



# Disorders of the Musculoskeletal System

Sharon Stevenson, DNP, APRN, PPCNP-BC

# Disclosures

Sharon B. Stevenson, DNP, APRN, PPCNP-BC

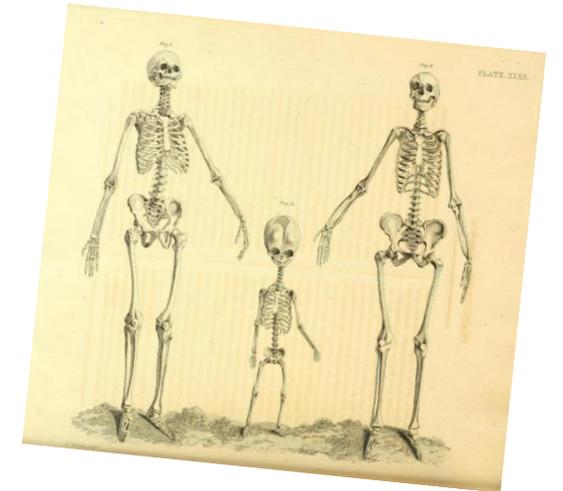
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# Learning Objectives

- Describe the process of history and physical assessment of the musculoskeletal system.
- Summarize common diagnostic tests (laboratory and radiology) utilized when evaluating a musculoskeletal concern.
- Compare and contrast the pathophysiology, clinical presentation, management, and follow-up of the most common musculoskeletal concerns seen in primary care.
- Describe education needs related to the most common musculoskeletal concerns.

# Skeletal Development

- Bones grow in length and width – through growth plates
- **Bone age measured by radiograph of left hand and wrist**
  - Determines maturation
  - Growth tempo
- Bone, muscle development influenced by use
- Nutrition, mechanics, hormones affect bones

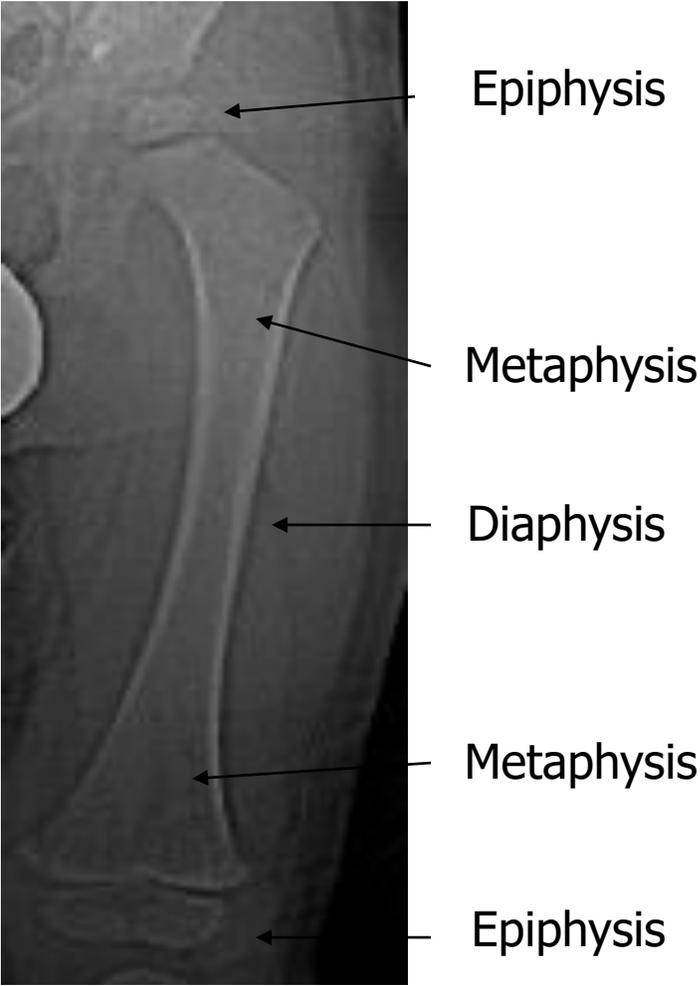


# Skeletal Maturation

- Maturation varies by gender and race
- Maximum rate of long bone growth occurs prior to and after menarche
  - Tanner stage 2 in girls
  - Tanner stage 3 in boys
- Long bones have growth plate (physis)
- **Long bone growth stops ~ 2 years after menarche or damage to the epiphysis can prematurely arrest bone growth**



# Parts of a Growing Bone



Physis = growth plate  
Epi- = on top of  
Meta- = adjacent to  
Dia- = between

# Fractures in Growing Bone

- Heal faster than in adults
- The younger the child, the faster the healing
- Rate of healing also depends on the bone affected, the part of the bone fractured, and the severity of the injury
- Bones are more flexible – allows for unique fractures (buckle, greenstick)
- Growth plate injuries (Salter fractures) can cause growth arrest, leading to shortening or angular deformity

# Assessment of the Musculoskeletal System

- History: Onset, pain, FH, medical/surgical, ROS
- Inspection and palpation
  - Skin color, swelling, atrophy, erythema, ecchymosis, scars, pigmentation
  - Posture while sitting, standing, walking
  - Evaluation of symmetry, ROM, muscle size, strength, tone
  - Reflexes
- Range-of-motion exam
  - Range, flexion, extension, rotation of joint
  - Hypermobility

- **Key Point**

- **Inability to bear weight (knee, ankle)**

- **Key Point**

- **In cases of acute trauma, especially when deformity is evident, defer testing for ligamentous stability, splint extremity and obtain radiographs for possible fracture**

# Assessment

- Gait examination
  - Developmental stages
  - Observe walking with and without shoes; Heel-Toe; In toe or out toe
  - Compare stance and swing phases
  - Shoulder symmetrical
  - Limp
- Posture

- **Key Points:**

- **Trendelenburg gait** (weakness of hip abductors) and **Gower sign** (weak hip extensors and abductors) commonly seen in DMD
- **Equine gait** (toe-walking or toe-to-heel) common with heel cord contracture and limited dorsiflexion



# Assessment

- Muscle Strength & Tone

Grading of Muscle Strength	
Grade	Physical Finding
0/5	No movement seen
1/5	Muscle can move joint with gravity eliminated
2/5	Muscle can move joint against gravity but not against added resistance
3/5	Muscle can move joint against slight resistance
4/5	Muscle can move joint against moderate added resistance
5/5	Normal strength

# Diagnostic Studies

Test	Indications	Conditions
Plain radiograph	Trauma with suspicion of fracture, joint or bone pain or localized tenderness	Fracture Perthes' Bone tumor SCFE
Ultrasound	Identify joint effusion	Septic arthritis Inflammatory arthritis
CT	Complex fractures or bone tumors	Fracture, bone tumors
MRI	Investigate sacroiliac joints (SIJs), temporomandibular joint (TMJ)	JIA confirmation, septic arthritis and osteomyelitis, bone and soft tissue tumors, early Perthes'
Bone scan	Multifocal disease or malignancy	Osteomyelitis, metastatic tumors, occult fractures
Labs (ESR, CBC, blood cultures, ANA, CRP, RA)	Identify systemic disease, infection, inflammatory	Rheumatoid, lupus, sarcoidosis



# COMMON CONDITIONS and INJURIES

# Nursemaid's Elbow

- **Key characteristics:**

- **Radial head subluxation/annular ligament displacement**
- Most common elbow injury (age 1-4 years); Female>Male
- Usually unintentional “pulling” child’s hand or arm to prevent them from falling, or by swinging or twisting child by arms

- **S/S:**

- Holds arm close, elbow bent, and palm down
- **Child refuses to use arm**



# Nursemaid's Elbow

- **Evaluation:**

- Characteristic history and examination
- **Clinical diagnosis**
- X-ray usually not needed

- **Management:**

- **Reduction Maneuver – either hyper-pronation method or supination/flexion method (see procedure handout)**
- Hyper-pronation – Support child's arm at the elbow, place moderate pressure with a finger on the radial head, examiner grips distal forearm with the other hand and hyper-pronates forearm until click felt over the radial head when reduced.
- Supination/flexion – Support child's arm at the elbow, exerts moderate pressure on the radial head, apply gentle traction, supinate forearm fully and flex elbow.

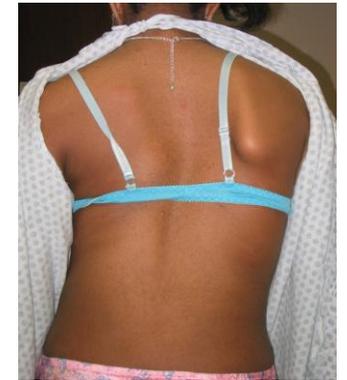
# Scoliosis

- **Key characteristics:**

- Non-structural vs structural
- **Lateral curvature of the spine associated with rotational deformity of the vertebrae and ribs**
- Infantile (ages 0-3 years)
- Juvenile (ages 4-9 years)
- **Adolescent (ages  $\geq 10$  years; most common)**

- **S/S:**

- Differences in shoulder or scapula height
- Waist, truncal or rib asymmetry
- Asymmetry in distance that arms hang
- S- or C- shape curve of spine



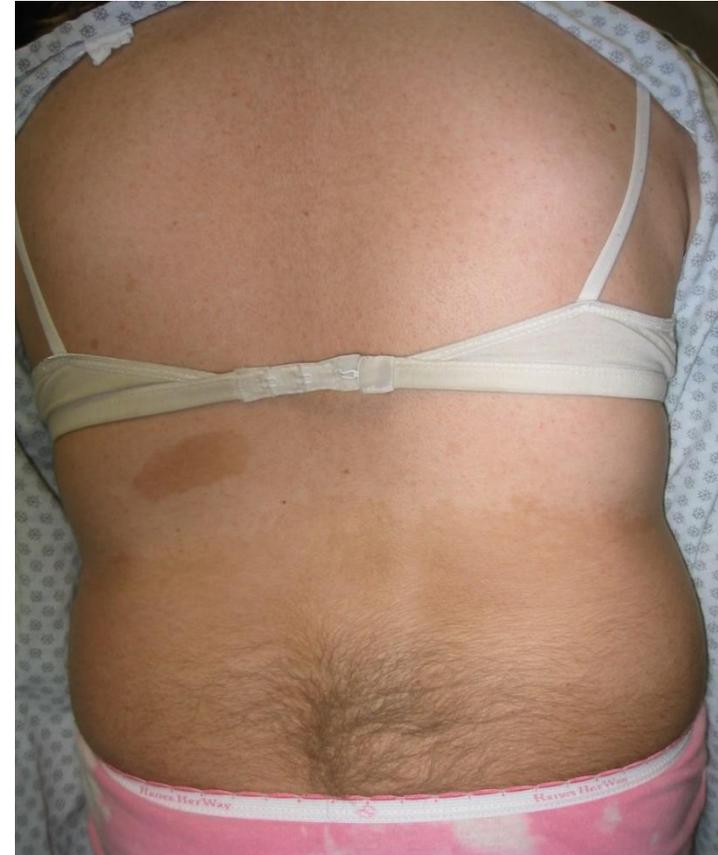
# Scoliosis

- **Evaluation:**
  - Evaluate with minimal clothing
  - **Adams forward bend test**
  - **Scoliometer** -  $> 5-7^\circ$  need further evaluation
  - **Radiographs** – Cobb angle  $> 10^\circ$
- **Management:**
  - Based on skeletal maturity
  - Observation – Cobb angle  $< 20^\circ$
  - Bracing or surgery (if needed)



# Scoliosis

- **Red flags and complications**
  - Cutaneous lesion over the spine
  - Weakness, atrophy, abnormal reflexes – **NOT TYPICAL**
  - Progressively worsening low back pain
  - Untreated scoliosis-  
cardiopulmonary compromise



# Costochondritis

- **Key Characteristics:**

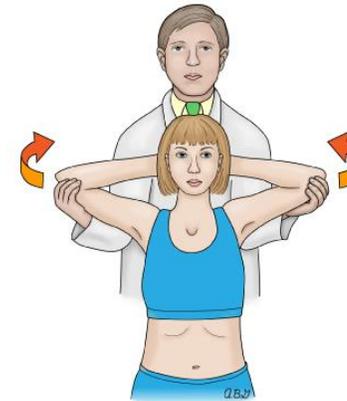
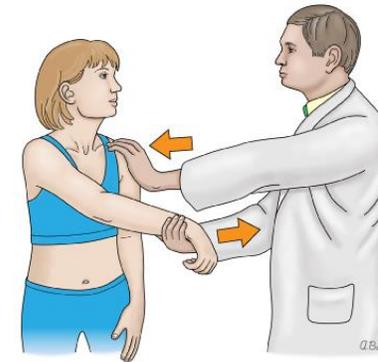
- Common cause of isolated non-traumatic chest wall pain in children and adolescents
- Inflammation of 1 or more costochondral cartilages
- Trauma, heavy lifting (i.e., book bag) can produce chest wall strain

- **S/S:**

- Acute or gradual onset
- Sharp, darting, dull
- Associated with point tenderness of the costal cartilages along the sternal border
- Coughing, sneezing, deep inspiration, movements can exacerbate pain

# Costochondritis

- **Evaluation:**
  - “Horizontal arm traction” or the “crowing rooster” maneuvers typically reproduces the pain.
- **Management:**
  - Analgesics (NSAIDS)



# Legg-Calve-Perthes Disease

- **Key characteristics:**
  - **Idiopathic avascular necrosis of the hip**
  - Usually occurs (between 3 – 12 years; peak 5 – 7 years)
  - Acute or chronic onset
- **S/S:**
  - **Insidious onset limp with groin, thigh, or knee pain**
  - Pain with weight-bearing
  - Muscle spasms
  - Decreased abduction, internal rotation of hip
  - Atrophy of gluteus, quadriceps, hamstrings

# Legg-Calve-Perthes Disease

- **Evaluation:**

- Initial x-rays normal
- **AP & lateral pelvis show early findings of “crescent sign”**
- Bone scan and MRI show perfusion and marrow changes, later revascularization

- **Management:**

- **Non-weight bearing**
- Refer to orthopedist
- Bedrest

# Slipped Capital Femoral Epiphysis (SCFE)

- **Key Characteristics:**

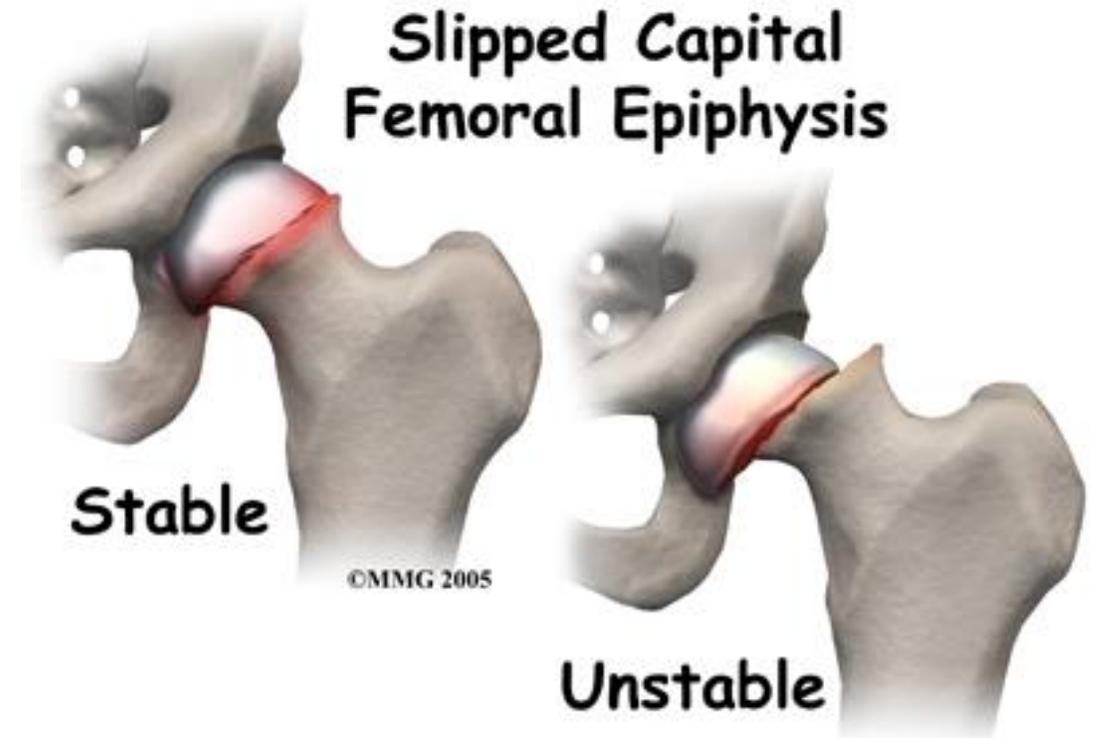
- Femoral neck displaces (“slips”) at physis (growth plate), altering shape of the hip resulting in bone impingement
- Most common hip problem (ages 10-14 years)
- Acute or gradual onset; high occurrence on the opposite side

- **S/S:**

- May complain of **knee, groin, thigh pain**
- Left hip more commonly affected
- **Obesity, delayed puberty**
- External rotation of thigh when hip is flexed
- Limited abduction/extension

# Slipped Capital Femoral Epiphysis (SCFE)

- **Evaluation:**
  - Categorized as stable or unstable
  - AP pelvis, frog-leg lateral views
- **Management:**
  - Place on crutches or wheelchair
  - Immediate referral orthopedist, surgery



# Osgood-Schlatter Disease

- **Key characteristics:**

- Micro-trauma in the deep fibers of the patella tendon at its insertion on the tibial tuberosity
- Painful swelling caused by repetitive stresses
- Male athletes affected > female

- **S/S:**

- Increased pain with activity (running, jumping, kneeling); resolves with rest
- Pain in anterior knee; warm, swelling and tenderness over tibial tubercle



# Osgood-Schlatter Disease

- **Evaluation:**

- Based on history/physical
- **Classic prominent tibial tubercle above physis**

- **Management:**

- Self-limiting; symptom management
- Avoid activities that cause pain
- Ice or cold therapy for inflammation
- Quadriceps-stretching exercises when acute symptoms subside
- **NSAIDs**
- Knee immobilizer



# Septic Arthritis

- **Key Characteristics:**

- Inflammation of a joint due to a bacterial infection (**staphylococcus and streptococcus are the most common**)
- Can occur in children of all ages; M>F

- **S/S:**

- Acute onset
- Knee or hip pain
- Redness, swollen, warm
- High fever, limp, refusal to bear weight, anorexia, appears ill

# Septic Arthritis

- **Evaluation:**

- Elevated WBC, ESR
- Diagnosis confirmed with CT or ultrasound guided aspiration

- **Management:**

- Emergent referral for surgical drainage of joint
- IV antibiotic

# Osteosarcoma

- **Key characteristics:**
  - **Solid tumor of the bone**, most common (ages 15-19 years)
- **S/S:**
  - Local pain, local swelling, and/or tenderness at tumor site
  - Increased pain with activity, limp
  - Fever
  - Soft tissue mass at the end of a long bone
  - Decreased ROM

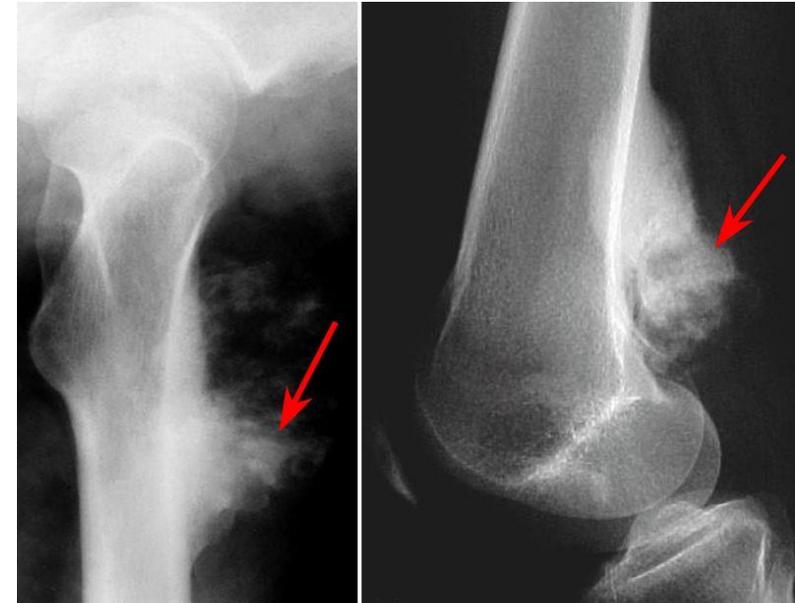
# Osteosarcoma

- **Evaluation:**

- Radiographs
- CT or MRI
- **Biopsy**

- **Management:**

- Chemotherapy
- Surgery



# Sprains

- **Key Characteristics:**

- **Sprains** (a stretch or tear in the ligaments or other connective tissue)
- **Strains** (a stretch or tear in a muscle or tendon) have the highest incidence of occurrence followed by contusions and fractures (ligaments attach bone to bone; tendons attach muscle to bone).
- Wrist, finger, ankle sprains most common
- Sprains are classified as Grade I to Grade III, dependent upon loss of joint stability.

- **S/S:**

- Pain or limp, tenderness to palpation, swelling, discoloration (ecchymosis or erythema)

## Classification of Sprains

Grade	Clinical Signs	Functional Loss
I - Minimal stretching of a ligament with microscopic tears	Mild swelling and tenderness	No joint instability, the patient is able to bear weight and ambulate with minimal pain
II - More severe injury involving an incomplete tear of a ligament	Moderate pain, swelling, tenderness, and ecchymosis	Mild to moderate joint instability with some ROM restriction and loss of function. Weight-bearing and ambulation are painful
III - Complete tear of a ligament	Severe pain, swelling, tenderness, and ecchymosis	Significant mechanical instability, significant loss of function and motion. Unable to bear weight or ambulate

# Sprains

- **Evaluation:**

- History, physical examination, and, when indicated, plain radiographs are often sufficient to make the correct diagnosis.

- **Management:**

- **PRICE:**

- **Protect** with splint/brace; limit weight-bearing
- **Rest** for 24 to 72 hours or until the pain resolves
- **Ice**
- **Compression** with an elastic bandage to decrease bleeding or swelling until edema is resolved
- **Elevation** at or above heart level

# Sprains (continued)

- **Management:**

- NSAIDs
- Mild exercise (passive range of motion and stretching after 1 to 2 days of rest)
- Strengthening exercises (gradual, beginning with isometric exercises)
- Return to sports/physical activities: when fully recovered
- Grade III orthopedist referral

# Overuse Syndrome

- **Key Characteristics:**

- Repetitive movement injury
- Microtraumatic damage to bone, muscle, tendons, ligaments
- Chronic pain during and/or after physical activity

- **S/S:**

- Dependent upon joint/extremity involved

- **Evaluation:**

- Assess for swelling, erythema, tenderness

- **Management**

- Ice following the activity
- Rest
- NSAIDs
- Strengthening exercises
- Immobilizer brace if pain is severe and persistent

# Fractures

- **Key Characteristics:**

- Damage to bone or joint as a result of trauma
- Most common causes: abuse, sports, falls, MVA or pedestrian/bicycle events
- Fractures suggestive of abuse: ribs, long bone, skull, fingers, clavicle/scapular, vertebral

- **S/S:**

- Pain, **point tenderness**, swelling, ecchymosis or erythema, loss of function, obvious deformity

# Fracture

- **Evaluation:**
  - AP/L or both obliques
  - CT or MRI for complex injuries
- **Management:**
  - Immobilization/splinting, compression, ice, elevation
  - Pain medication (initially narcotic)
  - Emergent referral to pediatric orthopedist

# Question 1

3-year-old Sarah is brought to the clinic by her mother who reports that the child refuses to use the right arm after being swung by both arms while playing. The child is sitting with the right arm held slightly flexed and close to the body. What will the primary care pediatric nurse practitioner do?

- A. Immobilize the arm with a sling and refer to orthopedics.
- B. Gently attempt a supination and flexion technique
- C. Consider maltreatment
- D. X-ray the child's right arm and elbow

# Question 1

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**Answer: Gently attempt a supination and flexion technique**

# Question 2

A 14-year-old boy who is overweight develops a unilateral limp with pain in the hip and knee on the affected side. Physical exam reveals external rotation of the hip when flexed and pain associated with attempts to internally rotate the hip. What is most important initially when managing this child's condition

- A. Provide information on weight loss
- B. Refer to Physical therapy
- C. Place child on crutches or in wheelchair to prevent weight bearing
- D. Recommend referral to orthopedic specialist

# Question 2

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**Answer: Place child on crutches or in wheelchair to prevent weight bearing**

# Question 3

An overweight adolescent boy complains of pain in his hip that radiates to the medial aspect of his knee. He denies trauma and has not had a fever. You note upon exam that he is walking with a limp. The most likely diagnosis is:

- A. Slipped capital femoral epiphysis
- B. Transient toxic synovitis
- C. Legg-Calve-Perthes
- D. Septic arthritis

## Question 3

An overweight adolescent boy complains of pain in his hip that radiates to the medial aspect of his knee. He denies trauma and has not had a fever. You note upon exam that he is walking with a limp. The most likely diagnosis is:

**Answer: Slipped capital femoral epiphysis**

# Question 4

Ben is an 11-year-old soccer player and presents in the clinic with pain and swelling in both knees. A physical examination reveals swelling and focal tenderness at the tibial tuberosities, with pain worsening when asked to extend the knees against resistance. What is the treatment for this condition?

- A. Obtain radiographic studies to rule out fractures or ligament tears
- B. Refer to a pediatric orthopedic specialist to evaluate the need for surgery
- C. Apply ice packs to both knees and avoid activities that cause pain
- D. Begin quadriceps stretching exercises to prevent further injuries

# Question 4

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**Answer: Apply ice packs to both knees and avoid activities that cause pain**

## Question 5

What clinical sign will the PNP elicit when assessing a child with a Grade II ankle sprain?

- A. Moderate pain, swelling, tenderness, and ecchymosis
- B. Mild swelling and tenderness
- C. Severe pain, swelling, tenderness, and ecchymosis
- D. Point tenderness and deformity

## Question 5

What clinical sign will the PNP elicit when assessing a child with a Grade II ankle sprain?

**Answer: Moderate pain, swelling, tenderness, and ecchymosis**

## Question 6

A young adolescent reports chest pain associated with coughing and lifting. Physical examination reveals tenderness over several ribs, radiating to the back. Auscultation of the heart, lungs, and abdomen are normal. There is no history of injury. What will the PNP do?

- A. Order EKG
- B. Obtain chest x-ray
- C. Refer to pediatric orthopedist
- D. Recommend ibuprofen, stretching exercises and ice pack

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