

# **Evaluation, Diagnosis, and Treatment of Back Pain in Children and Adolescents**

**Joshua M. Pahys MD**

**Shriners Hospital for Children, Philadelphia, PA**

# Disclosures

- **Pahys:** DePuy (b); NuVasive (b); Zimmer Biomet (b)

# Epidemiology

- Incidence: 11-33% (Jeffries L Spine 2007)
  - Increases with age
  - “Nonorganic Pain” has increased substantially over the past decade
    - Theories: sedentary lifestyle, obesity, increased backpack use
      - Children with back, hip, knee, or ankle pain have a significantly higher BMI (Smith S Int J Obs 2014)
- Review of 2,846 patients age 10-19 years (Miller R JPO 2013)
  - Only 63% had a specific diagnosis
  - 61% failed to followup after 1-2 visits

# Backpacks

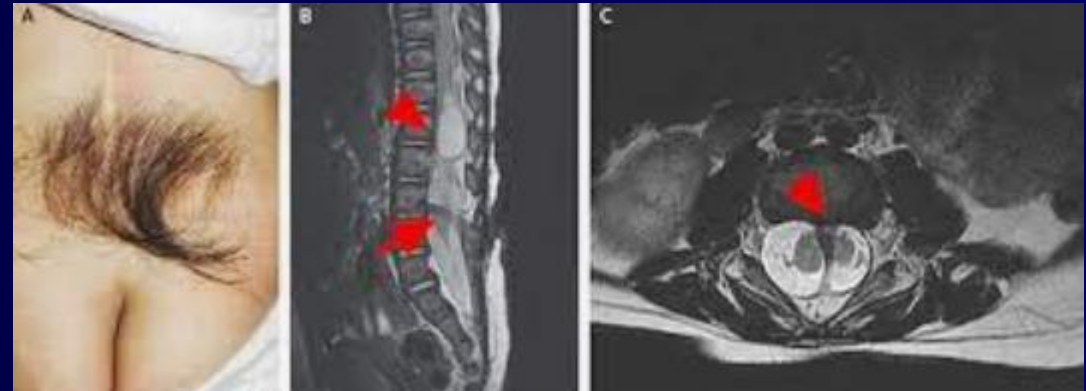
- Heavy backpacks relative to patient body weight and duration of use were associated with back pain
  - Backpack weight >15-20% of a child's body weight (Mackenzie W CORR 2003)
- Pain typically not severe enough to warrant referral to Orthopaedics (Bo A Spine 2006)
- Siambanes et al JPO 2004
  - 3500 students: backpack weight was predictor of pain
    - Girls who walk to/from school highest risk
    - Method of wear, age, socioeconomic status not significant

# History

- Onset
- Duration
- Frequency
- Severity
- Location
  - Radiation to lower extremities
- Concerning Complaints
  - History of trauma
  - Night pain
  - Constant pain
  - Weight loss
  - Fever
  - Pain >3 weeks
  - Pain in children <10 years

# Examination

- Skin
  - Examine for cutaneous lesions
    - Possible indicator of intraspinal anomalies
    - Sacral dimple
  - >5 café au lait spots
    - Neurofibromatosis



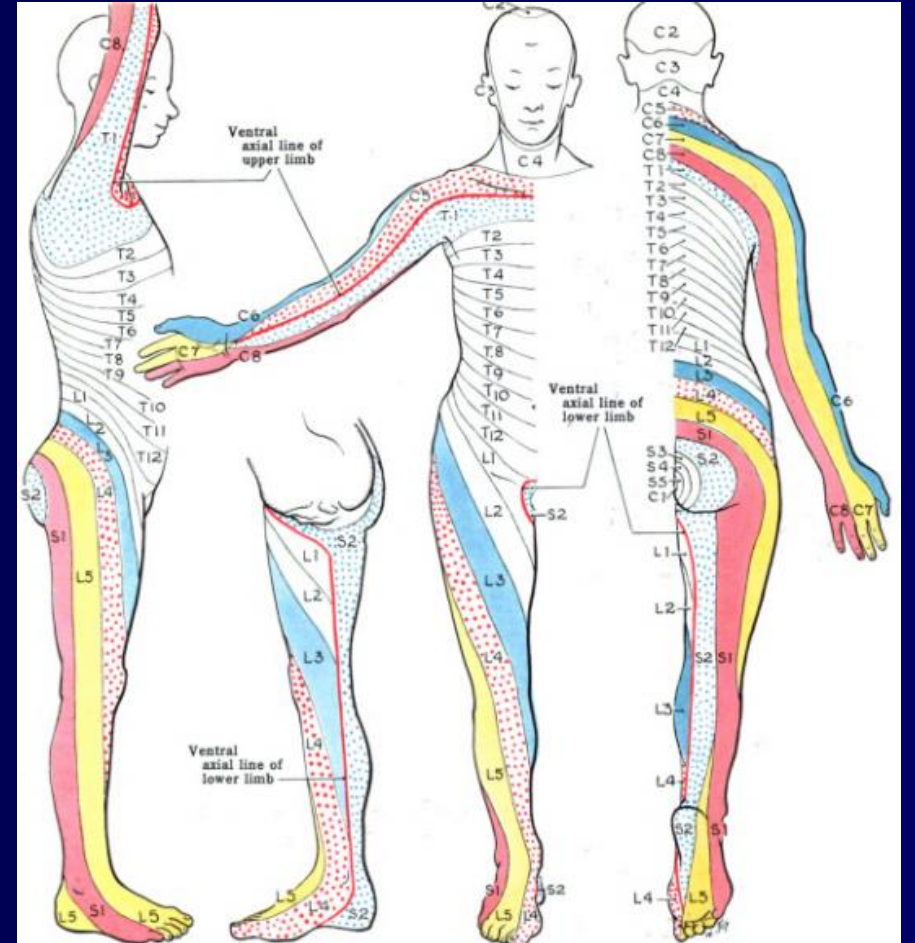
# Examination

- Midline/paraspinal palpation
  - Evaluate for stepoff, focal pain, or masses
- Forward bend test
  - Evaluate for kyphosis/scoliosis
  - Pain with extension
  - Start up pain
- Evaluate for hamstring tightness
  - Normal angle  $<30$  degrees



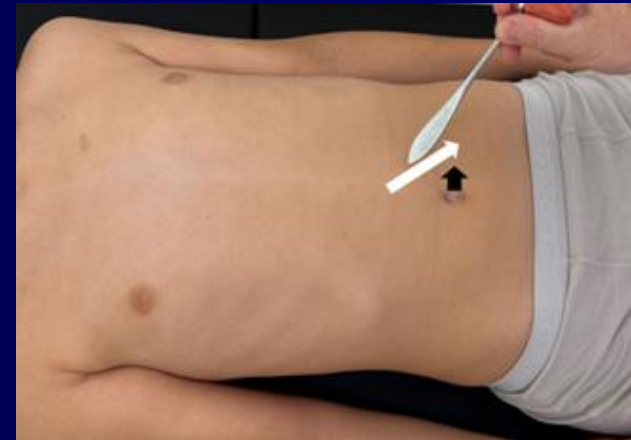
# Neurologic Exam

- Motor function L2-S1
  - Hip flexion (L2)
  - Knee extension (L3)
  - Ankle dorsiflexion (L4)
  - EHL (great toe) dorsiflexion (L5)
  - Plantarflexion (S1)
  - Can also ask patient to walk on toes/heels and squat
- Sensation
  - Light touch for lower extremity dermatomes



# Neurologic Exam

- Reflexes
  - Knee/Achilles
  - Assess for clonus
- Abdominal Reflex
  - Potential association with intraspinal anomalies
- Straight leg raise
  - Nerve root tension
  - Seated or supine



# Specific Exams

- Stork Test:
  - Trunk extension in single leg stance
  - Ipsilateral or bilateral pain suggestive of spondylolysis
    - Sensitivity and specificity low (Alquarni AM Phys Ther Sport 2015)



## Specific Exams

- FABER test
  - Hip flexion, abduction, and external rotation (heel on contralateral knee)
  - Possible indicator of sacroiliac pain/pathology if back pain is reproduced
  - Groin pain more indicative of intra-articular hip pathology



# When to get an Xray

- American College of Radiology (Booth TN J Am Coll Rad 2017)
  - Imaging in children and adolescents may be delayed unless the patient has:
    - Abnormal neurologic findings
    - Night pain
    - Radicular pain
    - Pain > 4 weeks
  - Lower threshold for imaging in children < 4 years and/or with constitutional symptoms

# What Xray to get?

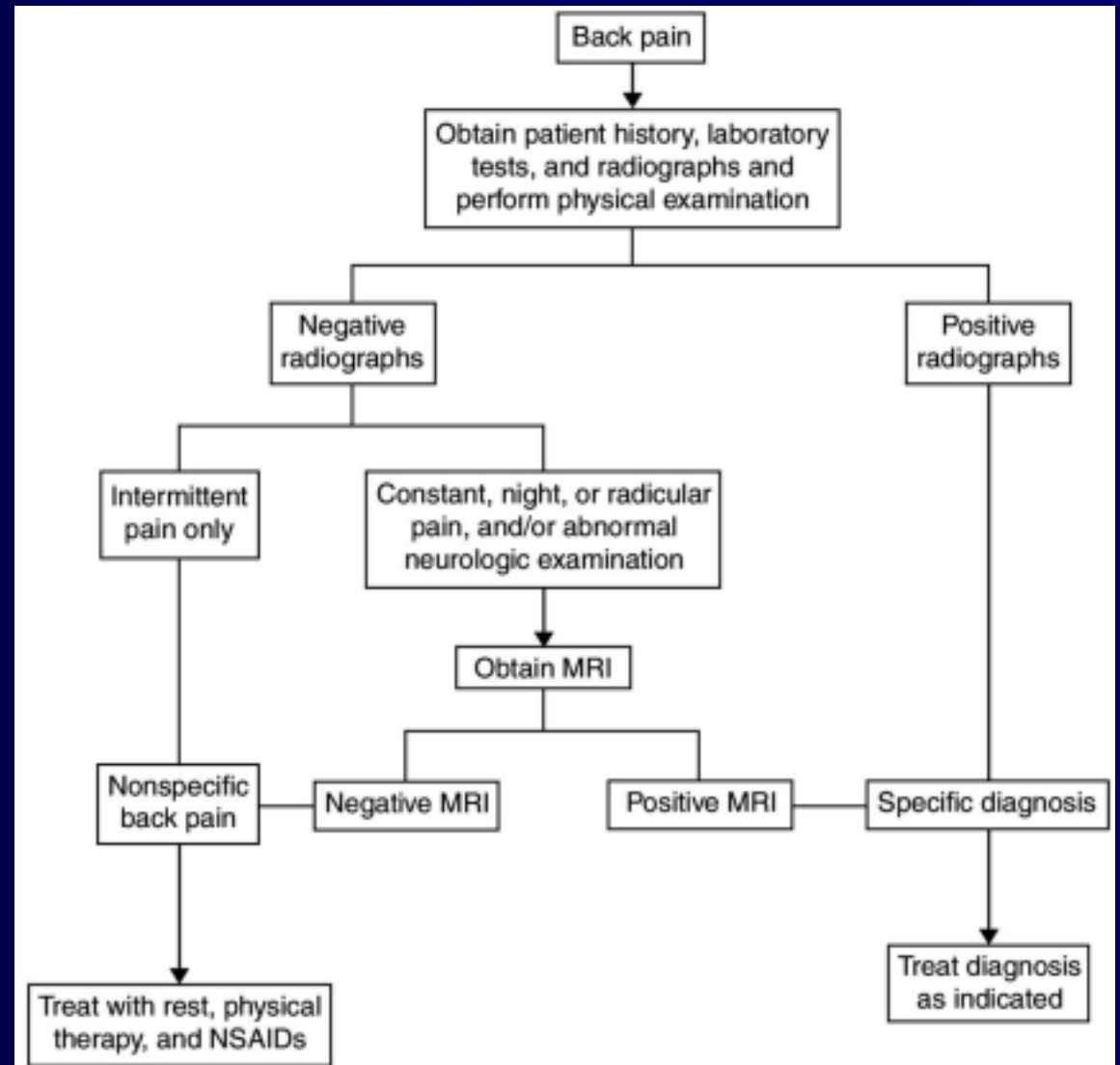
- ***\*\*Standing PA and lateral spine only\*\****
- Oblique views double radiation exposure and do not improve sensitivity to detect spondylolysis (Tufte JN Spine 2017)
- Assess for:
  - Alignment
  - Disc space narrowing
  - Endplate irregularities
  - Vertebral scalloping
  - Lytic lesions

# Advanced Imaging

- Considered when radiographs are inadequate to define pathology (neoplasm) and/or soft tissue pathology is suspected (disc herniation, infection, etc)
- MRI
  - No radiation, but may require sedation
  - May fail to detect spondylolysis, but improved with modern sequences
- CT
  - More helpful in identifying spondylolysis (specifically SPECT scan)
  - Markedly increased radiation exposure

# Back pain imaging algorithm

- Feldman et al JPO 2006
  - High diagnostic sensitivity and specificity for detecting abnormalities
  - No cause for symptoms found in 64% of patients with single report of LBP
    - Diagnosed with nonspecific LBP and treated nonoperatively



Algorithm for detecting an abnormality resulting in back pain that can be used without unnecessary advanced imaging. (Adapted with permission from Feldman DS, Straight JJ, Badra MI, Mohaiden A, Madan S: Evaluation of an algorithmic approach to pediatric back pain. *J Pediatr Orthop* 2006;26[3]:353-357.)

# Lab Work

- Consider for patients < 5 years with prolonged back pain and/or constitutional symptoms/night pain
  - CBC, ESR, CRP
- Infection
  - ESR >20; CRP >1-2mg/dL
    - 95% sensitivity for osteomyelitis, but 60% specificity
- Lymphoma
- Leukemia
- Inflammatory disorders
  - HLA-B27 strongly associated with seronegative spondyloarthropathy
  - High false positive rate
  - Should be reserved for highly suspicious patients
    - Morning stiffness, night pain, sacroiliac pain

# Differential Diagnoses

- Nonspecific Low Back Pain
- Spondylolysis/Spondylolisthesis
- Scheuermann Kyphosis
- Lumbar Disc Herniation
- Spondylodiscitis
- Neoplasm

# Nonspecific Low Back Pain

- 2/3 of patients with LBP have no demonstrable cause of organic pathology even after complete clinical evaluation and imaging (Beck NA JBJS 2013)
- Musculo-ligamentous strain
- Overuse syndromes
- Poor posture
- Deconditioning

# Nonspecific Low Back Pain

- Reassurance of lack of “red flags”
  - No radiculopathy and/or neurologic deficit
  - Present <3-4 weeks
  - No trauma
- Prescribe daily home exercise routine and/or physical therapy (1-2x/week for 4-6 weeks)
  - \*\*Stress adherence to daily exercises\*\*
  - Core strengthening/stabilization
  - Planks (make it a family competition, goal 3 minutes!)
  - Modalities

# Core Strengthening Daily Home Exercises



## Home Exercise Program

Created by Courtney Mullen, PT Aug 24th, 2020

View videos at [www.HEP.video](http://www.HEP.video)

Total 6 Page 1 of 2



### Abdominal Bracing

Lay on back with knees bent. Tighten abdominals as if a bowling ball were about to be dropped on abdomen. Be sure to not hold your breath. Do not tighten abdominals in a way that will change the neutral position of the spine.

May also try to brace as directed above, then try to pull belly button toward spine. Again, try to avoid changing the position of the spine.

Repeat 20 Times

Hold 5 Seconds

Complete 1 Set

Perform 4 Times a Week



### Supine Marches/Core Stability

#### Supine Marches/Core Stability

Lay on back with knees bent. Tighten abdominals as if a bowling ball were about to be dropped on abdomen. Be sure to not hold your breath. Do not tighten abdominals in a way that will change the neutral position of the spine. Slowly and under control, raise one leg from starting position while maintaining the neutral spine as well as not allowing the pelvis to roll forward or back. Return leg to starting position and perform one the opposite side. Relax. Alternate the starting side.

Repeat 20 Times

Hold 5 Seconds

Complete 1 Set

Perform 4 Times a Week

### BRIDGING

While lying on your back with knees bent, tighten your lower abdominals, squeeze your buttocks and then raise your buttocks off the floor/bed as creating a "Bridge" with your body. Hold and then lower yourself and repeat. Video # VVTJZ7GYR

Repeat 10 Times

Hold 3 Seconds

Complete 3 Sets

Perform 4 Times a Week



### PRONE HIP EXTENSION

While lying face down with your knee straight, slowly raise up leg off the ground. Maintain a straight knee the entire time. Video # VVYXQ3QHJ



Repeat 20 Times

Hold 1 Second

Complete 2 Sets

Perform 4 Times a Week

### PRONE ALTERNATE ARM AND LEG

While lying face down and keeping your lower abdominals tight, slowly raise up an arm and opposite leg. Slowly lower and then raise the opposite side.



Do not allow your spine to move the entire time. Video # VVM8LDHXQ

Repeat 20 Times

Hold 1 Second

Complete 2 Sets

Perform 4 Times a Week

### DEAD BUG

While lying on your back with your knees and hips bent to 90 degrees, use your stomach muscles and maintain pelvic neutral position. Do not allow your spine to move.



Hold pelvic neutral and then slowly straighten out a leg without touching the floor. At the same time raise an opposite arm over head. Do not allow your spine to arch during this movement.



Return to starting position and then repeat on the opposite side. Video # VVD3S264Y

Repeat 20 Times

Hold 3 Seconds

Complete 2 Sets

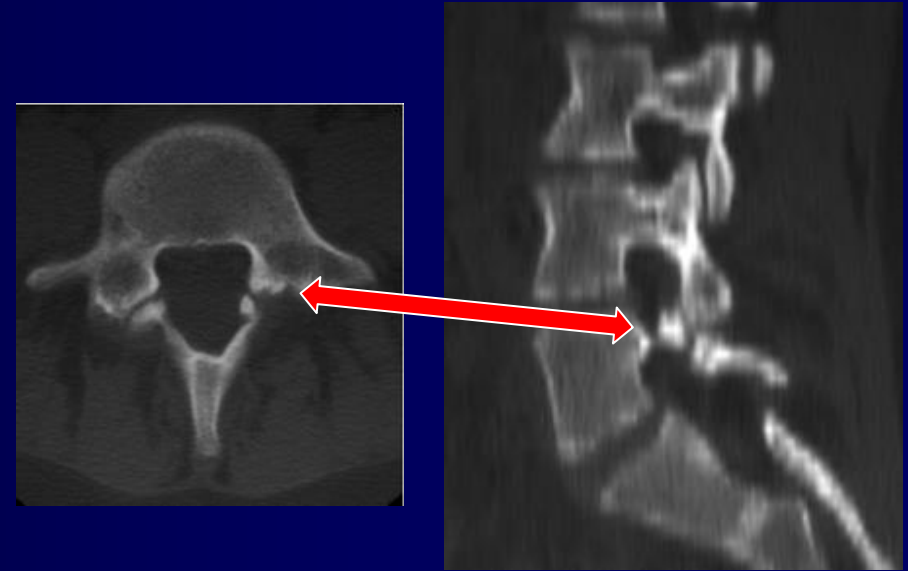
Perform 4 Times a Week

# Nonspecific Low Back Pain

- Be on the lookout for:
  - Depression
  - Conversion disorder
  - Amplified pain syndrome
- Consider Behavioral Health consultation
- Prescription of opioids and/or prolonged NSAIDs discouraged (Frosch M Children 2022)

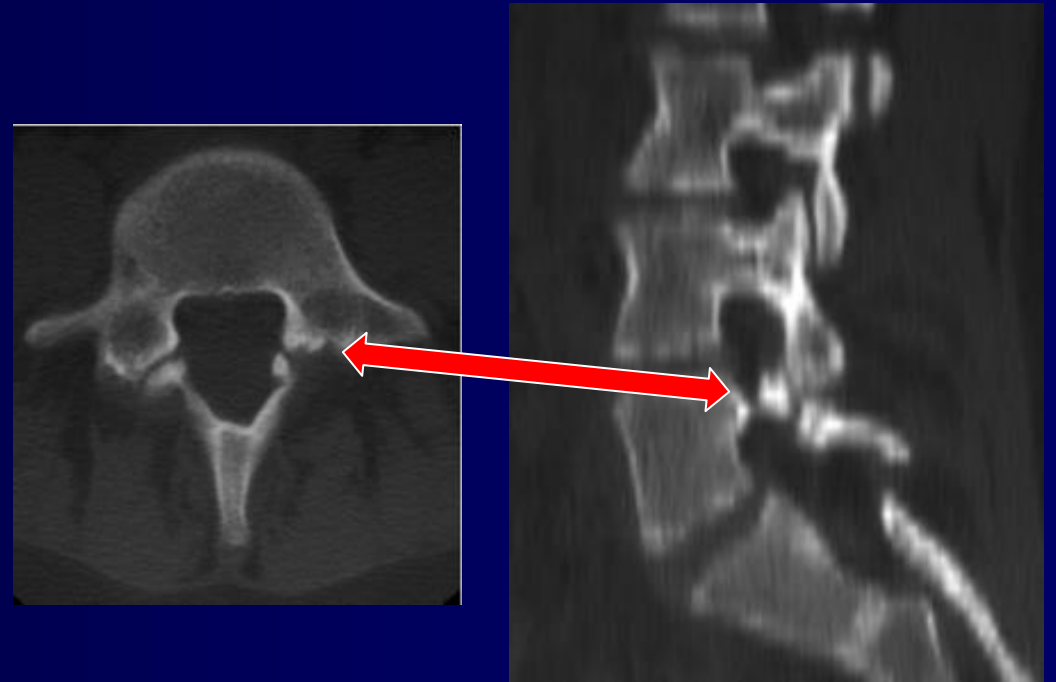
# Spondylolysis/Spondylolisthesis

- Spondylolysis
  - Defect in the pars interarticularis (typically in lumbar spine)
- Spondylolisthesis
  - Upper vertebral segment slips forward on the lower vertebra
- Prevalence: 4.4%
- If stable, clinical course similar to general population in 45 year f/u study (Beutler WJ Spine 2003)



# Spondylolysis

- Typically caused by stress fracture from repetitive lumbar hyperextension
  - Extension Sports
    - Gymnasts, wrestling, offensive linemen
  - L5 most common in adolescents
- Pain ranges from mild to severe
- MRI preferred over SPECT for decreased radiation exposure
  - Include concern for spondylolysis on prescription



# Spondylolysis

- Treatment
  - Activity modifications, NSAIDs, and PT
    - 83% successfully treated nonsurgically (Klein G JPO 2009)
    - Bracing controversial – no significant impact on outcomes
  - Surgical
    - Persistent symptoms >6 months despite conservative measures



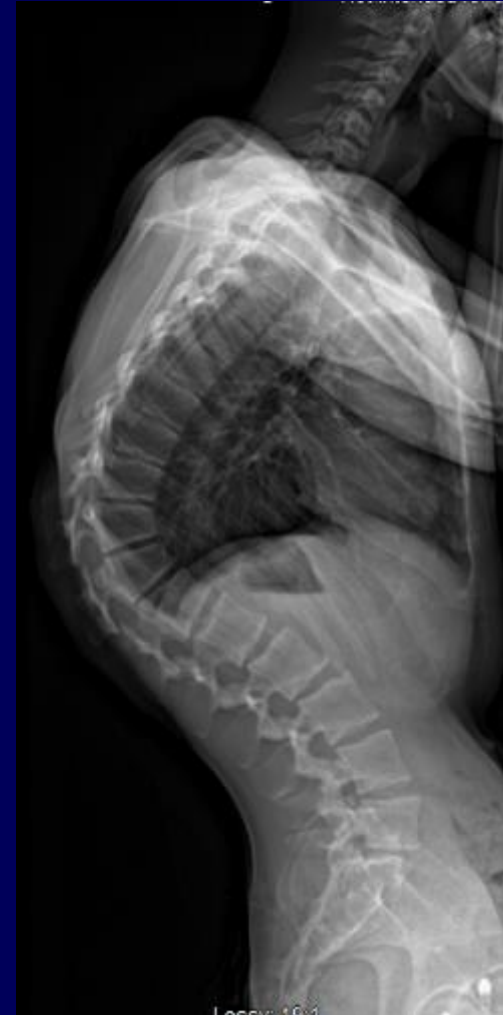
# Spondylolisthesis

- Upper vertebral segment slips forward on the lower vertebra
- Grade 0-2 (less than 50% slip) typically stable in skeletally mature patients
- Grade 3-4 (>50% slip) has higher potential for progression



# Scheuermann Kyphosis (SK)

- Differentiated from postural kyphosis that improves with trunk extension
- Typically seen in older adolescents
- May progress during adolescent growth spurt



# Scheuermann Kyphosis (SK)

- Pain present at apex of kyphosis
- $>5^\circ$  of wedging of three adjacent vertebrae and  $>45^\circ$  of global kyphosis
  - May see Schmorl's nodes, endplate irregularities, narrowed disc spaces



# Scheuermann Kyphosis (SK)

- Stable SK group ( $<75^\circ$ ) had 2.5x higher incidence of back pain compared to controls (Ristolainen L Eur Spin J 2012)
  - No greater analgesic requirements, lost work days, activity restrictions, and/or neurologic symptoms vs. controls in stable SK with 30 year followup (Murray PM JBJS 1993)
- Conservative treatment ( $<75^\circ$ )
  - PT, NSAIDs, +/- TLSO (challenges with compliance)
- Surgical treatment
  - Posterior spinal fusion considered for progressive curves  $>75^\circ$



# Lumbar Disc Herniation

- Less common in adolescents
- 30-60% have a history of trauma before onset of pain  
(Fucs PM Int Orthop 2012)
- Saddle anesthesia and/or bowel/bladder dysfunction warrant emergent evaluation/treatment
- 6% incidence of apophyseal ring separation



# Lumbar Disc Herniation

- Most with LDH +/- radiculopathy are treated conservatively
  - Activity modifications 1-2 weeks, NSAIDs, PT
- Surgery reserved for patients with symptoms refractory to conservative treatment or progression of neurologic deficit

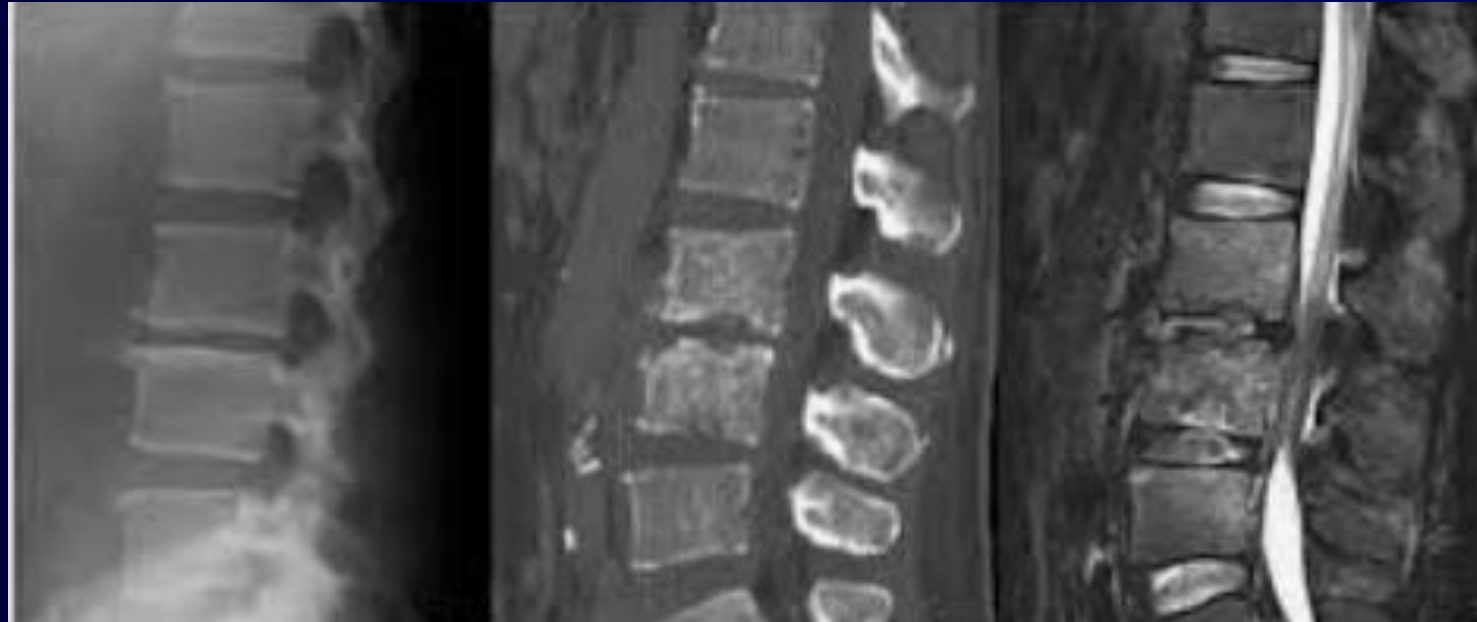
# Spondylodiscitis

- Symptoms can be variable/nonspecific
  - Back pain, abdominal pain, low grade fever, difficulty sitting/walking; refusal to bend trunk to pick up object
  - Gait abnormality most common symptom in kids >3 years (Spencer SJ JPO-B 2012)
  - Nerve root compression/meningitis in 12% of patients (Fucs PM Int Orthop 2012)



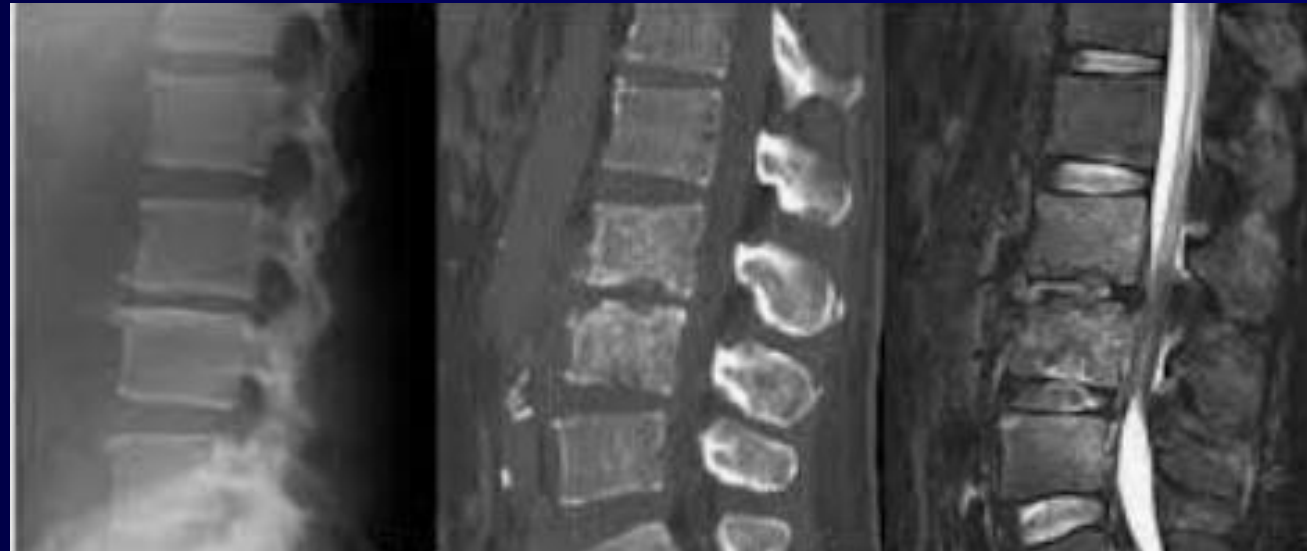
# Spondylodiscitis

- Infection of the intervertebral disc and/or adjacent vertebrae
- Most common in lumbar spine of patients 2-10 years old  
(Spencer SJ JPO-B 2012)



# Spondylodiscitis

- Radiographs may be normal
  - Narrowing of disc space typically first sign
  - End plate irregularities is later stage
- MRI of entire spine most useful modality
- Inflammatory lab markers are nonspecific
- Blood cultures negative in 50%-88% of cases
  - Tissue biopsies are rarely positive (Dormans J JBJS 2007)



# Spondylodiscitis

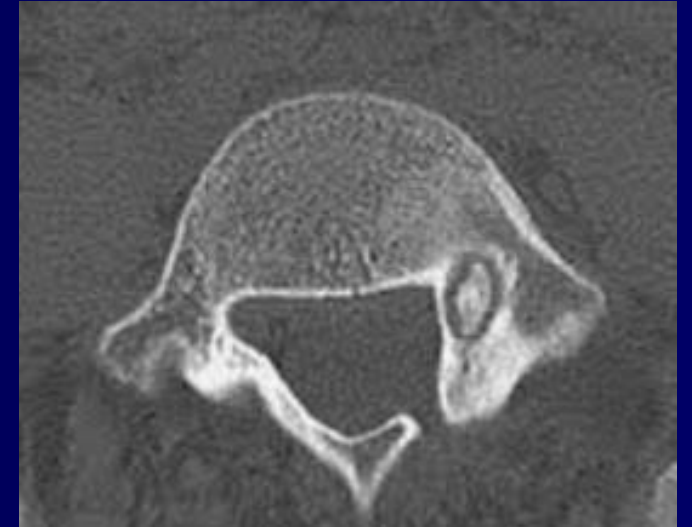
- Nonsurgical management is indicated in most pediatric cases with antibiotics, rest, and bracing
- Surgery reserved for neurologic issues, failure of antibiotic treatment, vertebral body destruction (Chandrsenan J JBJS-B 2011)



# Neoplasm

## Osteoid Osteoma

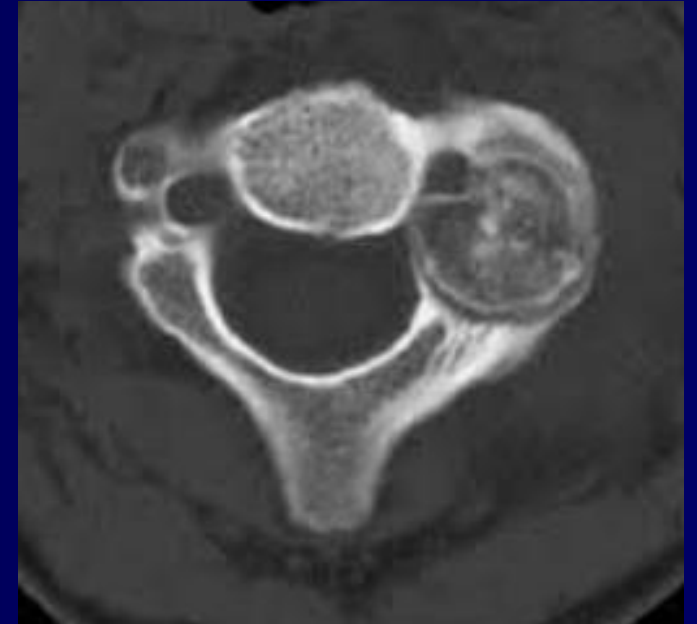
- 20% of Osteoid Osteomas found in the spine (posterior elements)
- Classically present with night pain relieved with NSAIDs
- Difficult to see on radiographs, CT often required
- Treatment
  - Activity modification/NSAIDs
  - Surgical excision if conservative tx fails
    - Associated scoliosis can improve after excision if present for <15 months (Kan P Neurosurg Clin N Am 2008)



# Neoplasm

## Osteoblastoma

- 40% of Osteoblastomas found in the spine (posterior elements)
  - Larger than osteoid osteoma (>2cm)
  - Scoliosis found in 40% of patients (Kan P Neurosurg Clin N Am 2008)
- Classically present with night pain relieved with NSAIDs
  - More often cause neurologic symptoms due to larger size
- Difficult to see on radiographs, CT often required
- Treatment
  - Surgical excision more often recommended at time of diagnosis (Kan P Neurosurg Clin N Am 2008; Boriani S CORR 1992)



# Neoplasm

## Eosinophilic Granuloma (EG)

- Spine involved in 10-15% of patients with EG
- Most common in cervical, followed by lumbar, then thoracic spine
- Pain over affected area
- Skeletal survey or bone scan recommended to detect multifocal disease (present in up to 50%)



# Neoplasm

## Eosinophilic Granuloma (EG)

- MRI to differentiate EG from infection or malignancy
  - Biopsy if indeterminate +/- curettage
- Most EG lesions in children resolve with time and do not cause long-term symptoms
- Bracing usually sufficient to allow for remodeling and reconstitution of vertebra (Plasschaert JBJS-B 2002)



# Conclusion

- Low Back Pain in Kids
  - 2/3 are nonspecific and resolve with home exercises/PT
  - Short course of NSAIDs is ok
  - No radiographs required

# Conclusion

- Red Flags in Pediatric Back Pain
  - History of trauma
  - Night pain
  - Constant pain
  - Weight loss
  - Fever
  - Pain >3 weeks
  - Pain in children <10 years
  - Neurologic deficit

# Conclusion

- When in doubt, give us a call!
- Shriners Children's Philadelphia
- Walk-in "fracture" clinic 8am-3pm Monday-Friday
- 215-430-4000



# Or tell them to take a hike...and find their happy place



El Capitan, Texas  
8000ft elevation



Guadalupe Mountain Peak  
9000ft elevation  
Winds: 65 mph

