LUMBAR DISC DISEASE
VERY IMPORTANT TALK!! -- LBP

- A major public health problem
- The leading cause of disability for people < 45
- 2nd leading cause for physician visits
- 3rd most common cause for surgical procedures
- 5th most common reason for hospitalizations
- Lifetime prevalence: 49%–80%

Pai et al. 2004, Orthop Clin N Am
60 – 90% of adults experience back pain at some point in their life.
- ↑ incidence age 35- 55 y.o.
- 90% resolve in 6 weeks
- 7% become chronic
- M/ F equally affected

Most patients with LBP improve on their own in time (even without treatment).
TYPES OF LBP

1. Non-specific “idiopathic”: 85%
2. Degenerative disc disease: discogenic pain, disk herniation, degenerative scoliosis
3. Developmental: spondylolisthesis, idiopathic scoliosis
4. Congenital: scoliosis
5. Traumatic
6. Infectious
7. Inflammatory
8. Neoplastic
9. Metabolic
10. Referred
Most episodes of LBP are self limited
These episodes become more frequent with age
LBP is usually due to repeated stress on the lumbar spine over many years (“degeneration”), although an acute injury may cause the initiation of pain
Unfortunately, DJD seems to be sort of a “wastebasket term” that is often used to describe age-related changes on MRI, etc.

While these changes are indeed “degenerative,” this happens as we age and is not necessarily indicative of any significant underlying pathology or condition.

The majority of individuals > 60 will show some type of degenerative change(s) on lumbar imaging.
Degeneration of an individual disc space typically refers to loss of disc height, loss of water content, fibrosis, end plate sclerosis/defects, osteophyte complexes, etc.
Lumbar Spine Motion Segment

- Three joint complex
- Intervertebral disc + 2 facet joint
- Ligamentous structure, vertebral body
SAGITTAL SECTION THROUGH THE SPINAL CORD

1. Intervertebral disc
2. Vertebral body
3. Dura mater
4. Extradural or epidural space
5. Spinal cord
6. Subarachnoid space
Intervertebral Disc

- Hydrostatic, load bearing structure between the vertebral bodies
- Nucleus pulposus + annulus fibrosus
- No blood supply
- L4–5, largest avascular structure in the body
Nucleus Pulposus

- Type II collagen strand + hydrophilic proteoglycan
- Water content 70 ~ 90%
- Confine fluid within the annulus
- Convert load into tensile strain on the annular fibers and vertebral end plates
Annulus Fibrosus

- Outer boundary of the disc
- Type I collagen
Vertebral End–Plate

- Cartilaginous and osseous component
- Nutritional support for the nucleus
- Passive diffusion
Facet Joint

- Synovial joint
- Rich innervation with sensory nerve fiber
- Load share 18% of the lumbar spine
Facet Joint

** Primary disc degeneration
→ Secondary change in the posterior facet joint and soft tissue
IMPORTANT QUESTIONS

1. Is systemic disease the cause?

2. Is there social or psychological distress that prolongs or amplifies symptoms?

3. Is there neurologic compromise that requires surgical intervention?
TO ANSWER THESE IMPORTANT QUESTIONS

1. Careful History and Physical Exam

2. Imaging and Labs WHEN indicated
**Differential Diagnosis of Low Back Pain**

<table>
<thead>
<tr>
<th>Mechanical low back or leg pain (97 percent)</th>
<th>Nonmechanical spinal conditions (about 1 percent)</th>
<th>Visceral disease (2 percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lumber strain (70 percent)§</td>
<td>Neoplasia (0.7 percent)</td>
<td>Disease of pelvic organs</td>
</tr>
<tr>
<td>Degenerative process of disks and facets, usually age-related (10 percent)</td>
<td>Multiple myeloma</td>
<td>Prostatitis</td>
</tr>
<tr>
<td>Herniated disk (4 percent)</td>
<td>Metastatic carcinoma</td>
<td>Endometriosis</td>
</tr>
<tr>
<td>Spinal stenosis (3 percent)</td>
<td>Lymphoma and leukemia</td>
<td>Chronic pelvic inflammatory disease</td>
</tr>
<tr>
<td>Osteoporotic compression fracture (4 percent)</td>
<td>Spinal cord tumors</td>
<td>Renal disease</td>
</tr>
<tr>
<td>Spondylolisthesis (2 percent)</td>
<td>Retroperitoneal tumors</td>
<td>Nephrolithiasis</td>
</tr>
<tr>
<td>Traumatic fracture (&lt;1 percent)</td>
<td>Primary vertebral tumors</td>
<td>Pyelonephritis</td>
</tr>
<tr>
<td>Congenital disease (&lt;1 percent)</td>
<td>Infection (0.01 percent)</td>
<td>Perinephric abcess</td>
</tr>
<tr>
<td>Severe kyphosis</td>
<td>Osteomyelitis</td>
<td>Aortic aneurysm</td>
</tr>
<tr>
<td>Severe scoliosis</td>
<td>Septic diskitis</td>
<td>Gastrointestinal disease</td>
</tr>
<tr>
<td>Transitional vertebrae</td>
<td>Paraspinous abscess</td>
<td>Pancreatitis</td>
</tr>
<tr>
<td>SpondylolysisΔ</td>
<td>Shingles</td>
<td>Cholecystitis</td>
</tr>
<tr>
<td>Internal disk disruption or diskogenic low back pain ¥</td>
<td>Inflammatory arthritis (often associated with HLA-B27) (0.3 percent)</td>
<td>Penetrating ulcer</td>
</tr>
<tr>
<td>Presumed instability**</td>
<td>Ankylosing spondylitis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Psoriatic spondylitis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reiter’s syndrome</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inflammatory bowel disease</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Scheuermann’s disease (osteochondrosis)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Paget’s disease of bone</td>
<td></td>
</tr>
</tbody>
</table>
EVALUATION IN OLDER ADULTS

- Cancer, compression fractures, spinal stenosis, aortic aneurysms more common
- Osteoporotic fractures without trauma
- Spinal Stenosis secondary to degenerative processes and spondylolisthesis more common
- Increased AAA associated with CAD
- Early radiography recommended
CLUES TO SYSTEMIC DISEASE

- Age
- History of Cancer
- Fever
- Unexplained Weight Loss
- Injection Drug Use
- Chronic Infection Elsewhere
- Duration and Quality of Pain
  - Infection and Cancer not relieved supine
- Response to previous therapy
- h/o inflammatory arthritis elsewhere
Things that should raise a “red flag”

- Previous hx of cancer, unexplained weight loss
- Immunosuppression, hx of steroid use, hx of IV drug abuse, hx of skin/other infection(s)
- Hx of recent falls or trauma (including surgery)
- Bladder dysfunction (usually urinary retention or overflow incontinence) or fecal incontinence, “saddle anesthesia”, leg weakness
- Pain that doesn’t improve with rest; failure to improve after 4 weeks conservative management
Lumbar Disc Disease

Discogenic Back Pain

A. Internal Disc Disruption (IDD)
B. Degenerative Disc Disease (DDD)
C. Segmental Instability

Lumbar Disc Herniation and Radiculopathy
Lumbar Disc Herniation

How pain is generated?

- Inflammatory
- Biochemical
- Vascular
- Mechanical compression
History

- symptom of disc herniation: acute or gradual
- after trauma or without and inciting event
- most common 3rd and 4th decade

Chief Complaint

- Pain, radiating from the back or buttock into the leg
- Numbness and weakness
- Sharp, lancinating, shooting/radiating down the leg posteriorly below the knee
- Coughing, Valsalva maneuver → increase intracecal pressure → increase pain
- Sitting position, driving → out of lordosis → increase intradiscal pressure → increase pain
NATURAL HISTORY

- Recovery from nonspecific LBP generally rapid – 90% within 2 weeks – some studies less rapid (2/3 at 7 weeks)
- Herniated Discs – slower to improve – only about 10% considered for surgery after 6 weeks
- With surgery, no earlier return to work – symptomatic and functional outcome sometimes better
POSTURE AND INTRADISCAL PRESSURE
CONCEPT

- Intervertebral discs can be thought of, conceptually, kind of like a “jelly donut.” The outside is the annulus fibrosus, and the inside “jelly” is the more watery nucleus pulposus.
  - Intervertebral discs act as shock absorbers between the vertebral bodies.
  - Just like jelly donuts have a “weak spot” where the jelly squirts out if you squeeze them, the annulus of discs is weak posteriorly where the nucleus pulposus can herniate through, causing symptoms.
The most common sites for a herniated lumbar disc are L4-5 and L5-S1, resulting in back pain and pain radiating down the posterior and lateral leg, to below the knee.

Back pain caused by a herniated lumbar disc is exacerbated by sitting and bending; conversely, the pain of lumbar muscular strain is aggravated by standing and twisting movements.
SCIATIC NERVE

- Pain Diagram

Fig. #1

Sciatica

The Sciatic Nerve

© ChiroGeek.Com
With age and repeated efforts, the lower lumbar discs lose their height and water content ("bone on bone")

Abnormal motion between the bones leads to pain
DISC

- Nucleus pulposus-water rich, gelatinous, axial load, pivotal point, binds vertebrae together
- Annulus fibrosus-fibrous and tougher, less water content, contains the nucleus pulposus
SAGGITAL VIEW

- Disc
  - diagram
DISC PHYSIOLOGY

- Morphologic
DISC NUTRITION

- diagrammatic
DIURNAL CHANGE

- During day time- disc shrinks by 20%
- Body height reduced by 15 – 25 mm
- In night- body height is increased.
Nucleus pulposus

Transition zone

Inner anulus fibrosus

Outer anulus fibrosus

© 1999 Scott Bodell
MRI APPEARANCE

- T-2 weighted image
- Black disc – dessication
NATURAL DISC AGEING

- Loss of the proteoglycan molecule from the nucleus of the disc.
- Progressive dehydration.
- Progressive thickening.
- Brown pigmentation formation.
- Increased brittleness of the tissue of the disc.
FACTORS CONTRIBUTING TO DISC AGING

Progression over time
IDIOPATHIC BLOOD VESSEL/NUTRIENT LOSS AND DEHYDRATION/DECREASED PROTEOGLYCANS PRODUCTION

- Endplate
  - degeneration
OTHER FACTORS

- Vertebral end plate calcification
- Arterial stenosis
- Smoking
- DM
- Exposure to vibration.
DISC DEGENERATION
STEPS OF DISC HERNIATION

Sequential degeneration
DISC HERNIATION OR PROLAPSE

- Protrusion (contained or subligamentous herniation)
- Extrusion (non-contained or transligamentous herniation)
- Sequestration (free fragment)
DISC PROTRUSION/PLL IS STILL INTACT
DISC EXTRUSION/ PLL IS RUPTURED

Figure 4
MRI DISC EXTRUSION
DISC SEQUESTRATION/FINAL END STAGE OF DISC DISEASE
PHYSICAL EXAMINATION

- Fever – possible infection
- Vertebral tenderness - not specific and not reproducible between examiners
- Limited spinal mobility – not specific (may help in planning P.T.
- If sciatica or pseudoclaudication present – do straight leg raise
- Positive test reproduces the symptoms of sciatica – pain that radiates below the knee (not just back or hamstring)
- Ipsilateral test sensitive – not specific: crossed leg is insensitive but highly specific
- L-5 / S-1 nerve roots involved in 95% lumbar disc herniations
The classic presentation of Herniated Nucleus Pulposus (HNP) is radiculopathy.

- The disc herniation impinges upon a nerve root, causing characteristic pain.
- Thoracic disc herniations are much, much rarer.
LUMBAR HNP

- 90% of herniated discs are paracentral (slightly off to one side) and affect the nerve root that corresponds to the lower vertebral level.
  - Example: a typical L4/5 disc herniation would cause symptoms referrable to the L5 nerve root.
ASSESSMENT OF FUNCTION

- 98% disc herniations: L4-5; L5-S1
- Impairment: Motor and Sensory L5-S1
  - L5: Weakness of ankle and great toe dorsiflexion
  - S1: Decrease ankle reflex
  - L5 & S1: Sensory loss in the feet
The straight leg raise test is positive if pain in the sciatic distribution is reproduced between 30° and 70° passive flexion of the straight leg. Dorsiflexion of the foot exacerbates the pain.
Root Tension Signs

- **Straight-leg raising**: L5, S1 root
- **Contralateral SLR**: sequestrated or extruded disc
- **Femoral stretching, reverse SLR**: L3, L4 root
Sciatica
- radiating pain down the leg

Radiculopathy
- radiating pain down the leg as a result of nerve root irritation

Back Pain
- change in disc loading and shape, biomechanics
- loss of viscoelasticity.
- 90% of radiating pain have long-standing prior episodic low back pain
Differential Diagnosis

**Vascular claudication**
- Vascular assessment and flow study
- Dorsalis pedis palpation

**Spinal stenosis**
- Leg pain, dysesthesia, paresthesia, often not dermatomal
- Pain d/t mechanical compression of spinal canal and foramen
- Lordosis and axial loading
- Symptomatic on walking, relief by sitting

**Thrombophlebitis**

**Metabolic and peripheral neuropathy**
<table>
<thead>
<tr>
<th>Root</th>
<th>Sensory</th>
<th>Motor</th>
<th>Reflex</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-1</td>
<td>Groin</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>L-2</td>
<td>Anterior thigh</td>
<td>Iliopsoas</td>
<td>—</td>
</tr>
<tr>
<td>L-3</td>
<td>Lateral thigh/knee</td>
<td>Quadriceps</td>
<td>—</td>
</tr>
<tr>
<td>L-4</td>
<td>Medial leg (postero-lateral thigh, across patella, anteromedial leg)</td>
<td>Anterior tibialis, quadriceps</td>
<td>Patella</td>
</tr>
<tr>
<td>L-5</td>
<td>First dorsal web space; medial foot (posterior thigh, anterolateral leg, medial foot, and great toe)</td>
<td>Extensor hallucis longus; extensor digitorum longus and brevis, gluteus medius</td>
<td>None (post-tibialis)</td>
</tr>
<tr>
<td>S-1</td>
<td>Lateral foot (posterior thigh and leg, posterolateral foot, lateral toes)</td>
<td>Gastrocnemius; peroneus longus and brevis, gluteus maximus</td>
<td>Achilles</td>
</tr>
</tbody>
</table>
IMAGING STUDIES

- Progressive Neurologic Defecits
- Failure to Improve
- Hx of Trauma
- Risk for Malignancy or infection
Plain Radiography limited to patients with:
- findings suggestive of systemic disease
- trauma

Failure to improve after 4 to 6 weeks

CT and MRI more sensitive for cancer and infections – also reveal herniation and stenosis

Reserve for suspected malignancy, infection or persistent neurologic deficit
MRI

- The gold standard for imaging of the herniated lumbar disc is magnetic resonance imaging
T-1 AXIAL VIEW

Figure #10

Figure #11
ZONES OF ANTERIOR EPIDURAL SPACE / HERNIATION ZONES

- Central region
- Paracentral region or lateral recess
- Intraforaminal zone or subarticular zone
- Extraforaminal zone
Figure #6

© ChiroGeek.com
Lumbar Disc Herniation – Treatment

**Conservative Tx.**
- Moderate bed rest
- Spinal manipulation
- Physical therapy
- Medication
  - NSAIDs
  - Muscle relaxants
  - Rarely narcotics

**Surgical Tx.**
- Microdiscectomy?
- Less than half of an inch incision
- Minimally invasive approaches
- Tubular; endoscopic
Indication of Surgery

**Absolute surgical indication**
- cauda equina syndrome
- acute urinary retension/incontinence.
  - saddle anesthesia, back/ buttock/ leg pain, weakness, difficulty walking

**Relative indication**
- progressive weakness
- no response to conservative treatment
Lumbar HNP – when to operate

- The natural history of herniated discs is to resolve over time. If conservative management can adequately treat a patient’s pain, this is the preferred course of action.
- If conservative management fails to adequately control pain, surgery can be performed (often times on an outpatient basis).
SURGICAL RISKS

- Wrong level surgery
- Failure to match pathology to presentation
- Inherent surgical risks
  - Infection
  - Epidural fibrosis
  - Residual/recurrent disc
  - Progressive instability
MINIMALLY INVASIVE SURGERY

- Dissatisfaction with exposure, postoperative pain or scarring
- Has this lead to shorter length of hospitalization, less blood loss and increased patient?
- Does route of minimally invasive approach matter to outcome?
- Is it worth the hype?
MICRODISCECTOMY/OPEN VS MIS

- Arts, et al (JAMA 2009, RCT)
  - 328 patients (161 mis, 167 open)
  - Functional outcome at 8 weeks and 1 year
    - Primary: roland-morris disability questionaire (RDQ)
    - Secondary
      - VAS
      - Patient self report of recovery
      - Functional scores on Prolo scale
      - Body pain and physical function on SF 36
Tubular discectomies were associated with statistically significant more leg and back pain p<0.05
No difference in size of incisions
Patients actually less satisfied overall with MIS
LESS TISSUE DAMAGE = LESS PAIN?

- Muramatsu, et al evaluated for postoperative enhancement as a sign of scar formation and found no difference between open and MIS.
- Arts, et al evaluated T2 MRI signal and serial CPK – multifidus.
  - No advantage on VAS, CPK even though T2 MRI lower on MIS.
  - ?? Corollary to postoperative pain.
THE PATHOLOGY DEFINES THE ROUTE

- History of endoscopic spine surgery has evolved in three phases
  - Inspiration
  - Invention
  - Innovation

Disc pathology targeted through surgical corridor that would become synonymous with it’s inventor, Kambin’s triangle

A triangular safe zone bordered by the exiting root anteriorly, the traversing root medially, and the superior endplate of the lower vertebrae inferiorly. This established a working corridor that allowed larger instruments and working channels to be introduced to formainal pathology without injuring the exiting nerve.
FUTURE DIRECTIONS

- Continued development of endoscopes with larger working channels
- Use of reamers to remove ventral portion of superior articular process which in turn expands foraminal window
- Angled lens scopes to better visualize pathology

- Do the limitations of microscopic visualization restrict a more direct approach to the pathology and the potential of a better outcome?
- Is there a role for intraoperative radiographic techniques in concert to achieve the best outcome?
Inflamed discs can cause referred leg pain without neural compression by irritating the sinu-vertebral nerve.

Mild disc degeneration can result in quite severe pain-
- because of inflammatory chemicals in the disc space- not seen on MRI scans.
TAKE HOME MESSAGES

- Know the natural history of the disease
- *Know* your patient
- Correlate clinical findings, MRI and discograms if needed
- Until definitive evidence available, choose the most cost-effective available treatment option: cognitive therapy, exercise, fusion, arthroplasty, dynamic stabilization
THANK YOU

Lloyd Zucker, MD