Radiographic Imaging of the Pathologic Spine

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Appendicular Skeleton

Cervical Anatomy of the Spine

Thoracic Anatomy of the Spine

Lumbar Spine and the Cauda equina elements

Spine Pathology

- Degenerative Conditions
  - Degenerative disc disease
  - Disc Herniation
  - Stenosis
  - Spondylolisthesis
- Deformity
  - Scoliosis
- Trauma
- Tumor
- Infection
Stenosis

Lumbar Stenosis

Spondylolisthesis

What Does Spine Pathology Cause?

- Neurologic Signs/Symptoms
  - Nerve related
    - Arm/Leg affected
  - Back Pain
    - Axial pain
    - Midline pain

Clinical Signs and Symptoms of Neurologic Dysfunction

- Neurologic symptoms
  - Radicular Pain
  - Neurogenic Claudication
  - Myelopathy

Neurologic Symptoms Etiology

- (Inflammatory/Mass Effect/Intrinsic?)
  - Local inflammation
  - Infection
- Mechanical compression
  - Mass effect by various etiologies
  - Ischemia of nerves
  - Infarct, blood loss

Radiculopathy Signs and Symptoms

- Evidence of Dysfunction
  - Radicular Pain
  - Paresthesias (numbness/tingling)
  - Weakness
  - Absent reflexes
  - Atrophy (late finding)
Neurologic Exam
motor vs Sensory

Neurologic Exam: Reflexes

Clinical Suspicion
Level Identification

Upper Motor Neuron
vs
Lower Motor Neuron Signs

* UMN
  * Hyperreflexia
  * Decreased Coordination
  * Increased tone/spasticity
  * Clonus/Hoffman’s

* LMN
  * Hyporeflexia
  * Atrophy
  * Decreased muscle tone/flaccid
  * Absent pathologic reflexes

Myelopathy Clinical Signs and Symptoms

* Neurologic symptoms
  * Hand dysfunction (fine motor)
  * Gait Dysfunction (spastic, uncoordinated)
  * Hyperreflexia (brisk reflexes)
  * Pathologic reflexes
  * Motor weakness
  * Paresthesias

Neurogenic Claudication

* Evidence of Dysfunction
  * Buttock and leg pain that is typically worse in lumbar extension
  * Worse with ambulation limiting walking tolerance
  * Relieved by lumbar flexion
    * Shopping Cart sign
**Back Pain**

- Etiology
  - Degenerative Disc DZ
  - Infection
  - Trauma
  - Tumor
  - Referred pain
    - Muscular/soft tissue related, Aortic aneurysm, Renal disease (infection/stone), Hip disease, Inflammatory conditions, Gynecologic conditions (fibroids/dysmenorrhea), etc.

**Clinical Signs and Symptoms**

- Back Pain
  - Limited range of motion consistently positive
- Various nonspecific findings of clinical exam
  - Tenderness on exam
  - Spasm
  - Skin Lesion
  - Waddells Signs

**Imaging Evaluation**

- Plain Film Radiography
  - Beginning of almost every Orthopedic imaging evaluation
    - (AP and Lateral Views)
  - Subsequent imaging dependent on clinical findings and potential plain film abnormalities. Confirm/Support diagnosis
    - Dynamic Flexion/Extension Views
    - Computed Tomography (CT)
    - Magnetic Resonance Imaging
    - CT Myelography

**Plain Film Radiography**

**Most Important View in Trauma**

- Alignment
- Listhesis
- Soft tissue abnormalities
- Swelling
- Masses
- Bony Integrity
- Fractures
- Facet joints

**Dynamic Films**

**Instability Assessment**

**Dynamic Films**

**Alignment Assessment**
Dynamic Films
Instability Assessment Sit vs Stand

AP Radiographic Evaluation
What’s Important?

The Details Matter !!

Postop Pain???
Imaging Evaluation
Scoliosis - Balance

Imaging Evaluation
Scoliosis - Flexibility

Imaging Evaluation
Magnetic Resonance Imaging

- Study used to evaluate for the presence of compression of neural elements
- Allows analysis for extradural compression
  - Soft tissue lesions
  - Fractures
  - Degenerative stenosis
- Intrinsic spinal cord pathology
  - Cord infarct
  - Multiple sclerosis
  - Transverse myelitis

Magnetic Resonance Imaging
Stenosis

MRI Cord evaluation

Tumor
Thoracic

Lumbar

Computed Tomography

- Bony Integrity in 3D analysis
  - Trauma
  - Abnormal anatomical variants
  - Prior hardware positioning
  - Fusion assessment
  - Real-time Intraoperative assessment
  - O-arm

Imaging Evaluation
Computed Tomography

CT Anatomical Considerations
Intraoperative 3D Navigational Systems

- Multi-dimensional surgical imaging platform
  - Provides real-time, intra-operative imaging of a patient’s anatomy with high-quality images
- Improved visualization
  - Complex and MIS procedures
  - Confirm the accuracy of instrumentation placed before the patient leaves the OR.

Spine Pathology Treatment Considerations

- NonSurgical Management
  - Initial treatment for majority of degenerative conditions
    - No rapidly progressive neurologic decline
    - No traumatic instability
  - Activity Modification/Physical Therapy/Nsads
  - Narcotic medications
  - Injections
    - ESI, Nerve root injections, Facet injection/ablation
Surgical Considerations

- Decompression
- Laminotomy
- Foraminotomy
- Laminectomy
- Microdiscectomy

- Stabilization
- Fusion
- Inherent instability (spondylolysis)
- Deformity
- Trauma (fracture)
- Tumor
- Iatrogenic instability

Cases

Case ***

- 75 yo female with 6 month history of progressive leg symptoms
- Pain radiating down posterior/anterior legs with ambulation.
- Symptoms improve with sitting down, bending forward
- Also with symptoms of genital area numbness/burning when standing, walking, improved with sitting
- Chronic back pain for several years

Clinical Presentation

- Sensory deficits in bilateral L5, S1
- Motor strength 5/5 bilaterally
- Absent Knee jerk reflex on the Left (L4)
- Radiculopathy
- Claudication
- Single level
- Multiple level

Spondylolisthesis
Surgical Considerations

Goals of Surgery
- Decompression needed?
  - Single vs multiple level
- Fusion needed?
  - Spondylolisthesis seen at 2 levels
  - Fusion materials:
    - Local autograft
    - Allograft (cadaver bone)
    - Iliac crest bone graft
    - Other products (Putty Mix, Infuse/BMP)

Approach
- Posterior Only
- Combined Anterior/Posterior

Case ***
- 65 yo female with
  - Chronic history of back pain
  - Bilateral constant leg burning in posterolateral legs
  - Bilateral leg cramping, numbness that is worse with prolonged walking, better with sitting down or bending forward
  - Notices she leans slightly to the right
  - **PE positive for bilateral EHL weakness
Surgical Considerations

- Goals of Surgery
  - Decompression
  - Imaging confirming multiple level stenosis
- Stabilization
  - Iatrogenic instability
  - Deformity correction?
- Fusion needed
  - Local autograft
  - Allograft (cadaver bone)
  - Iliac crest bone graft
  - Other products (Putty Mix, Infuse/BMP)

Surgical Considerations

- Approach
  - Posterior only
  - Anterior only
  - Combined Anterior/Posterior Approach

Case ***

- 68 yo male s/p GLF presenting to ED after ground level fall onto back
  - Back/neck pain
  - No neurologic deficits
  - Pain in mid back with attempted ambulation
  - History significant for presence of pacemaker

Case Neck/Back pain
Treatment

- Brace/collar?
  - TLSO brace, Cervical collar
- Pain management/ discharge?
  - No fracture seen on x-rays
- Further imaging studies?
  - MRI?
    - (history of pacemaker)

Surgical Considerations

- Goals of Surgery
  - Decompression needed?
  - Stabilization needed?
  - Instrumentation Only
  - Fusion needed
  - Local autograft
  - Allograft (cadaver bone)
  - Iliac crest bone graft
  - Other products (Putty Mix, Infuse/BMP)

- T8-L2 stabilization of unstable fracture
  - Mechanical instability without treatment:
    - Neurologic compromise
    - Paralysis
Ankylosing Spondylitis

Back pain = fracture until proven otherwise

Case ***

- 55 yo male with history of prostate cancer s/p chemotherapy 3 years ago
  - Presenting to clinic with back pain and radiating
  - Pain down the back of his legs
  - No fevers/chills/weightloss
  - No bowel/bladder symptoms

Treatment Considerations

- Diagnosis
- CT guided biopsy
- ChemoTx/RadiationTx
- Surgical Considerations:
  - Decompression
  - Stabilization
  - Posterior
  - Anterior
  - Combined
  - Fusion
Case ***

- 36 yo female with profound back pain, bilateral leg pain radiating down bilateral posterolateral legs into top and bottom of feet for 5 months. Worse with standing. Sudden onset
- PE
  - Weakness of foot dorsiflexion (L4)
  - Weakness of great toe extension (L5)
  - No bowel/bladder incontinence

Lumbar Disc Herniation

Surgical Considerations

- Goals of Surgery
  - Decompression needed
    - Unilateral vs bilateral
  - Microdiscectomy
    - Unilateral vs bilateral
  - Fusion needed?
L4-5 Bilateral decompression with microdiscectomy

Case ***
- 65 yo male presenting to ED with back pain and progressive bilateral leg weakness for 2 days with urinary retention
- Past medical history significant for
  - Pacemaker
  - Atrial fibrillation (on coumadin)
- **PE + for weakness in knee extension and foot dorsiflexion. Sensory disturbance in saddle region**

Bilateral Leg weakness
- Radiology read of L4-5 severe stenosis
- MRI recommended for further evaluation
  - Pacemaker considerations ???
- CT myelogram
  - On coumadin
- “Can’t you just operate on L4-5”

L1-2 disc

Surgical Considerations
**Goals of Surgery**
- Decompression needed?
  - Central, Bilateral, Unilateral
  - Discectomy
    - **CORRELATED with imaging**
- Stabilization needed?
  - Fusion

**Approach**
- Posterior
- Anterior
- Combined?
Patient not Picture
- L1-S1 laminectomy
- Imaging evaluating for discovery of additional pathology
- Imaging MUST correlate clinical findings

Is Anterior Decompression ever needed?

Musculoskeletal Radiology
- A rapidly advancing field
- Has altered physician’s approach to patients with musculoskeletal conditions
- Earlier diagnosis can have a profound effect on the management of these patients
- Imperative that radiology and spine surgery work in tandem to ensure a higher quality of patient care

Thank You!