Acute and Non-Acute Lower Extremity Pain in the Pediatric Population: Part III

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KEY WORDS
Pediatric/child limp, antalgic gait, leg pain, lower extremity pain

Lower extremity pain is common in childhood, with etiologies ranging from benign muscular conditions to systemic disease. We are presenting a three-part series of evidence-based practice guidelines to aid the provider in efficiently determining the diagnosis and treatment of a child with lower extremity pain. Part I focused on the history, physical examination, and diagnostic work up (Duey-Holtz, Collins, Hunt, Husske, & Lange, 2012; Duey-Holtz, Collins, Hunt, & Cromwell, 2012). Parts II and III have been divided to include comprehensive treatment guidelines, which are summarized in the Table. In general, the most common diagnoses for musculoskeletal pain can be categorized into the following etiologies:

- Trauma: strains/sprains, fractures, dislocations, foreign body, non-accidental trauma
- Infection: septic arthritis, osteomyelitis, diskitis
- Immune-mediated: toxic synovitis, juvenile idiopathic arthritis, Lyme disease, reactive arthritis
- Acquired/developmental: slipped capital femoral epiphysis, Legg-Calve-Perthes disease, Kohler disease, tarsal coalition, accessory navicular, osteochondritis dissecans
- Neoplastic: leukemia/lymphoma, Ewing sarcoma, osteosarcoma
- Referred: scoliosis, spondylolysis, spondylolisthesis
- Benign musculoskeletal: growing pains, tendinitis/apophysitis
- Neurologic: complex regional pain syndrome, restless leg syndrome
- Metabolic: rickets

The following non-painful conditions can present with a limp or abnormal lower extremity examination results:
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| Accessory navicular                | Medial foot pain; + radiograph findings                                                             | • Conservative treatment with NSAIDs  
• Activity modification  
• Possible immobilization or orthosis  
• Referral to orthopedics with no improvement  
• NSAIDs or naproxen twice a day  
• May consider short 1- to 2-wk immobilization or bracing  
• PT  
• Follow up in 6 wk, consider referral to orthopedics with no improvement |
| Apophysitis/musculoskeletal conditions: | Tender to palpation over apophysis; ± radiograph findings                                             | Based on local referring pattern, refer to subspecialist who routinely cares for children with neuromuscular conditions (i.e., pediatric physical medicine and rehabilitation, pediatric neurology, and/or pediatric orthopedic surgery) |
| Osgood-Schlatter disease           |                                                                                                     | Based on local referring pattern:  
• NSAIDs or naproxen twice a day  
• Begin PT for desensitization  
• Discontinuation of any bracing  
• Refer to pediatric pain specialty |
| Patella femoral pain               |                                                                                                     | Refer to pediatric orthopedics with positive examination findings or imaging studies (ultrasound or radiograph) |
| Sinding-Larsen-Johansson syndrome  |                                                                                                     | Based on the local referring pattern:  
• Treat with IV antibiotic therapy, typically with inpatient admission  
• Involvement of subspecialists who routinely care for bone/joint infections as necessary (i.e., infectious disease, orthopedic surgery, general pediatrics/hospitalists)  
• Consider immobilization for pain control  
• Remove foreign body  
• Antibiotic prophylaxis as needed  
• Referral to general surgery or orthopedics if bone involvement or surgical excision is required |
| Sever disease                      | Neurology deficits with motor impairment                                                             |                                                                                                                                                    |
| Cerebral palsy                     |                                                                                                     | Based on local referring pattern:  
• NSAIDs or naproxen twice a day  
• Begin PT for desensitization  
• Discontinuation of any bracing  
• Refer to pediatric pain specialty |
| Complex regional pain syndrome     | Pain after an injury, lower limb most common; pain to light touch that is disproportionate to mechanism of injury; evaluate for autonomic symptoms (skin temperature different; color changes; absence or increase of sweating) |                                                                                                                                                    |
| Developmental dysplasia of the hip | Check history for female, first born, breech, and family history; + Ortolani and Barlow signs, asymmetric thigh fold, + Galeazzi sign, + Klisic sign | Based on the local referring pattern:  
• NSAIDs or naproxen twice a day  
• Begin PT for desensitization  
• Discontinuation of any bracing  
• Refer to pediatric pain specialty |
| Discitis                           | Back pain, ± fever, decreased spinal motion, often systemic symptoms and systemically ill           | Refer to pediatric orthopedics with positive examination findings or imaging studies (ultrasound or radiograph) |
| Discitis                           |                                                                                                     | Based on the local referring pattern:  
• NSAIDs or naproxen twice a day  
• Begin PT for desensitization  
• Discontinuation of any bracing  
• Refer to pediatric pain specialty |
| Foreign body                       | Possible history of foreign body, red, swollen, ± radiograph findings                               |                                                                                                                                                    |
| Fracture                           | Swelling/pain with motion/palpation; + radiograph findings: if tender over physis, assume fracture   | Splint and refer to emergency department or orthopedics within a few days if physial, displaced, or angulated |
| Gonococcal/chlamydial arthritis    | + Sexual activity; arthritis of one or more joints; sometimes accompanying dermatitis and systemic signs and symptoms; ± positive nucleic acid amplification tests of synovial fluid, urine, vagina/cervix | • Involvement of local subspecialists as needed (i.e., infectious disease and/or rheumatology), especially if septic joint  
• Antibiotic treatment if septic joint (CDC, 2010)  
• Antibiotic treatment if aseptic joint and chlamydia likely plus pain management (Holmes et al., 2008)  
• Conservative management using symptomatic NSAIDs, massage, warmth, and other supportive measures until the syndrome resolves with time  
• May try a course of PT with muscle stretching and exercise |
<p>| Growing pains                      | Late evening or nighttime lower extremity pains, usually bilateral, resolve with pain reliever/massage, not typical during day; radiographs negative/laboratory results negative |                                                                                                                                                    |</p>
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| Juvenile inflammatory arthritis | Morning pain, often multiple joint involvement, warmth and/or diminished range of motion, CBC, ESR, CRP (consider ANA, AntiDNAse B, ASO, Lyme serology, if clinically indicated) | Based on local referring pattern:  
- Symptomatic relief can be obtained with NSAIDs  
- Referral to a pediatric rheumatologist  
- Restrict weight bearing and refer to orthopedics  
- Restrict activities and refer to orthopedics  
- Refer to orthopedics  
- Refer to the local referring pattern  
- Refer to cdc.gov for most recent treatment guidelines  
- Refer to Red Book: Report of the Committee on Infectious Disease (American Academy of Pediatrics [AAP], 2012)  
- Involvement of local subspecialists as needed (i.e., infectious disease and/or rheumatology)  
- Treat with NSAIDs  
- Refer to orthopedics  |
| Kohler disease                | Pain/swelling mid foot, limp, + radiograph findings navicular bone                                                                                                                                                               | Refer to orthopedics                                                                                       |
| Legg-Calve-Perthes disease    | White boys ages 4-10 y, hip and groin pain, decreased internal hip rotation, radiograph findings: flattening and fragmentation of femoral head                                                                                       | Refer to orthopedics                                                                                       |
| Limb length discrepancy       | ± Limp, not painful, + Galeazzi sign, + AP leg length films                                                                                                                                                                       | Refer to orthopedics                                                                                       |
| Lyme arthritis                | Exposure to endemic area, ± target rash, swelling/pain joints, + Lyme titer with + Western blot                                                                                                                                   | Refer to orthopedics                                                                                       |
| Neoplasm                      | Progressive or intermittent, deep seated, gnawing pain, often worse at night, ± constitutional symptoms, ± elevated laboratory results, ± radiograph findings                                                                          | Based on local referring pattern, expedited referral to pediatric tumor specialist or pediatric oncologist based on local referral pattern |
| Non-accidental trauma         | Injury doesn’t match story, child non-ambulatory with high suspicion fractures, + radiograph findings of affected area                                                                                                             | Based on local referring pattern:  
- Treat injuries and begin further workup to evaluate for non-accidental trauma based on facility guidelines  
- Admit to hospital for safety of patient and further workup  
- Involvement of Child Protective Services and additional subspecialists as needed (i.e., social work, child advocacy teams, neurosurgery, general surgery or trauma teams)  
- Treat initially with activity restrictions, immobilization, and non-weight bearing to affected limb  
- NSAIDs  
- Refer to orthopedics  |
| Osteochondritis dissecans     | Pain ± swelling affected joint, increase with activity, ± catch/locking, + radiograph findings for older child/teen                                                                                                               | Based on local referring pattern:  
- Treat with NSAIDs  
- Refer to orthopedics  |
| Osteomyelitis                 | Local tenderness/swelling bone, limp, ± fever, elevated CBC, ESR, and CRP                                                                                                                                                         | Based on local referring pattern:  
- ± order MRI  
- Refer to orthopedics/emergency department/admission to local hospital  |
| Restless leg syndrome         | Sleep disturbance, normal physical examination, no systemic symptoms, meet National Institutes of Health restless leg syndrome guidelines criteria                                                                                         | Based on local referring pattern, referral to pediatric sleep center                                          |
| Rickets                       | No supplemental vitamin D, darker skin, genu varum and radiograph findings: widening/cupping of the metaphysis; abnormal laboratory findings                                                                                                            | Based on local referring pattern:  
- Refer to orthopedics for treatment of genu varum  
- Treatment of rickets by primary care provider or endocrine team based upon provider  |
| Scoliosis                     | Thoracic/lumbar prominence on Adams forward bend test; asymmetric shoulders/ pelvis; radiograph shows scoliosis                                                                                                                        | Refer to orthopedics                                                                                       |
| Septic joint                  | Pain with joint motion, redness, swelling, warmth, restricted joint motion, non-weight bearing, fever, elevated CBC, CRP, ESR ± blood cultures                                                                                            | Based on local referring pattern:  
- Ultrasound hip joint or proceed with joint aspiration of small joints (if comfortable)  
- May refer to orthopedics, emergency department, or admission to hospital for joint aspiration and continued follow-up with positive cultures |
Part III will cover the most common infectious, immune-mediated, acquired, neoplastic, and metabolic etiologies. Along with the following summary of each differential diagnosis, a reference table and algorithm are included (Table and Figure).

**ACQUIRED CONDITIONS**

**Accessory Navicular**

**Definition**

An accessory navicular condition is an ossification center found on the medial side of the navicular bone. It is found in about 10% of the general population (Staheli, 2006).

**History of present illness**

**Classification**

- Type 1: Rarely symptomatic
- Type 2: Disruption of the synchondrosis probably due to repetitive trauma and likely causing pain and swelling
- Type 3: Bony prominence that can cause irritation with rubbing on shoes (Staheli, 2006)

**Physical examination**

- Tenderness to palpation over the apophysis
- Occasional tenderness to palpation over bony prominence

**Diagnostic tests**

- Anterior-posterior (AP), oblique, and lateral foot radiographs may demonstrate extra bone adjacent to navicular bone
- Consider magnetic resonance imaging (MRI), which may show edema at the insertion of the posterior tibial ligament

**Treatment**

- Symptomatic care
  - Nonsteroidal anti-inflammatory drugs (NSAIDs)
  - Physical therapy
  - Consider immobilizing in a brace, such as a short leg cast or Prowalker, for persistent symptoms
  - If no resolution is achieved with symptomatic care, surgical excision by an orthopedic surgeon may be required (Omey & Micheli, 1999; Staheli, 2006; Sullivan & Anderson, 2000)
Kohler Disease

Definition
Kohler disease is avascular necrosis of the navicular bone.

History of present illness
- Foot pain that might include a limp
- May be preceded by a history of trauma
- Most commonly seen in active boys

Physical examination
Physical examination may show pain, swelling, and erythema at the unilateral midfoot.

Diagnostic tests
- AP/lateral/oblique foot radiographs may show a fragmented, sclerotic navicular bone consistent with avascular necrosis
- Bilateral AP/lateral/oblique radiographs of the feet may be needed for comparison of navicular bone size

Treatment
- Based on symptoms; Kohler disease is a self-limiting condition
- Immobilize with a walking boot (e.g., Prowalker)
- May be weight bearing if symptom free; if pain occurs with ambulation, should be non-weight bearing until symptom free
- Scheduled NSAIDs as needed for symptoms (Herring, 2008; Sullivan & Anderson, 2000)

Legg-Calve-Perthes Disease

Definition
Legg-Calve-Perthes disease is idiopathic avascular necrosis of the unilateral femoral head.

History of present illness
- Legg-Calve-Perthes disease typically is three times more common in boys than in girls; it classically is found in small-for-age, very active children
- Patients have unilateral knee, thigh, or hip pain

Physical examination
- Antalgic (painful) gait/limp
- Complaint of knee or thigh pain (hip pain often is referred to the knee)
- Pain with hip internal rotation and abduction
- May have positive Galeazzi sign due to a leg length discrepancy from the collapse of the femoral head — With the patient in a supine position with the knees flexed and the feet in a plantigrade position, the Galeazzi sign is positive if one knee height is higher than the other (Figure 1)
- Limited abduction of symptomatic hip
- Normal findings of a knee examination

Diagnostic tests
- AP/frog pelvis radiographs reveal avascular necrosis to the femoral head
Occasionally in early stages, radiographs are normal; at that point, consider further workup for a septic joint (complete blood cell count [CBC], erythrocyte sedimentation rate [ESR], and C-reactive protein [CRP]) and, depending on the severity of symptoms and laboratory results, further imaging, including a bone scan (if the patient is young and cannot localize the pain) or magnetic resonance imaging (MRI) of the hip.

If the patient presents with knee/thigh pain, include radiographs of the knee/femur.

### Osteochondritis Desiccans

**Definition**
Osteochondritis desiccans is avascular necrosis of a bone.

**History of present illness**
- Most commonly seen in active, young persons
- Most commonly affects the knee, elbow, and/or talus
- Often the patient has no history of trauma
- Symptoms typically occur with activities
- Reports of swelling are common

**Physical examination**
Physical examination should be performed to check for erythema, pain, joint swelling, and limitation of range of motion of the affected joint.

**Diagnostic tests**
- AP/lateral radiograph of the affected joint
- At some point likely will require MRI evaluation of the articular surface

**Treatment**
- Scheduled NSAIDs
- Non-weight bearing on the affected joint
- Activity restrictions

### Slipped Capital Femoral Epiphysis

**Definition**
Slipped capital femoral epiphysis (SCFE) is displacement of the femoral head relative to the femoral neck and shaft through the physeal plate. It is one of the most common hip disorders of adolescence and occurs more frequently in boys. The exact etiology is unknown, although typically it is seen in children who are obese.

**History of present illness**
- The two most common features of the presentation of SCFE are pain and altered gait
- SCFE occurs most frequently in obese 10- to 14-year-olds, male > female
- SCFE also can be seen in children with trisomy 21 and hypothyroidism
- The mean age of presentation is 12 years in girls and 13.5 years in boys, near the time of peak linear growth
- Knee, thigh, or groin pain is present in 15% of patients
- Children with SCFE may present with a limp

**Physical examination**
- Pain with internal hip rotation or decreased range of motion
- May have prodromal symptoms, that is, hip or knee pain, limp, or decreased range of motion
- Limp
- When knee pain is present, always examine the hip, because knee pain may be referred pain from the hip via the obturator nerve
  — Patients often hold their affected hip in passive external rotation

**Diagnostic tests**
- Positive AP/frog and lateral pelvis radiographs
- Thyroid-stimulating hormone and free T4 hormone in children with a normal body mass index

**Treatment**
- Restrict weight bearing immediately
- Refer to the emergency department or an orthopedic surgeon for surgical stabilization (Herring, 2008; Kienstra & Macias, 2011; Morrissy & Weinstein, 2006; Staheli, 2007; Staheli & Song, 2007)

### Tarsal Coalition

**Definition**
A tarsal coalition is a fibrous, cartilaginous or bony connection between two or more bones of the hindfoot and midfoot.
History of present illness

- Pain in the foot with activity
- May have a flat foot

Physical examination

- Restricted subtalar foot motion
- May have tenderness to palpation

Diagnostic tests

- AP, lateral, and oblique radiographic views of the foot
- Computed tomography scan of the foot for further diagnosis

Treatment

The patient should be referred to orthopedics for surgical treatment (Morrissy & Weinstein, 2006; Omey & Micheli, 1999; Staheli, 2007; Staheli & Song, 2007).

INFECTIOUS CONDITIONS

Discitis

Definition
Discitis is an inflammatory or infectious condition of the thoracic versus lumbar spinal disc spaces.

History of present illness

- Infant/toddler: May display signs of fever, irritability, limping or refusal to walk, and/or nausea/vomiting
- Older child/adolescent: May complain of back, abdominal, and possibly even radiating leg pain; may have a history of a recent respiratory infection and fever
- Average age of onset is 2.5 years for discitis and 7.5 years for discitis with osteomyelitis

Physical examination

- Pain with palpation over the affected area
- Pain with back flexion/extension
- ± Positive straight leg raise
- Normal lower extremity examination with a limp

Diagnostic tests

- Imaging: AP/lateral radiograph of the affected area to rule out another etiology; often the disc space narrowing and end plated changes are not visualized until a few weeks into the disease process
- MRI for definitive diagnosis; perform a bone scan if unsure of the location
- Laboratory tests: CBC with manual differential, ESR, CRP, and blood culture; the CRP often is markedly elevated, and the ESR often is mildly elevated

Treatment

- Typical treatment with intravenous antibiotics followed by a course of oral antibiotics
  — Refer to the most up to date Red Book for current treatment guidelines (AAP, 2012)
  — Assume it is bacterial; the most common organism is Staphylococcus aureus, but the frequency of methicillin-resistant S. aureus continues to increase depending on the geographic location
- Recommend use of a the lumbosacral back brace for comfort
- Refer the patient to orthopedics or an infectious disease specialist based on the guidelines of the institution (AAP, 2012; Herring, 2008; Morrissy & Weinstein, 2006; Shereck & Schwend, 2004; Staheli, 2006)

Gonococcal/Chlamydial Arthritis

Definition

- The causal organism is either gonorrhea (monoarticular septic arthritis as part of disseminated gonococcal infection [DGI]) or chlamydia (reactive arthritis [RA])
- A localized mucosal infection becomes bacteremic and spreads to joints and other systems
- Gonococcal arthritis/DGI is more common in female patients and RA is more common in male patients
- Gonococcal/chlamydial arthritis always should be considered in adolescents who have acute arthritis, even if sexual activity is denied
- An asymptomatic urogenital/pharyngeal sexually transmitted infection is most common in patients with gonococcal arthritis/DGI; urethritis is common with classic RA but may be asymptomatic and thus overlooked

Gonococcal Arthritis

- Gonococcal arthritis may be part of the presentation of DGI (see the following section) or may present solely as a septic joint
- If monoarticular arthritis is the presenting complaint, the knee joint often is affected, but the wrist, elbow, or ankle also may be affected; occasionally sternoclavicular, temporomandibular, or the small joints of the hands
- Gonococcal arthritis is indistinguishable from other causes of septic joints
- A septic joint is always a medical emergency, and infectious disease experts should be consulted promptly in evaluation and treatment
- An increase in third-generation cephalosporin-resistant gonorrhea (the only treatment option that exists)
makes consultation especially important (Bolan, Sparling, & Wasserheit, 2012)

### Disseminated Gonococcal Infection

#### History of present illness
- The classic presentation includes the acute onset of a triad of findings: migratory polyarthritis, dermatitis, and tenosynovitis
  - Symptoms often appear within 7 days of menses and also may occur during pregnancy
  - May have recently had or currently have systemic symptoms (e.g., fever, headache, chills, anorexia, or weight loss)
  - Most likely a continuum of presentations (versus a clearly delineated progression to a septic joint)

#### Physical examination
- Migratory polyarthritis: asymmetrical, most often seen in the wrist and the metacarpophalangeal, ankle, and knee joints
- Arthralgias may be more common as a symptom of DGI
- If a septic joint is present, it usually is monoarticular as previously described
- Dermatitis: often a tender, necrotic pustule on an erythematous base
  - May see macules, papules, pustules, petechiae, bullae, or ecchymosis
  - Found on distal portions of extremities; usually < 30 in number
  - May have resolved by time of presentation (or never been present)
- Tenosynovitis: often affecting multiple joints at once, usually the wrists, fingers, ankles, and toes
  - Pain with passive range of motion at tendon insertion sites (Holmes et al., 2008)

### Reactive Arthritis

#### History of present illness
- Classic presentation is a two-phase process
  - The first phase includes urethritis or cervicitis and may be unrecognized
  - The second phase, which usually occurs within 2 to 4 weeks of the first phase, includes arthritis, conjunctivitis, and dermatitis
- Resolution of symptoms or lack of a classic presentation results in underevaluation and underdiagnosis
- May have had or currently have systemic symptoms (e.g., fever, headache, chills, anorexia, or weight loss)
- Aseptic, immune-mediated synovitis is a hallmark of reactive arthritis

#### Physical examination
- Arthritis: asymmetrical, monoarticular or oligoarticular, and often affects distal weight-bearing joints
  - Knees, ankles, feet
  - Spine and sacroiliac joint
- Sacroiliitis: a combination of synovitis and enthesitis is common
- Enthesitis: inflammation at the transitional zone where collagenous structures, such as tendons and ligaments, insert into bone
  - Occurs most commonly at plantar fascia or Achilles tendon
- Dermatitis
  - Circinate balanitis
  - Keratoderma blennorrhagicum
  - Becomes almost indistinguishable from psoriatic lesions, thus confusing the diagnosis (Holmes, 2008)

### Gonococcal Infection and Reactive Arthritis

#### Diagnostic tests
- Gonococcal (GC)/chlamydia (Chl) nucleic acid amplification tests (NAAT) of urine, vagina, and/or cervix
- NAAT, rectal, and throat cultures for GC/Chl
- Synovial joint aspirate for evaluation
  - For monoarticular joint involvement in which joint sepsis is under consideration, joint aspiration is indicated to include gram stain, NAAT tests for GC/Chl, nucleated cell count, and aerobic, gonococcal, anaerobic, fungal, and mycobacterium cultures
  - A nucleated cell count from joint aspirate is helpful because results are received quickly (within hours), whereas cultures will take days
    - > 50,000 white blood cell count (WBC) with >80% polymorphonuclear leukocytes is consistent with a bacterial infection
    - 25,000-50,000 WBC can be reactive or infectious
    - < 25,000 WBC is likely reactive synovitis
- NAAT results are positive in up to 50% of cases
- CBC, ESR, and CRP levels usually are elevated and consistent with inflammation but not specific for diagnosis

#### Diagnosis
- Often made clinically because culture/gram stain/NAAT tests of synovial fluid are positive no more than 50% of the time
If septic arthritis is possible, treatment should be started and the response used to assess the accuracy of the diagnosis.

**Treatment**

- Suspected gonococcal septic arthritis
  - Treatment should cover all possible bacterial pathogens unless gonococcal arthritis has been proven
  - Treatment of possible/probable gonococcal infection in adolescents
    - Ceftriaxone 1 g intramuscularly every 24 hours until clinical improvement is seen, usually within 48 to 72 hours; then switch to Cefixime, 400 mg twice a day, until 7 total days of treatment
  - Treat for chlamydia as well with azithromycin, 1 g (Centers for Disease Control and Prevention [CDC], 2010)

- Reactive Arthritis
  - Azithromycin, 1 g by mouth if + NAAT or other signs/symptoms consistent with chlamydial RA in adolescents (CDC, 2010)
  - Chlamydial antigens often persist, even after treatment of a localized mucosal infection
  - The mainstay of treatment, beyond azithromycin, is NSAIDs to treat the joint pain and swelling; corticosteroids and other antirheumatic drugs also may be used (Carter and Hudson, 2009; Holmes, 2008)
  - Consult with infectious disease and rheumatology
  - Chronic or recurrent RA is beyond the scope of this practice guideline

**Lyme Arthritis or Other Tickborne Diseases**

**Definition**
Lyne arthritis or other tickborne diseases consist of infection with *Borrelia burgdorferi* (Lyme arthritis) or other pathogens that can present arthritis symptoms.

**History of present illness**
The patient has a history of possible exposure to black-legged ticks and signs and symptoms as discussed in the following sections.

**Physical examination**
- Early localized stage: A red, expanding rash called erythema migrans (EM) occurs in 7% to 80% and presents 3 to 30 days after the bite (average, 7 days); as the rash enlarges, the center may clear, resulting in a “bull’s-eye” appearance; the rash can be associated with fatigue, chills, fever, headache, muscle and joint aches, and swollen lymph nodes
- Early disseminated stage (days to weeks after a tick bite): Additional EM lesions in other areas of the body with development of facial or Bell palsy (loss of muscle tone on one or both sides of the face); additional manifestations include meningitis, pain and swelling of large joints, heart palpitations with vertigo, and night waking pain to extremities; many of these symptoms will resolve over a period of weeks to months, even without treatment; lack of treatment can result in additional complications, described in the following sections
- Late disseminated stage (months to years after a tick bite): Intermittent bouts of large joint pain and swelling, especially of the knees; chronic neurological complaints months to years after a tick bite, including shooting pains, numbness or tingling in the hands or feet, and problems with short-term memory (CDC, 2011)

**Diagnostic tests**
- Lyme serology with Western Blot confirmation
  - First Tier Testing: Enzyme immunoassay or immunofluorescence assay; when results are positive or equivocal, proceed to the second tier
  - Second Tier Testing
    - For signs and symptoms < 30 days: obtain IgM and IgG Western blot
    - For signs and symptoms > 30 days: obtain IgG Western blot only (CDC, 2011)

**Treatment**
- See Red Book for most updated treatment guidelines (AAP, 2012)
- Early localized stage including Bell palsy and erythema migrans without neurologic manifestations
  - < 8 years: amoxicillin, 50 mg/kg/day three times a day × 14 days
  - > 8 years: doxycycline, 4 mg/kg twice a day × 14 days (maximum 100 mg/dose)
- Disseminated disease with acute neurologic manifestations including meningitis and/or radiculopathy
  - Ceftriaxone, 50-75 mg/kg/day every 6 to 8 hours × 14 days, administered intravenously (Wormser et al., 2006)
  - Alternatives include cefotaxime, 150-200 mg/kg/day administered intravenously every 8 hours or penicillin G, 200,000-400,000 units/kg/day administered intravenously every 4 hours with normal renal function (Wormser et al., 2006)
- Antibiotic treatment does not decrease the length of resolution of cranial nerve VII palsy but does prevent further disease sequelae
Refer to infectious disease for complex disease. May need to also consult rheumatology for arthralgias (AAP, 2012; CDC, 2011; Steere, Coburn, & Glickstein, 2004; Wormser et al., 2006)

Osteomyelitis

Definition
Osteomyelitis is infection of bone.

History of present illness
- Possible history of trauma
- Preceding recent upper respiratory infection

Physical examination
- Fever
- Acute change in weight-bearing status
- Localized pain, erythema, and associated joint effusion
- Ill-appearing

Diagnostic tests
- CBC, ESR, and CRP
  - WBC, ESR, and CRP will be elevated
- Normal radiographs unless infection is more than about 2 weeks old
- A bone scan should be performed in young children to localize the infection; an MRI should be performed in older children who can localize their pain
- Perform a bone aspiration with a nucleated cell count and culture if possible

Treatment
- Identify the pathogen if possible; initial antibiotic treatment is based on current Red Book guidelines (AAP, 2012)
- Pathogens
  - <1 year of age: Streptococcus pneumoniae and/or Kingella kingae
  - School age: methicillin-sensitive S. aureus, methicillin-resistant S. aureus, and/or Group A beta streptococcus (AAP, 2012; Herring, 2008; Liu et al., 2011)

Septic Arthritis

Definition
Septic arthritis is bacterial infection in a joint.

History of present illness
- Septic arthritis generally affects a single joint and normally causes extreme joint pain

Physical examination
- Redness, swelling and/or warmth of the joint
- Pain with joint motion
- Restricted joint motion
- Refusal to bear weight
- Fever

Diagnosis
Diagnosis is made via elevated CBC, CRP, and ESR values and possibly via positive blood cultures.

Treatment
- Treatment is based on the local treatment pattern
  - Perform an ultrasound of the hip joint or proceed with joint aspiration of small joints
  - Joint fluid must be sent for cell counts and culture prior to antibiotic treatment
  - Refer to orthopedics, emergency department, or admission to hospital for joint aspiration and therapy based on laboratory data; antibiotic treatment is based on current Red Book guidelines (AAP, 2012; Herring, 2008; Kocher et al., 2003; Mathews et al., 2007; Morrissy & Weinstein, 2006)

**IMMUNE MEDIATED**

Juvenile Idiopathic Arthritis

Definition
Juvenile idiopathic arthritis is any form of arthritis or arthritis condition that develops in a person younger than 18 years (Arthritis Foundation, 2009).

Etiology
- Juvenile idiopathic arthritis is considered an autoimmune condition
  - Polyarticular
  - Pauciarticular
  - Systemic onset

History of present illness
- Morning stiffness or stiffness after naps that tends to resolve in the ensuing hours
- Unilateral or bilateral joint swelling
- May present with a history of trauma
- More common in female patients
- Persistent pain despite use of over-the-counter treatments
Review family history for other diseases including psoriasis, ankylosing spondylolysis, sacro-ileitis, inflammatory bowel disease, or uveitis

Physical examination

- Polyarticular: Usually presents symmetrically, affecting five or more joints; most commonly affected joints are the knees, wrists, and ankles, although the hips, shoulders, neck, and jaw also can be affected
  — Most commonly associated with uveitis
- Pauciarticular/oligoarthritis: Affects four or fewer joints; affects female patients 3:1; a positive antinuclear antibody test in this group suggests high risk for developing uveitis
- Systemic: High spiking fevers, papular rash, general lymphadenopathy, ill appearing, serositis, splenomegaly and hepatomegaly, joint involvement develops slowly but may include up to five “smaller” joints such as fingers and the cervical spine

Diagnostic tests

- Diagnosis of exclusion; must rule out non-inflammatory musculoskeletal conditions that cause joint pain such as Legg-Calve-Perthes, Os-good Schlatter, and SCFE
- AP and lateral radiographs of bilateral lower extremities should be obtained; the radiographs should be normal initially in patients with JIA
- No single laboratory test can diagnosis JIA because it is a diagnosis of exclusion; obtain a CBC, ESR, and CRP to exclude infectious or neoplastic etiology; an elevated ESR and CRP can be associated with JIA, but normal laboratory findings do not exclude the diagnosis; rheumatology may order ASO, anti-deoxyribonuclease B, and Lyme serology in Lyme-endemic areas
  — Additional inflammatory laboratory tests: the antinuclear antibody test will only confirm uveitis; only 3% to 5% of children with JIA have a positive rheumatoid factor

Treatment

- Exclude other etiologies first, especially if the patient has a positive family history of the aforementioned conditions
- Refer the patient to pediatric rheumatology
- Subspecialist care may include scheduled anti-inflammatory drugs such as naproxen, 10-20 mg/kg/day in a divided dose twice a day; diclofenac, 2-3 mg/kg/day in a divided dose three or four times a day; or ibuprofen, 30-40 mg/kg/day in a divided dose two or three times a day (Arthritis Foundation, 2009; Junnilla & Cartwright, 2006; Stanley & Ward-Smith, 2011)

Toxic Synovitis/Transient Synovitis of the Hip

Definition
Toxic synovitis/Transient synovitis of the hip is the most common source of hip pain in the young child. It consists of acute hip pain with a limp in childhood without any associated musculoskeletal or constitutional symptoms.

History of present illness

- Limp may be present
- The patient is afebrile

Physical examination

- Mild/moderate hip pain with motion; the patient should not have refusal to range joint
- May have a limp

Diagnostic tests

- Normal or mildly elevated CBC, ESR, and CRP levels
- A hip ultrasound may show effusion

Treatment

- NSAIDs
- Follow-up in 2 to 3 days or sooner with increased symptoms
- Ambulation as tolerated and restrict sports activities
- Refer to the emergency department or an orthopedic surgeon with increasing pain and/or fever (Herring, 2008; Morrissy & Weinstein, 2006; Staheli, 2007; Staheli & Song, 2007)

NEOPLASM

Definition
A neoplasm is an abnormal growth of tissue that presents with new and uncontrolled proliferation of cells.

History of present illness

- Night waking pain
- Limp
- Systemic symptoms such as unexplained fevers, malaise, weight loss, fatigue, and loss of appetite

Physical examination

- Diminished range of motion to affected/surrounding joints
- Palpable mass
• Tenderness in the affected area
• Limp

Diagnostic tests
• Radiographs of the entire long bone, including AP and lateral
• CBC with differential because leukemia often presents with bone pain; the ESR often is mildly elevated, and the CRP level often is normal
• A bone scan should be performed if the source cannot be localized
• An MRI should be performed if a radiographic abnormality is seen or if the pain can be localized but radiographs are normal and the patient has an abnormal CRP or ESR value

Treatment
The patient should be referred to an oncologist or musculoskeletal tumor surgeon (based on local referral patterns) (Herring, 2008; Staheli, 2007; Staheli & Song, 2007).

METABOLIC
Rickets
Definition
Rickets is a bone disease caused by disturbances in the metabolism of calcium and phosphate, which results in inadequate mineralization of the bone matrix.

Classification
• Nutritional rickets is caused by a diet deficient in vitamin D; it is found especially among children who have had prolonged breastfeeding without vitamin D supplementation, persons who have eaten vegetarian diets, darker skinned populations, or persons with celiac or hepatic disease
• Rickets of prematurity: A result of treatment for and risks of prematurity
• Vitamin D-resistant rickets/familial hypophosphatemic rickets: A normal level of vitamin D is insufficient to achieve normal bone mineralization; genetic link

History of present illness
• Exclusively breastfed with no vitamin D supplementation
• Inadequate vitamin D dietary intake
• Lack of adequate sunlight exposure
• Winter season
• Northern latitudes
• Air pollution/cloud cover
• Malabsorption
• Drugs that increase catabolism
• Liver or kidney disease

Signs
• Enlargement of the skull, that is, frontal bossing or delayed fontanel closure
• Enlargement of the rib cage
• Wrist and ankle widening
• Angular deformities of extremities, that is, genu varum or valgum
• Muscle weakness
• Poor growth
• Delayed tooth eruption
• Increased susceptibility to infection

Symptoms
• Large variability with many patients asymptomatic
• Irritability
• Gross motor delay
• Bone pain
• Seizure due to hypocalcemia
• Failure to thrive

Diagnostic tests
• Radiograph of lower/upper extremities: widening/cupping of the metaphysis most evident in the epiphyseal ends of the bones
• Serum alkaline phosphatase, and if elevated, then 25 OH vitamin D, parathormone, calcium, and phosphorus screening
  — Abnormal laboratory results: serum calcium, phosphate, and vitamin D levels are decreased
• Administer vitamin D
  — < 1 month of age: 1000 International Units (IUs)/day
  — 1-12 month of age: 1000-5000 IUs/day
  — > 12 months of age: > 5000 IUs/day
• A single high dose of vitamin D or a high dose administered intermittently can be considered if poor compliance is demonstrated (100,000-600,000 IUs over 1 to 5 days)
  ▪ Usual course is 6 to 10 weeks (Wagner & Greer, 2008)

Treatment
• Refer the patient to pediatric orthopedics for treatment of lower extremity angular deformity
• Refer the patient to an endocrinologist as needed for treatment

Prevention
• Regular daily intake of vitamin D
  — Infants (0-12 months): 400 IUs
  — Children/adolescents: 600 IUs (Misra, Pacaud, Petryk, Collett-Solberg, & Kappy, 2008)
These doses may need to be adjusted based on measured vitamin D levels and/or clinical population (Herring, 2008; Misra et al., 2008; Morrissy & Weinstein, 2006; Wagner & Greer, 2008).

CONCLUSION

Providers commonly see children and adolescents with lower extremity pain. Although some causes of the pain can be obvious, often the diagnosis can be challenging. The goal of the three-part practice guidelines is to assist the provider in making the correct diagnosis and implementing the most appropriate treatment in a timely manner. Part one of the series provides an evidence-based guideline for evaluating the patient to elicit a diagnosis. Part II addresses traumatic, benign musculoskeletal, referred, developmental, non-painful, and neurologic diagnoses that present with the symptoms of lower extremity pain. Part III focuses on infectious, immune-mediated, acquired, neoplastic, and metabolic conditions that cause lower extremity pain. The Part II and Part III guidelines include the definition, history, and physical examination findings, recommended diagnostic tests, and treatment recommendations for each diagnosis. The overall intent of these guidelines has been to offer providers a detailed concise resource that can be used easily when these patients are seen in clinical practice.

REFERENCES


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