Functional Anatomy and Exam of the Lumbar Spine

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Disclosure
Anatomical Review

- Quick Review of Bony and Ligamentous structures
- Discal anatomy
- Neural Anatomy
- Relevant musculature – attachments and function
Anatomy of the Spine - Bone

• Lumbar spine consists of 5 vertebrae
• Each vertebrae consists of:
  – Wide body
  – Pedicles
  – Transverse processes
  – Laminae
  – Spinous process
Anatomy of the Spine - Bone

• Zygapophyseal joints
  – Superior and Inferior processes
  – Aligned in the sagittal plane
    • Allows significant flexion and extension with slight rotation
  – Lower two Lumbar joints aligned nearer to frontal plane
    • Allows more rotation with movements
Anatomy of the Spine - Ligaments

- Supraspinous ligament and Interspinous ligaments
- Ligamenta Flava – run between adjacent laminae
- Intertransverse ligament – run between transverse processes
- Anterior Longitudinal ligament – broad band along anterior surface of body
- Posterior Longitudinal ligament – along posterior surface of the body
  - Alternatively narrows over body and expands over discs
Anatomy of the Spine - Discs

• Main approximation between vertebrae is the intervertebral disks
• Numbered according to vertebra they are below
• Composed of two parts:
  – Annulus Fibrosus – firm outer layer of fibrocartilage
  – Nucleus Pulposus – softer mucoid material
Anatomy of the Spine - Discs

• Annulus Fibrosus
  – Fibers run obliquely from one vertebra to the other
  – Arranged in concentric rings
  – Each ring at different angles than the previous ring
  – Most common weakness in posterolateral disc

• Nucleus Pulposus
  – Contains about 75% water
  – Essentially incompressible but shape is changed with motion
Anatomy of the Spine - Nerves

• Nerve roots exit via intervertebral foramina
• Nerve roots level are related to superior lumbar vertebrae as they exit
• Dermatome – area of skin innervated by a single spinal nerve
• Myotome – a group of muscles innervated by a single spinal nerve
Anatomy of the Spine - Musculature

• Multifidus – the thickest and deepest muscles of the lumbar region
• Iliocostalis Lumborum – part of the erector spinae
• Segmental muscles
  – Interspinales
  – Intertransversarii
Anatomy of the Spine – Musculature

• Thoracolumbar fascia – provides attachments to multiple other muscles
  – Quadratus lumborum
  – Transverse Abdominus
  – Internal Obliques
  – Latissimus dorsi

• Other important musculature
  – External Obliques
  – Rectus Abdominus
  – Psoas
Functional Anatomy

• Important to look at the function of the musculature as whole
• Abdominal and posterior musculature acts together as a “corset” to provide stability as well as act as the primary movers of the lumbar spine
Examination of the Lumbar Spine

- Three main objectives for exam
- Determine etiology of injury
- Classification for treatment
- Functional movement assessment
Diagnosis

• Identify the injured structure
  – Importance of patient history
  • Mechanism of injury
  • Prior medical history
  • Description of symptoms lead examination

  – Physical testing
  • Quality of planar movement
  • Palpation, Special tests, Neural testing, etc.

  – Diagnostic testing – MRI, CT, X-Ray, etc.
Red Flags

• Very important when taking history and performing physical examination

• Look for the signs of more serious complications
  – Pathological changes in bowel and bladder
  – Paresthesia in perianal region
  – Pattern of symptoms not compatible with physical exam
  – Progressive neurological deficits
  – Night sweats, unexplained weight loss, prior medical or familial history of cancer / metabolic bone disorder / etc.
  – Abnormal reflexes
  – Significant upper or lower limb weakness
Diagnosis

• Diagnosis of injury helps with treatment plan
• Symptoms of injury truly guide the development of the treatment
• Leads to more successful outcomes with lumbar spine injuries
Treatment Classifications

• Fritz et al helped to develop a classification system to improve LBP interventions
  – Came up with 4 main treatment classes
  – Manipulation
  – Stabilization
  – Specific Exercise – Extension, Flexion, Lateral Shift
  – Traction
Manipulation

• Clinical Predictions
  – No symptoms distal to knee
  – Recent onset of symptoms - < 16 days
  – Low FABQW score - <19
  – Hypo mobility of Lumbar Spine
  – Hip IR ROM >35 degrees for at least 1 Hip

• Intervention Procedures
  – Manipulation of the lumbar spine as well as the pelvis
  – Active ROM exercises
Stabilization

- Clinical Predictions
  - Younger age < 40
  - Greater general flexibility
  - Incorrect movement during lumbar flexion / extension ROM
  - + Prone Instability test

- Intervention Procedures
  - Promote isolated contractures of the deeper stabilization musculature
  - Strengthen the larger stabilizing musculature
Specific Exercises - Extension

• Clinical Predictions
  – Symptoms distal to buttocks
  – Centralize with extension
  – Peripheralize with flexion
  – Patient preference for extension

• Intervention Procedures
  – Mobilization for extension
  – Avoidance of flexion movements
  – Extension exercises to end-ranges
Specific Exercises – Flexion

• Clinical Predictions
  – Older age > 50
  – Imaging evidence of lumbar spinal stenosis
  – Patient preference for flexion

• Intervention Procedures
  – Mobilization / Manipulation of lumbar spine
  – Increase flexibility impairments
  – Increase strength deficits
Specific Exercise – Lateral Shift

• Clinical Predictions
  – Visible frontal plane deviation of the shoulders to the pelvis
  – Patient preference for lateral translation movements of pelvis

• Intervention Procedures
  – Exercises to correct the lateral shift
  – Use of mechanical or autotraction
Traction

• This has the poorest supporting evidence in the literature of all the treatment classifications

• Clinical predictors
  – Symptoms of nerve root compression
  – No movements centralize symptoms upon exam
Functional Movement

- Pre or post injury screens to detect subtle or gross disruptions of normal movements
- Begins to look at the body as a “whole” and how everything is interconnected
- Lumbar dysfunction may result from deficiencies in other parts of the body
- Need to clear and improve these deficiencies to allow the Lumbar Spine to regain normal function
Functional Movements

• Many tools out there
  – FMS
  – NASM PES and CES
  – Video assisted screening
• Very helpful to help take the athlete the last step and prevent further incidence