Musculoskeletal Exams & Injections: Lower Extremity

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Disclosure

I have no financial interests or relationships to disclose.

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LEARNING OBJECTIVES

- Evaluate lower extremity injuries, diagnostic presentations and treatments
- Assess dislocations
- Demonstrate proper treatments to patients
- Review injection techniques for the lower extremity joints.

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ETIOLOGY

- Strains and sprains account for 36% of all lower extremity injuries
- Younger patients
  - Ankle sprains
  - Contusions
  - Foot sprains
- Older patients
  - Fractures
  - Leg contusions

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EVALUATION OF LOWER EXTREMITY

- History
- Physical Exam
- Diagnostic Test
- Treatment Pyramid

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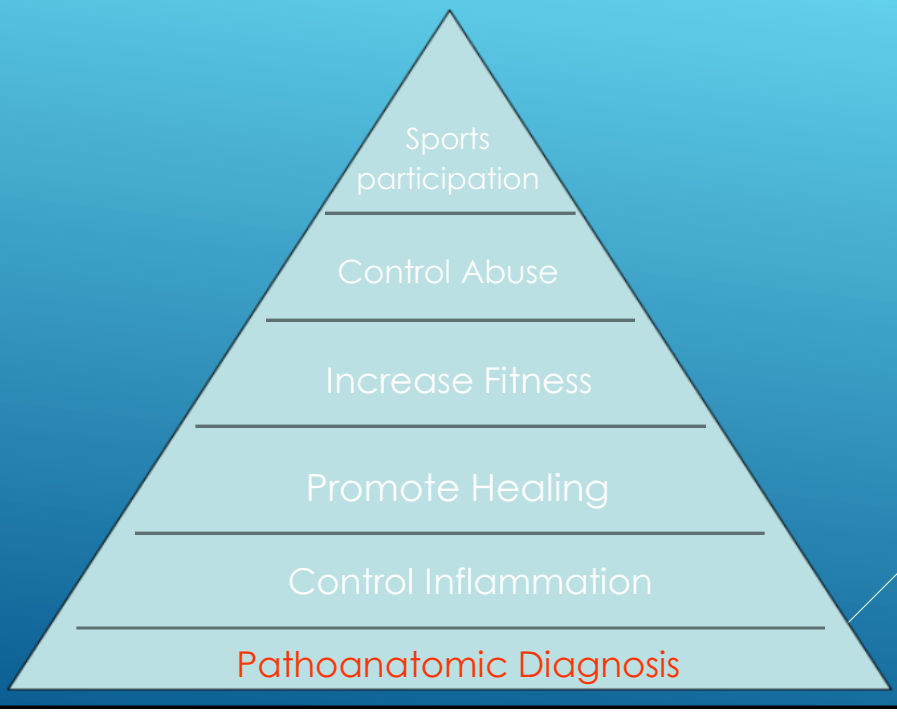
INJURY TREATMENT PYRAMID



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HISTORY

- Onset
- Duration
- Activity/Mechanism
- Swelling/Ecchymosis
- Description of Pain – (night pain? pain with movement?)
- History of previous injury

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PHYSICAL

- Inspection
- Palpation
  - Soft tissue
  - Bony
- Range of motion
- Neurologic examination
- Special Tests
- Radiographs

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REGIONAL REVIEW

- Hip
- Knee
- Leg
- Ankle/Foot

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HIP INJURIES

- Hip Bursitis
  - Greater trochanter
  - Direct pressure pain
  - Pain at night while rolling over
  - Overuse and traumatic
  - Elderly
  - X-rays negative

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HIP INJURIES

- Contusion/hematoma
  - Traumatically induced
  - Common in impact sports
  - Lateral and posterior more common
  - Tenderness, ecchymosis, swelling and muscle spasms
  - X-ray negative

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HIP INJURIES

- Strains
  - Very common in sporting activities
  - Increased risk with poor flexibility
  - Tender over lesser trochanter or ischiopubic ramus
  - Increased pain with muscle firing
  - X-ray negative

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HIP INJURIES

- Fracture
  - Not common in the young
  - Common in elderly with falls
  - Flexed, adducted, internally rotated
  - Unable to bear weight
  - X-ray diagnostic , CT if questionable

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HIP INJURIES

- Dislocations
  - Common after Total Hip Arthroplasty
  - Posterior dislocation more common
  - High velocity accident – MVA, Skiing, Sledding
  - Painful at hip region
  - Shortened, flexed, internally rotated, adducted
  - Impossible to distinguish if there is associated fracture

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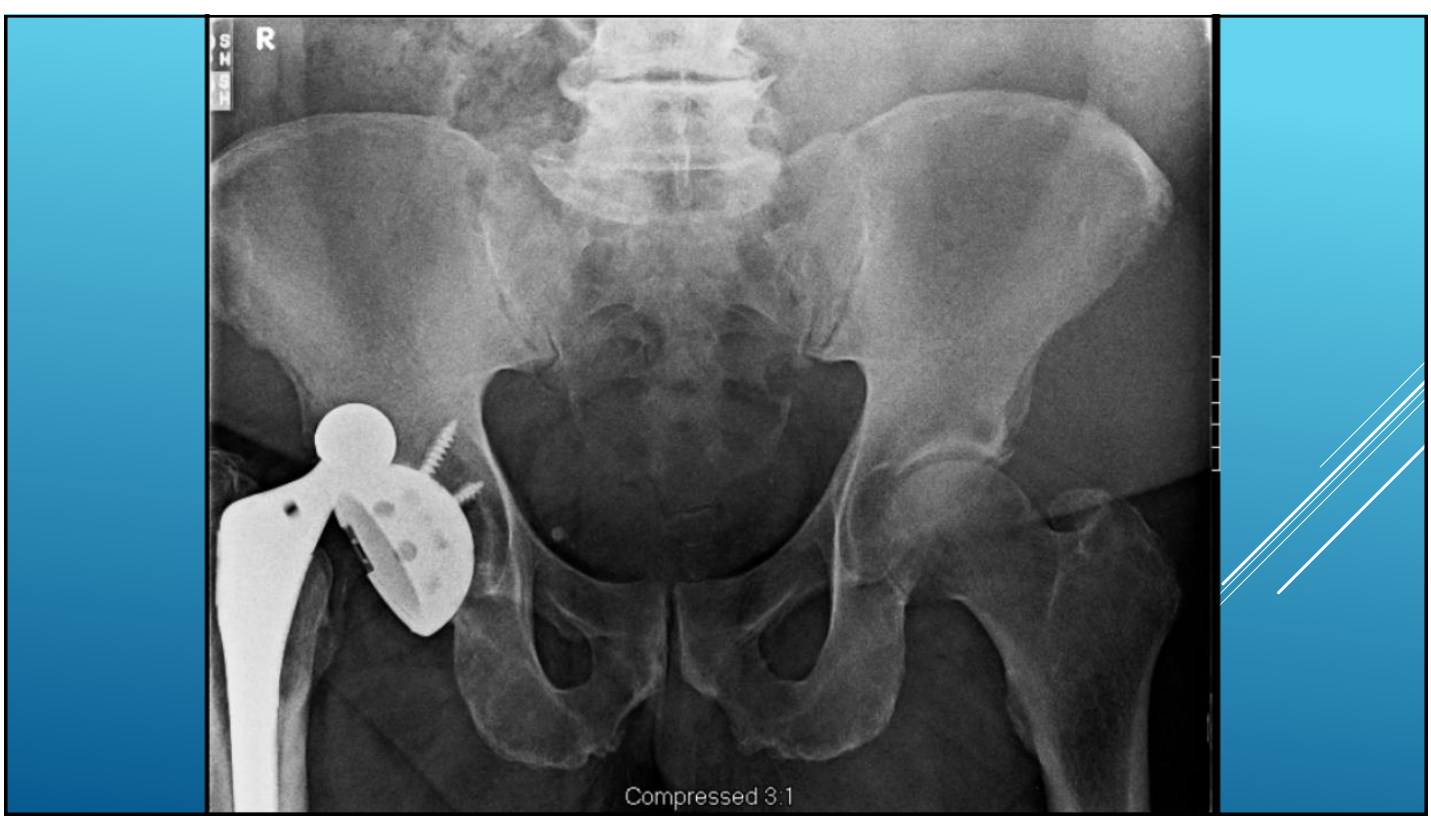

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HIP DISLOCATION

- Risk of sciatic nerve injury (10-14%)
- Do thorough lower extremity exam
- Risk of avascular necrosis – Ortho Emergency
- Immediate x-ray – prior to reduction attempt to assure no neck fracture
- Attempt closed reduction without x-ray only if delayed treatment 6 hours or more

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KNEE INJURIES

- Acutely swollen knee
- Sprains/Strains
- Dislocations

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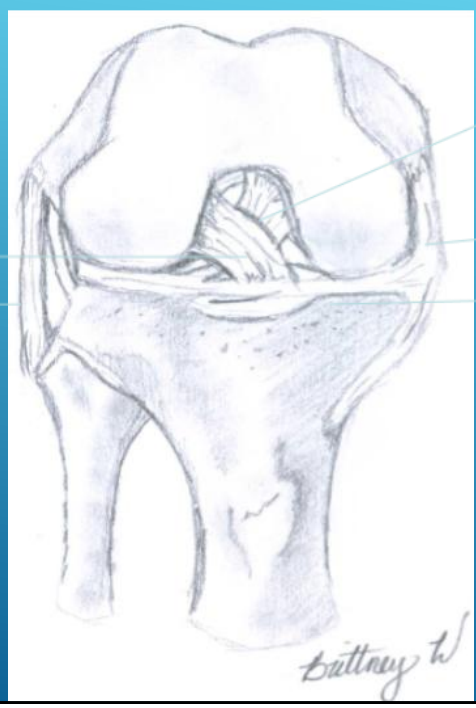
ANATOMY OF THE KNEE



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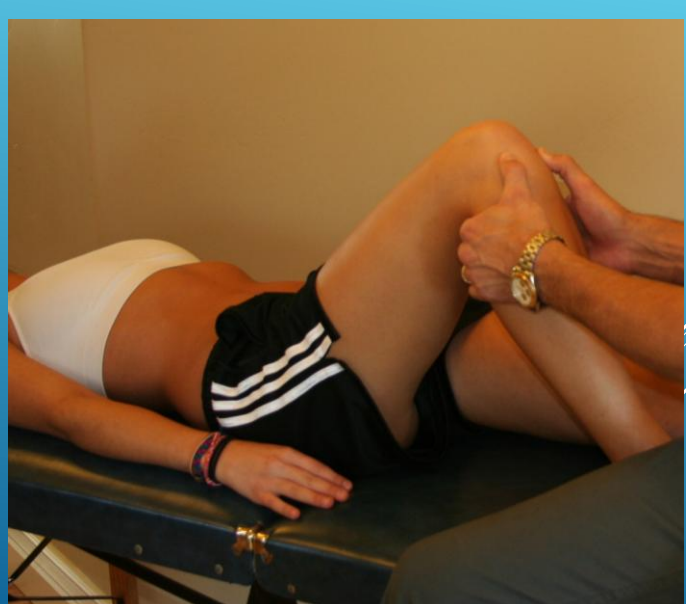
PALPATION

- Tenderness
  - Joint lines
  - Pes anserine
  - Peri-patellar
- Sensations
- Effusion



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RANGE OF MOTION

- Flexion (0 -135°)
- Extension (0 -15°)
- Medial rotation of tibia on femur (20 - 30°)
- Lateral rotation of tibia on femur (30 - 40°)

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RANGE OF MOTION

- Passive and active assessment
- Crepitation
- Pain
- Patellar location and tracking

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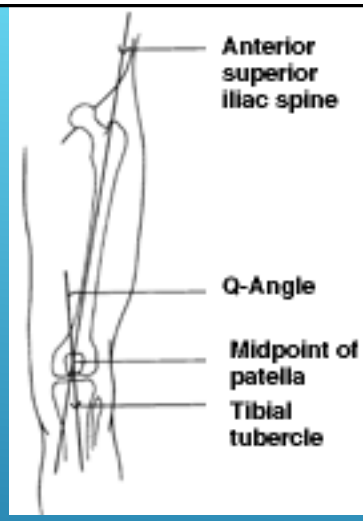
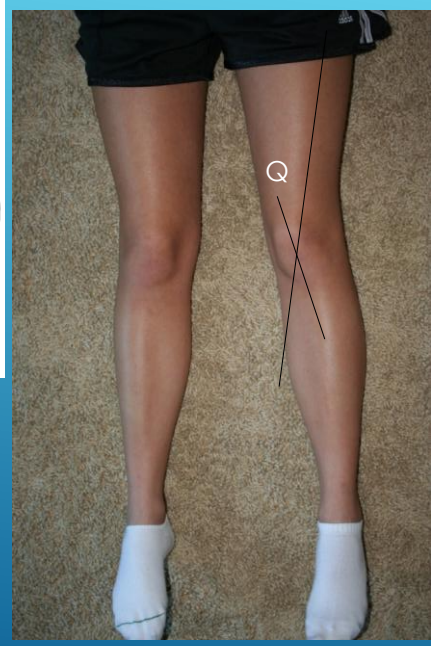
Q-ANGLE





- Q-Angle
  - male - 10 degrees or less
  - female 15 degrees or less

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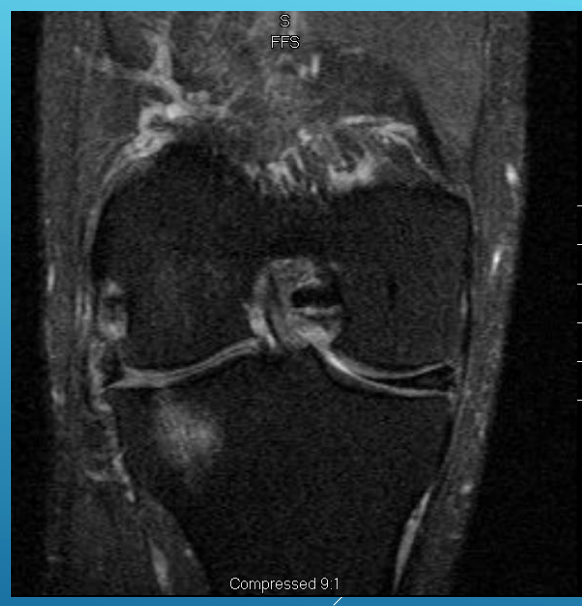
SPECIAL TESTS

- McMurray's Test
- Apley's Test
- Thessaly Test
- Lachman's
- Anterior Drawer
- Sag Sign
- Pivot Shift
- Patellar Apprehension
- Patellar Compression/Grind



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MCMURRAY'S TEST

- Place patient supine, knee hyper flexed
- Grasp the lower leg, flexing and extending the knee
- Simultaneously internally and externally rotating the tibia on the femur
- Feel for a clicking along the joint line

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APLEY'S TEST

- Place the patient prone, flex the knee to 90°
- Rotate the lower leg internally and externally with pressure applied to the heel (compression component)
- Repeat the internal and external rotation movements without pressure (distraction component)

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THESSALY TEST

- The physician supports the patient
- Patient stands on a flat foot and rotates their body
- Keeping the knee bent at 5° and 20°
- A positive test will elicit pain at the joint line
- Mechanical symptoms may also occur

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ANTERIOR DRAWER

- Place the patient supine with the hip flexed at 45°, knee flexed at 90°
- Stabilize the patient's foot by sitting on it
- Place fingers behind knee with the thumbs along the anterior joint line
- Gently pull and push the proximal part of the leg anteriorly and posteriorly repeatedly
- Note movement, may rotate foot (internal/external)

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LACHMAN'S TEST

- Place the patient supine with the knee flexed at 15-30°
- Hold the patient's thigh firmly with one hand and lift the proximal tibia anteriorly
- Note the amount of movement of the tibia and firmness of end-point (compare with uninjured knee)

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PIVOT SHIFT TEST

- Place the patient supine with knee fully extended.
- Internally rotate the tibia with one hand grasping the foot and the other applying mild valgus stress at knee joint level
- Slowly flex the knee until at 20-30°
- At this point a 'jerk' is felt

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APPREHENSION TEST

- With the knee straight, gently push the patella laterally
- May identify patellar dislocation
- A positive test is when it reproduces the sensation of impending dislocation

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PATELLAR COMPRESSION/GRIND

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EFFECTIVENESS OF TESTS

Test	Accuracy
McMurray	Sens = 26-58%, spec = 59-94%
Apley's	Sens = 16-58%, spec = 80-82%
Thessaly	94-96% accurate for + test
Joint Line Tenderness (meniscal tear)	Sens = 68-96%, spec = poor
MRI	Sens = 93%, spec = 86%

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OTTAWA KNEE RULES

- Knee X-ray series required only if:
  - Age 55 or older
  - Isolated tenderness of patella (patella must be the only area of bony tenderness in the knee)
  - Tenderness of head of fibula
  - Inability to flex to 90°
  - Inability to bear weight both immediately and in the emergency department for 4 steps (unable to transfer weight twice onto each leg regardless of limping)

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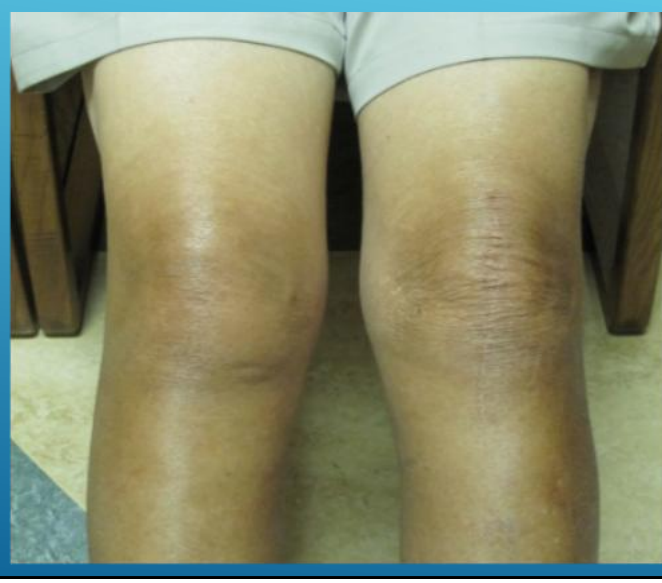
SWOLLEN KNEE

- Soft Tissue vs. Effusion



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ACUTE EFFUSION OF THE KNEE

- Trauma
- Polyarthritis
- Infection
- Gout
- Pseudogout
- Osteoarthritis
- Tumor

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CAUSES OF KNEE SWELLING

- Ligamentous
- Fracture
- Patellar dislocation
- Meniscal injury
- Reiter's Syndrome
- Juvenile rheumatoid arthritis
- Rheumatoid arthritis
- Gonorrhea
- Lyme disease
- Tuberculosis
- Brucellosis
- Gout
- Pseudogout
- Osteoarthritis

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KNEE SWELLING

- Traumatic vs. non-traumatic
  - What was mechanism of injury?
- Previous injury or surgery
- How quickly did swelling occur
- Type of occupation/activities
- Constitutional symptoms
- Sense of instability

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HELPFUL HISTORY HINTS

- High-velocity collision
- Inability to immediately bear weight
- "Pop" occurred with injury

Fracture

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HELPFUL HISTORY HINTS

- Cut or pivot mechanism of injury
- Knee "gave way"
- Inability to continue participation
- "Pop" felt or heard with injury

ACL Tear

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HELPFUL HISTORY HINTS

- Blow to proximal tibia
- Less instability than ACL tear

PCL Tear

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HELPFUL HISTORY HINTS

- Squat/kneel associated with a twist
- Clicking
- Locking
- Pain with rotational movement

Meniscal Tear

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HELPFUL HISTORY HINTS

- Fever, chills
- Intravenous drug use
- Lack of traumatic injury
- Recent sexual encounter
- History of abnormal joint

Infectious Arthritis

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HELPFUL HISTORY HINTS

- Night pain
- Fevers
- Night sweats
- Unintentional weight loss

Tumor

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ARTHROCENTESIS

- Improves examination accuracy
- Confirms injury severity
- Can give symptomatic relief
- History of trauma or suspected infection

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JOINT FLUID ANALYSIS

Findings	Normal	Non-Inflammatory	Inflammatory	Septic
Color	Yellow	Yellow	Yellow/whitish	Whitish
Clarity	Clear	Clear	Translucent	Opaque
Viscosity	High	High	Variable	Low
WBC per mm3	<2000	<2000	>2000	>50000

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KNEE SPRAIN/STRAIN

- Jumper's Knee
- Osgood-Schlatter
- Sinding-Larsen-Johansson
- Quadriceps tendonitis
- ITB Syndrome
- ACL/MCL/LCL sprains
- Bursitis – prepatellar, pes anserine, infrapatellar

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KNEE SPRAIN/STRAIN

- Very common injury
- Multiple ligaments, tendons, and bursae
- Stable on exam
- Able to bear weight
- + or – swelling
- X-ray negative

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KNEE DISLOCATIONS

- Rare due to strong ligamentous support
- Usually high impact or sports injury
- May occur more common in obese patients

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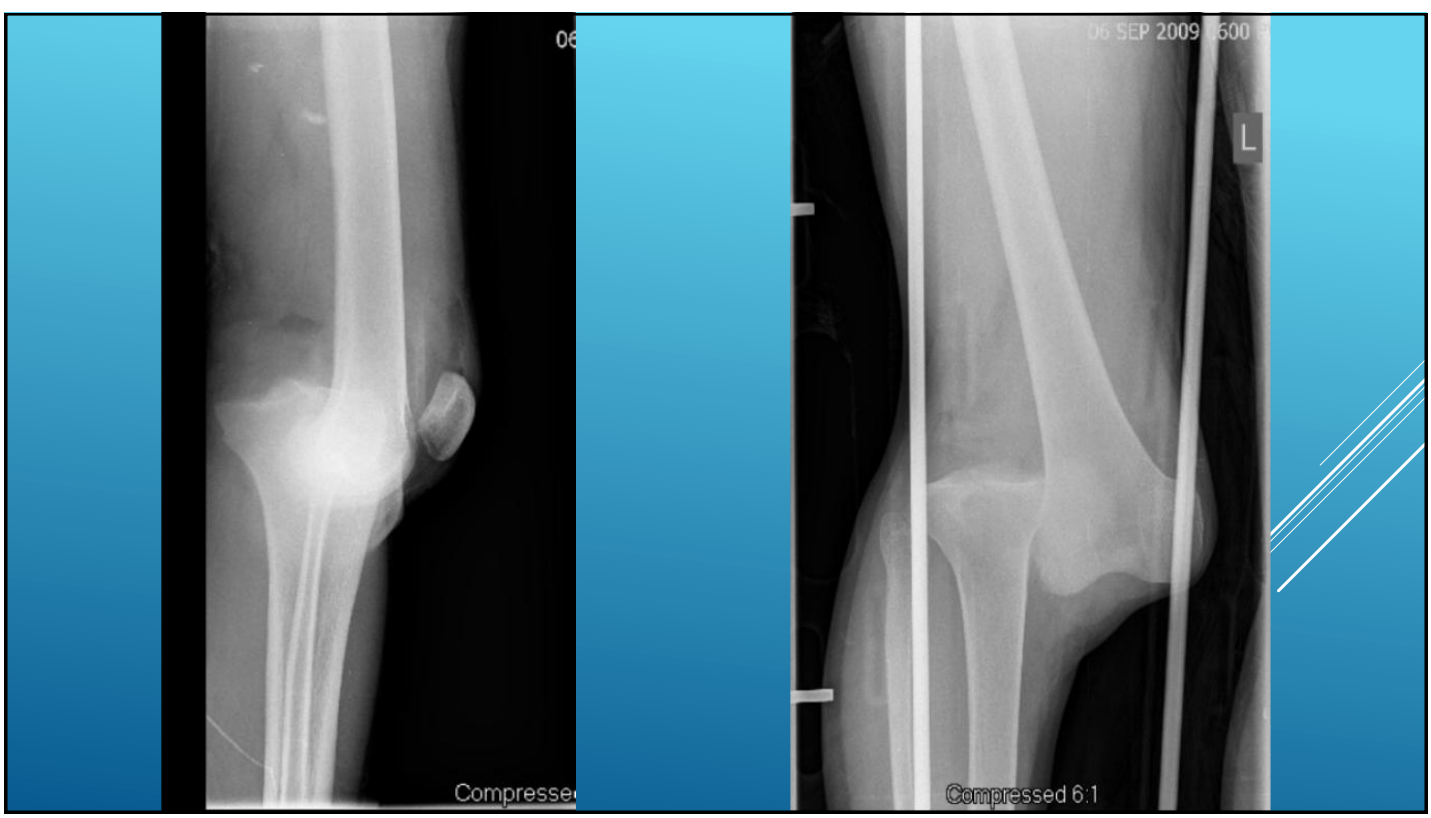

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KNEE DISLOCATIONS

- Usually clinically obvious
- May have been spontaneously reduced (delayed diagnosis)
- Could present as grossly unstable knee
- Vascular abnormalities is biggest concern
- Occasional peroneal nerve damage

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KNEE DISLOCATIONS

- Popliteal artery injury occurs in approximately 20% of knee dislocations
- Evaluation for active posterior hemorrhage, expanding hematoma, absent pulse, or the presence of a thrill/bruit
- Consider ABI of lower extremity
- Arteriography- gold standard (The decision to pursue angiography in the patient with the dislocated knee is best made in consultation with the patient's orthopedic surgeon.)

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PATELLAR DISLOCATION

- Fairly common
- Powerful quadriceps contraction combined with a strong valgus and external rotation component
- Sports (cutting), dancing or direct blow
- Chronic patellar problems (genu valgum or femoral anteversion)
- Described by the relation of the patella to the knee joint

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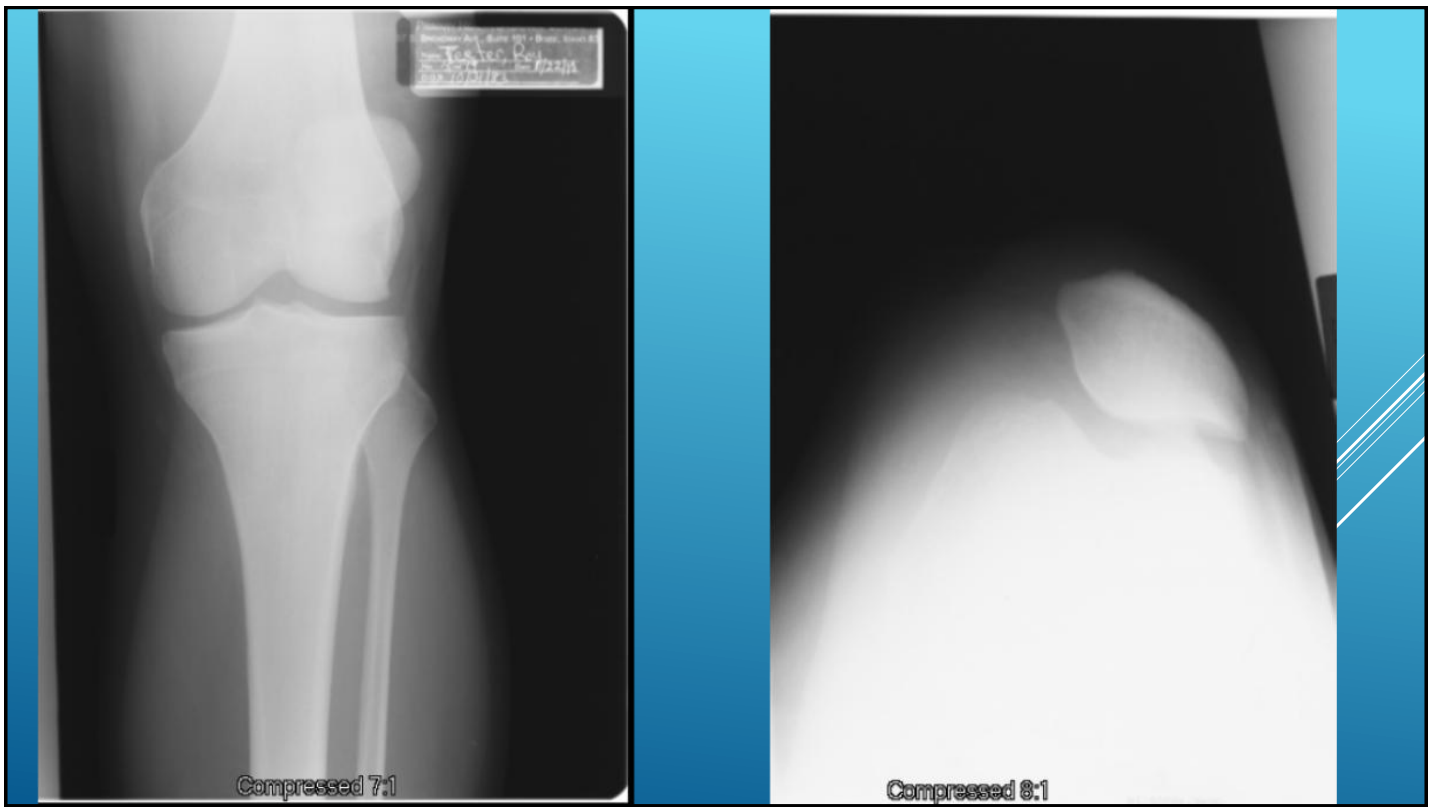

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CLINICAL ASSESSMENT

- Generally, clinically obvious
- Knee flexed and patella notable on lateral side of knee
- May self-reduce with knee extension
- Patient says "knee went out"
- + Apprehension (Fairbank's) sign

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LEG INJURIES

- Stress Syndrome
  - "Shin splints" to stress fracture
  - Active patients
  - Change in activity or footwear
  - Pain improves with rest
  - Painful with palpation
  - X-rays usually negative
  - Rest!!!

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ANKLE/FOOT INJURIES

- Ankle Sprains
  - Most common lower extremity injury
  - Severe fracture and dislocations are rare
  - Usually, nonoperative
  - Conservative management with follow-up

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ANKLE/FOOT INJURIES

- Grading system
  - Grade 1: Minimal pain, weight bearing not impaired
  - Grade 2: Moderate pain, weight bearing difficult
  - Grade 3: Severe swelling, pain, discoloration, unable to bear weight

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ANKLE/FOOT INJURIES

- Achilles' rupture
  - 30–45-year-olds male>female
  - Weekend athletes
  - Feel "pop", "like someone kicked me"
  - Weight bearing difficult, unable to raise on toes
  - + Thompson test
  - Many times, can be seen on x-ray

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ANKLE/FOOT INJURIES

- Ankle dislocation
  - Isolated/pure Dislocations are rare
  - Usually associated with fractures
  - Described by relationship of talus to tibia
  - Pre-reduction x-rays is a must
  - Only attempt reduction pre-radiograph if vascularly compromised
  - AP and lateral x-ray are sufficient in emergency

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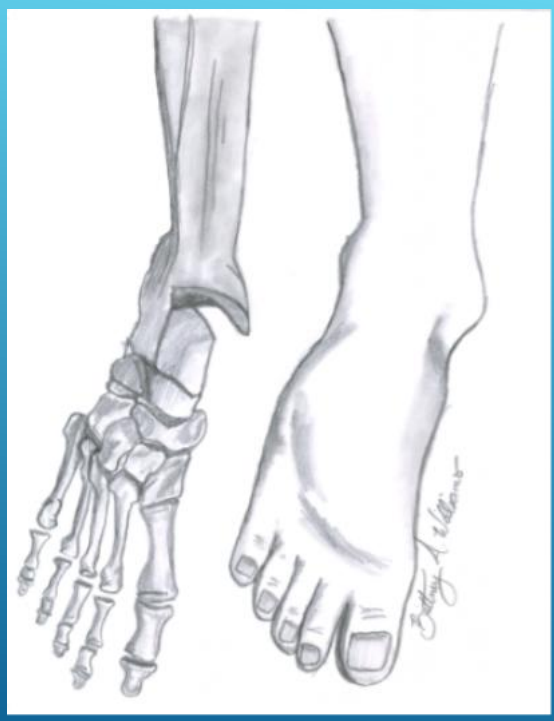

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ANKLE/FOOT INJURIES

- Posterior dislocation
  - More common
  - Fall on planter-flexed foot
  - Associated with fracture of one or more malleoli
- Anterior Dislocation
  - Forced dorsiflexion
  - Prominent talus and possible loss of dorsalis pedis pulse

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ANKLE/FOOT INJURIES

- Plantar Fasciitis
  - Insidious onset
  - Change in activities or sports
  - Poor footwear
  - Tender at fascial insertion on calcaneus
  - X-ray may show spur
  - Correct mechanics

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ANKLE/FOOT INJURIES

- Foot Fractures
  - Fifth metatarsal
    - Common
    - Avulsion vs Jones (within 1.5cm of the tuberosity)
    - Consider consultation if in doubt
  - Stress fractures
    - Repetitive microtrauma
    - Gradually increasing foot pain
    - X-ray or bone scan positive

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INJURY TREATMENT PYRAMID

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TREATMENT

- Acutely
  - Rest: crutches if unable to bear weight
  - Ice: pain relief and reduce swelling
  - Compression: support and reduce swelling
  - Elevation: reduce swelling
  - NSAIDs: pain relief

Nonpharmacologic and Pharmacologic Management of Acute Pain From Non–Low Back, Musculoskeletal Injuries in Adults: A Clinical Guideline From the American College of Physicians and American Academy of Family Physicians
Annals of Internal Medicine
Volume 173 • Number 9 • 3 November 2020
Pages: 739 - 748

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References

- Birnbaumer DM, Burns AM, Ferri FF. Knee Injury. MDConsult. FirstConsult. http://www.mdconsult.com. 24 Aug 2007.
- Johnson MW. Acute knee effusions: a systematic approach to diagnosis. *Am Fam Physician*. 2000; 61: 2391-400.
- Calmbach WL, Hutchens M. Evaluation of patients presenting with knee pain: Part I. History, physical examination, radiographs, and laboratory tests. *Am Fam Physician*. 2003;68:907-12.
- Calmbach WL, Hutchens M. Evaluation of patients presenting with knee pain: Part II. Differential Diagnosis. *Am Fam Physician*. 2003;68:917-22.
- Stiell IG, Greenberg GH, Wells GA, et al. Ottawa knee rule for knee injury radiography. Ottawa, ON: Ottawa Health Research Institute at the Ottawa Hospital, 1999.
- Allen JE, Taylor KS. Physical examination of the knee. *Prim Care*. 2004;31:887-907.
- Levandowski R, Cohen P. Sports Medicine for the Primary Care Physician. 3rd ed. Boca Raton, FL: CRC Press; 2004.

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References

- Lambers K, Ootes D, Ring D. Incidence of patients with lower extremity injuries presenting to US emergency departments by anatomic region, disease category, and age. Clin Orthop Relat Res. 2012;470(1):284–290. doi:10.1007/s11999-011-1982-z
- Fullem BW. Overuse lower extremity injuries in sports. Clin Podiatr Med Surg. 2015 Apr;32(2):239-51. doi: 10.1016/j.cpm.2014.11.006. Epub 2014 Dec 30
- Nouri F, Babaee M, Peydayesh P, Esmaily H, Raeissadat SA. Comparison between the effects of ultrasound guided intra-articular injections of platelet-rich plasma (PRP), high molecular weight hyaluronic acid, and their combination in hip osteoarthritis: a randomized clinical trial. BMC Musculoskelet Disord. (2022) 23:856. 10.1186/s12891-022-05787-8 [DOI] [PMC free article] [PubMed] [Google Scholar
- Dório M, Pereira RMR, Luz AGB, Deveza LA, de Oliveira RM, Fuller R. Efficacy of platelet-rich plasma and plasma for symptomatic treatment of knee osteoarthritis: a double-blinded placebo-controlled randomized clinical trial. BMC Musculoskelet Disord. (2021) 22:822. 10.1186/s12891-021-04706-7 [DOI] [PMC free article] [PubMed] [Google Scholar]

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References

- Barman A, Prakash S, Sahoo J, Mukherjee S, Maiti R, Roy SS. Single intra-articular injection with or without intra-osseous injections of platelet-rich plasma in the treatment of osteoarthritis knee: a single-blind, randomized clinical trial. Injury. (2022) 53:1247–53. 10.1016/j.injury.2022.01.012 [DOI] [PubMed] [Google Scholar]
- Xiong Y, Gong C, Peng X, Liu X, Su X, Tao X, Li Y, Wen Y, Li W. Efficacy and safety of platelet-rich plasma injections for the treatment of osteoarthritis: a systematic review and meta-analysis of randomized controlled trials. Front Med (Lausanne). 2023 Jun 27;10:1204144. doi: 10.3389/fmed.2023.1204144. PMID: 37441691; PMCID: PMC10333515.

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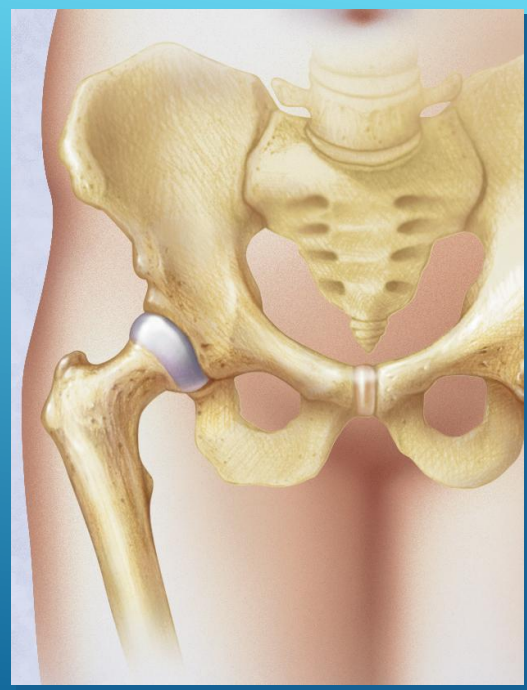
HIP

Trochanteric Bursa

- Enter perpendicular to skin at MTP
- At bone, withdraw 2-3 mm, aspirate and inject
- Often inject 1/3 into bursa and 2/3 (peri-tendon) in fan-like distribution
- 22 gauge, 1.5" needle
- 1 - 2 cc steroid
- 4 - 10 cc Lidocaine



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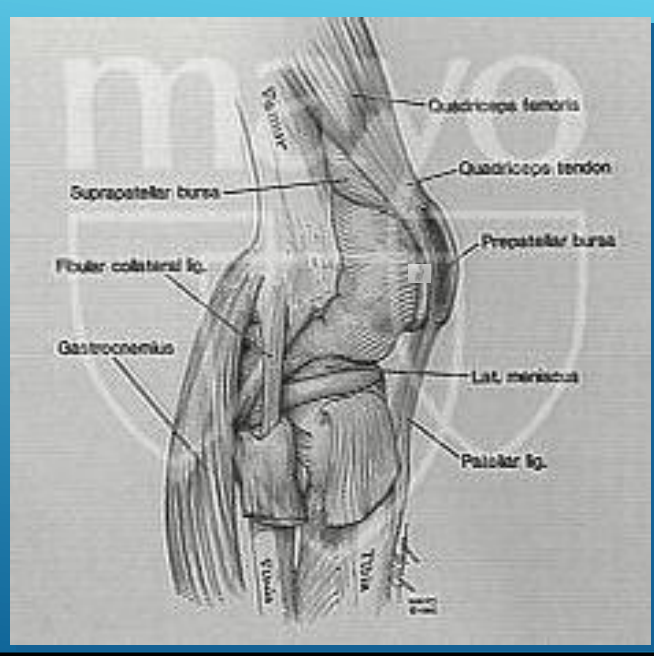
KNEE

Prepatellar Bursa

- May approach from above or below
- Aspiration: 18 - 20 gauge, 1.5" needle
- If cloudy, send for culture
- If non-infectious, may inject with 1cc steroid



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KNEE

Knee joint

- MULTIPLE APPROACHES!!
- Multiple authors support their personal techniques with erudite logic but with little to no supporting evidence

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KNEE

MULTIPLE APPROACHES!!
Aspiration ≠ Injection

For injection, accuracy highest for anterolateral approach and lowest for medial mid patellar

Esenyel C, Demiirhan M, Esenyel M, et al. Comparison of four different intra-articular injection sites in the knee: a cadaver study. Knee Surgery, Sport Traumatology, Arthroscopy 2007;15(5):573-7

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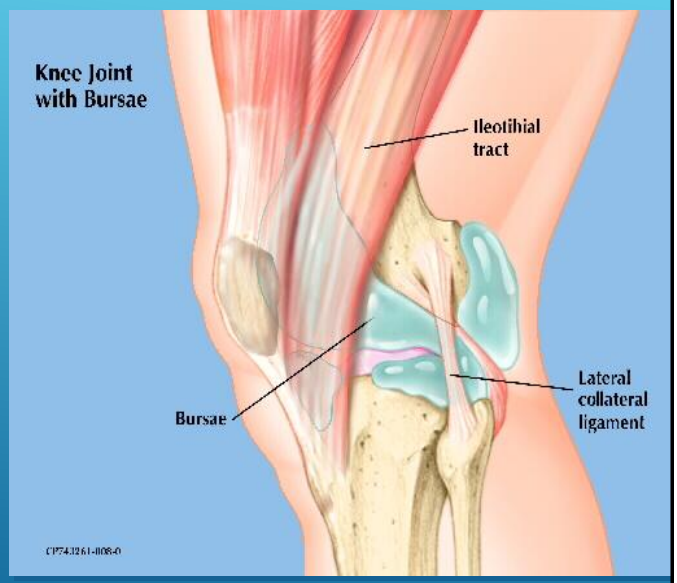
KNEE

Knee joint

- Superior-Lateral approach is **classically** described for aspiration:
- Pt supine with knee bent slightly
- Site is near the intersection of a line drawn at the lateral/medial and superior edges of patella
- Enter cephalad to patella just below the patellar tendon
- Direct parallel to floor toward superior pole
- 18-20 gauge, 1.5" needle for aspiration
- Use hemostat to change syringe



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KNEE

Knee joint

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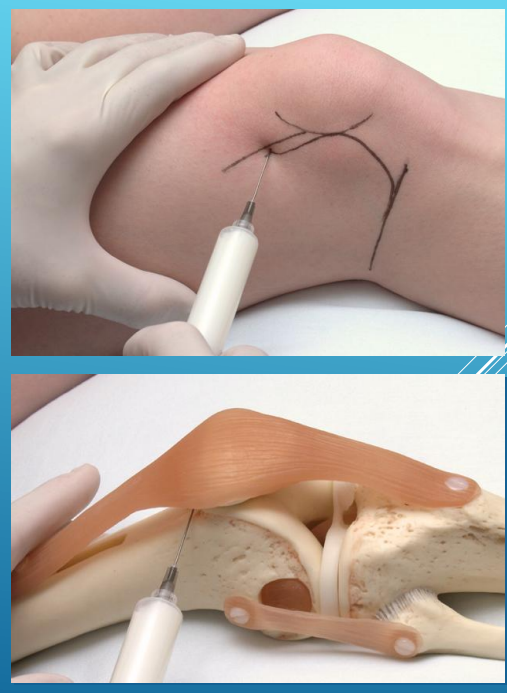

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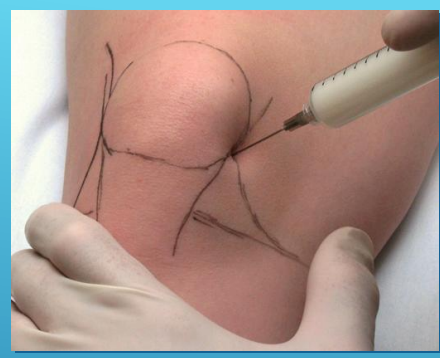
KNEE

Knee joint

- Alternatively, a mid-patella approach is described for aspiration (either medial or lateral):
- Pt supine with knee completely straight
- Site is at the middle of the patella (some start inferior to the middle where the edges of the patella and the femur diverge)
- Direct needle downward parallel to angled, bottom surface of patella (some suggest finding the space with a 25-gauge needle/Lidocaine injection)
- 18-20 gauge, 1.5" needle for aspiration
- Use hemostat to change syringe



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KNEE

Knee joint

- Seated/anterior approach is best for injections.
- Pt seated with knee bent 90 degrees and foot hanging
- Enter medial or lateral to patellar tendon ~1 cm above joint line. Needle parallels floor
- Direct needle to center of knee behind the patellar tendon
- 22ga, 1.5" needle, 3cm depth
- 2 cc steroid
- 3 - 8 cc Lidocaine

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KNEE

Pes Anserine Bursa

- "Goose's foot" Tendons from three muscles insert at medial tibia: Sartorius, gracilis, and semitendinosus
- Bursa often inflamed due to medial compartment OA
- Easiest method is to enter perpendicular to skin at MTP (tent skin?)
- Withdraw ~2 mm from bone, aspirate and inject
- 25 gauge, 1" needle
- 0.5cc steroid, 1-3cc Lidocaine

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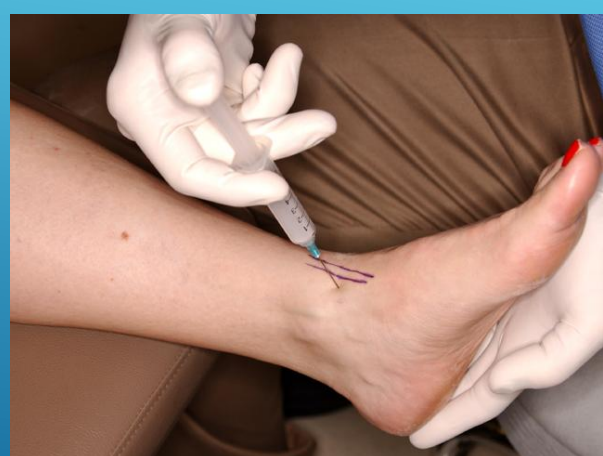
ANKLE

Ankle Joint

- Aspiration for w/up synovitis more common than injection
- Patient supine with foot off edge of bed, ankle at ~90-degree bend
- Enter just medial to anterior tibial tendon
- Direct roughly toward Achilles insertion
- Depth ~2-3 cm
- 20-25 gauge, 1.5" needle
- For injection, 1cc steroid, 2-5cc lidocaine



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ANKLE

Plantar Fasciitis

- Beware fat atrophy! Consider other treatment options.
- Enter at medial foot and direct needle laterally toward MTP at medial calcaneal tubercle. Stay deep (1-2 cm above sole)
- Depth ~2 cm
- 22-25 gauge, 1.5" needle
- 1 cc steroid, 1-2 cc lidocaine

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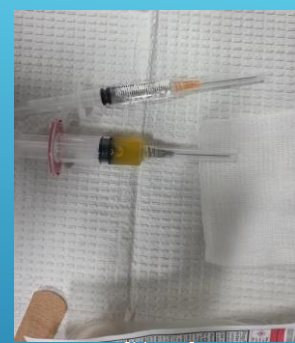
PRP INJECTIONS

- Not FDA approved
- Effective on tendons and soft tissues, Increase use in Knee DJD
- Extensive use in Sports Medicine
- Safe
- Ultrasound guided
- Most insurances do not cover, cost of $500-1500



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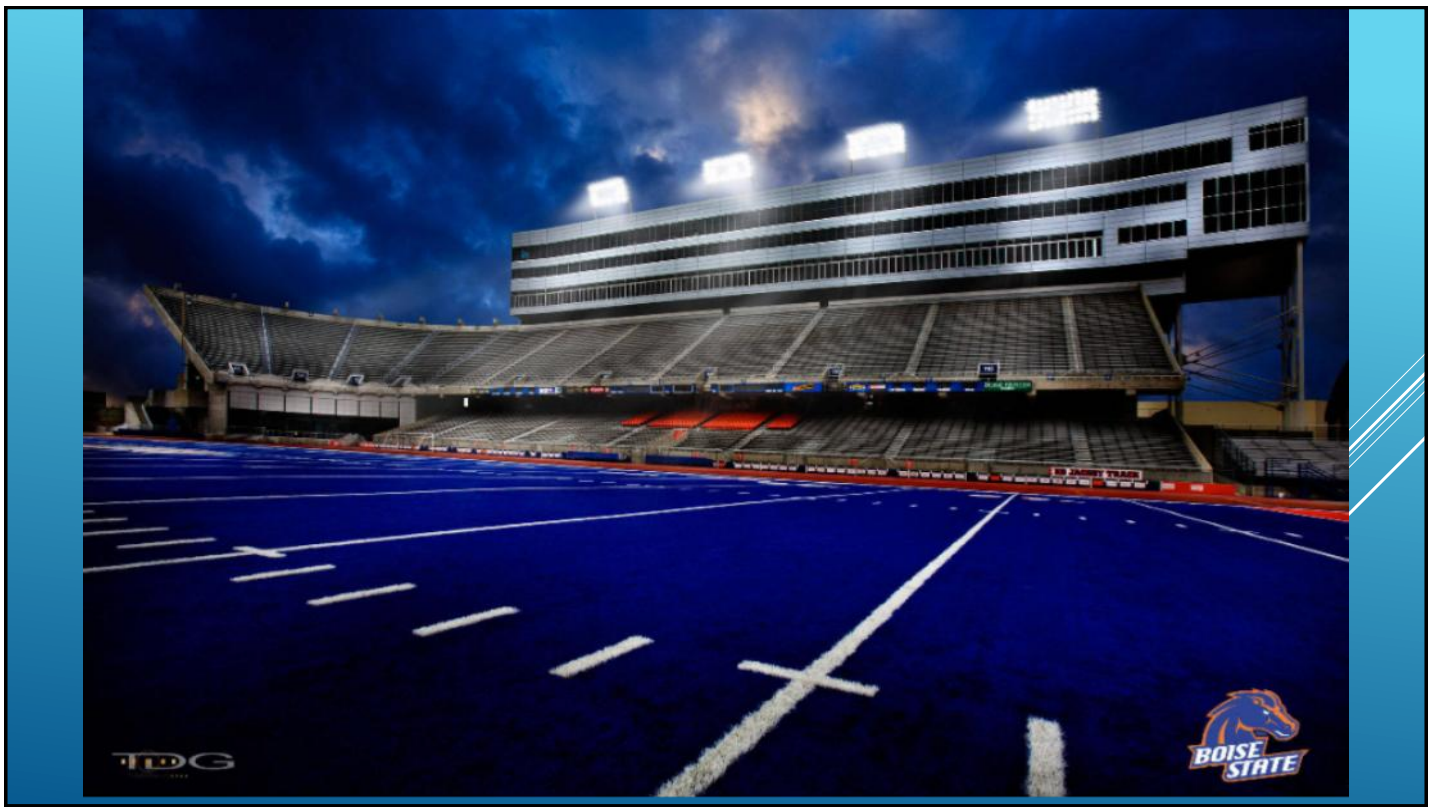

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Musculoskeletal Exams & Injections: Lower Extremity

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CONTINUING EDUCATION COMPANY

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