Thoracolumbar Spine: Assessment, Diagnosis, and Treatment

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OBJECTIVES

- Review the thoracic/lumbar anatomy
- Identify the assessment of the thoracic and lumbar spine.
- Identify the proper diagnostic tools in identifying spinal disorders.
- Describe conservative versus surgical intervention

Spinal Anatomy

S" curve helps a healthy spine withstand all kinds of stress.
- Cervical spine curves slightly inward
- Thoracic curves outward
- Lumbar curves inward. Carries most of weight bearing

Spinal Anatomy

Thoracic Spine
- Very narrow, thin intervertebral discs
- Less movement allowed
- Less space in the spinal canal for the nerves.
- Kyphotic shape “C”

Spinal Anatomy

Facet Joints
- Synovial Joints provides flexibility of the spine
- "Bony knobs" that meet between each vertebra

Spinal Anatomy

Neural Foramen — Nerve Tunnels
- Opening between every two vertebrae where the nerve roots exit the spine.

Spinal Cord and Nerve Roots
- Nerves travel through the spinal canal before exiting out the neural foramen.
- Spinal cord ends at L1

Cauda Equina
- Spinal cord divides into several different groups of fibers at L1 that go to the lower half of the body
Spinal Anatomy

Paraspinal Muscles

• Injury to the disc, ligaments, bones, or muscles
  • Muscle spasms occur to reduce the motion around the area.
• Lactic acid buildup causes a painful burning sensation.

http://www.sofamordanek.com/health-spinal.html

LUMBAR NERVE ROOTS

Dermatomal Distribution

• L2 – Groin/Medial Thigh
• L3 – Anterior Thigh
• L4 – Anterior Knee/Medial Calf
• L5 – Lateral Calf/Dorsum Foot
• S1 – Posterior Calf/Lateral Foot

Intervertebral Disk

“Shock Absorber”

Nucleus Pulposus (NP)
Anulus Fibrosus (AF)
Cartilaginous Endplate (CEP)

NP Chondrocytic Phenotype
Loose Matrix, ↑ Proteoglycan

AF Fibroelastic Phenotype
Matrix: Rich in Collagen

Spinal Degeneration

Pathophysiology

Changes to Nucleus

• Loss of cells
• ↓ Proteoglycans / Loss of H₂O
• ↓ Type II / ↑ Type I collagen
• Annular fissures
• Loss of mechanical competence
• Bony changes / Facet Changes

Assessment
Detailed History and Physical Exam
- Date of Onset -
- The Presence or Absence of Pain - Not all cases of Spondylolysis produce pain.
- Previous Surgeries
- Assessment of the back
- Neurological assessment
- Bowel or Bladder Dysfunction
- Motor Function

Radiographic Evaluation
Attempt conservative treatments before imaging
Exceptions:
- Neurological deficits
- Fever / infection
- Severe pain
- History of malignancy

Radiographic Evaluation of Spinal Disorders
- Magnetic Resonance Imaging (MRI)
- Computed Tomography
- Myelography
- Plain X-rays
  - A/P, lateral, flexion, extension to evaluation spinal alignment / instability
- Bone Scan

Magnetic Resonance Imaging (MRI)
Advantages
- Excellent detail of soft tissue structures
- Fine detail of neural anatomy
- Gold Standard for evaluation for many spinal disorders
Disadvantages
- Size constraints of scanners
- Longer studies (often hours)
- Claustrophobia
- Contraindicated with some implants / metallic
  - cardiac pacemakers
  - epidural stimulators
  - shrapnel
- Artifact from spinal implants

Computed Tomography (CT)
Advantages
- Good detail of bone anatomy
- Quick (minutes)
- Large bore (no issues with claustrophobia)
Disadvantages
- Poor resolution of soft tissues
- Radiation Exposure
**Diagnostic Evaluation**

**Myelography / CT Scanning**
- Contrast is injected into spinal fluid followed by plain x-rays to visualize intraspinal structures.
- Often combined with CT for better detail.
- Able to visualize intradural and epidural pathology.
- Often used when MRI cannot be obtained.

**Bone Scan**
- ID Bone tumors
- Bone Density
- Compression Fractures
- Infections

[Image: bone-scan-image]

**Lumbar Radiculopathy**

**PHYSICAL FINDINGS**
- Radicular pain
- Hypontonia (muscle weakness)
- Plantar extension, dorsi-flexion weakness
- Atrophy of muscle
- Possible foot drop
- Difficulty with micturation or sexual activity
- Paresthesia and numbness from root compression
- Absent knee or ankle reflexes

**Classic Physical Findings**

- **Straight Leg Raise (Lasegue’s)**
  - + Low back pain – 20°-30°
    - especially L5 and S1
- **Kernig’s Sign** -
  - + if the patient cannot extend the legs or complains of hamstring pain.
**Lumbar Radiculopathy**

**L4-5 Herniated Disk**

**Pain Pattern**
- Lateral calf/ Dorsum foot
- 90% leg/ 10% back
- Shooting Pain
- Numbness of great toe
- Worse sitting and straining
- Groin pain – Hip Pathology

**Beware of other musculoskeletal pathology**

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**Lumbar Radiculopathy**

**Radiographic Evaluation**

**Radiologic Evaluation**
- MRI w/o contrast
  - Disc Herniation
  - Spondylosis
  - Osteophytes
  - Foraminal stenosis
- Order MRI with contrast if previous surgery to evaluate for epidural scarring

CT Myelography – used for patients that cannot receive MRI

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**Lumbar Radiculopathy**

**Conservation Management**

Attempt conservative treatment before surgical referral (except severe pain, weakness, urinary incontinence)

- Physical Therapy
- McKenzie exercises
- NSAIDS
- Steroids
  - Medrol dose pack
  - Decadron
  - ESI

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**Lumbar Radiculopathy**

**Surgical Indications**

- Failure of extensive conservative treatment (6 weeks or greater)
- Pain distribution = MRI findings
- May consider earlier treatment with severe pain or motor weakness

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**Lumbar Radiculopathy**

**Surgical Interventions**

**Microdiskectomy**
- Small 2-3 cm incision
- Small laminoforaminotomy (bone removal)
- Compressed nerve root exposed
- Underlying herniated disk material removed
- Very successful procedure
- Outpatient surgery vs overnight stay
- Risk: 8-14% reherniated at same level
Case Example:

35 y/o female with severe pain radiating down left leg for 8 weeks. Pain radiates from buttock, to back of thigh and into the lateral aspect of the foot. Numbness in same distribution. Pain increases with sitting.

Cauda Equina Syndrome

- Rare syndrome with perineal numbness, urinary retention / incontinence, +/- radicular pain, +/- radicular weakness
- Typically associated with massive disk herniation occupying entire spinal canal compressing cauda equina
- Emergent MRI
- If found to truly have a massive herniation, surgery within 24 hrs better prognosis for recovery of urinary function.

Cauda Equina Syndrome

- If not associated with a massive disk herniation, consider other causes for urinary symptoms
  - Pain
  - Narcotics
  - Prostate

Case Example: 28 y/o male who acutely developed groin numbness, urinary retention then incontinence over hours, and some bilateral foot pain / paresthesias.

T2 Axial MRI

No CSF seen (CSF should be white in canal on T2 MRI)

Entire Canal is occupied by an extruded disk herniation

Despite emergent decompression with diskectomy, pts urinary incontinence continued
Lumbar Spinal Stenosis

50+ yr age group
Burning/tightness in buttocks (walking)
Neurogenic claudication
  • Pain/numbness ↑ walking/standing
  • Relief with flexion/sitting
  • Leg heaviness
  • Back and leg pain

Lumbar Spinal Stenosis
Physical Findings

• Radicular Distribution +/-
• Pain induced with exercise
• Loss of DTR
• Muscle Weakness (AT/EHL)
• SLR rarely +
  - If acute – Disc Protrusion

Lumbar Spinal Stenosis
Always check for signs of Myelopathy

• Hyperreflexia
• Extremities weakness
• Gait disturbances
• Clonus
• ~ 20% of lumbar stenosis patients also have cervical stenosis

Differential Diagnosis

• Peripheral Vascular Disease
• Peripheral Neuropathy
• Mechanical Low Back Pain
• Osteoarthritis (Hip and Knee)

Consider Coexisting Diagnoses

Differential Diagnosis

<table>
<thead>
<tr>
<th>Neuro Claud</th>
<th>Vasc Claud</th>
<th>Mech LBP</th>
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</thead>
<tbody>
<tr>
<td>Pain</td>
<td>Aching/Burning</td>
<td>Cramps/Tightness</td>
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<tr>
<td>Locale</td>
<td>Buttocks/Legs</td>
<td>Calf/Thigh Musc</td>
</tr>
<tr>
<td>Worse</td>
<td>Extension</td>
<td>Leg Exercises</td>
</tr>
<tr>
<td>Better</td>
<td>Flexion</td>
<td>Standing/Rest</td>
</tr>
<tr>
<td>Neuro Deficits</td>
<td>Occasional</td>
<td>None</td>
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Lumbar Stenosis
Surgical Indications

- Stenosis and referable symptoms
- Failure of Conservative Treatments
- Treatment
  - Laminectomy
  - Fusion? +/-
  - Spondylolisthesis
  - Scoliosis

Case Example:
63 y/o male with severe buttock and thigh pain that occurs with walking less than 1 block. Relieved with sitting.

Degenerative Spondylolisthesis

Spondylolisthesis – forward subluxation of vertebral body upon adjacent vertebrae

Spondylolisthesis Subtypes
- Degenerative (most common)
- Isthmic (2nd most common)
- Dysplastic
- Pathologic (tumor)
- Traumatic
- Iatrogenic

Degenerative Spondylolisthesis
Etiology

- Anterior Disk Degeneration Cascade
  - Anterior Ligament Laxity
  - Arthritic Changes / Laxity in Facets
  - Subluxation
  - Facet / ligament hypertrophy

Spinal Stenosis
(Central and Foraminal)

Degenerative Spondylolisthesis
Natural History

- 10 year observation
- 30% increased slippage
- No specific predisposing factors
- Females > males 66%
  - ? Potential role of hormones in etiology
- Most common site L4-L5
- Increased progression in patients engaged in physical labor

Matsunaga, Spine, 1990
Degenerative Spondylolisthesis

Clinical Signs and Symptoms

Most present with Stenosis Symptoms
- Central Stenosis (most common)
  - Radiating pain into posterolateral thighs
- Lateral Recess or Foraminal Stenosis
  - Monoradiculopathy (less common)

Rarely can present with severe back pain
- Dynamic subluxation may contribute to back pain

Treatment Options

Surgical Treatment Options
- Laminectomy
- Laminectomy w/ fusion (uninstrumented)
- Laminectomy w/ instrumented fusion
- TLIF/PLIF
- Posterior Motion Sparring Instrumentation
- Intraspinous Spacers

Case Example – 74 y/o female who complains of severe leg pain that increases with standing and laying supine. Improved with sitting. Epidural injections provided temporary relief.

Treated with decompressive laminectomy with L4-L5 posterior lateral fusion.
Leg pain resolved.

Back Pain

- 2nd most common reason for seeing a physician
- 5th most frequent cause of hospitalization
- 3rd most frequent reason for surgery.
- 75 to 85 % people will experience some pain during their lifetime
- The highest rate of back pain occurs in the 45 to 64 years old old age group.
- Men > Women – Low Back Pain (10%)
- Women > Men – Upper Back Pain (3%)

Source: National Health and Nutrition Examination Survey III
**Back Pain Etiology**

- Trauma/Fractures
- Aging - DDD
- Infections/Discitis
- Osteoporosis
- Osteoarthritis
- Tumors
- Spinal Deformity
- Myofascial
- Referred Pain


**Back Pain**

**Presurgical Management**

- Physical Therapy
- Core Strengthening
- Modalities - heat, massage, US
- Hydrotherapy
- NSAIDS / Steroids
- Chiropractic
- Consider referral to physiatry for non-operative management

**Back Pain**

**Non-surgical Management**

- Physical Therapy
- Core Strengthening
- Modalities - heat, massage, US
- Hydrotherapy
- NSAIDS / Steroids
- Chiropractic
- Consider referral to physiatry for non-operative management

**Imaging Findings in Asymptomatic Patients**

- DEG DISK
- BULGE
- HNP
- STENOSIS

**DEGENERATIVE DISC DISEASE**

**Symptoms**

- Back pain – aching, deep, midline
- Pain often positional
- May have radicular pain as well
- Long history of pain – progressive gradually
- Smokers are more likely affected

**DEGENERATIVE DISC DISEASE**

**Symptoms**

- “Discogenic” back pain
  - typically increases with flexion
  - relieved with unloading spine
- Facet pain
  - typically increases with extension
**DEGENERATIVE DISC DISEASE**

**Surgical Interventions**
- Surgery should only be considered for disabling pain that has been refractory to multiple conservative treatments.

**Surgical Interventions**
- Artificial disc replacement
- ALIF (Anterior Lumbar Interbody Fusion)
- XLIF (Extreme Lumbar Interbody Fusion)
- PLIF/TLIF (Posterior or Transforaminal Lumbar Interbody Fusion (i.e., cages, allograft bone)
- Posterolateral Lumbar Fusion
- Anterior/Posterior Fusion

**Total Disc Replacement**

*Two Artificial Discs* approved for DDD at one level between L4-S1 for patients with no relief from low back pain after at least 6 months.

**Activ-L™ Artificial Disc Clinical Trial**

**PRODISC®-L TDR** (Synthes Spine, Inc. of West Chester, PA).

**CHARITÉ™ Artificial Disc** (DePuy Spine, Inc.)


**Compression Fractures**

**Thoracic/Lumbar**

750,000 people in the U.S. each year
500,000—of the vertebral fractures that occur each year are not diagnosed
25% of all postmenopausal women in the United States have had a vertebral compression fracture


**Compression Fractures**

**Thoracic/Lumbar**

Causes-
- Osteoporosis, Tumors, Trauma
Symptoms
- Sudden, forceful injury,
- Severe pain
- Weakness or numbness
- TTP at fracture site
Treatment – TLSO or LSO
Bracing for 3 months

**Compression Fractures**  
**Thoracic/Lumbar**

**Surgical Interventions**
- Vertebroplasty – injection of acrylic cement into vertebral body
- Kyphoplasty – vertebral endplates are elevated by balloons – restores height to vertebral body
- Decompressive surgery – with posterior displacement of bone into canal
- Fusion procedures for stabilization

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**Thoracic Disc Herniation**

**Symptoms**
- **Central disc protrusion**
  - Upper back pain
  - +/- Myelopathy depending on the size and pressure on the spinal cord.
  - Can lead to paralysis from the waist down.
- **Lateral disc herniation**
  - Impinges on the exiting nerve root at that level of the spine and cause radiating chest wall or abdominal pain.
- **Centro-lateral disc herniation**
  - Combination of symptoms of upper back pain, radiating pain, or myelopathy.

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**Thoracic Disc Herniation**

**Symptoms**
- Isolated to the upper back or may radiate in a dermatomal pattern
- Exacerbated with coughing or sneezing
- Sensory disturbances – N/T below the level of compression
- Myelopathy (SC dysfunction)
- Ataxia
- Unsteady balance
- Lower extremity weakness
- Bowel or bladder dysfunction
- Hyperreflexia

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**35 y/o male with progressive weakness in legs. MRI shows large disk herniation at T10-T11 with compression of spinal cord.**

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**Spondylolysis**

- Occurs in 5-6% population
- Vertebral defect usually L5
- Disconnection between the vertebra and the facet joints
- More common in gymnasts and football lineman
- Appears first time in childhood
- Stress fracture that never healed
**Spondylolithesis**

“Listhesis”—slipping or sliding associated with degenerative changes of the facet joints
- Long-standing motion between two vertebrae
- Anterior subluxation
- Most common at L4/5

**Symptoms**

Often asymptomatic
Low back pain, vague, dull, achy
Positive straight leg raising (SLR)

http://www.umm.edu/spinecenter/education/spondylolysis_spondylolisthesis.htm

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**Isthmic Spondylolisthesis**

- A small fracture in the pars interarticularis (Latin for “bridge between two joints”) that connects the facet joint above to the one below causes a slippage.

**Case Example:**

35 y/o fireman. Felt a pop in his back while lifting and twisting. Persistent back pain that increases with flexion. Leg pain after walking for long periods.

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**Spondylolithesis**

Degree of subluxation—expressed in grades
- Grade I - 25%
- Grade II - 50%
- Grade III - 75%
- Grade IV - 100%

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- [Image of X-rays and MRIs showing spondylolisthesis]
Spinal Surgery

- Surgery for neural compressive pathology has excellent outcomes.
- Surgical treatment of back pain is much less predictable.
- 95% patients will be relieved of leg pain

Spinal Anatomy

Spinal balance loss = strain to the spinal muscles and deformity of the spine

Spinal Cord Tumors

- Primary Spinal Cord Tumor (60%)
- Metastatic Spinal Cord Tumor (40%)
- Neurofibroma

- Location of tumor
  - 50% Thoracic
  - 30% Cervical
  - 20% Lumbarsacral

Spinal Metastasis

- 30% of cancer patients will develop symptomatic spinal metastasis
- ~10% spinal metastases are the initial presenting complaint
- Up to 90% of cancer patients have spinal mets in cadaveric studies

Spinal Metastasis Presentation

- Back pain out of proportion
- Night Pain
- Only 2% of patients have weakness as a first symptom
- 76% of patients have weakness at the time of diagnosis
- A normal neurological examination in a cancer patient with new back pain does not rule out spinal cord compression

Surgical Advancements

- SPINAL INSTRUMENTATION
  - Resection of tumor
  - Correction of deformity
  - Stabilization (↓ pain)
Stereotactic Radiosurgery
Gamma Knife

New techniques for tumor resection
Improved technology allows for more precise radiation treatment.

Back Pain Summary

Stewart Dunsker, MD, President
American Association of Neurological Surgeons

• Goal is to stop the irritation of the nerve root
• Start with anti-inflammatory medications like ibuprofen,
  Aleve, Relafen, not aspirin or acetaminophen
• Restrict activities for a few days
• If after 3 days home treatment, PCP/APN evaluate if nerve root irritation or other serious condition.
• Prescribe pain relievers, muscle relaxants, anti-inflammatory meds
• No relief in 2 weeks, obtain MRI w and w/o contrast
• Refer to a Neurosurgeon

Thank You

???'s

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