Diagnosing and Treating Lumbar Spine Disorders: Evidence-Based Guidelines

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Objectives:
- Understanding of basic lumbar anatomy.
- Differentiate the etiologies, physiologies, physical examination techniques, and differential diagnoses of common lumbar spine disorders using EBP guidelines.
- Recognize presented lumbar spine disorders through a review of lumbar radiographs.
- Construct EBP recommended nonpharmacological and pharmacological treatments, as well as patient education, for lumbar spine disorders.
- Describe overview of new research endeavors relating to some lumbar spine diagnoses.

This presenter has no conflicts of interest to report

LUMBAR SPINE
- Vertebrae
  - Kidney shaped bodies
  - ML > AP dimensions
  - Smaller Transverse Process
  - Spinal Processes are large, square, and horizontal
  - Foramen
    - Vertebral: wider and triangular
    - Intervertebral: 33% occupied by nerve

Lumbar Vertebral Joints
- Facet Joints - formed by the superior & inferior articular processes of opposing vertebrae
- Pars Interarticularis – the space between the superior & inferior articular processes of the same vertebra

INTERVERTEBRAL DISCS
- Discs are located between the endplates of the vertebral bodies
- Most important and unique articulating system in the spine, allowing for multi-planar motion
- Make up ¼ of the total length of the spine column
- Largest avascular structure in the human body
- Cartilaginous joint of the motion segment
- Shock absorbers of the spine, which are so strong that with compression the vertebral bodies will fail before the discs
### Intervertebral Discs

- **2 Components**
  - **Annulus Fibrosus**
    - Outer part of the disc
    - Collagen fibers with water and proteoglycans
    - Layered in concentric layers called Lamellae, which are thicker and more numerous in the anterior portion of the disc
  - **Nucleus Pulposus**
    - Interior substance of the disc (gelatinous)
    - Increased water and proteoglycan content (85% Water content)

### Ligaments (brief overview)

- **Anterior Longitudinal Ligament**
- **Posterior Longitudinal Ligament**
- **Ligamentum Flavum** (noncontinuous, yellow color)
- **Interspinous Ligament** (connects the SPs)
- **Supraspinous Ligament** (connects the tips of the SPs)
- **Intertransverse Ligament** (connects the TPs)

### Spinal Cord / Nerves

- Spinal cord
  - Begins at Foramen Magnum and continues with termination at Conus Medullaris near L1
- Cauda Equina
  - Collection of nerves which run from conus medullaris to the filum terminalis
- Nerve Roots
  - Canal is broader in cervical lumbar regions due to the large number of nerve roots
  - Branch off the spinal cord higher than actual exit through the intervertebral foramen

- In lumbar region, the nerve root exits below the vertebral body
- Example: At the level of the L4/5 disc, the L4 nerve roots exit through the neuroforamen and the L5 nerve roots traverse along within the thecal sac

### Dermatomes

- Areas of skin innervated by sensory fibers from a single spinal nerve

### Lumbar Diagnoses: Incidence / Prevalence

- 5th for reasons US patients present for an office visit
- 2nd most common chief complaint
- Prevalent among all age groups, especially adolescents to elderly
- LBP care / economic losses exceeds $90-100 billion annually
- Most common reason for disability for patients ≤ 45 years old
- Prevalence for continued disability is 60-80% after one year
- Patients with h/o prior work absenteeism showed a 40% prevalence for future occurrences
Lumbar Diagnoses – 2 Main Differentiations

Low Back Pain (w/o lower extremity pain)
- Non-specific LBP (NSLBP)
- Degenerative Disc Disease
- Facet Joint Hypertrophy
- Vertebral Endplate Sclerosis
- Vertebral Osteophytes
- Lumbar Stenosis *
- Lumbar Disc Displacement *
- Spondylolisthesis *
- Lumbar Fractures
- Scoliosis

* may sometimes cause leg pain

Low Back Pain (w/ lower extremity pain)
- Lumbar Stenosis
- Lumbar Radiculopathy (r/t Lumbar Disc Displacement)
- Lumbar Radiculopathy (r/t Facet Synovial Cyst)
- Lumbar Radiculopathy (r/t Spondylolisthesis)

* Exists in 25-57% of all lumbar cases

Non-specific Low Back Pain (NSLBP)
- Mechanical type pain that varies with activity and posture
- Unrelated to a recognizable pathology, osteoporosis, structural deformity, or radicular syndrome
- Usually difficult in identifying a cause
- Mostly associated with muscular strain
- Typically is related to degenerative changes in the disc, facet joint hypertrophy, vertebral endplate sclerosis, or vertebral osteophytes

Degenerative Disc Disease (DDD)
- Loss of normal tissue structure and function due to the aging process.
- Usually is a gradual process, however acute trauma will accelerate the process
- Changes within the intervertebral disc
  - Water and proteoglycan decrease in the nucleus first, then the annulus
  - Fibers of the annulus become distorted, tears may occur in the lamellae decreasing the strength of the disc
- Most common level is L4/5
- By age of 50, 95% of people will have evidence of DDD

Effects the entire motion segment
- Facet joints override and wear at the hyaline cartilage
- Disc shrinks and the disc space narrows
- Loads are transferred from disc to the endplates
- Osteophytes may develop and encroach on neurological structures

Spinal Stenosis
- Refers to narrowing present in the neuroforaminal spaces, lateral recesses, or central canal
- Primary (Developmental/Congenital) or Secondary (Acquired, which is the most common)
- Secondary Stenosis
  - Acquired through degenerative changes, pathological changes, or prior surgery
  - Typically found in the older population > 50 years old
  - L3/4, L4/5 are most involved lumbar segments
  - Diagnosis and severity are largely dependent on the history and physical examination

Presentation
- Back pain increased by changes in position or with flexion of the spine
- Pain noted with prolonged sitting (differentiating symptom)
- If located midline over the spinous processes, 84% association with DDD

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Stenosis Symptoms

- Presence or absence of LBP
- Pain is typically improved with forward flexion (grocery cart test) as the canal space increases and with rest
- Neurogenic claudication
  - Most common finding for lumbar stenosis severely impacting patients’ function and quality of life
  - Radiating pain into the bilateral / unilateral buttock, anterior thigh, or posterior pain down the leg to the calf and sometimes to the feet
  - Worse with standing, walking upright, and extension
  - Can include sensation of weakness and/or heaviness, paresthesias, fatigue, hamstring tightness, and occasional nocturnal cramps
  - Important to differentiate from vascular claudication, which is pain relieved upon standing alone, typically below the knee, unchanged by flexion of the spine, and with a fixed duration of walking.

Lumbar Disc Displacement (Herniation)

- Most frequent surgically treated pathologies of the spine
- Commonly occurs at L4/5 & L5/S1 (regions with the greatest ROM and axial loading)
- Internal disruption to the disc is permanent due to the disc being avascular
- Four degrees of herniation
  1. Fissure / Bulging
  2. Protrusion
  3. Extrusion
  4. Fragmented / Segmented
- Symptoms are similar to NSLBP or Lumbar Radiculopathy, depending on leg involvement

Lumbar Radiculopathy

- Pain radiating from the lower back into the legs as a result of impingement on the nerve roots
- Causes:
  - Lumbar Disc Displacement (primary cause)
  - Facet Synovial Cyst
  - Spondylolisthesis
- Typically in younger patients

Radiculopathy Symptoms

- Pain radiating from the lumbar region that is primarily unilateral and greater than patients LBP, with some patients not having any LBP
- Typically worse during rest or in the night
- Paresthesias (burning, numbness, tingling) that follow a dermatomal pattern (mostly along L4-S1)
- Muscle Weakness, typically below the knee
- Changes in patellar or Achilles reflexes
- Pain may be increased with Valsalva maneuvers

Spondylolysis & Spondylolisthesis

- Confusing Terminology:
  - Spondylosis – degenerative changes in vertebrae at the disc and facet joints
  - Spondylolysis – defect in the vertebrae in area of pars interarticularis
- Descriptive Terminology:
  - Anterolisthesis – anterior / forward
  - Retrolisthesis – posterior/ backward
  - Lateral – sideways movement

Spondylolisthesis

- Slippage of one vertebrae in relation to the adjacent vertebrae
- Incidence is approximately 3-4% of all populations
- Strong hereditary factor
- Noticed more in gymnasts, football linemen, and weightlifters
- Most slips are related to a deficit in the pars interarticularis
- Disc degeneration is associated with almost all forms of spondylolisthesis
- Symptoms
  - Most common complaint is LBP
  - Radiation into the buttocks and occasionally posterior thighs
SPINAL FRACTURES

- Most common fractures seen in an outpatient setting:
  - Compression / Burst
    - Associated with falls from greater than 6 feet or any fall in a patient with osteoporosis
  - Transverse Process / Spinous Process
  - Burst (severe compression) or Facet fractures are more common in emergent settings
- Trauma to spine implies injury to any or all anatomical structures: bony elements, soft tissues, and neurological structures

Scoliosis

- Defined as a lateral curvature of the spine
- Adult scoliosis: Idiopathic / Degenerative
  - Idiopathic
    - Continued progression from adolescent
  - Degenerative
    - Onset of scoliosis in previous straight spine
    - Result of asymmetric deterioration of spinal components, caused by spondylosis

The History & Physical Exam

Key Items in History

- Provider should classify LBP from back pain with lower extremity pain
- Should be specific regarding locations of pain (midline, lateral, bilateral), especially if leg pain is present
  - Determination of leg pain aids in differentiating between stenosis and radiculopathy
- List the degree of pain on the visual analog scale
- Activity difficulties (walking, sitting, standing, flexion/extension)
- Sensorimotor deficits
- Aggravating / Alleviating factors
- Prior beneficial / failed treatments, especially in regards to medication regimens

Key Items in Physical Examination

- Should encompass inspection and palpation for alignment, tenderness, and/or erythema / edema
- Neurological Assessment
  - Motor assessment
    - Muscle strength (graded on 5 scale) or atrophy
    - 5 – Normal strength (full resistance)
    - 4 – Movement possible against some resistance by examiner
    - 3 – Movement possible against gravity but not against examiner’s resistance
    - 2 – Movement possible, but not against gravity (test in horizontal plane)
    - 1 – Muscle flicker, but no movement
    - 0 – No contraction
  - Sensory assessment – tactile to detect dermatomal deficits
  - Reflex Testing
  - Special Tests

- Cardiovascular Assessment (bruits, decreased pulses, pitting edema)

Special Tests (LUMBAR):

- Gait Testing (Motor)
  - Normal Gait Pattern (no evidence of foot drop)
  - Heel Walking – If difficult, can indicate L4/5 involvement
  - Tip Toe Walking – If difficult, can indicate S1 involvement
- Straight Leg Raise (AKA Laseque’s test) (Neurological)
  - Perform if history includes nerve root symptoms
  - Patient lays supine or sits upright while provider passively raises each leg individually with knee extended until the patient complains of pain down the back of the leg. Once pain is elicited, drop the leg slowly until they feel no pain, then dorsiflex the foot.
  - Positive if pain is elicited within the leg between 35-70 degrees of elevation. Dorsiflexion should increase this pain (if not, likely hamstring tightness). Hamstring pain involves only the posterior thigh. Back pain alone is not a positive SLR.
Special Tests (LUMBAR) – cont.:

- **FABER** [AKA Patrick’s Maneuver & Läfere test] (Motor) –
  - Flex the knee and place ankle above contralateral knee. Apply downward force onto the flexed knee to stress the lower back, St joint, & hip.
  - Positive – pt will elicit pain that should point to the source of pathology
- **Femoral Nerve Stretch** (Neurological) –
  - Opposite of SLR and tests L3 (femoral nerve)
  - Conducted in standing or prone position with back straight, examiner grasps the limb flexing the knee while slightly hyperextending the hip
  - Positive – produces L2-4 radicular symptoms to the anterior knee
- **Rectal Assessment** (Neurological) –
  - Performed for c/o saddle paresthesias or bowel incontinence

**Special Reminders**

- Multiple Myotome / Dermatome Dances / Sayings
  - Umbilicus – Level of L3/4
  - Line across iliac crests – Level of L4/5
- **DTR's**
  - Standard 2+ and equal bilaterally
  - Positive if < or > than 2+ unilaterally or bilaterally
- **Ankle Clonus**
  - Quick dorsiflexion of the relaxed ankle joint.
  - Positive with repetitive (4+) twitching/pulsing of the foot
- **Babinski's**
  - Stroking of lateral aspect of sole of foot from the heel to the toes
  - Positive with extension of great toe and fanning of four small toes

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**Long Tract Signs (Pathologic Reflexes) [suggestive of upper motor neuron lesions]**

- DTRs
  - Standard 2+ and equal bilaterally
  - Positive if < or > than 2+ unilaterally or bilaterally
- **Ankle Clonus**
  - Quick dorsiflexion of the relaxed ankle joint.
  - Positive with repetitive (4+) twitching/pulsing of the foot
- Babinski’s
  - Stroking of lateral aspect of sole of foot from the heel to the toes
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**Lumbar Neurological Examination Key Points**

<table>
<thead>
<tr>
<th>T12 – L3</th>
<th>M</th>
<th>Hip Flexion (Knee Raising - Iliopsoas) – L2, Quadriceps (Knee Extension) – L3, Hip Adduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>NONE</td>
<td>Hips abducted, lumbar flexion, straight leg raise</td>
</tr>
<tr>
<td>S</td>
<td>L1 – Patellar (Ankle) Thigh</td>
<td></td>
</tr>
<tr>
<td></td>
<td>L2 – Middle of Ankle Thigh</td>
<td></td>
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<td></td>
<td>L3 – Distal Half of Ankle Thigh</td>
<td></td>
</tr>
<tr>
<td>L4</td>
<td>M</td>
<td>Foot Inversion (Tibialis Anterior), Ankle Dorsiflexion</td>
</tr>
<tr>
<td>R</td>
<td>Patellar Tendon Reflex</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>Medial Leg (Tibial Crest – Medially), Medial Foot, and Medial Great Toe</td>
<td></td>
</tr>
<tr>
<td>L5</td>
<td>M</td>
<td>Hip Abduction (Gluteus Medius), Great Toe Extension (EHL), 2nd-5th Toe Extension</td>
</tr>
<tr>
<td>R</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>Lateral Leg (Tibial Crest – Laterally), Dorsum of Foot</td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td>M</td>
<td>Foot Extension, Calf Reflexes (Gastrocnemius), Hip Extension (Sitting Maximus)</td>
</tr>
<tr>
<td>R</td>
<td>Achilles Tendon Reflex</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>Lateral Rot, Posterior Plantar Surface</td>
<td></td>
</tr>
<tr>
<td>S2 – S4</td>
<td>M</td>
<td>Iliac Muscles of Rect Bladder motor supply, Knee Flexion – S2</td>
</tr>
<tr>
<td>R</td>
<td>Superficial Ankle Reflex (Subtalar Joint)</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>Conscient Rims – S2, Outer Rim Ring, S3 – Middle Ring &amp; S4/S5 – Internal Rim</td>
<td></td>
</tr>
</tbody>
</table>

**Differential Diagnoses**

- **Primary EBP goal = rule out serious pathology, present in 5% of cases (red flags)**
  - **Spinal Cancer**
    - Age greater than 50
    - Prior h/o cancer (prostate, thyroid, breast, lung, kidney)
    - Insidious onset, recent weight loss, night pain, pain at multiple sites, esp. at rest, urinary retention, unresponsiveness to prior care
  - **Spinal Fracture**
    - Age greater than 50
    - H/O osteoporosis, trauma, or chronic steroid use
  - **Spinal Infection**
    - Recent fever, h/o IVDA, prior or current infections, esp. from prior lumbar ESIs, and immunocompression
  - **Cauda Equina Syndrome**
    - Acute or worsening radicular symptoms, sensorimotor deficits, foot drop, saddle paresthesias, and/or bladder/bowel incontinence

- **Secondary goal = classify patients as radicular or non-radicular LBP**
  - **Non-radicular major causes (lumbar strain/spin, myofascial pain, DDD)**
  - **Radicular (Lumbar Stenosis / Radiculopathy)**
    - Make sure to differentiate neurogenic claudication from vascular claudication
  - Other possible diagnoses: ankylosing spondylitis, diffuse idiopathic skeletal hyperostosis (DISH), aortic aneurysm, pancreatitis, or renal calculi

**Diagnostic Examination**

- Routine use is not warranted based on current guidelines
- Should be reserved for patients with progressive neurologic involvement or if suspicious of an underlying pathology
Diagnostics

**X-rays**
- Provides basic evaluation of bone and disc spacing allowing visualization of degeneration, fractures, and instability of the spine.
- AP/Lateral for pathology.
- Flexion/Extension added if concerned about spinal instability.
- Oblique added if concerned about spondylolisthesis / spondylolysis (Scotty Dog).

**Magnetic Resonance Imaging (MRI SCANS - non-radiation)**
- Primary diagnostic for neurological involvement.
- Adept at evaluation of soft tissue pathology (i.e. nerves, spinal cord, and discs).
- Order w/ contrast if prior surgery has been done to rule out scar tissue involvement or tumor.
- Can be performed unless pt has pacemaker/defibrillator implant, aneurysm clips, other motor run implants, spinal cord stimulators, or a bullet close to the spine.

**Computed Tomography (CT SCANS - high radiation)**
- Particularly good for detecting bone pathology.
- May consider CT if patient had prior hardware and there's concern for artifact on MRI or lucency of the hardware.

**CT Myelogram (high radiation)**
- Secondary test if concern for neurological involvement.
- Needle is introduced into the subarachnoid space and contrast is injected with the patient tilted on the table so the dye will go to the specific region we are testing.
- AP/Lateral views of spine are then taken.
  - Contrast appears white w/ neural structures dark.
  - Compression or displacement of neural elements may be visualized.
- Painful procedure.

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**AP View (Owl)**

- **Pedicles**
- **Vertebral Body**
- **Transverse Process**
- **Spinous Process**

The eyes should be open. Winking owls is typically sign of pathology.
Nose should be one piece. If separated in the middle, indicative of spina bifida occulta.
Spondylolysis

Spondylolisthesis
Treatment Options

- Evidence shows that most treatment options have minimal impact on outcomes, are typically short term, and rarely change the longer term prognosis.

- Goals of treatment include:
  - Pain relief
  - Improvement of function
  - Reduced work absence
  - Prevention of chronicity.

Patient Education

- Education regarding their diagnosis, which is important for self-management and reassurance
- Shared Decision Making
- Encouragement for Active Lifestyle
- Health Seeking Behaviors
  - Smoking Cessation
  - Exercise
  - Weight Loss

Nonpharmacological

- Exercise
  - Physical Therapy
  - Aqua Therapy
  - IHEP (Walking, Stretching, Swimming, & Cycling)
- Chiropractic Care (aka spinal manipulation therapy)
- Massage
- Heat / Ice
- Traction
- Acupuncture
- TENS
- Back Supports

Pharmacological

- Acetaminophen
- NSAIDs (oral / topical)
- Weak Opioids
  - Tramadol
  - Tylenol #3
- Antidepressants
- Muscle Relaxants
- Antiepileptic / Antineuropathics
- Steroids

Common Medications for LBP Management

- Traditional NSAI ds: etodolac (Lodine) diclofenac (Voltaren) naproxen (Naprosyn, Aleve)
- COX-2 inhibitor NSAI d: celecoxib (Celebrex)
- Weak Opioids: tramadol (Ultram) acetaminophen / codeine (Tylenol #3)
- Muscle Relaxants: baclofen (Gabapentin, Librax) tizanidine (Zanaflex) methocarbamol (Robaxin)
- Antiepileptics: gabapentin (Neurontin) topiramate (Topamax)
Invasive Procedures

- Pain Injections
  - Epidural Steroids
  - Facet Injections
  - Rhizotomy
  - Nerve Blocks
  - IDET
- Surgical Referral
  - Sternosis = lumbar laminectomy / decompression
  - Radicopathy = lumbar discectomy

Probable causal factors
- Increased causal necrosis factor a

Genetic Predisposition
- Changes in Interleukin 1, aggreecran, vitamin D receptors, collagen fiber genes (I, IX, XI), matrix metalloproteinase 3, and several proteins
- Obesity
- Smoking

References


