A Systematic Approach To The Spine

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As You Are Arranging The Films......

- AP
  - Illuminate the hips, lateral pelvis and everything above the diaphragm
  - Glance in flanks for stones
- Lateral
  - Look anterior to the bodies for an aneurysm
Alignment

- I start with the AP and then I go to the lateral
Alignment

- AP
  - Pelvic leveling
  - Curvature
Pelvic Leveling

- Easy with digital tools
- Film: before putting on view box, overlap the AP and lateral holding the edges so they are flush. Slide the lateral down until you get to the top of the ilia and see if there is a difference. Then slide down to the top of the femur heads to confirm.
- Typically described by the inferior side.
The idea is to use the smallest amount of lift that changes the lumbar curve.

With the patient prone, use a grease pencil to mark the SP and mammillary processes at each level and connect the dots at each level.

Have the patient stand.

Begin by inserting lifts and continue until the curve no longer changes.
Lateral Curvature

- Name by the convex side
- Cobb’s method most accurate
- Don’t use term scoliosis unless 10-12 degrees
Lateral

- Lordosis
- Weight Bearing
- Anterolisthesis
- Retrolisthesis
Lordosis

- Landmarks: superior end-plate of L1 and inferior end-plate of L5
- 50-60 degrees normal
- UNRELIABLE????
Weight Bearing

- Drop a vertical from the middle of the body of L3
- If more than 1 cm anterior to the sacrum it indicates added biomechanical stress to the posterior facets
Anterolisthesis

- Myerding's method
- Percentage method
- Pure measurement
Retrolisthesis

- Authors differ on significance
  - May be result of degeneration or can cause degeneration
- Can contribute to stenosis
- Often an optical illusion because of shape of posterior body: If seen at more than one level it is likely to be positional
Bone Density

- I look at the AP and then I look at the lateral
- This is the hardest area and your search pattern must be consistent
- JC's pattern:
  - Overall density
  - Individual structures
  - Cortices
  - Medullary cavity
Transitional Segments

- Known cause of recurrent pain if the segment is moveable AND there is unilateral or bilateral accessory articulation
- Predisposes to disc herniation at the level above
Castellvi Classification

http://2.bp.blogspot.com/-J628KSTyGci/ToozNyFtfDI/AAAAAAAAYHc/HRY0Rnfabuc/s1600/The+Castellvi+system.bmp
Spina Bifida Occulta

- Not a cause of pain
- At L5 and/or S1 it does predispose to pars defects
Knife Clasp Syndrome

- Spina bifida at S1 with elongation of the L5 spinous process
- Majority of cases are NOT symptomatic
- When it is a cause of pain, the symptoms are reproduced when the patient is hyperextended in the standing position
Hemangioma

- **Plain film:**
  - Rare to seen on plain film (have to affect almost the entire vertebral body)
  - Increased vertical striations (corduroy cloth appearance) with no change in size or shape to the vertebral body

- **MRI:**
  - VERY common
  - Typically decreased signal on T1 and increased signal on T2
  - Rarely of any significance
Metastasis

- Variety of appearances
- Lytic, blastic or mixed
- Typically multiple lesions, multiple bones, with varying sizes and shapes
- Other classic things: Ivory white vertebra, missing pedicle(s)
Active vs Inactive Pars Defects

- Stress fractures in the PEDICLE due to repetitive hyperextension
- Esp. 6 mos -2years, and adolescents
- Starts as one sclerotic pedicle, then the other = ACTIVE
- Active is confirmed with MRI or SPECT
- If stressor is not removed usually results in non-union at the pedicle lamina junction or PARS
- While the non-union is trying to stabilize with hard fibrous tissue, slippage can occur
- Once healed and stable the pars is typically radiolucent and is INACTIVE
Determining Active Pars Defect

- Sclerotic pedicle(s)
- Especially your athletes
- Hx of repetitive hyperextension
- MRI or SPECT
Compression Fractures

- Hyperflexion injuries (axial load makes it easier)
- Wedge shape
- Step defect
- Zone of condensation
- May have additional collapse
Recent Compression Fxs on MR

- The fracture cause bleeding
- The blood has water density causing bone marrow edema
- As the blood resorbs the bone marrow edema goes away
- The bone marrow edema is gone in about 6 weeks in most people (but may take up to a year)
- After 6 weeks bone scan
Universal Compression Fracture

- Loss of height all across the segment: anterior middle and posterior
- Causes:
  - Osteoporosis
  - Metastatic disease
  - Multiple myeloma
# Universal Compression Fx

<table>
<thead>
<tr>
<th></th>
<th><strong>Bone Scan</strong></th>
<th><strong>Lab work</strong></th>
<th><strong>MRI</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Osteoporosis</td>
<td>Cold except at fx</td>
<td>Negative</td>
<td>Fx only</td>
</tr>
<tr>
<td>Mets</td>
<td>Hot multiple places</td>
<td>Inconsistent</td>
<td>Fx (and other abormals?)</td>
</tr>
<tr>
<td>MM</td>
<td>Cold except at fx</td>
<td>Very positive</td>
<td>Fx (and other abormals?)</td>
</tr>
</tbody>
</table>
## Universal Compression Fracture: Benign vs Malignant on MRI

<table>
<thead>
<tr>
<th>Normal marrow</th>
<th>Abnormal fatty marrow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focal involvement</td>
<td>Multifocal involvement</td>
</tr>
<tr>
<td>No pedicle involvement</td>
<td>Pedicle involvement</td>
</tr>
<tr>
<td>Posteriorly angulated fragment?</td>
<td>Posterior convexity?</td>
</tr>
<tr>
<td>No soft tissue mass</td>
<td>Soft tissue mass</td>
</tr>
<tr>
<td>Fluid sign</td>
<td>No fluid sign</td>
</tr>
</tbody>
</table>
Limbus Bone/Vertebral Edge Separations

- Not an avulsion fracture
- A type of schmorl's node
- Triangular lucency at the anterior superior corner of the vertebral body
Cartilage

- I look at the lateral first and then I look at the AP
- Lateral
  - Anterior body
  - Through the disc/end-plate
  - Posterior body and disc
- AP
  - End-plates
  - Facets
  - SI's
  - Hips
Anterior Body/Disc

- Triangular extensions of end-plate: osteophytes
- Thick flowing anterior ossification including the mid body: DISH
- Thin anterior ossification with squaring of the body: AS
**DJD Facts**

- Scientific studies suggest that spondylosis deformans is the consequence of normal aging, whereas intervertebral osteochondrosis (AKA deteriorated disc), results from a clearly pathologic process with (or without) symptoms.
  - J Bone Jnt Surg 1962; 44: 243-68
  - Acta Ortop Scan 1985; 56: 496-99
  - Cin Orthop Ri Res 1987; 224: 97-104
  - Spine 2004; 4(6suppl): 167s-72s
End-plate

- Spondylosis
  - Osteophytes/spondylophytes
    - Traction spur: early change
    - Claw osteophyte: late change
Disc Bulge

- **Physiologic**
  - 1-3mm
  - Due to compressive forces during course of a day

- **Degenerative**
  - Not a herniation
  - Can contribute to stenosis
  - Due to lack of water binding from decreased glucosaminoglycans (GAGs)
Disc in DDD

- Intervertebral osteochondrosis
  - Loss of disc height (X-ray, MR, CT)
  - Vacuum phenomenon (X-ray, CT)
  - Disc calcification (X-ray, CT)
  - Decreased T2 signal (MR only)
  - Posterior spur/osteocartilagenous ridge (X-ray, MR, CT)
DISH In Lumbar Spine

- Thick flowing anterior ossification with relative preservation of the discs
- Can look very similar to AS
- NEVER involves lower 2/3 of SI joint
- May calcify the upper 1/3 of SI joint or may not
- R/O OPLL and diabetes m
Early AS in Lumbar Spine

- Romanus lesion (radiolucent corners to vertebral body)
- Shiny corner sign (radio-dense corners to vertebral bodies)
Late AS

- Marginal syndesmohytes (bamboo spine)
- Trolley track or dagger sign
- Costotransverse joint fusion
- Rule out upper cervical instability
AP

- End-plates
- Facets
- Si joints
- Hips
Facet OA

- Best seen on AP indirectly
- Bone lateral to the disc/body
- May result in lateral recess stenosis and/or degenerative spondylolisthesis
Signs of Degenerative Spondylolisthesis in Lumbar Spine

- Primarily scleratogenous leg pain (one or both legs)
- Comes and goes
- Often reduced by leaning forward or sitting down
- No neurologic findings
- Very common
- 4 F's: fat, female (I didn’t come up with this ladies), forty, L4
Tropism/Facet Asymmetry

- Increased incidence of recurrent back pain
- Predisposed to disc herniation/annular tear at the level above, especially on the side of the coronal facet
Si Joint OA

- Most commonly see sclerosis at junction of the upper 1/3rd to lower 2/3rds of the joint
- May see osteophytes at the inferior joint (rare)
Early AS

- Pain and or stiffness upon waking that last more than 30 min
- Bilateral and symmetric SI sclerosis and erosions
- HLA-B27, ESR
- Significant risk of GI problems
Soft Tissue

- I look at lateral first and then I look at the AP
- Lateral
  - Atherosclerosis and aneurysm
- AP
  - Gas patterns
  - Kidney stones
  - Gall stones
  - Liver
  - Fibroids
Atherosclerosis and AAA

- Scattered vascular calcification
- Can contribute to DDD
- 3.8cm is typical cut point for aneurysm
- Ultrasound modality of choice
- Surgery usually not considered until 5.5cm or if rapid increase in short period of time
Gas Patterns

- Should have minimal small bowel gas
- Anywhere in abdomen, more than 2-3 air-fluid levels can indicate significant underlying lesions
- Palpate percuss and auscultate
- Repeat the film next visit
- If still there, Lower GI or helical CT for further assessment
Kidney stones

- Vary in size
- Singular or multiple
- Homogenous well defined calcification
- Project over vertebral body or just anterior to it on lateral
- CT, IVP, or Ultrasound
Gall Stones

- Multiple stones common
- Right upper anterior abdomen
- Typically a peripheral rim of calcification and radiolucent centrally
- Ultrasound or CT to further access
Liver

- On upright should not extend below iliac crest (except in thin individuals)
- My just be due to upright posture
- Follow with palpation and percussion
- Lab work also helpful
Uterine Fibroids

- Singular or multiple
- Don’t typically calcify until menopause
- Vary in size
- Mottled/mulberry-like calcification centrally with a well defined but irregular border
- Get out of way early
- Position of lateral masses
- Integrity of dens
Jefferson Fx

- Hyper flexion with axial load
- Spreading of lateral masses
- CT when unsure
- Unstable
Dens Fx

- Hard to see on plain film
- Tilting of dens on APOM
- Offset of cortex on lateral
- CT best to see
- Any MOI
- Unstable
Dens Fracture

- **Type I: Oblique from tip**
  - Probably doesn’t exist

- **Type II: At base of dens**
  - Most common.
  - Unstable

- **Type III: well into the body of C2**
  - Better prognosis than Type II
Os Odontoideum

- Thick lucency base of dens
- Usually stable
- Do F/E
Lateral Cervical ALIGNMENT
Gravitational Line

- Vertical line from tip of dens
- Should intersect C7
- Anterior means stress at C/T jct and predisposes to DJD
ADI

- Up to 3mm in adults
- Up to 5mm in children
Bone Density

- Lateral first
- Then AP
Congenital Block Vertebrae

- Smooth anterior body concavity, rudimentary disc, usually has posterior arch fusion as well.
- C2/C3 most common site.
- Any symptoms would indirectly be due to increased biomechanical stress (predisposing to premature DJD).
Hangman’s fracture

- Pedicle body junction of C2
- Minimal anterolisthesis of the body
- Possible tear drop fracture
Compression Fractures

- Hyperflexion and axial load
- Wedge shape
- Step defect
- Zone of condensation
- Rule out retropulsion
- Age???
  - Up to 6 weeks: MRI
  - 6 weeks to 1 year: Bone scan
Clay Shoveler’s Fracture

- Middle or anterior third, distal is rare
- Usually inferior displacement
- Stable but usually doesn’t re-unite
Cervical Ribs

- 2X as common in females
- 66% are bilateral
- Most are asymptomatic
- TOS occurs in less than 5%
  - 97% of these are on the dominant extremity
Metastasis

- Lytic, blastic or mixed
- Cortical (end-plate) destruction
- Preserves joints
- Universal type compression fxs
Universal Compression Fracture

- Anterior, middle and posterior collapse
- Osteoporosis
- Metastasis
- Multiple myeloma
Joints

Lateral then AP
Anterior End-plate
End-plate

- Spondylosis
  - Osteophytes/spondylophytes
    - Traction spur: early change
    - Claw osteophyte: late change
Disc

- Intervertebral osteochondrosis
  - Loss of disc height
  - Vacuum phenomenon
  - Disc calcification
  - Posterior spur/osteocartilagenous ridge
Torg Ratio

- Most posterior aspect of end-plate to spinolaminar line
- If 80% or less than AP dimension of mid body: central stenosis
Soft Tissue

- Lateral then AP
Increased Retrotracheal Space

- Hemorrhage
- Abscess
- Mass
- Rules of 2's and 5's
  - Not greater than 5mm at C2
  - Not greater than 22mm at C5
Anterior Mediastinal Mass

- Substernal thyroid (most common)
- T-cell lymphoma
- Teratoma
- Thymoma
Pancoast Tumor

- Apical density
- Rib destruction
- Often cause signs of TOS or Horner’s syndrome