Back Pain in Children and Adolescents

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Division of Spine Surgery

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Learning Objectives

• Know the most **common causes** of back pain in children
• Know the common ‘**Red flag’ symptoms** in back pain
• Know the basic **physical exam** for back pain (and scoliosis and kyphosis)
• Know the appropriate **imaging and lab studies** for back pain
• Know the natural history and treatment of **spondylolysis**
But there are similarities!

**Back pain prevalence in children:**

**Remarkably common:**
- As a survey response:
  - Swiss and New Zealand school children
    - Up to 40% can recall back pain
  - As a symptom presenting to school nurses:
    - Up to 8%

**Predictors:**
- Family hx of back pain, surgery
- Low activity levels
- Family smoking
Back Pain Prevalence

Age 9: 33%

Age 15: 48%

Age 20: 70-80%

8-9% in Ortho Clinic
When is back pain significant?
Contemporary view:

- **in Children**
  - Prevalence studies - back pain common, often benign
  - *Back pain as a presenting complaint commonly has pathologic cause*

- **in Adolescents**
  - Prevalence studies - back pain very common
  - *Back pain as a chief complaint -*
    - Majority (?) have definable diagnosis
    - Many have non-specific mechanical LBP = adults.

*But don’t miss the ‘Red Flag’ signs*
History, symptoms of *significance*:

- ‘Red Flag’ signs:
  - Constant pain or night pain
    - infection or tumor
  - Radicular pain:
    - pain in leg or root distribution
  - Activity-related pain with/after athletics
    - Normal? vs
      - stress fracture, spondyloysis
  - Morning pain
    - spondylo-arthropathy
What questions to ask?

- Duration? Frequency? Trauma?
- Location- diffuse? midline? Unilateral?
- Same, better, worsening?
- When during day? AM stiffness?
- Inciting, relieving factors? School, sports, sitting, standing?
- Radicular symptoms to leg(s)?
- Other joint symptoms?
- Relationship to bowel/bladder/menses

Red Flags:

- Radicular pain
- Night pain
- Constant pain
- (Pain after sports)
Simple Exam for Back Pain

• Visual inspection:
  – Scoliosis, Kyphosis

• Functional exam:
  – What motions, maneuvers create pain
  – Best clue as to diagnosis
Scoliosis Screening - asymmetries

Looking for Asymmetry:

Back:
- Shoulders level
- Hips level
- Shoulder blade prominence
- Forward Bend

Standing Assessment:
1. Shoulders uneven
2. Prominent shoulder blade
3. Visible curve
4. Hips uneven
5. Waist asymmetrical

Forward Bending Assessment:
1. Upper back hump
2. Lower back hump
<table>
<thead>
<tr>
<th></th>
<th>Scoliosis (50 yr f/u)</th>
<th>Controls</th>
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<tbody>
<tr>
<td>Reported Back Pain</td>
<td>87%</td>
<td>86%</td>
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Note: Scoliosis Doesn’t Usually Cause Pain

The prevalence of back pain in children who have idiopathic scoliosis.

Ramirez N, Johnston CE, Browne RH.
Texas Scottish Rite Hospital for Children, Dallas 75219-3993, USA.
Normal posture vs. Abnormal Kyphosis

Side view:
- Cervical Lordosis
- Thoracic Kyphosis
- Lumbar Lordosis

- Is it poor posture or structural, abnormal kyphosis?

-- *Is it flexible?*
Physical exam for pain: (more info than an MRI!)

- **What hurts?**
- Palpate, percuss for tenderness:
  - spine
  - iliac crest
  - sacro-iliac joint
  - sciatic notch.
  - flank (for kidneys)
  - abdomen

**What motion hurts?**
- Range of motion of spine standing - which direction hurts?
  - **Flexion** –
    - suggests problem with *disc* or nerve roots
  - **Extension** –
    - suggests a problem with the *posterior* vertebral elements - *spondylolysis, stress fracture*
Physical exam for back pain:

- Reflexes:
- Strength:
  - Trendelenberg
  - Heel, toe walk
- **Straight leg raising:**
- Leseque's, or popliteal stretch test for sciatic nerve or root irritation.
- Tight hamstrings – non-specific sign
Physical exam for back pain:

• **Sacro-iliac inflammation**
  – Figure 4 (FABER) test
  – Gaensalen's test
  – Side to side pelvic compression

• **Palpate abdomen** - (for masses, aortic dissection, etc)
Diagnostic Studies - First Order:

- **Radiographs:**
  - AP & Lat entire spine:
    - If scoliosis, kyphosis or diffuse pain
  - AP & Lat lumbar and sacral spine:
    - If LBP complaint
    - Obliques rarely helpful
- **Contrast with adult back pain algorithms – N/A**
  - No xray unless Sx of certain duration or over age 55?

- **Labs: ?When?**
  - Night pain
  - Compression fracture with minimal trauma
  - Osteopenia
  - Disc space narrowing
  - Vertebral collapse
  - No diagnosis
- **What?**
  - CBC and diff
  - ESR, CRP
  - DEXA (and bone age)
  - Urinalysis
Diagnostic Studies - Second Order:

- **CT Scan shows:**
  - Trauma
  - +/- Stress fractures
  - Spondylolysis
  - Spondylolysis staging

- **MRI shows:**
  - ++ Stress fractures
  - Spondylolysis
  - Discs
  - Tumors, infection, osteoid osteoma
  - Vertebral osteo, discitis
  - Spinal cord anomalies

- **CT scan**
  - Rapid
  - Radiation

- **MR –**
  - Expensive
  - Sedation/anesthetic for younger child
  - Preapproval daunting – often need to have failed 6 wks formal PT for approval

- **Bone Scan –**
  - generally replaced by MRI
Etiology of back pain: *most common final diagnoses* (author’s practice):

**Children:**

1. *No diagnosis*
   - ?*mechanical, non-specific, ‘muscular’*
2. Spondylolysis
3. Epiphysitis (Lumbar Scheuermann’s)
4. Infection (discitis)

……..uncommon:

   Metabolic
   Tumor

**Adolescents:**

1. *No diagnosis*
   - ?*mechanical, non-specific, ‘muscular’*
2. Stress reaction without spondylolysis
3. Spondylolysis
4. Disc degeneration or protrusion
5. Epiphysitis (Lumbar Scheuermann’s)

…………..Uncommon:

   Metabolic (osteopenia)
   Infection
   Tumor
Mechanical, Non-specific, ‘Muscular’ Back Pain

• Extremely Common
  – Maybe ‘normal’

• Typical presentation:
  – Intermittent
  – Low back and upper thoracic
  – Doesn’t (usually) limit activity
  – Doesn’t wake from sleep
  – Worse at end of day
  – No focal physical findings
Mechanical, Non-specific, ‘Muscular’ Back Pain

- **A diagnosis of exclusion**
- Are there definable causes???
  - Normal?
  - Posture?
  - Screen time? (*Parents think so*)
  - Deconditioning and inactivity?
  - Back packs? +/-
- **Rx?:**
  - PT – usually responds to PT
    - compliance, availability, $ all barriers
  - NSAIDs?
    - For pain - Y
    - For ‘inflammation’? – questionable
  - Passage of time helps?
Spondylolysis- terms can be confusing

- Not: Spondylitis, Spondylosis)

- **Stress Reaction**
  - Microfractures with + MR bone edema, negative CT

- **Stress Fracture**
  - +MR, +CT with sclerosis, visible fracture line(s)

- **Spondylolysis**
  - Complete discontinuity of pars inter-articularis
    - Unilateral or bilateral

- **Spondylolisthesis**
  - ‘Slippage’ or translation of vertebra
Stress Reaction, Stress Fracture, Spondylolysis

- **Prevalence in North America:**
  - Infants – 0%  -  Adults – 5%
  - Baker, Fredrickson studies
    - 4% by age 5, 6% by 18
  - Most asymptomatic as lysis is occurring
  - L5 > L4 >>L3,2,1
  - Adults w spondylolysis – same prevalence of back pain as general population


- 2000 census est:
  - approx 60 million age 5-19
  - 3 million instances of child/adolescent spondylolysis
  - 200,000 new cases/yr. between age 5 and 19

- **Associations:**
  - Extension activities - Ballet, Gymnastics, etc –
  - Are these activities etiologic, or just productive of symptomatic spondylolysis?
Stress Reaction, Stress Fracture, Spondylolysis

- **Spondylolysis:**
  - Best explanation of *etiology, natural history*:
    - Excess stress to pars interarticularis
    - Stress reaction, then stress fracture, then spondylolysis
    - Often no symptoms as this is occurring

- **Spondylolisthesis:**
  - Uncommonly - spondylolysis progresses with growth to slippage – spondylolisthesis
  - Rare – high grade spondylolisthesis – typically adolescent female with hyperlaxity
Treatment of symptomatic spondylolysis:

- **Things we can do:**
  - Activity modification/cessation
  - PT
  - Semi-rigid 15-degree Boston Overlap Brace
  - Typical course:
    - 4-8 wks. - brace, no activity
    - 4-8 wks - activity as tolerated in brace
    - 4 - -→wks - part-time brace, or transition or sports brace
Dichotomous Rx of Spondylolysis, Stress Fx

Assessment, staging of lysis:

- **Some chance of bony healing:**
  - Short duration of symptoms, narrow gap or partially healed, active bone healing on CT or MR
  - Treatment: Activity cessation, brace x 6-8wks, then gradual return and PT
- **Goals: Bony Union**
  - Steiner – high rate of union
- **Major impact on lifestyle**
- **Significant re-fracture rate**

- **Low chance of bony healing:**
  - Longstanding symptoms, wide gap, no bone healing activity on MR or CT
  - Treatment PT, brace if needed, activity modification as needed
- **Goal: Symptomatic improvement.**
  - Pizzitullo – 98% success in adolescents
- **Minimum impact on lifestyle**
Successful non-op Rx for spondylolysis - healing

• 16yo athlete
• Unilateral, +bone scan
• Brace, no sports x 4 wks
• Brace; sports allowed x 4wks
• Brace for sports only x 4 wks
• (PEMF stimulator)
Successful non-op Rx for spondylolysis - *no bony healing*

- 14yo athlete
- 2 year history of pain
- Negative bone scan
- Brace, no sports x 4 wks
- Brace; sports allowed x 4 wks
- Brace for sports only x 4 wks
- *Still asymptomatic 3 yr F/U*
- *No bony healing*
Disc Disease in Adolescents

- **Prevalence?**
  - Samartzis, Cheung, JBJS 2011
    - 83 Juveniles (age 13-20), no deformity
    - 35% had lumbar disc degeneration
  - Associations with disc degeneration:
    - Increased BMI
    - Decreased social functioning
    - Increase LBP and Sciatica

- **Natural History during growth?**
  - Lund, et al, PLOS ONE 2022
    - Longitudinal study of 94 healthy children with MRI ages 8, 12, 18
    - Disc changes 18% age 8–9, 38% age 18-19
    - No significant associations between self-reported LBP and disc changes were observed at any age
Disc Disease in Adolescents:

- **Disc degeneration**
  - Common MRI finding in asymptomatic adolescents.
  - Not necessarily source of pain.

- **Disc protrusion, herniation, rupture** - not rare in adolescents
  - +/- LBP
  - *Sciatica*
  - *Positive straight leg raising*
T 7-8 disc causing T-L pain, radiation to chest wall
Treatment: Adolescent Disc Herniation

• **Non- Surgical**
  - (no *severe* radicular component)
    - *Time*
    - Bracing
    - Epidural steroids
    - *Time, more time*

• **Change to Surgical if:**
  - cauda equina syndrome
  - significant weakness

• **Surgical**
  - Discectomy
    - Traditionally poor long term outcome, high recurrence rate
  - Microdiscectomy
    better mid term results
Developmental Causes of Back Pain:

• **Scheuermann's Thoracic Hyperkyphosis**
  – Excessive (>50 deg) or localized, or thoraco-lumbar hyperkyphosis
  – *Structural* – doesn’t bend out on extension or prone position
  – Wedging, end-plate irregularities
  – *may be painful* - brace or PT or time cures most symptoms
Developmental Cause of Back Pain:

- **Lumbar Epiphysitis**
  - AKA
    - ‘Lumbar Scheuermann’s’
    - ‘Limbus vertebra’
  - X-ray changes of Scheurmann's but in lumbar spine.
  - Potential confusion with infection, tumor
  - Painful or normal finding
    - responds to bracing, time.
Lumbar Epiphysitis

• 14 yo gymnast
  – Activity related pain
  – Resolution with temporary activity modification, brace, PT
Infectious etiologies for back pain:

- **Vertebral Osteomyelitis**
  - Unusual in healthy children, adolescents
  - Acute, febrile, severe limitation of spine motion
  - MRI quite sensitive

- **Example:**
  - Vertebral Osteo in NICU with generalized sepsis
Infectious etiologies for back pain - Discitis

- **Intervertebral Discitis**
  - Symptoms vague, may include abdominal pain
  - Subacute onset, +/- elevated ESR
  - Narrowed disc space later
  - MRI usually edema in adjacent bodies
  - Much less common than in past decades

- **Contemporary attitude**-
  - Better cultures
  - All likely infection

- **Example:**
  - Discitis, osteo in an 18 mo old 6 weeks after otitis media, pharyngitis
Infectious etiologies:

• **Septic Arthritis of Sacro-Iliac joint**
  – Poorly localized back pain, hip pain or abdominal pain
    • Often misdiagnosed
    • ↑ ESR, neg. X-rays, back pain,
    • Bone scan may be negative.

• **Best diagnosis is by physical exam** - Figure 4 or FABER test
Infectious etiologies:

- **Epidural abscess**
  - rare, many symptoms possible
  - usually missed
  - may quickly lead to paralysis

- **Tuberculosis**
  - Spinal infection possible
  - Rare as primary focus in children, adolescents
Epidural abscess in an 18 mo old – presented with limp, progressed to weakness
TBC in an immigrant referred for back pain, kyphosis
Osteoid Osteoma

- Night pain typical, relieved by aspirin or NSAID’s
- Benign, ?Etiology?
- Nidus of inflammation with surrounding sclerosis
- Bone scan very positive
- MR detects.
- Can cause scoliosis
- Radiofrequency ablation if in safe location
- Intraoperative bone scan assists surgery
- Probably self-limited if very patient
Neoplastic causes of Pediatric Back Pain:

- **Osteoblastoma**, other primary bone tumors
- **Histiocytosis X**
  - vertebra plana
- **Leukemia, Lymphoma**
- **Primary tumors** of meninges, spinal cord
- Bony metastases
Work up for Pediatric compression fractures?

- Is the history or trauma enough to explain the fractures?
- Be suspicious:
- DDx:
  - Osteopenia
    - Juvenile osteoporosis
    - D deficiency
  - Leukemia
  - Osteogenesis Imperfecta
  - Non-accidental trauma
  - Histiocytosis
Visceral causes of back pain:

- Pneumonia
- Pyelonephritis, stones
- Abdominal, retroperitoneal neoplasms
- Hematocolpos
- Retrocecal appendix
- Aortic dissection (Marfan's)
- Endometriosis
Back pain conclusions:

- **Children:**
  - Often pathologic if back pain is a presenting complaint
  - Pursue a diagnosis

- **Adolescents:**
  - May be no diagnosis, ‘normal’
  - Spondylolysis, stress fractures common
  - respond to bracing, PT
Conclusions?

- **Children**
  - Prevalence studies - back pain common, often benign
  - *Back pain as a presenting complaint* commonly has *pathologic cause*

- **Adolescents**
  - Prevalence studies - back pain very common
  - *Back pain as a chief complaint*
    - Majority (?) have definable diagnosis
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**But don’t miss the ‘Red Flag’ signs**