Leg Complaints and Limping

What a Pain!
Radiology Evaluation of
Leg Complaints and Limping

Maria-Gisela Mercado-Deane, MD FAAP
Christus Santa Rosa Children Hospital
San Antonio, TX

I have nothing to disclose

Age groups
- Infant and toddler
  - Up to the age of 3-4 yrs
- Children
- Adolescent

Talk about specific and common etiology of acute and chronic pain and the radiological workup
- Idiopathic
- Trauma
- Infectious
- Congenital

Description of findings in plain radiographs
Discuss other imaging alternatives
Familiarize clinicians with findings in advance imaging

Leg Complaints

Trauma is by far the most common cause of acute limp in children (Barkin et al., 2000).
Trauma may induce limping as a result of fracture, sprain/strain, and contusion.
Fractures are more common than are sprains and ligamentous strains in very young children.
In children older than 10 years, the most common cause of limping is ankle sprain.

Overuse syndromes are caused by microtrauma
Examples
- Stress fracture
- Osgood-Schlatter disease
- Shin splints
- Sever's disease

Overuse syndromes are very common in school-aged children engaged in competitive sports activities.


History

- Description of pain: OLDCAR
- Onset/precipitating event
- Location
- Duration
- Characteristics, nature, or quality
- Associated factors which improve or worsen
- Radiating pattern of pain

Distinguishing Characteristics of Benign and Serious Musculoskeletal Conditions in Children

**Characteristics of Benign Conditions**

- Pain relieved by rest and worsened by activity
- No bony tenderness
- Normal strength
- Normal growth pattern
- No constitutional symptoms
- Normal CBC, normal ESR
- Normal radiographic findings

- Pain at the end of the day
- Nocturnal pain relieved by simple analgesics and massage of painful areas
- No objective joint swelling
- Hypermobile joints

**Characteristics of Serious Conditions**

- Pain relieved by activity and present at rest
- Muscle weakness
- Poor growth, weight loss
- Fever, malaise
- Abnormal CBC, elevated ESR
- Abnormal radiographic findings: soft-tissue swelling, osteopenia, periosteal elevation, cortical destruction ("moth-eaten" lesion)

**Broad Differential Mnemonic**

- VITAMIN C
  - Vascular
  - Infection, inflammation
  - Trauma
  - Autoimmune
  - Metabolic
  - Idiopathic
  - Neoplasm
  - Congenital

Diagnosis

Imaging is guided by clinical suspicion

- Options include:
  - Radiograph of the area affected.
  - At least 2 views
  - Computer Tomography (CT)
  - Magnetic Resonance Imaging (MRI)
  - Nuclear Medicine Imaging
  - Ultrasound

Imaging

- **Plain Radiography**
  - Fractures, bone tumors, osteomyelitis
  - Normal in early inflammatory process, or early osteomyelitis
  - Abnormal in 44% of patients with leukemia
- Initial evaluation for patients with significant joint and bone pain
Imaging

MRI, CT
Periarticular inflammation, tumors, bone and cartilage abnormalities, complex fractures
More sensitive than plain film radiographs in detecting malignancy and inflammatory conditions.
Intravenous enhancement helps detect inflammation when joint examination is equivocal or difficult

Imaging

Nuclear Medicine
Radionuclide bone scintigraphy is much more sensitive for detecting occult fracture, osteomyelitis, diskitis, avascular necrosis, bone infarct, and neoplasm.

Imaging

Ultrasound
Can be utilize for evaluation of joints, superficial soft tissues, tendons, bone cortex
For localization of nonopaque foreign bodies
For evaluation of superficial masses

VITAMIN C

Vascular
Infection, inflammation
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Children

BENIGN NOCTURNAL LIMB PAINS OF CHILDHOOD
AKA “Growing Pains”

Cramping pains of the thigh, shin, and calf
Affect approximately 35 percent of children four to six years of age
Associated with the pubertal growth spurt but theoretically may be associated with growth in general.
The pain typically occurs
in the evening or at night,
may awaken the child from sleep,
and disappears by morning.
BENIGN NOCTURNAL LIMB PAINS OF CHILDHOOD
AKA “Growing Pains”

Benign nocturnal limb pains are not associated with a limp.
Physical examination of the child is normal
No further diagnostic testing is necessary

BENIGN HYPERMOBILITY SYNDROME

Common cause of evening limb pain
May result in a limp.
Occurs typically in young girls before or during adolescence.
Present with musculoskeletal pain associated with generalized hypermobility of joints but no associated congenital syndrome.
Prevalence estimated to range from 8 to 20 percent.

BENIGN HYPERMOBILITY SYNDROME

Criteria for hypermobility
Evaluation of mobility of the thumb onto the forearm
Degree of hyperextension of the metacarpals, elbows, and knees; ability to place the palms on the floor with knees straight.

VITAMIN C

Vasculart
Infection, inflammation
Trauma
Autoimmune
Metabolic
Idiopathic
Neoplasm
Congenital

Trauma
Non Accidental

Infants and Toddlers

Hallmark of the syndrome are multiple, asymmetric fractures in different stages of healing
Marked irregularity and fragmentation of metaphyses
“Corner” fracture (11%) or “Bucket-handle” fracture
Symptoms
Irritability
Refusal to walk, stand,
use an extremity
Skeletal Survey

AP of Bones in Upper Extremity

Skeletal Survey
AP of Bones in Lower Extremity

Distal Femur, proximal tibia, ankle
Metaphyseal corner fractures

Spiral fracture
with associated hairline fracture
in children less than 1 yr of age

Non-Accidental Trauma

Corner fracture

Bucket-handle
fracture

Periostitis
Non Accidental Trauma

Schematic diagram of: a. "Corner" fracture (11%) and b. "Bucket-handle" fracture

2 month old
Extensive periosteal reaction from large subperiosteal hematoma

Non Accidental Trauma

Toddler’s Fractures

Non-displaced oblique fracture of the tibial shaft, from an indirect twisting or rotational force applied to the foot and lower leg

Toddler’s Fractures

Other "toddler's" type fractures involving the bones of the feet particularly the calcaneus and cuboid bone
These are more easily recognized by radionuclide bone scanning
Usually not visible on radiographs until healing results in a zone of sclerosis.
These injuries usually are fairly self-limited, with symptoms resolving spontaneously

Nuclear Medicine bone scan can be obtain in children older that 2 yr, instead of the skeletal survey or if the skeletal survey is negative and there is a high level of suspicious to find occult fractures

Non-displaced oblique fracture of the tibial shaft, from an indirect twisting or rotational force applied to the foot and lower leg

These injuries usually are fairly self-limited, with symptoms resolving spontaneously
Cuboid Fracture

Stress Injuries

Competitive athletes
Repetitive microtrauma (the equivalent of a stress injury) to the physis.
Widened physis both on radiographs, when apparent, and on MR images
MRI in children with overuse pain may be performed to confirm physeal widening detected on radiography and to exclude other injuries that may cause prolonged joint pain.

Stress Injuries


Stress injuries

Children who were compliant with rest and immobilization improved both symptomatically and radiologically within 3 months.

The one noncompliant child not only continued to be symptomatic, but also developed malalignment at her knees.

Stress Injuries

It is important to recognize the widened physis both on radiographs, when apparent, and on MR images because these children should not undergo physical therapy and progressive rehabilitation, which often are prescribed for patients with overuse knee pain.

Osteochondritis Dissecans

Osteochondritis dissecans (OCD) is a term for osteochondral fracture. Overall, the knee is most frequently involved. Since the advent of cross-sectional imaging (CT and MRI), OCD of the talus has been diagnosed more frequently and, in future series, may represent the most frequent site of OCD.

Osteochondritis Dissecans Knee

Juvenile form:
- Occurs at age 10-15 while the physis is still open.
- The male-to-female ratio is 2-3:1.
- Bilateral involvement is noted in 30-40% of cases.
- Of patients with OCD, 21-40% have some history of trauma.

Symptoms:
- Activity-related pain that is vague and poorly localized.
- Mechanical symptoms.
- Recurrent effusions of the knee.

Physical exam:
- Localized tenderness.
- Stiffness.
- Swelling.

On conventional radiographs, osteochondral lesions may appear normal. When detectable, osteochondral lesions appear as luencies in the articular epiphysis.

Obtain tunnel (notch) view which allows better demonstration of the lesion.

Support of tunnel view.
Osteochondritis Dissecans Knee

MRI
- Demonstrated the lesion
- The status of the cartilage
- Ascertain the stability of the lesion
- Help treatment decision making
Synovial fluid behind the lesion carries a worse prognosis for nonoperative management

Osteochondritis Dissecans Knee

Nonoperative Treatment
- restricted weight bearing and bracing indicated in younger children with open physis
- 50-75% will heal without fragmentation

Osteochondritis Dissecans Ankle

Locations include
- medial talar dome
  - more common
  - more posterior
  - deeper
- lateral talar dome
  - more superficial
  - lower incidence of spontaneous healing

Symptoms
- Pain
- Limitation of motion
- Joint effusion

Osteochondritis Dissecans Ankle

MRI indicated in ankle sprains that do not heal with time
Osgood-Schlatter's

An overuse injury
- caused by a microfracture of the immature apophysis of the tibial tuberosity
due to stress imposed by the extensor mechanism

Common in jumpers or sprinters

Symptoms
- pain on anterior aspect of knee

Physical exam
- enlarge tibial tubercle

Radiographs may show irregularity and fragmentation of the tibial tubercle

MRI shows edema of the tendon and irregularity of the insertion.

Sinding-Larson-Johansen Syndrome

“Jumpers knee”

Caused by a microfracture of inferior patella due to overuse

Presents with pain on anterior aspect of knee

Physical exam
- tenderness over inferior pole of the patella

Sever's Disease

The most common cause of heel pain in adolescents is calcaneal apophysitis.

Radiographs of the heel are felt to be normal
The sclerosis of the apophysis is normal

MR demonstrates the edema in the apophysis and the calcaneus bone.

Foreign Body

- Thorns, splinters, wooden fragments, plastic pieces are usually not sufficiently opaque to be visualized in radiographs.
- In selected cases ultrasound can be utilized
VITAMIN C

- Vasular
- Infection, inflammation
- Trauma
- Autoimmune
- Metabolic
- Metabolic
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Infants, Toddlers, and Children

Osteomyelitis

Most common in children 3 to 12 years of age
Staphylococcus aureus is the most common bacterium involved in the infection.

Hematogenous osteomyelitis is predominantly seen in children and involves the highly vascular long bones, especially those of the lower limb
With acute osteomyelitis, the presenting complaint is usually local pain, swelling, and warmth. These often occur in association with fever and malaise.

Osteomyelitis

Tubular bones have the most rapid growth and the largest metaphysis; therefore, they are common sites of infection.
75% of children have infections in sites such as distal and proximal femur and tibia, distal humerus, and fibula

Osteomyelitis

Current imaging recommendations
plain radiography
3-phase bone scanning and/or MRI.
Although osseous changes become apparent on conventional radiographs 5-7 days into the disease process, plain radiographs are useful in ruling out other causes of bone pain, such as stress fractures.
Osteomyelitis

Nuclear medicine bone scans are a highly sensitive (>90%) modality in the diagnosis of osteomyelitis. This procedure is performed in 3 stages. Blood flow, Blood pool, delayed static images. The sensitivity of bone scans is often helpful when the exact site and extent of the infection is not known.

Osteomyelitis

- MRI demonstrate the extent and structure of the area involved in the pathologic process.

Osteomyelitis

- CT can be obtain, in chronic osteomyelitis to demonstrate involucrum and the extent of the bony destruction.

VITAMIN C

- Congenital

Children and Adolescents
Congenital Discoid Meniscus

Present during childhood but usually asymptomatic until adulthood.

When symptomatic during childhood, the symptoms are variable and inconsistent.

Symptoms
- pain, clicking, locking, lack of mobility

Physical exam
- loss of active extension on range-of-motion testing

Discoid Meniscus

- AP may show
  - widened joint space due to widened cartilage space (< 11mm)
  - squaring of lateral condyle
  - cupping of lateral tibial plateau
  - hypoplastic lateral intercondylar spine

Coronal MRI will show thick and flat meniscal tissue extending across entire lateral compartment. MRI is important to rule out associated meniscal tears.

Tarsal Coalition & Peroneal spastic flatfoot

Tarsal coalition
- the most common cause of peroneal spastic flatfoot (pes planus)

Flatfoot may be rigid (spastic) or flexible
Disorder of mesenchymal segmentation leading to fusion of tarsal bones and rigid flatfoot.

Most common coalitions:
- calcaneonavicular coalition (most common in children 10-12 yrs of age)
- talocalcaneal (subtalar) coalition (most common in children 12-14 yrs of age)

Coalition may be fibrous cartilagenous osseous

Symptoms:
- appear ~ 10-12 years of age
- calf pain due to peroneal spasticity

Physical exam
- rigid flatfoot
- limited subtalar motion and hindfoot valgus
- forefoot abduction
- heel cord contractures

Tarsal Coalition

calcaneonavicular coalition
- lateral and oblique x-rays may show an elongated anterior process of the calcaneus (“anteater” sign)
- best seen on oblique x-ray

talocalcaneal coalition
- lateral x-ray may show talar beaking
Talocalcaneal coalition

CT scan can help identify coalition and best determine cross-sectional area of a coalition

MRI may be helpful to visualize a fibrous or cartilaginous coalition

Flexible Flat Foot

Flexible flatfoot may be familial associated with generalized ligamentous laxity and lower extremity rotational problems usually bilateral

Symptoms
usually asymptomatic in children may have arch pain or pretibial pain

Physical exam
foot is only flat with standing and reconstitutes with toe walking or foot hanging normal subtalar motion

Flexible Flat Foot

Physical exam
foot is only flat with standing and reconstitutes with toe walking or foot hanging normal subtalar motion

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- Pain or stiffness in the morning
- Objective joint swelling
- Stiff joints
- Bony tenderness

- Nocturnal pain not relieved by simple analgesics
- Abnormal radiographic findings
- Stiff joints
- Bony tenderness

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