A Pediatric PERSPECTIVE

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Pediatric Back Pain: When to Sit Up and Take Note

by Tenner Guillaume, M.D.

Back pain is uncommon among children who are under 10 years old, but the incidence of back pain increases for adolescents. A 2005 study of 7542 European teenagers states, "A total of 1180 (20.5%) teenagers reported one or more episodes of low back pain (LBP), of whom 900 (76.3%) had consulted a health provider."[1] Not surprisingly, athletes have a higher incidence of back pain than nonathletes.

For primary care providers, the key questions are—when is back pain the result of overuse or muscle strain? When is the pain symptomatic of more serious pathology, such as a herniated disc, spondylolysis, scoliosis, Scheuermann's disease, osteomyelitis, discitis, leukemia, tumors, or ankylosing spondylitis? What follows is a practical guide to evaluating pediatric back pain, with recommendations about which cases should be referred to an orthopedic specialist and which cases can be managed in the primary care setting.

Start With the Basics – A Thorough History

The answers to the following questions will provide nearly all of the information needed to differentiate a benign issue requiring conservative management from a more serious condition. The answers will also help you determine whether to simply treat the symptoms or whether a complete radiographic study is necessary.

1. Characterize the back pain.
Is the pain acute? The result of trauma? Unremitting or more subtle? Has it grown progressively worse? Is the pain recurrent, related to activity or worse at night? Is the pain associated with constitutional symptoms, such as unintentional weight loss, fevers, chills or malaise?

2. Determine the location of the pain.
Establish whether the pain is lumbar, thoracic or cervical and whether it is focal, diffuse, radiating or radicular. The more focal the pain, the easier it will be to potentially identify an underlying cause. Nonfocal, diffuse pain ("My whole back hurts" or "I can't put my finger on it because it hurts everywhere") is less likely to result in the discovery of a focal underlying pathology with radiographic work-up.

3. Consider the patient's age and check neurological signs.
Is the patient 10 or younger? The younger the patient, the more worrisome the back pain, because a pathologic abnormality is more likely to be the cause. Also, ask about transient paraparesis, paralysis, numbness or paresthesias, and determine if bowel or bladder function is affected. Neurological impairment signals a more complex condition.

4. Listen for these reassuring signs.
Ask if the patient has missed school or sports because of the pain, whether the pain has improved over time, and if the pain responds to nonsteroidal anti-inflammatory drugs (NSAIDs) or acetaminophen. Additionally, discuss whether the pain is intermittent or activity-related, generalized or focal.

KEY INSIGHTS

- Back pain is surprisingly common among adolescents and young athletes, but cases require further investigation to identify causes and treatment recommendations.
- A thorough history and a comprehensive physical exam for back pain provide most of the information needed for a differential diagnosis.
- For initial screening, begin with AP, lateral or oblique view radiographs. An MRI is needed only if there is evidence of a serious condition or if the patient has not improved after six weeks.
- See the guide on P. 2 for more details about which imaging studies to request.
- Younger patients (ages 10 and under) who complain of back pain are more worrisome—a pathologic abnormality is more likely.

Inside

If the pain is decreasing, responds well to NSAIDs, is generalized or is activity-related, it is more likely to be the result of muscle strain or injury. Similarly, if the patient participates in normal activities, (i.e., pain does not prevent him or her from participating), the back pain is less likely to be serious. The exception would be a highly competitive athlete or dancer who might be motivated to compete despite significant pain. An absence of all of the "red flags" listed below is also reassuring.

5. Be aware of these red flags.

Associated findings like those mentioned below are definitely cause for concern. Pursue additional testing if the pain is:

- Associated with constitutional symptoms like fever, malaise, night sweats, unintentional weight loss, easy bleeding or bruising
- Worse at night or if it wakes the patient from sleep
- Associated with neurologic symptoms
- Acute, unremitting or focal pain that is not responsive to NSAIDs or acetaminophen
- Constant (not activity-related)

Complete a Comprehensive Exam for Back Pain

Evaluate patients while they are standing, walking, bending at the waist and lying on the exam table. Include these exams:

Standing and walking – Are the shoulders level? Does the patient have any obvious abnormalities of the spine, hips or stance? Does the patient limp?

Appearance – Look for rash, bruising or ecchymoses, which are potential symptoms of leukemia. Check for cutaneous manifestations of dysraphism: hairy patches, dimples and deep sinuses at the base of the spine (possible neural tube defect); café au lait spots (possible neurofibromatosis); heart-shaped buttocks (possible high-grade spondylolisthesis); kyphosis.

Palpation and inspection – Palpate to determine the location and nature of the pain: focal, diffuse, in the spinous process or paraspinal. Have the patient do an Adam's forward bend test, and inspect the spine for any deformity, such as scoliosis or kyphosis.

Range of motion – Is the pain worse with spine flexion? Extension?

Neurologic exam – Test sensory and motor responses. Check these reflexes: biceps (C5); triceps (C6); brachioradialis (C7); patellar (L3, L4); Achilles (S1); upgoing Babinski; Hoffman's test of the upper extremity; and clonus. Also look for unilateral or bilateral weakness, asymmetric abdominal reflexes, foot drop, or loss of fine motor skills in the hands.

Refer Red Flag Issues Immediately

Refer patients suspected of having leukemia to a pediatric oncologist. If patients have any of these conditions, refer them to a pediatric spine specialist:

- Vertebral fractures
- Apophyseal ring fracture
- Discitis
- Vertebral osteomyelitis
- Osteoid osteoma
- Disc herniation
- Spondylolysis
- Spondylolisthesis
- Scheuermann's disease
- Idiopathic scoliosis
- Ankylosing spondylitis

Guide to Imaging Studies for Pediatric Back Pain

Overview – What to Request and When

Radiographs

- For trauma or a history that suggests the pain is not muscular, start with AP and lateral radiographs, rather than an MRI.
- *Request a standing view (or seated view, if the patient cannot stand).*
- For lumbosacral involvement, avoid pelvic shielding.
- Request an oblique view radiograph for suspected spondylolysis.
- Request flexion/extension view radiographs for suspected spondylolisthesis.

MRI

- Reserve MRIs for cases in which the back pain has lasted more than six weeks and is not responding to NSAIDs or therapy.
- Consider an MRI if the patient's history and physical reveal focal back pain or radicular pain.
- Consider an MRI if there are obvious red flags during history-taking that suggest possible underlying infection or neoplasm.
- Request an MRI if the preliminary radiographs point to a serious condition (acute stress reactions or fractures, spondylolysis, spinal neoplasms, discitis and so forth).
- If you are likely to refer the patient to a specialist, the specialist can order an appropriate MRI.

CT Scan

Reserve for cases that fail nonoperative management or for visualization of bony changes that have resulted from fracture, tumor or infection. This can largely be left to the specialist to order if it is indicated.

Bone Scan/Scintigraphy/SPECT Scan

Because these tests are highly sensitive and nonspecific, they are used much less commonly today. They will identify areas of high metabolic activity or bone turnover. MRIs are currently the preferred test of choice among orthopedic surgeons and radiologists.

Interpreting Imaging Results – What to Look For

Anterior/Posterior Radiographs

- Check overall alignment – Any scoliosis?
- Pedicles – Normal cascade? Widening at any level? Clearly identifiable at all levels? Any effacement or cortical destruction?
- Spinous processes – Widening between spinous processes? Well-aligned? No offset in coronal plane?

Lateral Radiographs

- Overall alignment – Lumbar lordosis, thoracic kyphosis, cervicothoracic lordosis?
- Posterior vertebral body cortical line – Is it aligned?
- Is there anterior or posterior offset of a vertabra (possible spondylolisthesis)?
- Interspinous widening?
- Cervical spine posterior laminar line?

Lumbar Oblique Radiographs

Look for spondylolysis (the infamous "Scotty dog").

Flexion/Extension Radiographs

Check for atlantoaxial instability (cervical) or spondylolisthesis (lumbar).

MRI

Examine images for acute stress reactions or fractures, apophyseal ring fractures, cord abnormalities, discitis, herniated nucleus pulposus (HNP), juvenile degenerative disc disease, spinal neoplasms, spondylolysis.

CT Scan

Examine bony anatomy for suspected cases of vertebral, burst or pedicle fractures or of osteoid osteoma.

Special tests – Include these additional exams, if you suspect:

- Spondylolysis – check extension in single leg stance and popliteal angles
  If the patient has pain while standing on the right leg and extending the spine, but does not have pain when standing on the left leg and extending the spine, presume a unilateral pars stress fracture/spondylolysis on the right. If the pain occurs bilaterally, presume that the pars stress fracture/spondylolysis is bilateral.
- Herniated nucleus pulposus or apophyseal ring avulsion – straight leg raise
  Consider the test positive if any degree of passive elevation reproduces pain radiating down the affected leg. The straight leg raise specifically tests nerve roots that contribute to the sciatic nerve (L4, L5, S1). For suspected femoral nerve root involvement (L1, L2, L3), perform a femoral stretch test, because those nerve roots contribute to the femoral nerve.
- Cervical radiculopathy – Spurling's test
  Turning the patient's head in the direction of the suspecte cervical radiculopathy while tipping and extending the neck in the same direction will cause foraminal compression. That compression should reproduce the patient's experience of radiculopathy and pain radiating down the affected upper extremity.

Follow In Clinic or Refer?

The history and physical exam will help determine the severity and acuity of the patient's back pain. If there are no red flag issues, send the patient to be evaluated by a physical therapist who provides care for children and follow up with the patient in clinic. If the history and physical uncover red flag issues, request appropriate radiographs and lab tests. See Page 2 for a guide to imaging studies. If screening radiographs point to a serious orthopedic condition, request an MRI or refer the patient to an orthopedic specialist who will get the necessary MRI.

[1] *Prevalence of nonspecific low back pain in schoolchildren aged between 13 and 15 years. Masiero S, Carraro E, Celia A, Sarto D, Ermani M., Acta Paediatr. 2008;97(2):212*

Differential Diagnosis	History	Physical Findings	Imaging Studies
Vertebral Fractures	Back pain, trauma.	Focal tenderness when palpated. Pain is worse with erect posture.	• Radiographs – AP and lateral views. • CT scan – Evaluate specific anatomy of fracture.
Apophyseal Ring Fracture	Acute traumatic onset of pain. Symptoms mimic a herniated nucleus pulposus with lower extremity radiation.	Positive single leg raise. Other neurologic signs are present infrequently.	• Radiograph – Look for osseous fragment posterior to vertebral body. • CT scan – Identify size and location of bony fragment.
Discitis	Most common cause of back pain in patients who are 5 or younger. Back pain, limping, refusal to walk, abdominal pain.	Fever, malaise. Pain is worse when standing or with forward flexion. Gowers' sign is present. Patient is systemically ill.	• Radiograph – Check for narrowing of disc space, soft tissue swelling. • MRI – Use to localize infection and determine soft tissue involvement.
Vertebral Osteomyelitis	Back pain, refusal to walk, fever, night sweats.	Fever, malaise. Pain is worse when standing or with forward flexion. Gowers' sign is present. Patient is systemically ill.	• Radiograph – Check for bony destruction, cortical scalloping. • MRI with IV contrast – Determine extent of bony and soft tissue involvement, possible abscess.
Leukemia	Back pain (6 – 25 percent of patients present with it initially), pallor, fatigue, malaise, anorexia, fever, bruising, abnormal bleeding.	Fever, ecchymoses, possibly focal tenderness with palpation.	• Radiograph – Look for generalized osteopenia, compression fracture. • CBC with differential, peripheral smear, erythrocyte sedimentation rate.
Osteoid Osteoma	Most common benign spinal tumor in children. Severe back pain, worse at night, relieved by NSAIDs.	Patient often stands with a list, decreased spine range of motion.	• MRI, CT scans, SPECT scan.
Disc Herniation	Back pain with radiation into legs. Pain worse with valsalva (sneezing, coughing, or straining).	Straight leg test is positive for 85 percent of patients. Absent reflexes, weakness and sensory changes rare in children.	• Radiograph – AP and lateral. • MRI – Visualize HNP, rule out tumors or epidural abscesses.
Spondylolysis or Spondylolisthesis	Patient is gymnast, offensive lineman, ballet dancer or diver. Low back pain is exacerbated by hyperextension.	Pain with extension and single leg stance extension. Tight hamstrings, increased popliteal angle.	• Radiograph – Lateral lumbar spine and oblique views • MRI – Look for increased pedicular signal intensity on T2/STIR. • CT or SPECT scan – For better bony definition (recalcitrant or pre-op).
Scheuermann's Disease	Boys > girls. Parent may note "poor posture." Pain at apex of kyphosis or lower lumbar spine. Aching pain, does not radiate or wake patient at night.	Kyphosis, particularly on forward bending. Rigid kyphosis on extension or over bolster.	• Radiograph – Three contiguous vertebrae with > 5 degrees of anterior wedging, intervertebral disc space narrowing, Schmorl's nodes.
Idiopathic Scoliosis	Most patients do not complain of back pain, but apex curves left with spinal cord abnormalities.	Positive Adam's forward bend test. May have focal tenderness over rib prominence.	• Radiograph – AP and lateral to define extent of scoliosis. • MRI – Specialist will order this if deemed appropriate.
Ankylosing Spondylitis	Loss of spine mobility, back pain, boys > girls. Pain worse in morning.	Loss of lumbar flexibility on Adam's forward bend. Increased kyphosis, positive FABER test.	• Radiograph – "Bamboo spine," sacroiliac (SI) joint sclerosis. • MRI – SI joint increased T2 signal intensity. • Labs – Human leukocyte antiger (B27) is positive.

Suspected Scoliosis

This tall, thin, 13-year-old male was referred by his primary care physician for a scoliosis evaluation. Originally, the patient's dermatologist noticed some prominence during a physical exam. The patient's primary care physician requested radiographs, which indicated a 14-degree thoracolumbar curve.

History

The patient denied any history of back pain. However, he had a history of anxiety and insomnia and takes melatonin and sertraline. He had never missed school or extracurricular activities because of back pain.

Physical

During the examination, he was alert, oriented and in no acute distress. He had normal lordotic posture and mild evidence of positive sagittal imbalance. He had no evidence of shoulder height imbalance. His gait appeared normal with no evidence of ataxic or antalgic gait. He was able to toe walk, heel walk, and perform tandem gait maneuvers without significant difficulty. Skin examination of his back demonstrated no cutaneous manifestations of underlying spinal dysraphism. During the Adam's forward bend test, he had no evidence of any clear thoracic, thoracolumbar, or lumbar prominences. He did, however, have evidence of increased thoracic kyphosis both in the erect position and even more so when bending forward. He had an acute thoracic kyphosis with an apex at the midthoracic spine. When he stood erect, he was able to retract his scapulae somewhat to straighten his posture. Although there was some evidence of correction of his kyphosis, some of the kyphosis seemed structural. He had no pain with lumbar extension.

The examination of his bilateral lower extremities showed that his motor strength, neurological signs and reflexes were all within normal limits. He was noted to have a popliteal angle on the right of approximately 75 degrees and on the left of approximately 70 degrees. His hamstrings were extremely tight. That tightness was associated with some spasm and pain when his knees were extended passively.

Imaging Studies

Lateral radiographs were repeated, which showed thoracic hyperkyphosis that measured from T1 to T12 at approximately 70 degrees. He also had findings consistent with Scheuermann's disease from T6 to T9. He had anterior wedging of greater than 10 degrees at each of these levels and more than 30 degrees of kyphosis across these segments. There were also end plate irregularities suggestive of Schmorl's nodes. This was consistent with a diagnosis of Scheuermann's disease. His C7 plumb line was noted to fall posterior to the superior posterior corner of the S1 vertebral body, suggesting somewhat negative sagittal balance.

Treatment

Given the patient's tight hamstrings and thoracic hyperkyphosis, we recommended physical therapy: hamstring stretching, core strengthening exercises, and postural exercises with a focus on thoracic extension. We recommended monitoring him and repeating PA and lateral spine films in six months. There was no indication for bracing. Should the PA film again demonstrate no evidence of scoliosis, we will discontinue PA films altogether and only obtain lateral films on follow-up.

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Tenner Guillaume, M.D., is an orthopedic surgeon who specializes in spine surgery. His professional interests include management of pediatric congenital and idiopathic scoliosis as well as isthmic spondylolisthesis. He received his medical degree from the University of Minnesota Medical School. He completed an internship and residency at the University of California – San Francisco Medical Center and a spine surgery fellowship through the Twin Cities Spine Center in Minneapolis. Guillaume has presented research, posters and abstracts and has professional publications. He is a member of the American Academy of Orthopaedic Surgeons and the North American Spine Society. He is a candidate for membership in the Scoliosis Research Society and the Pediatric Orthopedic Society of North America.

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A Pediatric PERSPECTIVE *Has A New Look*

Our redesigned newsletter includes these new features:

- "Key Insights," a summary on P. 1
- Links and a QR code for quick access to relevant resources on the Gillette website.

Although the newsletter has a new design, the editorial focus remains on providing a practical, in-depth discussion of clinical topics. We hope the newsletter's new design will be helpful.

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