

## Dx Imaging Midterm

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Under teaching files start with files under Musculoskeletal Radiology from University of Washington (CHORUS-collaborative hypertext of radiology <http://chorus.rad.mcw.edu>)

Ex. Bennett fracture- occurs with hyperabduction of the thumb

Chorus is organized by system

★ *Have to face and eliminate your ignorance before somebody else finds out!*

Create an eponym list (especially in trauma list) - name of disorders associated with people's names

Ex. Galeazzi fracture of the radius at the junction of the middle and distal thirds with associated subluxation of the distal ulna

Musculoskeletal Radiology Signs: this is teaching radiology by signs which is a common way to teach radiology

Ex. Elbow Fat Pad Sign

Ex. Terry-Thomas sign - late comedian that had a wide inter-incisor space- when people fall on an outstretched hand the scaphoid lunate ligament is often separated and

Expression of pathophysiology and how it is expressed on the film is the way Kettner teaches

**Radiology Study Guide-** Youchm, Williams and Wilkins, 1998 - a great review for tests and boards

Midterm and Final- MT is 1 hour and Final is 2 hours (comprehensive)

MRI is best modality to check spinal deformity

**Greenstick** = pediatric fracture-Baby's bones fracture like a "greenstick"- like a wet stick-buckle with a fracture that doesn't go all the way through it

Old bones fracture/snap just the opposite of a greenstick

All related to hydration of bone

**Neuropathic arthropathy-** Disorder of joint as a result of no innervation- seen in Diabetes - like a stick of dynamite went off- patient doesn't have pain because no afferent info to the cortex

1/22/09

**Mondays-** Lab time

Normal Musculoskeletal Radiology covered next Monday

### Lateral C/S

- 7-9 mm is normal soft tissue space in upper cervicals
- 22mm is normal soft tissue space C6 and down
- If greater than normal: Neoplasm, Infection or Trauma (Pus, Blood, Cells)
- Articular pillar is often a target for fracture
  - Mechanism of extension is what often causes fracture
- Get a compressive fracture with flexion/whiplash injury
- When fall on an outstretched hand (FOOSH)-wrist for scaphoid fracture, elbow for radial head fracture, greater tuberosity for avulsion fracture you often brace yourself
- Three joints in C/S
  - Z-joints
  - Uncovertebral joints
  - Disc
- Amount of degeneration and production of pain correlation is weak
- Know difference between Myelopathy (cord compression) vs. radiculopathy
- ADI is important -indicated #1 in RA
  - "Wacking" of the spinal cord with arch of atlas causes a contusion in the cord

### Lateral C/S

- Can't see any lamina- only articular pillars
- Stenosis: Inadequate dimension to vertebral canal
- Congenital Stenosis
- Spinal cord compression may be asymptomatic
  - If compress cord slowly up to 18-20% you may stay below radar screen of clinical detection but if you hit it more acutely that will present itself clinically

### APOM

- Usual mistake is that you chop off the top of the dens
- 60% of fractures are at the base of the dens (type II fracture)
- Assessment includes
  - Articular pillars

### APLC

- Make sure trachea is in mid plane
- Two VICTANE categories that occur in the lung are Infection (Pneumonia) and Neoplasm (Bronchogenic Carcinoma)
  - Bronchogenic Carcinoma presents with Cervical Brachialgia- looks often like TOS
    - Pancoast Syndrome (NOT tumor)
    - If invasion of sympathetic chain occurs- Horner's Syndrome
      - Lose Sudomotor function- anhidrosis
      - Lose ciliary motor function- miosis
- Can't visualize pedicles on the AP film past C6
- Evaluate the Intervertebral disc and uncovertebral joint
- Vertebral arteries can't be seen on this view
- Can often see atherosclerotic plaque in carotid bulbs- check for bruits
  - 5% of bruits are hemodynamically significant
  - Ultrasound carotids

*Ripping the carotid a little bit like in whiplash can also cause Horner's because that's another location for sympathetics*

### Flexion/Extension Films

- Used to evaluate ligaments
- Degenerative instability

### Oblique Films

- Neural foramina volume in the vertical is maintained by the height of the intervertebral disc space
- When you have discogenic spondylosis you lose foraminal height

1/29/09

### Joint Involvement in OA

#### Common:

- C/S
- L/S
- Hip
- Carpometacarpophalangeal
- Proximal Interphalangeal
- Distal Interphalangeal
- Knee
- First Metatarsophalangeal

#### Uncommon:

- Temporomandibular
- Shoulder
- Sternoclavicular
- Ankle
- Talocalcaneal
- Midtarsal

**Osteoarthritis/Osteoarthrosis:** focal cartilage failure (chondrolysis) due to inflammatory mediators and mechanical dysfunction

#### Symptoms:

- Joint pain associated with movement
- Limitation of motion
- Stiffness after periods of rest
- Referred pain (acts on central sources)

#### Signs:

- Limitation of motion
- changes in shape of the joint,
- Malalignment
  - Degenerative subluxation-cartilage loss has altered the posture
  - Most common in L4/L5 (female, 40, L4)
    - Degenerative spondylolisthesis secondary to apophyseal arthritis
- Instability
  - Especially degenerative instability
  - Not to be confused with traumatic instability
- Spasm or atrophy of surrounding muscles
  - Range from hypertonicity to atrophy
  - Arthrogenic/Reflexogenic inhibition is the recognition that joint dysfunction is accompanied by inhibition and loss of proprioception in the muscles nearby
- Fine crepitation on joint motion
  - Little bitty chunks of cartilage

★ *Chronic pain incorporates psychosocial as well as anatomical and physiological components*

- ★ Job of an articulation is load transfer- normal joints should distribute the load uniformly
- If not uniform distribution there is Focal High load impact that starts to knock away chunks of cartilage because its soft tissue stabilization has failed
- Cartilage has no innervation or perfusion thus without neural and vascular support the tissue is destined to fail
  - All we know to do is to reduce load and maintain physical activity that causes imbibition (how nutrients are pumped into the cartilage)
  - Same amount of force in time that maintains cardiovascular sufficiency also keep joints and cartilage maintained
- All systems have Intrinsic, endogenous mechanisms to attempt to repair
- Tensile strength of our bone is due to the trabecular structure which is equivalent to steel
  - Two histological osteoid stains on the trabeculae
    - Lighter more central stain
      - The original trabeculation
    - Darker stain that wraps around central stain
      - Added trabeculation due to added strain
- Appears to also be an electrical component/biopotential
  - Osteoclasts would find themselves collecting on convex side due to electromagnetic/pisoelectric forces pull which "shaves away bone." Osteoblasts would find themselves collecting on concave side
  - Electric currents flow through our tissues contributing to pathology and regenerative capabilities
  - These Biopotentials appear to be generated by compression
- Turn over time (repairs and regenerates) for
  - Skin- 24 hours
  - Gastric cells- couple of days
  - Skeletal- couple of years
- Have to be able to tell the difference between OA and Osteonecrosis-Ischemic disease of bone
  - They can each cause each other

#### **Radiographic Expression:**

- Thinning of disc
- Endplate sclerosis
  - Osteoblasts are coming in to make more bone
- Cartilage is undergoing metaplasia
  - Fibrocartilage (disc) or cartilage into bone (osteophyte)
  - Osteophytes is a reparative response -attempting to repair degenerative instability
  - Osteophytes take a long time to evolve
- Neural foramin is decreased (neural foraminal encroachment) with uncovertebral arthrosis and spondylosis
  - Impression would sound something like this
    - Spondylosis of C5/C6 with accompanying uncovertebral arthrosis complicated by neural foraminal encroachment
    - If multiple levels you can say Degenerative changes present at C5/C6 and C6/C7 - can list some of those changes like endplate sclerosis etc but don't have to after time
- Recurring herniations and epidural fibrosis are common complications these patients face

#### **Functional Analysis of the Cervical Spine in a Symptomatic Population**

- Looked at 100 patients with neck pain
- Symptomatic motions are decreased at C4/C5, C5/C6 and C6/C7
- Crossover at C3/C4 becoming hypermobile
  - When something stops moving, something else becomes hypermobile
- Take Flexion and Extension Film
- Penny method: Make a copy on a 14 X 17 film to get an intersegmental range of motion which often doesn't match global range of motion
- Klippel-Feil syndrome- multiple segments of spondylosis causing blocked vertebra

2/4/09

#### **Disc Disease**

- Natural History
  - Everything between death and resolution
    - Natural History of Bronchogenic Carcinoma is death
    - Natural History of URT cold is resolution
  - We have to do better than what the natural history of disease is
- Disc Herniation with radiculopathy
  - Orthopedic surgery is unfounded in the literature
    - Don't know how to identify the pain generator
  - Conservative management for months
  - Search: disc herniation AND natural history
    - Cribb GL, Jaffray DC, Cassar-Pullicino VN - "Observations on..." - showed that conservative management was effective

- Masui T, Yukawa Y... "Natural history of patients with lumbar disc herniation..."
    - Saal JA "Natural history and nonoperative tx of lumbar disc herniation"
  - Stenosis isn't usually talked about with disc herniations- talked more about bony intrusion into canal
  - Size of herniation has nothing to do with prognosis of the patients- many study support this so no matter what the patient has been told or what's on the MRI this is the case
  - All herniations go under a trial of care
    - Exception: Patient in progressive neurological deficit
      - Cauda equina syndrome in Back
      - Progressive radiculopathy and weakness in neck
- Picture of MRI
  - Use term non-segmentation rather than fusion - fusion occurs surgically
  - See osteophytes in the anterior and disc herniation in the posterior
- Three types of disc herniation
  - Protrusion= cross sectional of lesion- base is wider than the height- the dimension into the canal is minimal- less likely to be symptomatic
  - Extrusion = lesion has longer height than base- tend to be more symptomatic
  - Sequestration = complete dislodge- can give rise to thecal compression



*Protrusion*



*Extrusion*



*Sequestration*

- Disc Buldge
  - Discal material over 50% of body
  - Do not progress to herniation
  - Usually reported but no clear cut impact
- Picture of Lateral C/S
  - See ossification of PLL
- Picture of Lateral C/S
  - DISH
  - ★ ○ When you see it look in the canal - look for ossification of PLL (OPLL)
  - If you have an osteophyte
  - Think about getting an esophogram because aspiration can occur with protrusion
- CT Scan
  - Ossification of PLL
  - Where's the cord? Wherever it can be
  - Neuroplasticity is a function of the nervous system which is capable of cunition in the face of ablation = compensation
    - First learned about it in hydrocephalus
    - Up to a certain point (looks like 15-18%) of cord compression seems to be the problem point

2/5/09

### Dr. Cho's Lecture

Cervical Laminectomy is associated with C/S Kyphosis

### Four Types of Stenosis

1. Degenerative Stenosis
  - a. Most Common
2. Post-Operative Stenosis
3. Congenital Stenosis
  - a. Achondroplasia is most common cause
4. Post-Traumatic Stenosis

### Terminology for Writing Reports

CT:

If white- increased attenuation

If dark- decreased attenuation

MRI:

If black- decreased signal intensity

If white- increased signal intensity

Intravenous contrast and you see a tumor that is bright

### Three types of Atherosclerosis

1. Atertioscleroris
2. Arteriolosclerosis
3. Monckeberg's Medial Scelrosis- hardening of wall rather than intima itself- doesn't narrow the lumen - known association with diabetic patients

## Extremity Osteoarthritis

★ Look at slide show for pictures

Dr. Kaeser

### Definition of OA:

Arthritis characterized by erosion of articular cartilage, either primary or secondary to trauma or other conditions, which becomes soft, frayed and thinned with eburnation of subchondral bone and outgrowth of marginal osteophytes; pain and loss of function result; mainly affects weight-bearing joints, is more common in older person

**Eburnation:** Change in exposed subchondral bone in degenerative joint disease in which it is converted into a dense substance with a smooth surface like ivory

### Hip OA

- Non-uniform loss in joint space
  - Superior, medial (inferior) and axial (central)
  - Superior M/C - medial joint space is widened (Waldenstrom sign)
  - Axial L/C
- Osteophytes- supra-acetabular margin and lateral and inferomedial surfaces of the femoral head
- Prominent subchondral bone cysts- adjacent to reduced joint space
- Sclerosis- M/C in acetabular margin of the ilium
- Cortical buttressing- thickening of the cortex (medial side of femoral neck)
- Joint deformity- flattening of the femoral head and acetabular roof

*Tri-compartment osteoarthrosis of the knee when three of the joint spaces are affected*

### Knee OA

- Common site of OA due to weight bearing function and susceptibility to injury
- Non-uniform loss of joint space
- Sclerosis
- Small osteophytes
- Loose bodies
- Deformity
- Three compartments of knee
  - Medial Femorotibial-M/C
  - Lateral Femorotibial
  - Patellofemoral

### Femorotibial Joint

- Decreased medial joint space
- Weight bearing AP films are essential
- Sclerosis and osteophytes are usually not prominent
- Sharpening of the tibial eminences is a feature
- Loose bodies- may be singular but are often multiple
- Subchondral cyst, if apparent are inferior to the tibial plateau, especially near the tibial eminences
- Varus deformity - late manifestation

### Patellofemoral Joint

- Found in combination with femorotibial OA
- If isolated, consider CPPD or significant previous trauma
- Signs of patellofemoral OA
  - Loss of joint space- more pronounced in lateral initially
  - Osteophytes- inferior, superior, medial and lateral poles
  - Sclerosis
  - Anterior femoral erosion- bone excrescences (tooth sign)

### Ankle and Tarsal Joint OA

- Ankle- uncommon site unless significant previous trauma
  - Example: tibiofibular diastasis that results in chronic instability
- Tarsal-infrequently involved
  - If involved, usually the first tarsometatarsal joint

### Foot OA

- First metatarsophalangeal joint- M/C
- Osteophytes
  - Dorsal and medial surfaces of the first metatarsal head
  - May arise from the hallux sesamoids
  - May simulate gout
- Deformity
- Loss of joint space
- Sclerosis
- Small subchondral cysts

### AC Joint OA

- Loss of joint space
- Sclerosis
- Osteophyte formation
- Small subchondral cysts in distal clavicle

### Shoulder OA

- Most common in AC joint
- OA in glenohumeral joint should arouse suspicion of previous significant trauma or an underlying cartilage disease (CPPD, ochronosis, acromegaly)

### Elbow OA

- Secondary to previous trauma, occupation or other abnormality
- Loose body formation
- Osteophytes
- Olecranon spur at the triceps tendon insertion

### Wrist OA

- Usually limited to the first metacarpal-trapezium joint
- Radial subluxation of the first metacarpal base
- Sclerosis
- Osteophytes
- Loose bodies
- Radiocarpal joint OA – secondary to trauma
  - Radial and scaphoid fractures, carpal ischemic necrosis and CPPD
  - Diminution of radiocarpal joint space, sclerosis and osteophytes, subchondral cysts in carpal bones

### Hand OA

- Heberden's nodes- DIP joints
- Bouchard's nodes- PIP joints
- Lateral osteophytes
- Sclerosis
- Loss of joint space
- Malalignment- especially in the DIPs

### Glenohumeral Joint OA

- Non uniform loss of joint space
- Sclerosis
- Osteophyte formation
  - Particularly at the inferior humeral head

### Rotator cuff degeneration

- Small cyst formation in the tuberosities
- Superior migration of the humerus in relation to the glenoid cavity owing to the unopposed action of the detroid muscle
- Erosion with sclerosis of the inferior surface of the acromion usually accompanies superior humeral displacement

### Calcific Tendinitis and Bursitis

- In symptomatic and asymptomatic shoulders
- A sequelae of degenerative tendinitis at the bony attachments of the tendon – usually B/L
- M/C location is supraspinatus tendon insertion at the greater tuberosity (seen on external rotation)
- Next most common site is the subacromial bursa
- Other tendons which may calcify:
  - Infraspinatus, teres minor and subscapularis

2/12/09

## Neurotrophic Arthropathy

- A destructive articular disease that occurs secondary to a loss or impairment in joint proprioception
- Results in the involved joint undergoing premature and excessive traumatic degenerative changes that lead to severe destruction and instability

👉 Look at slide show for pictures

### Other Terms

- Neurogenic arthropathy
- Neuroarthropathy
- Neurogenic osteoarthropathy
- Charcot's joints

### Two Presentation of Neurotrophic Arthropathy

- Atrophic- M/C in non-weight bearing joints
  - Resorbed articular surface
  - Tapered bone ends - "licked candy stick"
  - Surgical amputation appearance
- Hypertrophic- M/C found in weight bearing joint
  - Distended joint
  - Density increase
  - Debris production
  - Dislocation
  - Disorganization
  - Destruction

### Clinical Features

- May develop over a period of weeks, months or years
- Laboratory findings will be negative for the joint disease
- Relatively painless instability, enlargement and crepitus-

### History

- 1868 Charcot, a French physician first noted a cause-and-effect association between destructive joint disease and lesions of the nervous system, specifically tabes dorsalis

### Diabetic neurotrophic arthropathy

- 35% of patients will develop neurotrophic arthropathy
- Usually involving the ankle, subtalar joints and feet (known as Charcot's foot)
- Often presents as hypertrophic

### Syphilitic neurotrophic arthropathy

- 20% will show changes
- Especially in lumbar spine (tabes dorsalis), knee and ankle
- Often present as hypertrophic

- may be extreme (bag of bones)
- May occur secondary to a number of conditions
  - Syphilis- previously number 1 reason
  - Diabetes- currently number 1 reason
  - Alcoholism
  - Trauma
  - Syringomyelia

#### **Alcoholic Neurotrophic Arthropathy**

- Can produce the same hypertrophic joint destruction as diabetes in the tarsal and metatarsal articulations

#### **Several Other Causes of Neurotrophic Arthropathy**

- Congenital indifference to pain
- Steroids
- Multiple sclerosis
- Tumor
- Amyloidosis

#### **Pathologic Features**

- No exact pathogenetic sequence of events
- Charcot ascribed the bone and joint changes to a lack of nutrition from the central nervous system trophic centers (French theory)
- Volkmann and Virchow perceived the resultant joint destruction as the cumulative effects of multiple unprotected mechanical microtraumatic events (German theory)
- Currently, neurotraumatic theory whereby destructive joint changes occur as the sequelae to an ineffective protective neurological mechanism
- Neurovascular theory has been proposed to explain the cyclic progression of radiographic changes

#### **Spine**

- M/C location
- M/C associated with syphilitic neuroarthropathy
- Pattern is hypertrophic
  - Loss of disc height
  - Sclerosis
  - Osteophytes
  - Vacuum phenomena
  - Fragmentation of the vertebral body (jigsaw puzzle)
  - Vertebral malalignment with anterior, posterior and lateral displacements (tumbling building-block spine) denotes underlying ligamentous instability

#### **Knee**

- Hypertrophic
- Early phases
  - Joint effusion, degenerative changes, fracture through the medial tibial plateau
- Advanced changes
  - 6 D's
  - Malalignment can be severe, with lateral displacement of the tibia and fibula in relation to the femur
  - Patella may be dislocated laterally

#### **Foot**

- Early site of involvement is the subtalar joint
- Hypertrophic changes at the talocalcaneal junction and collapse of the lowest portion of the talus- eventually the entire talus may be destroyed
- Tendency toward atrophic pattern at the tarsometatarsal region

2/18/09

#### **Seven Wonders of the Lumbar Spine Revisited**

Dr. Terry R. Yochum

#### **1. Arthritides**

- Degenerative
  - Decreased disc height- asymmetric
  - Spondylophytes- bone spurs
  - Vertebral endplate sclerosis (eburnation)
  - Facet arthrosis - posterior joints
  - Vacuum phenomenon
- DISH

★ Ch. 17- NAMED VERTEBRA associated with different diseases- Study for boards

- Flowing anterior vertebral spurs
  - 4 contiguous segments
- Relative preservation of disc space
- Most common at T7-T11, second within the cervical spine and 3rd within the lumbar spine
- Lack of posterior joint disease
- Quadrupeds (dogs) can also have DISH
- Ankylosing Spondylitis
  - Targets SI joint B/L
    - If unilateral -initial stages more likely Psoriasis or Reiters
    - If bilateral and located at SI—can't really differentiate between these three
  - Likes lower 2/3 of synovial joint
  - Rose bead appearance of erosions- pseudowidening of joint in second stage
  - Late in disease causes fusion of joint
  - Spurs are marginal syndesmophytes
    - Bilateral and symmetrical
  - Enteropathic sacroiliitis appears the same as AS- seldom goes above TL junction
  - Bamboo spine (Poker Spine)
    - Ankylosis of the vertebrae with marginal syndesmophytes
  - Dagger spine
    - Ankylosis of the interspinalis ligaments
  - Facet fusion
  - Romanus lesion- resorption at corner of the vertebra
  - Shiny corner sign- reactive sclerosis on front of vertebra forming a barrel shaped/squared vertebra appearance

## 2. Trauma

- Step Defect- vertebra doesn't go back to original height once fractured
- Band of condensation- drive cortical bone and get a hazy white layer of bone below
  - Sign of more recent fracture (Old vs. New Fracture)
  - Edema also found in newer fracture if MRI is taken
- Transverse process fractures are the second most common site for lumbar vertebrae to fracture
- Can traumatize kidney so watch out
- Limbus bone- old avulsion injury; usually asymptomatic
  - Maybe schmorles nodes deformity e
- Chance fracture
  - Lap seatbelt injury
  - Horizontal fracture through the neural arch and body
  - Common at TL junction

## 3. Tumors

- a. 70% metastatic, 30% primary
- b. 75% lytic, 25% blastic
- c. Vertebral bodies and pedicles most common site
- d. Need 30-50% bone destruction to visualize any radiographic changes
- e. Rarely disc is invaded by tumor
- f. Blastic changes easier to see
  - i. Prostatic
  - ii. Breast (10% are blastic)
  - iii. Colon
- g. Ivory vertebra differential
  - i. Paget's disease
    - 1) Expands skull and vertebral body size
  - ii. Hodgkins Lymphoma
    - 1) Extrinsic erosion on front of body
  - iii. Metastatic disease
- h. Winking owl sign
  - i. Bone scan is most sensitive way to detect this
- j. Multiple myeloma
  - i. Punched out lytic lesions
  - ii. Collapsed vertebra (vertebra plana)
  - iii. Bone scans cold

2/19/09

### Stable vs. Unstable

- Quantitative Definition
  - Instability on a lateral cervical spine; look for;
    - 3.5 mm horizontal translation of one vertebral segment over another
    - 11 degrees or more of angular deformity between two adjacent vertebral segments
- Qualitative definition
  - A stable spine is one that can withstand stresses without progressive deformity or neurological abnormalities

- An unstable spine, under normal stresses, can lead to increased deformity or increased neurological deficit or both

### Classifications for Whiplash Injury

- Take history and calculate **MIV** - mean injury vector
- MIV in most whiplash injuries is tensile and in the mid cervical spine damaging the most posterior ligament (nuchal ligament)
- **Grade 1** C/S sprain/strain
  - No radiographs, no MRI findings ★ *All soft tissue injury- no fracture*
  - 99% of injuries in C/S in flexion
  - If palpate over the midline and interspinous space hurts you know there's sprain of a posterior ligament
  - Strain dx is when you move your neck it hurts
- **Grade 2**
  - Torn nuchal ligament AND interspinous ligament
  - Patient won't move the neck or if they do it's very minimal ROM ★ **Ligaments hold bones together**
  - Interspinous pain with gap of the SPs ★ **Bones move them**
- **Grade 3**
  - Nuchal ligament, interspinous AND capsular ligament (ligament that holds joints together)
  - No facet surfaces will move excessively in relation to the others
  - Instability is NOT hypermobility- you don't have a joint because of torn capsular ligament
  - Anterolisthesis or angulation on radiographs
- **Grade 4**
  - All 9 ligaments are gone *Whiplash prominent in females 18-26 yoa*
    - Supraspinous (nuchal), interspinous, intertransverse, ligamentum flavum, capsular ligament, PLL, disc, ALL
  - Only thing holding patient's head on the shoulder is not much *Look up article in JMPT- Vernon H, Humphreys BK "Chronic mechanical neck pain in adults treated by manual therapy: a systematic review of change scores in randomized controlled trials of a single session"*
  - Either unilateral or bilateral dislocation
    - Unilateral is a stable injury
    - Bilateral dislocation is death
  - Hemorrhage may occur

### Classification of C1 Burst Fracture (Jefferson Fracture)

- Stable Jefferson fracture: intact transverse ligament *Look for landmarks basion and episthion (foramen magnum in between)*
- Unstable Jefferson fracture: disrupted transverse ligament
  - Spence et al: Total overhang or offset > 7 mm
  - Oda et al: Atlantodental interval > 3 mm
  - Torn transverse ligament isn't common unless with fracture
  - ADI instability is usually RA
- Arches are fractured in Jefferson fracture and articular pillars are pushed apart
  - Wherever pillars are connected to neural arch is where you have the fracture
  - Pillars stay intact- it's the arches that break
  - Four part fracture
- MIV is axial loading (diving in a shallow creek)
  - Forces through the column in axial plane
  - Football players can get this when headbutts another player

### Classification of Hangman's Fractures

- Type I (65%)- Undisplaced fracture involving the posterior body or any part of the ring. C2-C3 disc remains intact
- Type II (28%)- In addition to the fracture, the body of C2 is displaced anteriorly (> 3 mm) or angulated (> 15 degrees). The C2-C3 disc is disrupted
- Type III (7%)- Similar to Type II but accompanied by unilateral or bilateral C2-C3 facet dislocation with locking

### Dens Fractures

- Type I (Rare)
  - 10% takes off the very tip of the dens
- Type II (High)
  - Unstable - fracture at base of the dens
  - These are the majority of the types of dens fractures
- Type III (Low)
  - Piece of the body plus the dens

**Avulsion of the Anterior Cortex of C2**

- Hyperextension injury that yanks ALL from C2

Dens angle with the body of C2 should be 90°

- Fracture in the base of the dens is the only thing that will change this angle
- When dens "marches forward" neural arch of C1 goes with it and cord is in front of that- huge risk

**Flexion Teardrop (burst) Fracture**

- Typically affecting C5; not to be confused with extension teardrop fragments off C2 or C3 which are usually stable injuries
- Devastating, unstable injury produced by a combination of flexion and axial loading; 49% due to diving and 36% due to MVAs
- High incidence of neurological damage, with the majority (56%) developing quadriplegia

**Compression Fracture = Wedge Fracture**

High in the back, narrow in the front like a wedge

Do not use HVLA at segment in an acute fracture- work your way to the fracture site

★ **Wherever you have lots of movement you have greater risk for fracture/injury**

- C4/C5 and C5/C6 is the highest range of motion in the sagittal plane and thus the largest place for sagittal plane injuries
- Most dislocated body joint is shoulder because greatest ROM in body
- 3.5 mm horizontal translation of one vertebral segment over another or 11 degrees or more of angular deformity (angulation) between two adjacent vertebral segments

3/3/09

**HNP Complicating Cervical Spine Trauma**

- Very little was published about it prior to MRI
- High association of unstable injuries and HNP (54%); especially with facet subluxation or dislocation. Neurological damage reported with closed reduction over an unrecognized disc herniation
- Presence of acute HNP alters management. Some authors advocate MRI for all patient who are candidates for surgical intervention
- With flexion instability, torn tissues include: nuchal ligament, interspinous, flavum, capsule, PLL/annulus
- Annular fibers are interwoven with the ALL and PLL

**MRI Cord Patterns Associated with Severe neurologic deficit**

- Intramedullary hemorrhage: location of hematoma corresponds to clinical level of neurological levels
- Spinal cord contusion (bruise, ie from excessive HVLA) greater than on spinal segment

**Hyperextension Injury**

- 2 mechanisms
  - Direct anterior craniofacial trauma
  - Rear-end motor vehicle collision resulting in forceful extension of the head (whiplash)
- Disruption of the ALL and horizontal rupture of the adjacent disk
- This injury is associated with significant morbidity and mortality due to spinal cord injury
- Older patients with spondylosis are more likely to have this injury because of the limited elasticity of their soft tissues
- Majority occur in the mid and lower cervical spine

3/5/09

**Flow Void vs. No Flow Void**

You normally don't see vertebral artery on film. If there is a flow void you will see it

Kaiser's ppt

**Lumbar Spine****Compression Fractures**

- Most common fracture of the lumbar spine
- Result from combined flexion and axial compression

- M/C level is T12-L1
- Degree of compression and comminution depends on severity of the force applied and the strength of the vertebra
- Children- torus type fracture
- Incidence increases with age due to osteoporosis

#### **Osteoporosis and Compression Fractures**

- Precipitates spontaneous compression fractures during everyday activity
- Classified as insufficiency fractures ("grandma fracture")
- Most commonly occur in women
- Up to 35% in female pts. Over the age of 45 years may be the result of early menopause and 30% to secondary osteopenia (corticosteroids 15%, hyperthyroidism 8%, malignancy > 2%)

#### **Symptoms/Treatment**

Acute symptoms of only 10-14 days duration, if no dislocation

Treatment is based on the nature of the collapse and whether or not there is associated neurological symptomology

#### **Radiographic Signs of Vertebral Compression Fracture**

- Lateral radiographs best demonstrate fracture features
- Include
  - Step defect
    - Anterior aspect of the vertebral body is under the greatest stress
  - Wedge deformity
    - Anterior depression of the vertebral body occurs creating a triangular wedge shape
    - The posterior vertebral height remains uncompromised differentiating a traumatic fracture from a pathological inferior endplate
    - Superior endplate is far more often involved than tolgic fracture
    - May create angular kyphosis in adjacent area
    - Up to 30% or greater loss in anterior height may be required before the deformity is readily apparent on convention x-rays
    - Normal variant anterior wedging of 10-15% or 1-3 mm is common though the T/S and most marked at T11-L2
  - Linear zone of condensation
    - Band of radiopacity may be seen just below the vertebral endplate that has been fractured
    - The band represents the early site of bone impaction following a forceful flexion injury where the bones are driven together
    - Callus formation
  - Displaced in the vertebral endplate
    - CT provides definitive means of id
    - Edges of disruption are often jagged and irregular
    - Superior is most commonly fractured
  - Paraspinal edema
  - Abdominal ileus
    - Ileus = obstruction
    - Excessive amount of small or large bowel in a slightly distended lumen
    - Occurs as a result of disturbance to the visceral autonomic nerves
    - Indicates that fracture may be in there (especially

#### **Old vs New Compression Fracture**

- Signs of a fracture <2 months old = soft tissue hemorrhage, step defect and white band of condensation
- Healing of compression fracture can take up to 3 months in the adult spine
- Presence of contiguous disc degeneration is common in old compression fractures owing to altered discovertebral mechanics
- MRI reveals bone marrow edema with recent fracture

#### **Burst Fractures**

- Specific form of a compression fracture
- Most are stable
- Neurological injury may result in up to 50% of cases

#### **Posterior Apophyseal Ring Fractures**

- Caused by trauma
- Nucleus pulposus goes through a defect in endplate causing vertebral body to be broken off
- Cord complication

#### **Kummel's disease**

- Delayed post-traumatic vertebral collapse
- Occurs months after an episode of spinal trauma
- Caused by complicating avascular necrosis resulting in progressive compression deformity

### Fractures of the Neural Arch

- TP fractures are 2nd M/C fracture of the L/S

★ *Spondylolisthesis is most common stress fracture in L/S*

### Pars Interarticularis Fractures

- True fractures, not stress fractures, are uncommon
- MOI- violent hyperextension of the L/S- usually at the L4 or L5 level
- Not to be confused with spondylolysis of the pars, which is usually the result of a stress fracture
- Acute fractures are U/L, spondylolysis is B/L
- Acute fractures heal without residual defects or anterior displacement

### Chance or Lap seat Belt Fracture

- Transverse fracture through vertebral body
- Horizontal splitting of the spine and neural arch
- Use of lap-type seat belts in the '50s and '60s coincided with an increasing occurrence of Chance fractures
- Severe abrasions can be seen on the lower anterior abdominal wall, outlining the position of the seat belt
- M/C L1-L3

### Fracture-Dislocation

- M/C in the T/L area after a violent flexion injury
- Avulsion fractures (teardrop) are commonly found associated with dislocation of the L/S
- Most dislocations are anterior in position, without lateral displacement

3/10/09

### FOOSH-fall on outstretched hand

- 3 Hyperextension fractures
  - Scaphoid
  - Radial Head
  - Greater tuberosity of the humerus
- Scaphoid- most common bone to fracture (over 75% of wrists fracture)
  - Rare in children - Taurus fracture
  - Find by percussing anatomical snuff box and 3rd ray
  - Mechanism of injury for a waist fracture (horizontally through the middle of the scaphoid) is pinch between capitate and radial styloid
  - Corticosteroid injection accidentally injected into the joint space with scaphoid fractures may get into fracture site effectively stopping the healing process
  - Proximal pole will demonstrate avascular necrosis (15% of scaphoid fractures)

**Allodynia:** lowered pain threshold (get pain when you shouldn't)

Both allodynia and hyperalgesia are both seen in nerve injuries

### Keinboch's Disease

- Occurs more often in males
- Avascular necrosis of the lunate
- Great pain
- 20-40 years old
- Previous history of acute trauma or repetitive injury
- Plain films negative for the 1st year
  - Becomes positive on film during revascularization ( 6 months- 4 years)
  - Repair-Remodeling Stage (1-2 years)
  - Deformity Stage
- Can see early on bone scan
- MR is most sensitive
  - To detect edema in the acute stage (T1 signal low, T2 signal high)
  - To detect sclerosis (T1 signal low, T2 signal low)

### Little League Elbow

- Baseball, tennis serve and football pass
- Medial epicondyle fragmentation and avulsion growth alteration of capitulum
- Osteochondritis of the radial head
- Hypertrophy of the ulna and olecranon apophysis
- ★ During the growth stages bone acts as tacky. Throwing arm may stretch out due to centripetal forces

### Galeazzi

- Distal radius fracture with ulna dislocation
- Ulna should not be more proximal than the radius (normal)

### Monteggia

- Proximal ulna fracture with radial dislocation