  - Increased rotation toward side of paraspinal fullness
  - Pelvic rotation on bent knee fall out
  - Sidelying painful, decreased with towel under waist
  - Active SLR painful with lateral pelvic tilt frontal plane
  - Passive hip rotation painful before end range
Impairments

- **Tight**
  - Back extensors
  - Rectus abdominus
  - TFL
  - Hip abductor

- **Weak**
  - Abdominals
    - External oblique
    - Internal oblique