Common Orthopaedic Conditions of the Spine

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Disclosures

I am not Rick Davis
Vinko Zlomislic UCSD loaned me some slides
Putting all this into one hour is hard…

Objectives

• Demonstrate an understanding of the most common spinal problems and their presentations
• Interpret the patient’s history, physical examination and radiographs
• Establish accurate diagnoses
Common Orthopaedic Conditions of the Adult Spine
• Arthritis
• Trauma
• Deformity
• Infection
• Malignancy

Pain
Surgery

Is it a tumor?
• Indolent course
• Weight loss
• Anorexia
• Night pain
• Progressive worsening despite rest
• Abnormal laboratory tests

Always consider infections and malignancies!

Physical Examination

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Physical Examination

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Always consider infections and malignancies!
Joe Lunchbox!

- Mid-40’s
- Married, couple of kids
- Occasional cigar
- Works 40 hours a week “on the line”

What is his likelihood of developing low back pain?
What is the impact of debilitating low back pain on society?

BACKGROUND

- Epidemiology
  - 25% incidence of LBP in US
  - 80% of back pain patients seek primary care
- United States Healthcare Expenditures Rising
  - Over $100 billion annually
    - 13% pharmacy
    - 13% primary care
    - 17% therapy
    - 17% inpatient services


Healthy Disk-Structure

- Nucleus pulposus
  - Notochord cells
    - proteoglycan
- Anulus fibrosus
  - Fibrocytes
    - collagen
- Vertebral endplate
  - Chondrocytes
    - cartilage
Healthy Disk - Function

- **Nucleus pulposus**
  - Hydrostatic column
- **Anulus fibrosus**
  - Restrains deformation of nucleus
- **Vertebral endplate**
  - Transmits compressive load

Healthy Disk - Care and feeding

- **Nucleus pulposus**
  - Avascular, aneural
- **Anulus fibrosus**
  - Vascular, innervated
- **Vertebral endplate**
  - Avascular, innervated

Healthy Disk in Action

- **Resting supine**
  - 0.1-0.2 Mpa (1-2 atm)
- **Standing**
  - 1 MPa
- **Bending and Lifting**
  - 2.5 MPa

*5 MPa induces chondrocyte apoptosis!*
Why would a healthy disk fail?

- **Injury**
  - Direct trauma
    - Accidental
    - Iatrogenic
  - Postural
    - Acquired
    - Congenital
    - Obesity?

- **Illness**
  - Inflammatory arthritis
  - Infection
  - Vascular disease
    - Tobacco?

What does it mean for a disk to fail?

- No longer able to transmit load
- Nucleus pulposus no longer avascular

Vascular Causes

- Normal capillaries approach but do not cross endplate
- Vasoconstrictive chemicals may decrease nutrient diffusion across endplate
- Vaso-occlusive disease may limit blood flow
- Endplate sclerosis may limit diffusion
La Camptocormie

How many ribs?

Is it enough?
Pelvic Incidence

- Measures relationship of center of sacrum to center of hip
- Anatomic constant
  - In adults
- Mathematical sum of pelvic tilt and sacral slope

\[
\text{Pelvic Incidence} = \text{Sacral Slope} + \text{Pelvic Tilt}
\]

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**Is it enough?**

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Compensated sagittal spinopelvic malalignment patients have similar response to treatment as decompensated patients.
**Spondylolisthesis**

**Type (Wiltse)**
- I: Dysplastic
- II: Isthmic
- III: Degenerative
- IV: Traumatic
- V: Pathologic

**Grade (Meyerding)**
- I: 1-25%
- II: 26-50%
- III: 51-75%
- IV: 76-100%
- V: Greater than 100%

Also Marchetti and Bartolozzi

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**Anatomic Measurements**

- **Lumbar Index**
  - Measure of wedging
  - Low lumbar index correlates with high grade slips

- **Slip Angle**
  - Measure of kyphosis
  - Line perpendicular to posterior vertebral body to line parallel to superior endplate

**Marchetti and Bartolozzi**

**Developmental**
- High dysplastic
  - With lysis
  - With elongation
- Low dysplastic
  - With lysis
  - With elongation

**Acquired**
- Traumatic
  - Acute fracture
  - Stress fracture
- Iatrogenic
  - Direct
  - Indirect
- Pathologic
  - Local
  - Systemic
- Degenerative
  - Primary
  - Secondary
Stability

“Clinical instability is defined as the loss of the spine’s ability under physiologic loads to maintain its patterns of displacement, so as to avoid initial or additional neurologic deficits, incapacitating deformity and intractable pain.”

White and Panjabi 1987

Upper Cervical Anatomy

- Biomechanically Specialized
  - Support of “large” Cranial mass
  - Large range of motion
    - Flexion/extension
    - Axial rotation
- Unique osteological characteristics
- Unique vascular characteristics

Anatomy – The Axis

- Important transition point for forces within the c-spine
- Important anatomical points
  - Superior and inferior articular processes are “offset” in the AP direction- due to different functions at each articulation
  - Pars interarticularis- due to this transition is a frequent fracture site
  - Odontoid process- the “pivot” for rotation
Odontoid Fractures
Most common fracture of Axis
(nearly 2/3 of all C2 Fxs)
10 – 20 % of all cervical fractures
Etiology Bimodal distribution
   Young - high energy, multi-trauma
   Elderly - low energy, isolated injury
   (most common C-spine Fx elderly)

Radiographic Evaluation
Normal Vertebral Artery

Type II Fracture Nonunion
Risk Factors (Nonoperative)
Nonunion 10-70%
Initial displacement >6mm
Age > 60 yr old
Delay Diagnosis > 3 wk
Angulation > 10°
Posterior displacement

Atlantoaxial Rotatory Subluxation
- Type I, the most common type, demonstrates no displacement of C1
- Type II demonstrates 3-5 mm of anterior displacement of C1 and is associated with abnormality of the transverse ligament
- Type III demonstrates over 5 mm of anterior displacement of C1 on C2 and is associated with deficiency of the transverse and alar ligaments
- Type IV, a rare entity, demonstrates C1 displacement posteriorly.
Motion is life, life is motion

- Stabilize in collar
  - assess stability
- Reduce in longitudinal traction
  - Halo
- Consider anterior fixation if favorable fracture
- Definitive procedure is posterior stabilization

Subaxial Cervical Spine

- From C3-C7
- ROM
  - Majority of cervical flexion
  - Lateral bending
  - Approximately 50% rotation

Subaxial Osseous Anatomy

- Uncovertebral Joint
  - Lateral projections of body
  - Medial to vertebral artery
- Facet joints
  - Sagittal orientation 30-45 degrees
- Spinous processes
  - Bifid C3-5, prominent C6, C7

![Subaxial Cervical Spine Diagram](image)

![Subaxial Osseous Anatomy Diagram](image)
Columns

- Holdsworth 2 column theory
  - Anterior Column
    - Body, disc, ALL, PLL
  - Posterior Column
    - Spinal canal, neural arch and posterior ligaments

Initial Management Considerations

- Manage the airway
- Support spinal cord perfusion pressure
- Obtain appropriate imaging
- Reduce dislocations
- Remove spinal compression
- Restore spinal stability

Obtain Appropriate Imaging

- CT scan with sagittal and coronal reconstructions
  - All cervical spine occiput-T1 (EAST2009)
  - All thoracic and lumbar spine with fractures
- MRI
  - All neurologic deficit
  - All patients undergoing operative intervention
  - Clearance in obtunded, spondylotic patients
- Radiographs
  - Upright before discharge
Timing of Reduction vs. MRI

- 82 pts uni/bilateral facet fx/dx
- CR successful 98%
- Emergent OR in 2
- Post-reduction MRI: 22% herniation, 24% disruption
- Pre-reduction MRI: 2/11 HNP, 5/11 HNP post reduction
- One patient with secondary neuro deterioration
- Root impingement
- Onset several hours after reduction

**Why Bother?**

- Early decompression improves long-term outcomes
- Prospective evaluation of closed reduction or surgical decompression within 24 hours of injury
- Outcomes measure >2 grade AIS improvement
- Higher rate of neuro recovery in Early group compared to late group (19.8% vs 8.8%)
**AO/OTA Classification**

- Not specific for cervical spine
- Provides some treatment guidelines

**Type A**
- Axial loading; compression; stable

**Type B**
- Bending type injuries

**Type C**
- Circumferential injuries; multi-axial

**Allen and Ferguson**

- 165 patients
- Stability of each pattern is based on the two column theory
- Each category broken down into stages
- Uses both mechanism and stability to determine treatment and outcome

- 6 categories:
  - Compressive flexion
  - Vertical compression
  - Distractive flexion
  - Compression extension
  - Distractive extension
  - Lateral flexion

**Remove Spinal Compression**

- Reducing any dislocations
- In-line traction for burst fractures
- Be aware of overdistraction!!
- Operative decompression
Non-operative Care

- Rigid collars
  - Conventional collars offer little stability to subaxial spine and transition zones
  - May provide additional stability with attachments (JTOI)
  - Good for post-op immobilization
- Halo
  - Many complications
  - Better for upper cervical spine injuries
  - Subaxial “snaking”
  - Great for temporizing

Disk Herniation Nonoperative Treatment

- Time
- Activity Modification
- Physical Therapy
- NSAIDs and Medrol Dose pack
- 70-80% improvement by 6 weeks
- Epidural Steroid Injections
  - Ackerman, Anesth Analg 2007
    - Prospective randomized 90 patients with TFESI
    - Improved outcomes compared to caudal and interlaminar ESI

Operative management

- Relative Indications
  - Persistent radiculopathy (6 weeks)
  - Recurrent episodes of incapacitating sciatica
  - Significant motor deficit with persistent pain
  - Neurogenic claudication
- Absolute Indications
  - Progressive neurologic deficit
  - Cauda Equina Syndrome
Cauda Equina Syndrome

- Low back pain
- Sciatica
- Saddle anesthesia
- Motor weakness
- Bowel or bladder dysfunction
  - Normal PVR < 50 – 100 cc
  - PVRs > 300 cc bladder scan highly sensitive for cauda (Urology 1994)

Cauda Equina Syndrome

- Most common males 4th-decade
- Surgical Emergency
  - Early decompression
  - Outcomes correlate with symptoms severity/duration
  - Motor recovery to 1 year;
  - Bladder recovery to 16 months
  - Preop neurologic status/bladder function best outcome predictor (Chang, Surg Neur 2002)

Lumbar stenosis

- “Reduction of space for neural elements”
- Canal dimensions (Verbiest, 1979)
  - Central: < 12mm
    - (absolute <10mm)
    - Compression of dural sac
  - Lateral recess: < 3-4 mm
    - Compression of nerve root in lateral recess or neural foramen
Neurogenic claudication

- Vague weakness and pain associated with activity
- Pain, numbness, weakness that develops with walking or standing
- Classically relieved with forward bending, crouching or sitting
  - “Shopping cart sign”
- Differentiate neurogenic claudication from vascular claudication

Cervical myelopathy

- Spinal cord compression
- Etiology
  - Cervical spondylosis
  - Congenital stenosis
  - OPLL
  - Trauma
- Prognosis
  - Slowly progressive
  - Stepwise deterioration
  - Early recognition is key

Cervical myelopathy

- Classification
  - Nurick: Gait and ambulation
  - Ranawat: Strength, gait, long tract signs
  - JOA: Functional scoring (Motor, sensory, bladder)
- Presentation
  - Extremity paresthesiae
  - Weakness and clumsiness
  - Gait instability
- Exam – UMN signs
  - Hyperreflexia
  - Hoffmann’s sign
  - Clonus
  - Heel-to-toe walk
Stingers and burners  
- Neuropraxia of cervical root or brachial plexus  
- Reversible peripheral nerve injury  
  - Most common at C5-6 level  
- Unilateral burning pain or weakness  
  - "Dead arm"  
- Symptoms resolve in seconds to hours  
- MOI:  
  - Hyperextension and lateral flexion  
  - Cervical stenosis may predispose  
- Management: Nonoperative  
- RTP: Normal ROM, resolution of symptoms, full strength

Cervical cord neuropraxia  
- "AKA" transient quadriplegia  
- Temporary physiologic conduction block  
- Neurologic symptoms in >1 extremity  
- Mechanism:  
  - Hyperflexion and axial loading  
  - Hyperextension  
  - "Spear Tacklers Spine"  
  - Cervical stenosis  
- Imaging: dynamic radiographs and MRI  
- Nonoperative or Surgical management

Putting it all together  
- 55 yo female with rheumatoid arthritis has back and leg pain  
- Worse with activity  
- Top of feet and shins burn when walking more than a few blocks  
- Getting difficult to stand more than a few minutes  

Yeah, I have been wetting myself... Why do you ask?
And…oh by the way…I drop stuff a lot

Among things I did not cover…
- Epidural hematoma
- Epidural abscess
- Insufficiency fractures
- Hangman fractures
- Jefferson fractures
- Incomplete spinal cord syndromes
- Thoracolumbar fractures
- Waddell’s signs

Summary and Take Aways
- History of trauma or other red flags warrant consideration of imaging modalities
- Persistent or worsening pain warrants re-evaluation and further consideration of imaging or additional imaging
- A progressive neurologic deficit warrants an emergent diagnosis and treatment
- Ask someone when you are not sure