Approach to the Child with a Limp:
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Background

The child with a limp is a common problem seen in pediatrics. A limp is defined as any deviation in walking pattern away from the expected normal pattern for the child's age.

A child may have a limp due to a myriad of different causes, some being benign, and others being life threatening. It is therefore necessary to have a systematic approach.

An understanding of the components of the normal gait cycle will aid in describing abnormalities of gait.

The Normal Gait Cycle:

The normal child begins to walk at 12 to 14 months of age, but it isn't until approximately 3 years that the child will have a mature adult gait pattern. Before this point it is normal to walk with a wide based externally rotated gait, taking a greater number of steps shorter in length. The mature adult gait pattern comprise of 60% of the time in the stance phase (from heel strike to toe off), and 40% of the time in the swing phase (from toe off to the next heel strike).

Limping can be caused by three categorical processes:

1. **Pain** (Antalgic gait): the child will attempt to minimize support time on the painful limb resulting in a decreased stance phase of the affected limb with a compensatory increased stance phase on the opposite side. Pain can originate from bone, joint, or soft tissue and be traumatic, infectious, inflammatory, or neoplastic in origin.
2. **Structural Abnormalities**: limb length discrepancies, angular limb deformities, tortional abnormalities, articular surface abnormalities, muscle contractures or shortened tendons may all result in a limp. These may be congenital or acquired.
3. **Neuromuscular problems, including weakness or ataxia (cerebellar or sensory).** Unsteady gait can be a result of muscle injury, inflammation or dystrophy, or a focal lesion in the central or peripheral nervous system affecting either proprioception or motor control.

DIFFERENTIAL DIAGNOSIS OF LIMP BY AGE:

All Ages:

- □ Trauma
- □ Septic Arthritis
- □ Osteomyelitis
- □ Stress Fracture or overuse syndromes
- □ Neuromuscular
- □ Neoplasm, leukemia

Toddler: 1-3 Years Old

- ☐ Toddlers' Fracture
- ☐ Transient Synovitis
- ☐ Septic Arthritis
- ☐ Developmental Dysplasia of the Hip
- ☐ Leg-length discrepancy

Child: 4-10 Years Old

- ☐ Viral Transient Synovitis
- ☐ Juvenile idiopathic arthritis
- ☐ Legg-Calve-Perthes disease

Adolescent: 11-16 Years Old

- ☐ Slipped capital femoral epiphysis
- ☐ Avascular necrosis of femoral head
- ☐ Chondromalacia
- ☐ Neoplasm
- ☐ Gonococcal septic arthritis

Notes on specific diagnoses:

Septic arthritis:
The most concerning diagnosis, and therefore the cause that needs to be ruled out in all children presenting with a limp, is septic arthritis, as it can lead to joint destruction.

Septic arthritis usually results in exquisite pain that results in the child's refusal to walk or even move at the joint in question. Other signs and symptoms include fever, a toxic appearing child, tenderness, warmth, and soft tissue swelling. A septic joint will result in a joint effusion demonstrated on physical exam.

Laboratory investigations may show elevated ESR, CRP, leukocytes. As mentioned, septic arthritis is a surgical emergency and requires immediate treatment. A unilateral painful joint is septic arthritis until proven otherwise and there is no excuse for not obtaining a joint aspirate. Antibiotics should not simply be started without investigation. If your index of suspicion is high an orthopedic consult should be obtained.

Osteomyelitis:
Osteomyelitis, like septic arththritis, may result in refusal to bare weight. Joint range of motion testing may be decreased or normal.

Remember that it can take 7-10 days for radiographs to show changes in cases of osteomyelitis so a strong index of suspicion is necessary.

Stress Fractures:
Stress fractures occur secondary to repetitive microtrauma. This is often seen in children who begin activity after sedentary periods or after beginning a new sporting activity. Repetitive microtrauma can produce stress fractures of the femoral neck, femoral shaft, tibial shaft and anterior tibial muscles (shin splints), tibial tubercle (Osgood-Schlatter disease), calcaneal insertion of the Achilles tendon (Sever disease)

and metatarsals. They will often not be demonstrated on plain radiographs, but may be observed on bone scan or MRI.

Patellofemoral Pain Syndrome:
An extremely common form of repetitive microtrauma seen in active adolescents is chondromalacia patella also known as patellofemoral pain syndrome. Pain results from improper tracking of the patella often as a result of weakness of the medial thigh muscles (the Vastus Medialis Obliqus or VMO). The child will often describe pain worse with activity, particularly knee bends and stair climbing that is improved with rest. Physical exam demonstrates a positive patellar grind test and painful patellar compression, with a laterally tracking patella also known as a J-sign. Treatment is rest and quadriceps muscle strength balancing.

Bone Tumors:
Both primary benign and malignant bone tumors should be included in the differential diagnosis for all children presenting with a painful limp. If pain is persistent and associated with swelling or constitutional symptoms of weight loss, fatigue, night sweats, and especially if waking the child from sleep, one must act swiftly to rule out malignant processes. Common benign bone tumors include unicameral bone cysts (well circumscribed lytic lesions), aneurismal bone cysts, fibrous dysplasias (ground glass appearance), and eosinophilic granulomas. Malignant bone tumors in children are most often osteogenic sarcoma and Ewing's sarcoma. Plain radiographs often show cortical destruction that may be associated with a periosteal reaction. Skeletal neoplasms often occur in the metaphyseal areas of the long bones, especially the knee and proximal femur. Don't forget that leukemias can also cause a painful limp, therefore it is important to check the blood for atypical lymphocytes.

Toddlers Fracture:
Because the bones of young children are less brittle, relatively minor traumas such as jumping or twisting can result in incomplete fractures. Typically Toddlers' fractures involve the tibia or calcaneous, and are manifested by tenderness to palpation along the bone with subtle spiral fractures seen on radiographs.

Leg Length Discrepancy:
Evaluated by measuring true and apparent leg lengths. It is important to establish the cause of the leg length discrepancy because some can be progressive. Generally less than 2 cm of inequality is acceptable for adult leg lengths. If the predicted length discrepancy exceeds this, orthopedic management is necessary.

Legg-Calve Perthes Disease:
Idiopathic avascular necrosis of the femoral epiphyses occurring in young children most commonly between the ages of 4 and 8 years and more common in males. Usually presents with insidious onset limp with mild activity related pain in the groin, hip, thigh, or knee. Physical exam demonstrates decreased abduction and internal rotation of the hip. Plain radiographs of the hips are often sufficient to make the diagnosis.

Slipped Capital Femoral Epiphysis:
Typically seen in overweight adolescents just prior to the growth spurt. It is more common in males. It is often idiopathic, but may be associated with endocrine diseases including hypothyroidism. Usually presents with pain in hip, thigh, or knee. Physical

exam demonstrates a Trendelenburg gait with external rotation at the hip. Internal rotation of the hip is limited. Plain radiographs of the hip are often sufficient to make the diagnosis. Because a slipped epiphysis is at significant risk for further slipping and destruction of the vascular supply to the head to the femur, once diagnosed the patient should be non weight bearing and immediate referral to orthopedics obtained. 25-40% will have bilateral involvement therefore it is necessary to monitor the contralateral side with serial radiographs to screen for pathology.

QUESTIONS TO ASK ON HISTORY

- □ Duration and Progression of Limp. Make sure to ask if it is getting better or worse
- □ History of Trauma
- □ Characterize any associated pain. Remember that often hip pathology is reflected by knee pain.
- □ Does the pain awaken the child from sleep? This finding is worrisome for malignancy. Search for other constitutional symptoms including fatigue, weight loss and night sweats.
- □ Is the pain unilateral or bilateral? Bilateral leg pain that occurs only at night and is not associated with any limp, pain or other symptoms during the day, may represent “growing pains”, a diagnosis of exclusion.
- □ Characterize any associated weakness, swelling, redness, or stiffness suggesting ongoing inflammation.
- □ Characterize whether there is a time of day during which the limp is worse
    - worse in the morning - may suggest Juvenile Idiopathic Arthritis
    - worse in the evening - may suggest muscle fatigue and weakness
    - constant - may suggest a structural cause including tumors
- □ Systemic Symptoms: Any recent illnesses, fevers, or chills? A recent upper respiratory tract infection can suggest transient viral synovitis. A bacterial infection however can spread hematologically to cause septic arthritis or osteomyelitis. Think of Post-streptococcal reactive arthritis in the child with a recent Streptococcal throat infection.
- □ Family history of rheumatologic or neuromuscular disease
- □ Dietary intake including supplementation with Vitamin D. A deficiency can lead to pathological fractures and Rickets.
- □ How has the limp affected normal activities?

PHYSICAL EXAMINATION

As with all orthopedics physical exams, the evaluation of the limping child should include inspection, palpation, range of motion, and special tests.

See the PGALS (Pediatric Gait Arms Legs Spine) link elsewhere in this module to review an approach to a screening examination, looking for affected joints that might be involved in rheumatologic disease. Here we present a more focused approach to the child with a limp.

Inspection:

- ☐ Don't forget to ensure proper exposure of the child. There should be minimal clothing and the child should be barefoot so that you may observe the feet and toes
- ☐ Gait: Have the child walk barefoot noting any abnormalities in gait. Try to focus on movement at each of the hip, knee and ankle joints through all phases of gait. If an abnormality is noted, try to classify among the following types of abnormal gait:

    1. **Antalgic Gait**: less time spent in stance phase of the affected limb
    2. **Trendelenburg Gait**: the pelvis tilts away from the pathologic hip during stance on the ipsilateral leg. During walking this can appear as shifting of the torso towards the pathological side to compensate for abductor weakness. This is seen in conditions causing hip inflammation or hip muscle weakness.
    3. **Steppage Gait**: commonly is observed in patients with foot drop due to injury to the peroneal nerve or disease causing weakness of the tibialis anterior muscle.
    4. **Toe-walking gait**: is manifested unilaterally when a true or apparent leg length discrepancy is present. It may also be present bilaterally in the case of short Achilles tendons or it may be a behavioral phenomenon.

- ☐ Can the child run, stand on one foot, hop on one foot, walk on heels and toes, squat?
- ☐ Have the child stand on one foot (Trendelenburg test) to assess hip abductor strength
- ☐ Note muscle bulk, swelling, erythema, deformities, asymmetries of the trunk, hips, and lower extremities
- ☐ Evaluate the shoes for unusual wear patterns
- ☐ Measure True and Apparent Leg Lengths
  True leg length is the distance from the anterior superior iliac spine to the medial malleolus. The apparent leg length is the distance from the umbilicus to the medial malleolus. Contractures and muscle spasms can make the lengths seem different, when in fact the skeleton is symmetric. Generally less than 2 centimeters of true inequality is acceptable in an adult
- ☐ Assess the spine for deformities, scoliosis, range of motion, or pain

Palpation:

- ☐ Assess any suspected joints for tenderness to palpation
- ☐ Pay attention to palpation over the hip joints, sacro-iliac joints, greater trochanters, knees and ankles. Test for joint effusions, especially in the knees.

Range of Motion:

- ☐ Assess range of motion, laxity, stiffness and guarding at all suspected joints.

Full Neurological Evaluation

- ☐ Test lower extremities for strength, sensation (especially proprioception), deep tendon reflexes. Also cerebellar testing should be performed should ataxic gait be a concern.

Special tests

- ☐ Assessment of hips with the child prone. Prone internal rotation of the hip is the most sensitive provocative marker of hip pathology
- ☐ FABER Test (Hip **F**lexion, **AB**duction, **E**xternal **R**otation). With the child supine, place the ipsilateral ankle on the contralateral knee and provide slight downward pressure on the ipsilateral knee. This will bring out pain of sacroiliac origin.
- ☐ Galeazzi Test: With the child supine place heels to buttocks with hips and knees flexed. If the knees are different heights this is a positive Galeazzi test, suggesting leg length discrepancy or developmental dysplasia of the hips
- ☐ Measurement of circumference of calves and thighs to look for atrophy

INVESTIGATIONS:

Based upon your careful history and physical examination, the following tests may be helpful in assessing a child with a limp.

- ☐ CBC and differential count
- ☐ Erythrocyte Sedimentation Rate
- ☐ C Reactive Protein
- ☐ Joint Aspiration for cell count, differential, Gram's stain, culture and sensitivity, protein, glucose, and crystals.
  *Note that a negative culture does not rule out a septic joint, as about one third of all septic joint aspirations will not recover an organism. Don't forget that gonorrhea can be a source of septic joints in sexually active adolescents and you should request a special gonococcal culture of the aspirate (separate collection swab).
- ☐ Blood Cultures
- ☐ Imaging
  - The first step is usually obtaining plain film radiographs or areas in question both AP and Lateral. It is often necessary to include the joint above and below the area of question. Films should be done weight bearing when possible.
  - Hip films should have AP, and frog leg lateral
  - Ultrasound of suspected septic joints, joint effusions or abscess
  - Bone scan is a sensitive way to highlight increased metabolic activity seen in stress fractures, infection, fractures, and most tumors
  - CT and MRI as indicated

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