

Bros Don't Let Bros Skip Leg Day

Lower Extremity Injury and Evaluation

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Disclosures

I have no relevant relationships with ineligible companies to disclose within the past 24 months. (Note: Ineligible companies are defined as those whose primary business is producing, marketing, selling, re-selling, or distributing healthcare products used by or on patients.)

Educational Objectives

- Recall common lower extremity injuries
- Identify differential diagnosis based of common lower extremity injuries based on history of present illness.
- Identify common lower extremity injuries on imaging
- Explain treatment for common lower extremity injuries

Abbreviations

- HPI = History of Present Illness
- MOI = Mechanism of Injury
- ROM = Range of Motion (Active, Passive, Resisted)
- TTP = Tenderness To Palpation
- DTR = Deep Tendon Reflexes
- ROM = Range of Motion (Active, Passive, Resisted)
- ESR = Erythrocyte Sedimentation Rate
- CRP = C-Reactive Protein
- WBC = White Blood Cell
- CT = Computed Tomography
- MRI = Magnetic Resonance Imaging
- ED = Emergency Department
- NSAID = Nonsteroidal Anti-inflammatory Drugs
- NWB = Non-Weight Bearing
- WBTT = Weight Bearing To Tolerance
- PT = Physical Therapy
- RICE = Rest, Ice, Compression, Elevation
- ORIF = Open Reduction Internal Fixation

Lower Extremity History

- Location of pain
- Duration of pain
- Type of Pain
- Altered Gait
- Alleviating and Aggravating
- Radiating Pain
- Paresthesia, Numbness, Weakness
- Mechanism of Injury or Atraumatic
- Edema, Effusion
- Ecchymosis
- Rash, open sores
- Previous Injury or Surgery
- Pertinent Medical History
- Associated Symptoms (fever, URI, GU, skin)

Lower Extremity Evaluation

- Initial Observation: Gait, posture, standing, gross movement, scars, ecchymosis, lesions, edema, atrophy, deformity, guarding
- History of Present Illness
- Scanning Examination (edema, ttp)
- Active Range of Motion (AROM)
- Passive Range of Motion (PROM) with overpressure
- Resisted Range of Motion (RRROM)
- Deep Tendon Reflexes
- Sensation
- Special Tests
- Imaging?

Lower Extremity Differential Diagnosis

Acute Pain

- Fracture
- Dislocation
- Contusion
- Sprain
- Strain
- Muscle/Tendon Tear/Rupture
- Deep Vein Thrombosis
- Infection
- Gout/Pseudogout

Subacute Pain

- Bursitis
- Stress Reaction or Fracture
- Tendonitis

Chronic Pain

- Referred pain
- Neurological
- Osteoarthritis
- Autoimmune
- Mass/Malignancy

Muscle Strain

- Generally sudden onset
- Exam:
 - TTP of muscle
 - Possible defect, ecchymosis, weakness
 - Painful AROM, PROM with overpressure, and RROM
 - Check neurological status
- Treatment generally includes RICE, gentle stretching, WBTT

Deep Vein Thrombosis

- Wells Score
 - Active Cancer (+1)
 - Bedridden recently > 3days or major surgery w/in 12 weeks (+1)
 - Calf swelling >3cm unilateral (+1)
 - Collateral superficial veins present (nonvaricose) (+1)
 - Entire leg swollen (+1)
 - Localized tenderness along deep venous system (+1)
 - Pitting edema, confined to symptomatic leg (+1)
 - Paralysis, paresis, or recent plaster immobilization of LE (+1)
 - Previously documented DVT (+1)
 - Alternative dx to DVT as likely or more likely (-2)

Gout

- Gout is inflammatory arthritis that can affect any joint of the body but commonly lower extremity.
- Men 40 – 60 years old
- Intraarticular “negatively birefringent needle-shaped intracellular crystals” (www.orthobullets.com)
- Presentation: Recurrent acute exacerbation, joint swelling, severe pain/tenderness.
- Diagnosis: on exam and if tolerated joint aspiration
- Xray: may show tophi (soft crystal deposits)
- Treatment: indomethacin or colchicine (chronic allopurinol)

Pseudogout

- Inflammatory arthritis
- Differs from gout:
 - Generally elderly
 - Affects more proximal joints (knee and wrists)
 - weakly positive birefringent rhomboid-shaped crystals on aspiration
- Presentation: Recurrent joint pain, stiffness, swelling (monoarticular)
- Xray: may show calcification of fibrocartilage (meniscus)
- Treatment: NSAIDs, splint

Gout and Pseudogout Xray



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Septic Joint

- Most common in knee, hip, shoulder, elbow, ankle, sternoclavicular joint
- Presentation: Pain and loss of function of joint, cannot tolerate even PROM or micro-motions. Possible fevers or toxic appearing.
- Imaging:
 - Xray: may rule out osteomyelitis
 - Ultrasound: used to guide aspiration and confirm effusion
 - MRI, CT with contrast not standard in ED.
- Labs: elevated WBC, ESR, CRP
- Joint aspiration is gold standard:
 - appears cloudy or purulent,
 - cell count with WBC >50,000 (should include gram stain, culture, crystal analysis)
- Treatment: Wash out in operating room and admission for IV antibiotics.
- Consider hardware infection, STD testing, post-Streptococcal Reactive Arthritis (8-14 and 21-37yo)

Hip Fractures



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Transient Synovitis of Hip

- Most common cause of hip pain in pediatric patients
- Age 4- 8 years old, Males > Females
- Presentation:
 - Acute unilateral pain, Refusal to walk vs antalgic gait improving throughout the day.
 - Decrease internal rotation, guarding in flexion, abduction, external rotation (FABER).
 - Painless PROM
 - +/- Fever, recent illness (viral, bacterial, allergic, trauma)
- Imaging:
 - Xray usually normal
 - Ultrasound for effusion
- Labs: Usually normal WBC and CRP.
- Kocher Criteria
- Treatment: NWB, observe with NSAIDs 24hrs.

Kocher Criteria

- Four Criteria
 - WBC >12,000 cells/ μ l of serum
 - Inability to bear weight
 - Fever >101.3^o F (38.5^o C)
 - ESR >40 mm/h
 - Modified Kocher Criteria includes CRP (CRP > 2.0 (mg/dl) in combination with refusal to bear weight yields a 74% probability of septic arthritis)
- Order of sensitivity: fever > CRP > ESR > refusal to BW > WBC
- probability of septic arthritis may be as high as 99.6% when all four criteria above are present
- if none of the above predictors are present, probability of having septic arthritis is <0.2%

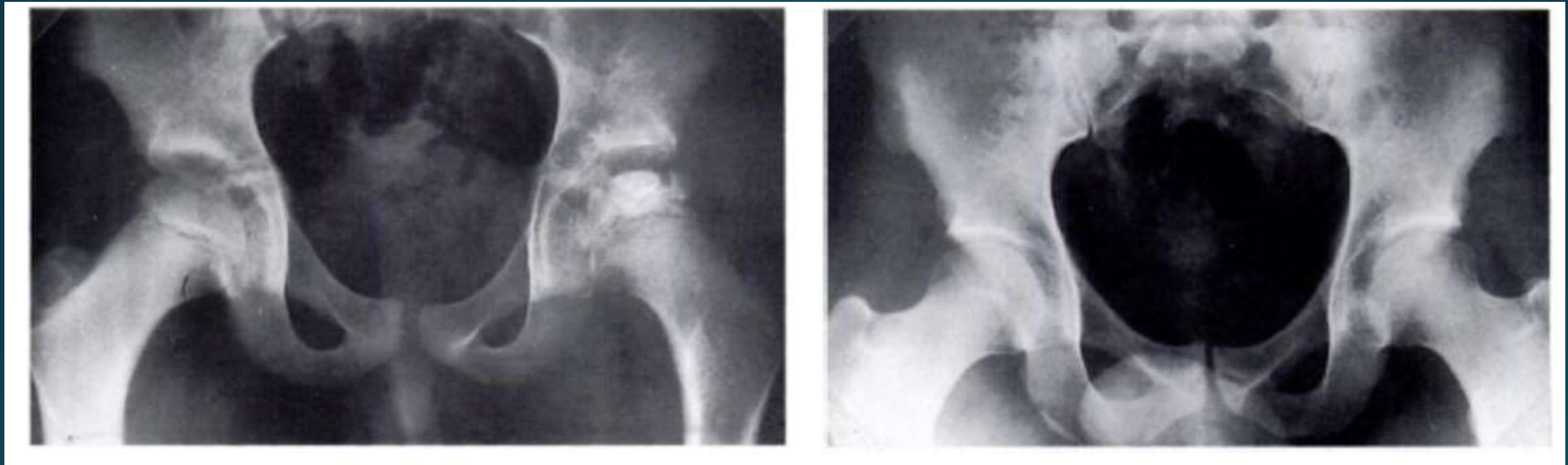
Septic Arthritis of Hip

- Similar in presentation to Transient Synovitis of Hip
 - Same FABER position on presentation
 - Recent trauma or infection (viral vs bacterial)
- Differences
 - Generally under 2 yo
 - Likely febrile
 - Painful PROM, refusal to move hip
- Imaging:
 - Xray: likely normal
 - Ultrasound for effusion
- Treatment: Surgical Emergency

Legg-Calve-Perthes Disease

- Idiopathic avascular necrosis of proximal femoral epiphysis in children generally aged 4-8y. M > F and 12% b/l but rarely at same stage of disease
- Presentation: insidious onset, intermittent pain and limp
- Examination: loss of internal rotation and abduction, antalgic limp, Trendelenburg gait (weakened abductors)
- Imaging is critical for diagnosis:
 - Xray with medial joint space widening, irregularity of femoral head, crescent sign (subchondral defect)
 - MRI difficult
- Treatment: NSAIDs, NWB, PT for ROM.
- Refer to orthopedic surgeon for full eval

Legg-Calve-Perthes Disease Xray



Slipped Capital Femoral Epiphysis

- Most common hip disorder affecting adolescent
 - Obese males more common
 - Generally occurs during periods of rapid growth 10-16 yo
 - Can be bilateral
- Presentation: FABER position, antalgic gait, quadriceps atrophy
- Xray:
 - Kleins Line
 - "S" Sign
 - Growth plate widening or lucency
 - Blurring of proximal femoral
- Treatment: Surgical fixation

Slipped Capital Femoral Epiphysis Xray



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Avascular Necrosis/Hip Osteonecrosis

- Caused by reduced blood flow to the femoral head
- Risk factors: Trauma, steroid use, alcoholism, autoimmune disorder, hypercoagulable states
- Presentation: insidious onset, anterior pain with stairs/inclines
- Examination: normal initially, later with similar exam to OA with limited ROM particularly internal rotation
- Xray: cystic or sclerotic changes, later subcondral collapse or crescent sign, later flattening of femoral head with narrowing of joint space, last with advanced degenerative changes
- Treatment:
 - Generally observation
 - Management of underlying condition.
 - Surgical for advanced disease subchondral collapse

Avascular Necrosis/ Hip Osteonecrosis Xray



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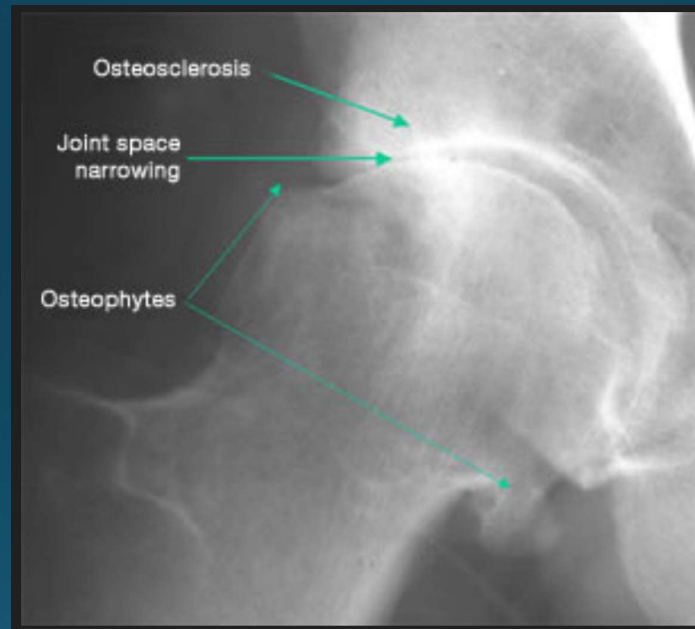
Piriformis Syndrome

- Sciatic nerve compression at the hip musculature, particularly piriformis.
- Presentation: Pain starts in posterior gluteal area sometimes with radiating pain to post thigh. Reproducible or exacerbated by palpation of piriformis
- Special Test: FAIR test causing pain
- No imaging: Diagnosis on clinical examination
- Treatment: RICE, NSAIDs, muscle relaxers, PT, steroid injections near piriformis

Hip Osteoarthritis

- Degenerative joint disease causing progressive articular cartilage loss at femoral head and acetabulum
- Female > Male, advanced age or trauma/overuse
- Presentation:
 - Pain at night or rest, first thing in morning, may improve with some movement in early phases.
 - Grinding, clicking, locking. Loss of full extension or internal rotation
- Xray: joint space narrowing, osteophytes, subchondral defects/sclerosis/cysts
- Treatment:
 - NSAIDs,
 - cane (contralateral side), weight loss, modify activities
 - corticosteroid injections
 - surgical intervention including total hip arthroplasty

Hip Osteoarthritis Xray



Hip Bursitis

- Trochanteric Bursa most common
 - Generally caused by repetitive trauma, Iliotibial Band tracking over the bursa
 - TTP over bursa at lateral hip/greater trochanter
 - No imaging: Diagnosis on clinical examination
 - Treatment: NSAIDs, stretching, PT, corticosteroid injections.
- Ischiogluteal Bursa – prolonged sitting
 - Ischium and gluteus maximus

Knee Pathology

- Direct vs Indirect Trauma
- Overuse
- Valgus/Varus force
- Hyperextension
- Twisting/Pivoting Injury
- Clicking and Locking
- Instability

Patella Maltracking

- Dynamic movement between patella and trochlea of the femur with maltracking due to imbalance
- Young women
- Leads to osteochondral defects or possible patella dislocation or subluxation
- Imaging: diagnosis on clinical examination
- J sign: “visual lateralization of the patella as it disengages from the trochlea when extending the knee” (www.orthobullets.com)
- Treatment: RICE, NSAIDs, PT for strengthening

Patella Dislocation/Subluxation

- Usually noncontact injury with twisting or pivoting
 - Reflexive contraction of quadriceps will spontaneously reduce dislocated patella.
- Risk factors: previous dislocation, patella alta
- Presentation: anterior knee pain, possible hemarthrosis or peripatellar effusion
- Special Test: Patella apprehension, Ballottement
- Imaging:
 - Xray: only to rule out fracture of medial patella facet or lateral femoral condyle or loose body
 - MRI: Medial retinacular or medial patellofemoral ligament tear
- Treatment:
 - NSAIDs, RICE, PT
 - Short term immobilization with modified immobilization for 6 weeks
 - J sleeve brace
 - May require surgical intervention for loose body or failed conservative treatment

Meniscus Tear

- MOI: Overuse, traumatic, in conjunction with other knee injuries.
- Presentation varies: knee joint pain, clicking, locking, catching, giving away
- Males > Females
- Special tests: McMurray, Apley, Thessaly (all lack accuracy)
- Imaging: MRI
- Treatment:
 - Surgical intervention preservation, repair, and reconstruction.
- NOTE: Arthroscopic partial meniscectomy is recently falling out of favor with no better outcomes than placebo.

Medial Collateral Ligament Injury

- Most common ligamentous injury of the knee
- Males > Females
- MOI: Valgus force with foot planted usually contact
- Presentation: Medial joint pain, instability, effusion
- Special test: Valgus stress test at 0° and 30° flexion
- Treatment:
 - Grade I: NSAIDs, RICE, PT. Likely return to full activities 5-7 days
 - Grade II: Add hinged brace. Likely return to full activities 2-4 weeks
 - Grade III: possible immobilization for comfort only then hinged brace. Return 4-8 weeks. Consider surgical intervention.

Medial Collateral Ligament Injury Grading

Hughston Modification of the AMA Classification	
	<p>Based on joint laxity and injury severity. Severity graded by the extent of tenderness and quality of the endpoint with valgus stress at 30. Degrees of knee flexion. Often referred to as "degree" of injury.</p>
Grade I	<p>Mild First-degree injury Firm endpoint with no joint laxity Stretch injury or few MCL fibers torn (no significant loss of ligament integrity)</p>
Grade II	<p>Moderate Second-degree injury Incomplete / partial MCL tear Firm endpoint +/- mild increase in joint laxity Some MCL fibers remain intact, generating the firm endpoint</p>
Grade III	<p>Severe Third-degree injury Complete MCL tear No endpoint with valgus stress Increased joint laxity (subdivided by degree of joint laxity) Grade 1+: 3-5 mm Grade 2+: 6-10 mm Grade 3+: > 10 mm</p>

Anterior Cruciate Ligament Rupture

- MOI: Generally noncontact pivoting injury
- Presentation: feel/hear a pop, usually able to ambulate shortly after but feel instability, hemarthrosis
- Female > Male
- Special Tests: Anterior Drawer, Lachman's, Lelli/Lever test, Pivot Shift
- MRI gold standard
- Treatment: RICE, WBTT, PT
 - Refer to orthopedic surgeon to discuss operative repair versus conservative treatment only.
- NOTE: Unhappy Triad

Lateral Collateral Ligament Injury

- Rare when not concurrent with trauma or other ligamentous injuries
- MOI: Varus force with leg planted
- Presentation: Lateral joint pain, effusion, instability with pivoting
- Special tests: varus stress test
- MRI
- Treatment:
 - limit immobilization, RICE, NSAIDs, PT
 - Return to full activity likely 6-8 weeks
 - Unlikely surgical if only injury

Posterior Cruciate Ligament Injury

- MOI:
 - Direct blow to proximal tibia with flexed knee (dashboard injury)
 - noncontact hyperextension, or hyperflexion with plantar flexed foot
- Presentation: Effusion and instability
- Special Tests: Posterior drawer, Posterior Sag Sign
- MRI
- Treatment:
 - Grade I and II: NSIADs, RICE, PT with return in 2-4 weeks
 - Grade III relative immobilization in extension for 4 weeks. Possible surgical intervention

Bursitis

- Knee Bursa
 - Prepatellar (most commonly involved)
 - Superficial and Deep Infrapatellar
 - Tibiofemoral
- MOI: Excessive kneeling, common in wrestlers
- Infectious versus non-infectious
 - 20% are septic
 - Aspiration should be discussed with ortho surgeon first, rarely indicated
- Treatment: compression wrap, NSAIDs, rarely resections

Popliteal Cyst

- Located in posterior knee in popliteal fossa, most easily seen with knee in full extension.
- In adults most associated with a meniscal tear. In children herniated post knee joint capsule synovium
- Imaging: Ultrasound versus MRI
- Treatment:
 - In most cases observation with spontaneous resolution in children.
 - RICE, NSAIDs, PT in most cases
 - Aspiration and steroid injection with isolated Baker's Cyst in younger patients
 - Arthroscopic treatment if symptomatic, unable to repair meniscus. High recurrence rates

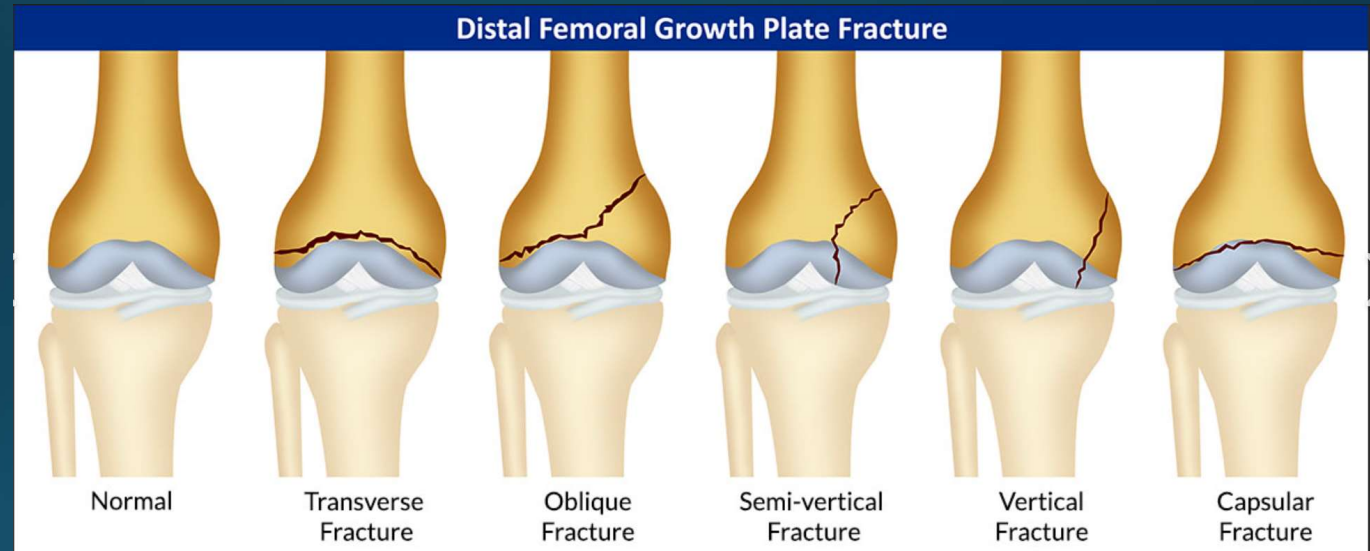
Patella Tendinopathy

- MOI: Jumping sports, repetitive force
- Males > Females
- Presentation:
 - Anterior knee pain and TTP patella tendon
 - Reproducible with knee extension RROM
 - Basset's Sign
- Tibial Tubercle Apophysitis (Osgood Schlatter's Disease)
 - Traction apophysitis of the tibial tubercle
 - Males (12-15yo) > Females (8-12yo)
 - Presentation same and also tenderness and enlarged tibial tubercle
- Sinding-Larson-Johansson Syndrome
- Imaging not necessary: Diagnosis on clinical exam
- Treatment: RICE, NSAIDs activity modification, patella strap

Patella Fracture

- MOI: Direct fall onto patella
- Xray: Horizontal versus Vertical
- Treatment:
 - Conservative:
 - if intact extensor mechanism (able to perform straight leg raise), nondisplaced or minimally displaced fracture, vertical fracture, if patient has significant comorbidities unable to have ORIF
 - Knee immobilization in extension. WBTT.
 - Surgical:
 - If extensor mechanism failure, open fracture, horizontal fracture displaced >3mm, articular step off, loose bodies.
 - Knee immobilization in extension and WBTT until ORIF

Distal Femur Fracture



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Proximal Tibial Fracture



Tibial Plateau Fractures

- Usually require ORIF
- Can result in vascular injury
- May be difficult to see on xray if nondisplaced
- CT helps with surgical planning

Tibial Metaphyseal Fractures

- Children 3-6 years old
- Can develop valgus deformity later
- Nonoperative or closed reduction and casting



Ankle Sprain

- Lateral Ankle
 - Inversion injury
 - Anterior Talofibular Ligament, Calcaneofibular Ligament
 - Special tests: Anterior Drawer, Talar Tilt
- Medial Ankle
 - Deltoid ligament
 - Rarely isolated injury
 - May be surgical
- High ankle/Syndesmosis Sprain
 - Forced DF or ER, spreading the mortis
 - Distal tibiofibular ligament
 - Kleiger's external rotation test, squeeze test (Hopkin's) at mid calf
 - NWB, cast/boot for 2-4 weeks syndesmosis fixation if mortis widened

Ottawa Ankle Rules

- Inability to BW
- Medial or lateral malleolar point tenderness
- TTP base of 5th MT
- Navicular TTP

- Consider MRI if:
 - xray negative and high suspicion of syndesmosis injury
 - prolonged pain and inability to BW with negative xray
 - pain persists 6-8 weeks.

Achilles Tendinopathy

- MOI: Tightness in heel cord causing thickening, generally middle-aged adults, overuse, poor blood supply, inflammatory arthritis, fluoroquinolone use
- Presentation: posterior heel pain, irritation from shoe wear, painful plantar flexion, possible palpable thickening of tendon, bony enlargement
- Achilles tendonitis
- Retrocalcaneal Bursitis/Haglund Deformity (enlargement of the posterosuperior tuberosity of the calcaneus)
- Xray/MRI
- Treatment: RICE, NSAIDs, heel lifts, PT for gastric and soleus stretching. CAM boot
- Sever's Disease: calcaneal apophysis

Achilles Tendon Rupture

- MOI: Male > Female, weekend warrior, feel or hear pop
- Presentation: Palpable defect, weak plantar flexion
- Special Test: Thompson Test
- Imaging:
 - Ultrasound partial vs complete tear
 - MRI if retracted for surgical repair
- Treatment: Consult surgeon
 - Nonoperative bracing/casting in resting equinus
 - If partial likely gradual decrease of heel lift after casting
 - Likely operative for complete tear

Plantar Fasciitis/Heel Spur

- Inflammation of plantar fascia aponeurosis, usually at origin on calcaneus.
- MOI: Overuse
- Presentation:
 - Sharp pain on plantar surface of foot.
 - Worse first step in am and after long day of standing.
- Imaging: No imaging needed but can show heel spur on calcaneus, may be needed pre surgical
- Treatment:
 - Conservative: RICE (frozen water bottle), night splints, stretching with PT, orthotics
 - Surgical: heel spur, plantar fasciotomy

Forefoot Pathology

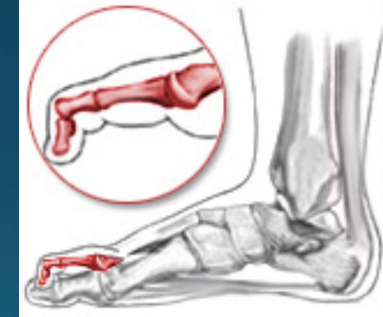
- Midtarsal Foot Sprain
- Turf Toe
 - Hyperextension injury to plantar plate of 1st MTP
 - Painful push-off
- Charcot Foot
 - “chronic and progressive disease that occurs as a result of loss of protective sensation (neuropathy) which leads to the destruction of the foot and ankle joints and surrounding bony structures”
 - Xray:
 - obliteration of joint space and fragmentation of both articular surfaces
 - leading to subluxation or dislocation of forefoot bones
 - Complications: Painless therefore leading to skin breakdown and recurrent infections. Amputations

Charcot Foot Xray



Toe Deformities

Claw toe vs. Hammer toe vs. Mallet toe			
	Claw Toe 📷	Hammer Toe 📷	Mallet toe 📷
DIP	Flexion	Extension	Flexion
PIP	Flexion	Flexion	Normal
MTP	Hyperextension	Slight extension	Normal

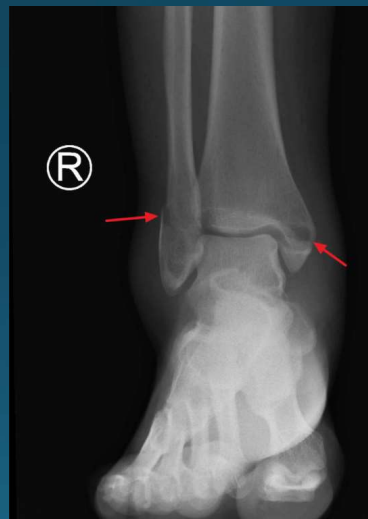


Malleolar Fractures

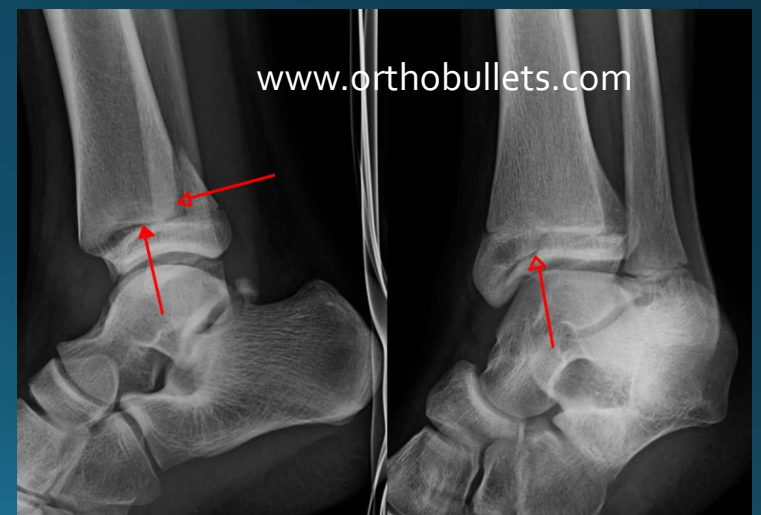
Unimalleolar



Bimalleolar



Trimalleolar



Malleolar Fractures



Maisonneuve Fracture

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Foot Fractures



Take Home Points

- A good history is just as important as your examination
- Trust your gut!
 - Don't blindly believe the initial Xray report. Do full examination
 - If a kid refuses to BW or range a joint, further evaluation needed
 - Rule out the bad
- Imaging:
 - Xray bone only
 - CT for bone and possible infection (with contrast)
 - MRI for soft tissue
 - Consider ultrasound, less invasive
- Practice your special tests if this is routine care for you

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Question?

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