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# Knee Pain

## Review of Physical Exam and An Approach To The Differential Diagnosis


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# Disclosures

- No financial disclosures or conflicts of interest
- Acknowledge Dr. Kurt Spindler for surface anatomy photos

# Objectives

- Review pertinent anatomy and pathology associated with common causes of knee pain
- Review historical and physical exam findings that help differentiate common causes of knee pain
- Review imaging findings relevant to these causes of pain and discuss a rationale for appropriate use of diagnostic tests
- Review the best evidence available to the guide treatment of these conditions

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| LEVELS OF EVIDENCE FOR PRIMARY RESEARCH QUESTION | | | | |
|---|---|---|---|---|
| | Types of Studies | | | |
| | Therapeutic Studies—Investigating the Results of Treatment | Prognostic Studies—Investigating the Outcome of Disease | Diagnostic Studies—Investigating a Diagnostic Test | Economic and Decision Analyses—Developing an Economic or Decision Model |
| Level I | 1. Randomized controlled trial<br>a. Significant difference<br>b. No significant difference but narrow confidence intervals<br>2. Systematic review[2] of Level-I randomized controlled trials (studies were homogeneous) | 1. Prospective study[1]<br>2. Systematic review[2] of Level-I studies | 1. Testing of previously developed diagnostic criteria in series of consecutive patients (with universally applied reference "gold" standard)<br>2. Systematic review[2] of Level-I studies | 1. Clinically sensible costs and alternatives; values obtained from many studies; multiway sensitivity analyses<br>2. Systematic review[2] of Level-I studies |
| Level II | 1. Prospective cohort study[3]<br>2. Poor-quality randomized controlled trial (e.g., <80% follow-up)<br>3. Systematic review[2]<br>a. Level-II studies<br>b. Nonhomogeneous Level-I studies | 1. Retrospective study[4]<br>2. Study of untreated controls from a previous randomized controlled trial<br>3. Systematic review[2] of Level-II studies | 1. Development of diagnostic criteria on basis of consecutive patients(with universally applied reference "gold" standard)<br>2. Systematic review[2] of Level-II studies | 1. Clinically sensible costs and alternatives; values obtained from limited studies; multiway sensitivity analyses<br>2. Systematic review[2] of Level-II studies |
| Level III | 1. Case-control study[5]<br>2. Retrospective cohort study[4]<br>3. Systematic review[2] of Level-III studies | | 1. Study of nonconsecutive patients (no consistently applied reference "gold" standard)<br>2. Systematic review[2] of Level-III studies | 1. Limited alternatives and costs; poor estimates<br>2. Systematic review[2] of Level-III studies |
| Level IV | Case series (no, or historical, control group) | Case series | 1. Case-control study<br>2. Poor reference standard | No sensitivity analyses |
| Level V | Expert opinion | Expert opinion | Expert opinion | Expert opinion |

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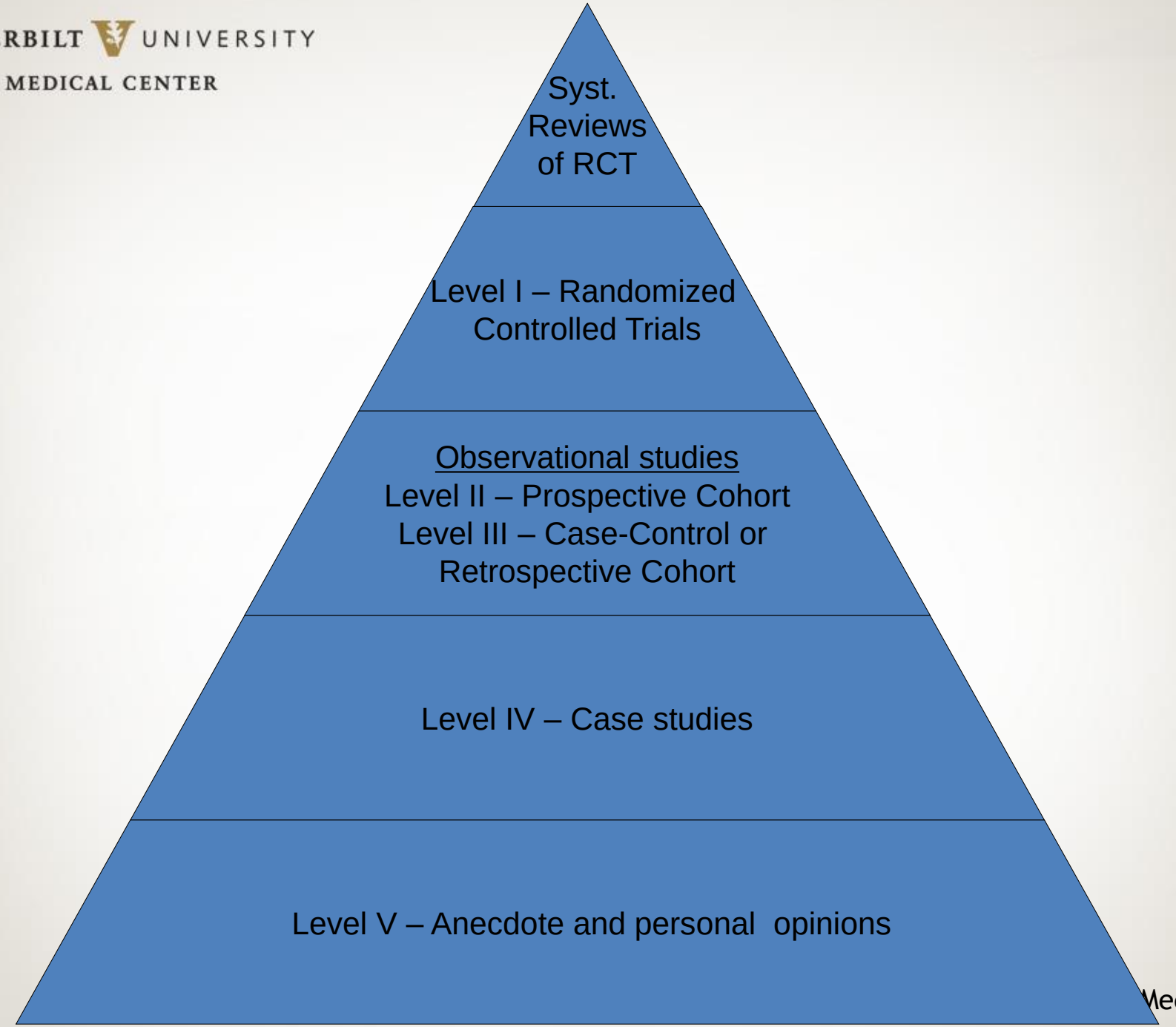

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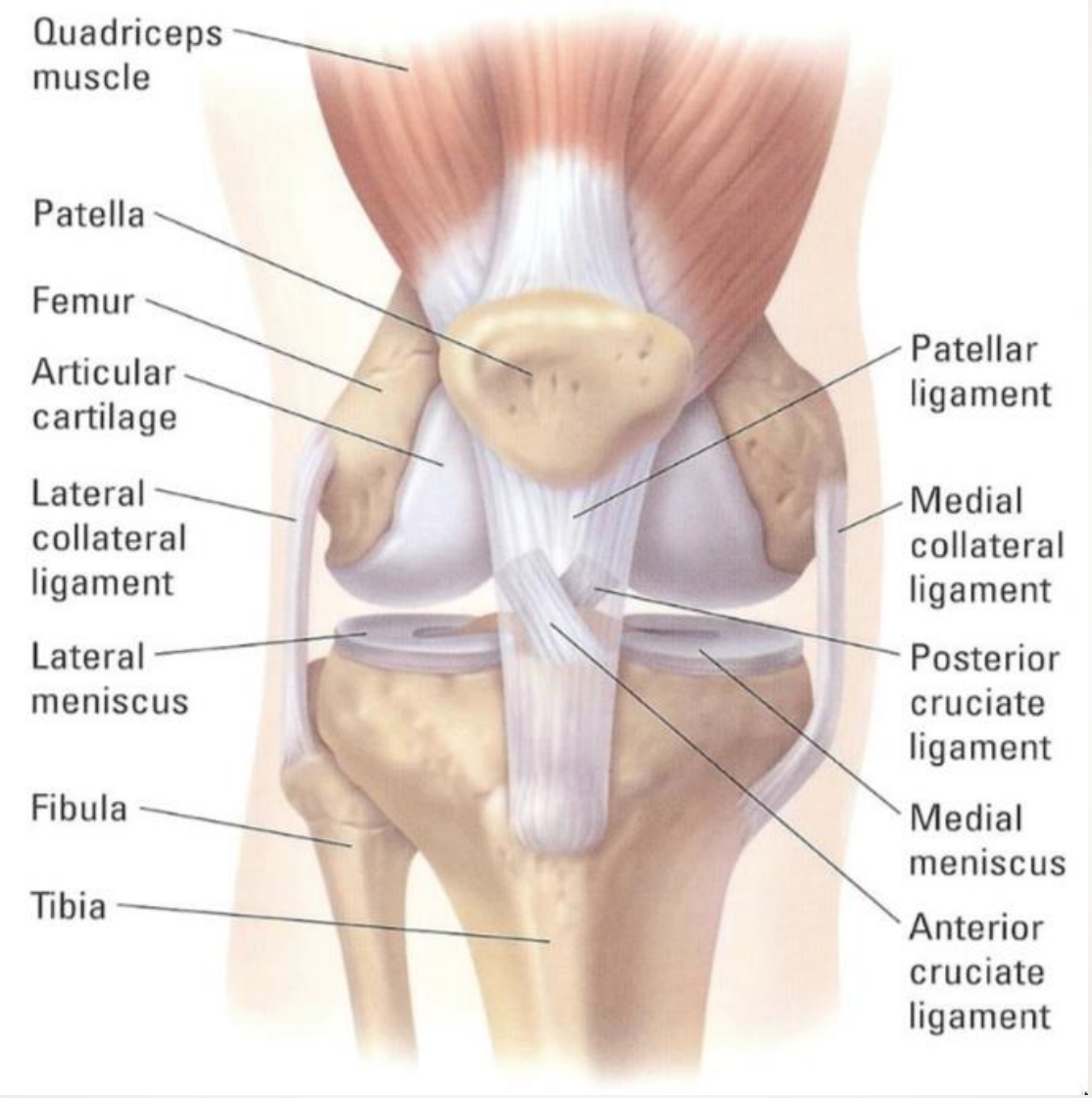
# Anatomy Review

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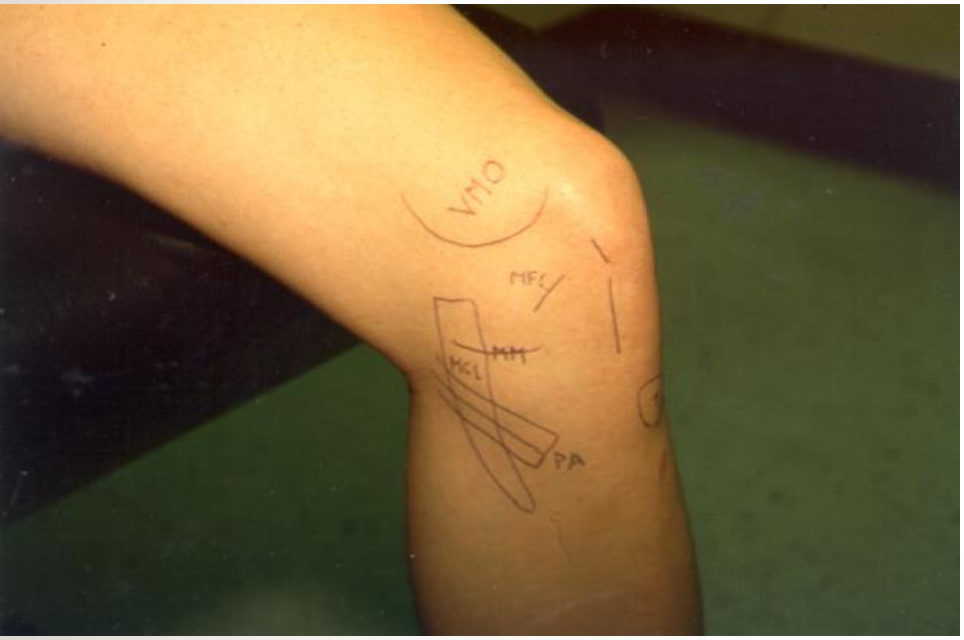
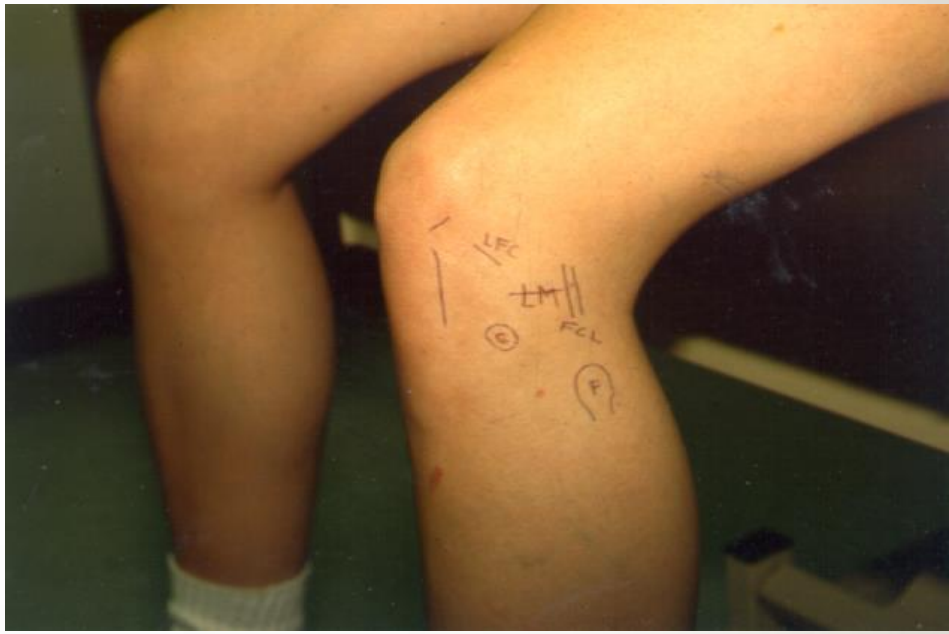
# Surface Anatomy

Medial




Lateral



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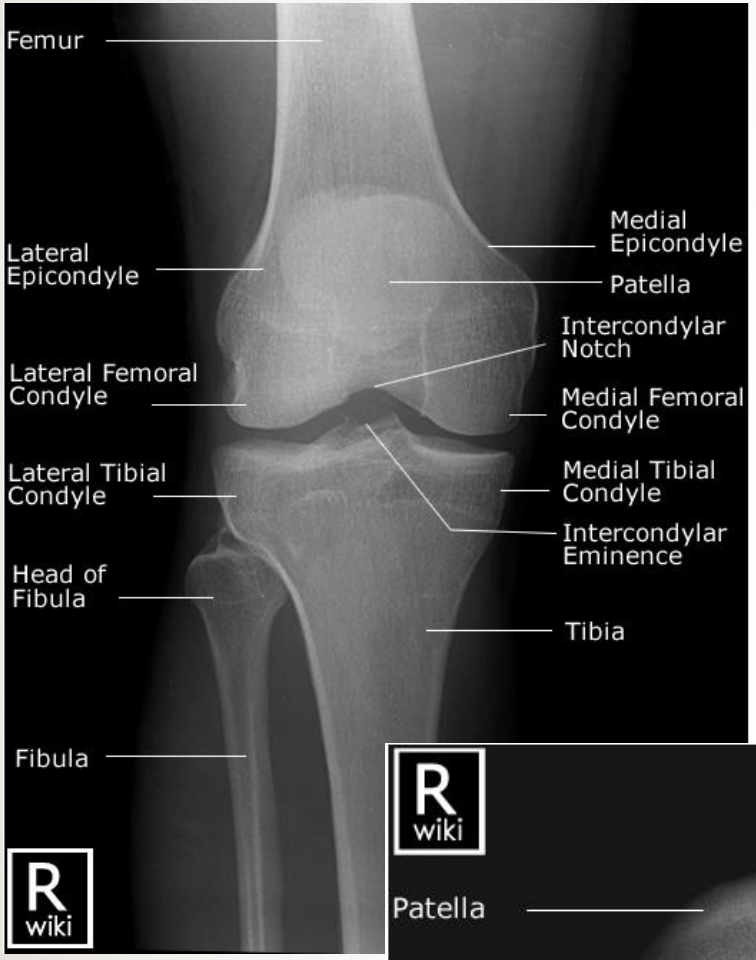
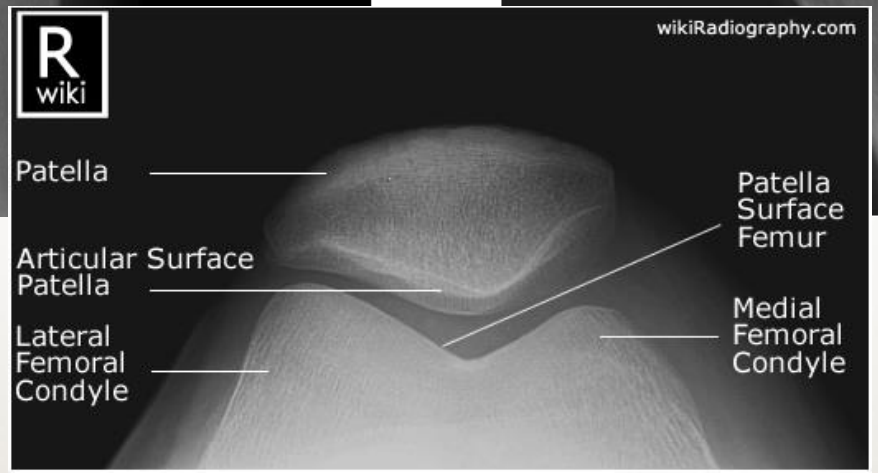
# XR Review





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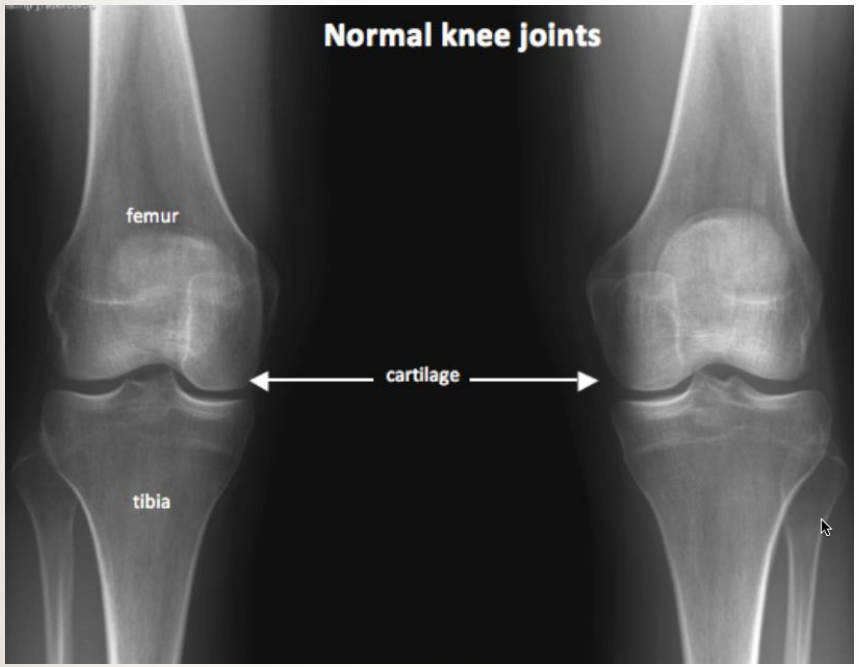
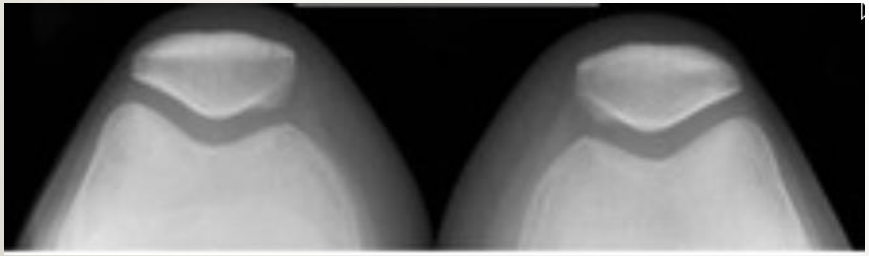
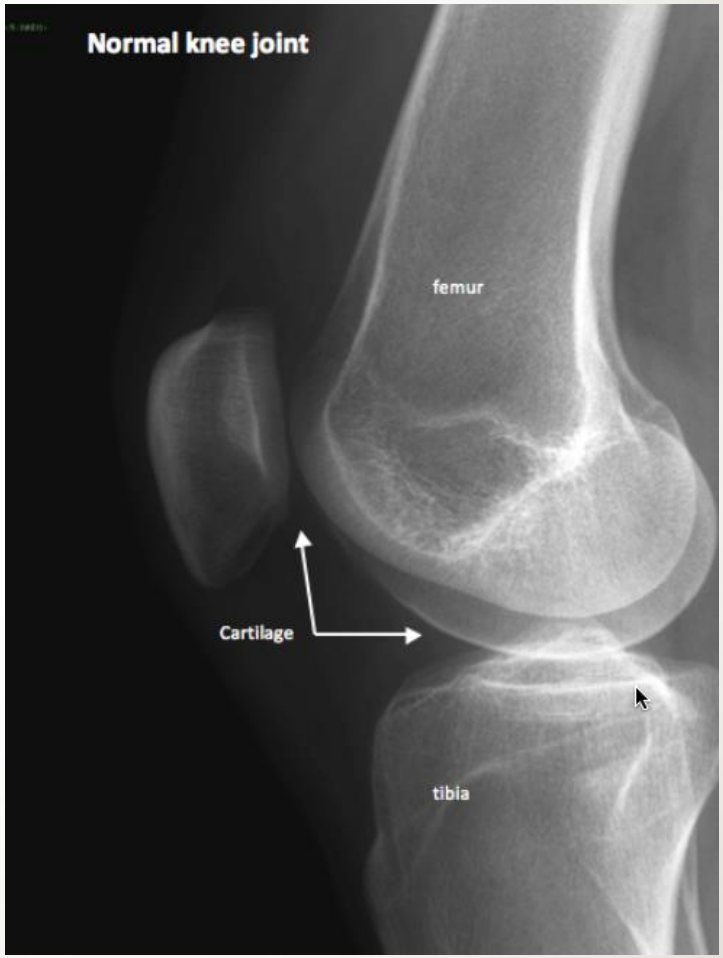
# XR To Order

If They Can Walk, They Can Stand!

## Bilateral Standing AP, Bilateral Sunrise, and Lateral





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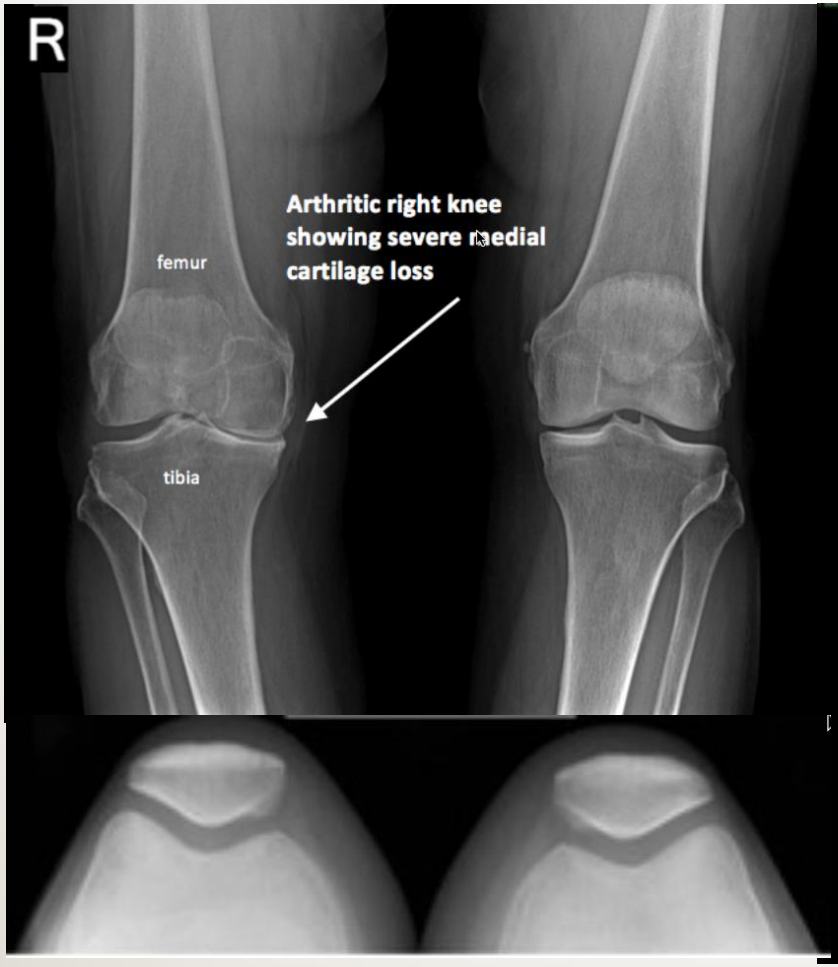
# XR Review

## Grading Arthritis

Mild? Moderate? Severe? = What?





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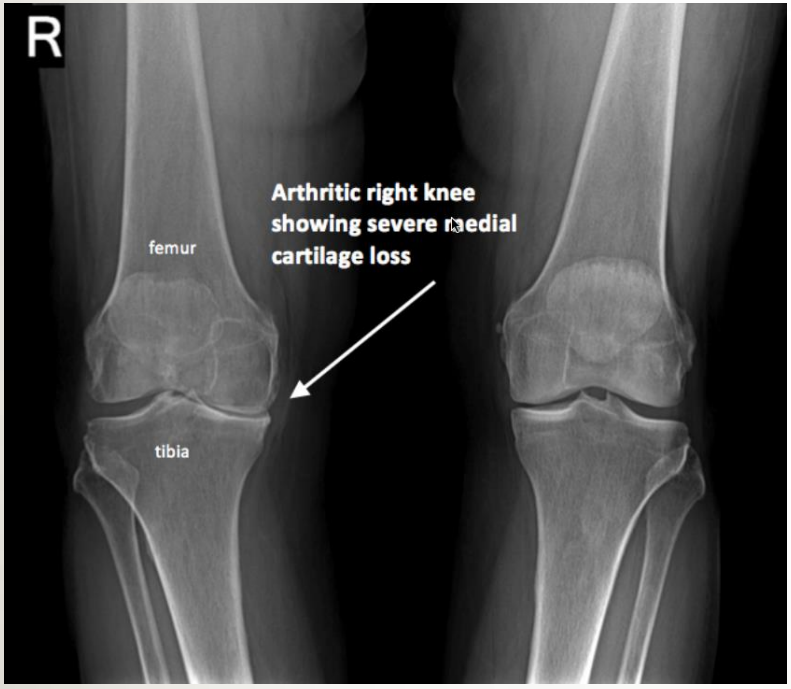
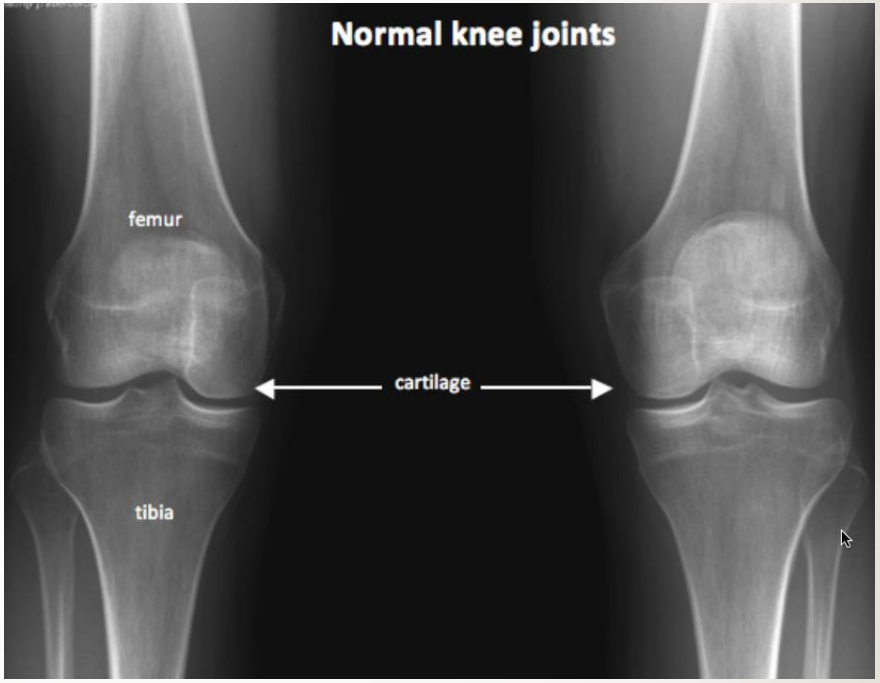
# XR Review

## Grading Arthritis

- Take Home on Clinical Meaningful Difference

>50% Joint Space Narrowing = Changes Arthroscopic outcomes ➔ Non-Op as initial Tx

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Avoid ordering a knee MRI for a patient with anterior knee pain without mechanical symptoms or effusion unless the patient has not improved following completion of an appropriate functional rehabilitation program.

Avoid recommending knee arthroscopy as initial management for patients with degenerative meniscal tears and no mechanical symptoms.

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# Differential Diagnosis For Knee Effusions

- <u>Injury/Event</u>
  - Fracture
  - Dislocation
  - Cruciate Tear
  - Bone Bruise
  - Meniscus Tear
- <u>No Injury/Event</u>
  - DJD
  - Septic Arthritis
  - Gout/CPPD
  - PVNS
  - Chondromatosis
  - Inflammatory Arthritis
  - Reactive Arthritis
  - Spontaneous Hemarthrosis

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# Knee Effusions

- <u>Leg MUST Be Straight</u>
  - If not, fluid will hide in Popliteal Fossa
- Direct Palpation
  - Feel femoral condyles at the patella
  - Compress suprapatellar pouch
  - Feel for fluid femoral at the condyles
- Visualize Fluid Wave
  - Milk Fluid from the anterior-medial joint line
  - Push fluid out of superolateral suprapatellar pouch
  - Watch for wave at anterior-medial knee

# Non-Arthritis Knee Pain

**Non-Operative**

- Patellofemoral Pain Synd.
- Patellar Tendonitis
- Quadriceps Tendonitis
- Pes Anserine Bursitis
- IT Band Friction Syndrome

**Operative &/or Non-Op**

- Meniscal Tears
- Patellar Dislocation (Initial Tx Non-Op)
- ACL Tear (Majority = Reconstruction)
- PCL Tears (Majority = Non-Op)
- MCL and LCL Sprains (Maj. = Non-Op)
- Osteoarthritis/DJD
- Popliteal Cysts (Non-Op)

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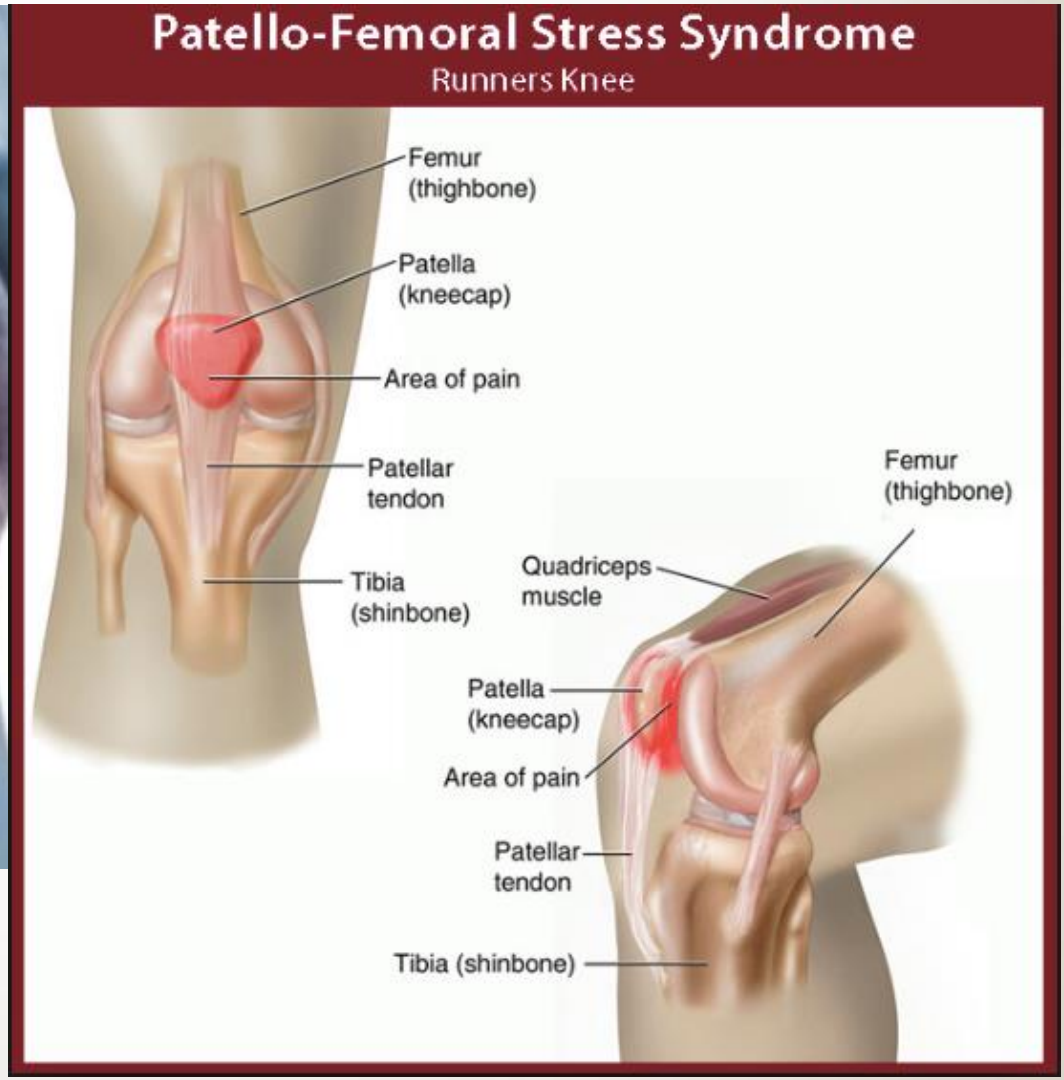
# Patellofemoral Pain Syndrome



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# Patellofemoral Pain Syndrome

**History**

- Pain at anterior/medial knee or "behind knee cap"
- May radiate to popliteal fossa
- Worse with incr. activity, sitting, or upon standing (start-up)
  - First steps hurt, then improves
- (+/-) h/o trauma
  - May start with an event
  - Or be entirely the result of a process

**Exam**

- TTP at anterior/medial joint line or patellar facets
- Weakness in hip abductors, gluteus medius/deep hip rotators
- Weak on affected side with Trendelenburg Stance or Single-Leg Squat tests
  - Often present bilateral but asymmetric
    - Worse on sympt. side

# Patellofemoral Pain Syndrome

**Imaging**

- Bilateral Standing AP, Bilateral Sunrise and Lateral of affected side
  - To Eval DJD and other pathology
  - PFPS will have NL XR

**Treatment**

- Rehab
  - PT for hip/core/quad strengthening
  - Quad/hamstring flexibility
- Weight loss
- Tylenol and/or NSAIDs
- Activity as tolerated
  - Painful but not dangerous

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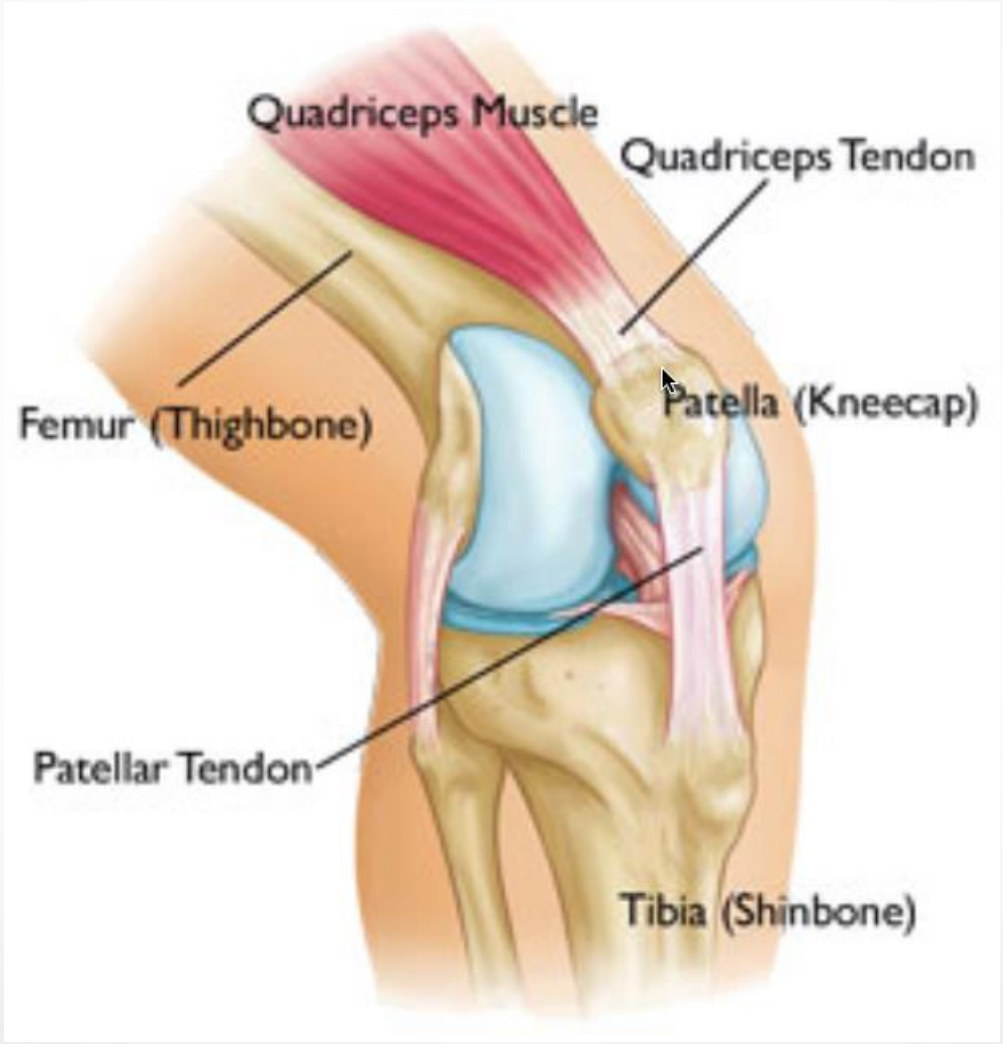
# Patellar and Quadriceps Tendonitis

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# Patellar Tendonitis

**History**

- Pain at patellar tendon or anterior knee
- Worse with incr. activity, sitting, or upon standing/start-up
- Common in jumping and kicking sports

**Exam**

- TTP at patellar tendon
- Pain with resisted extension and passive flexion of knee
  - Pain with resisted extension may improve with patellar tendon compression
- Weakness in hip abductors, gluteus medius/deep hip rotators
- Weak on affected side with Trendelenburg Stance or Single-Leg Squat tests

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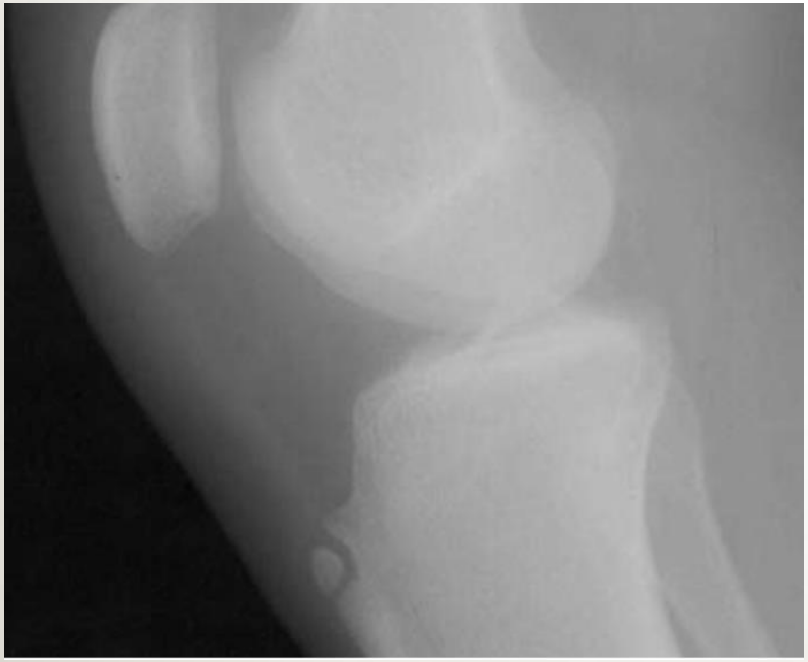
# Patellar Tendonitis

## Imaging

- Bilateral Standing AP, Bilateral Sunrise and Lateral of affected side
  - Usually normal but may have old Osgood-Schlatter's ossicle



## Treatment

- Rehab
  - Eccentric quad exercises
  - Hip/Core strengthening
  - Quad/hamstring flexibility
- Patellar tendon strap

- Weight loss
- Tylenol and/or NSAIDs
- Activity as tolerated

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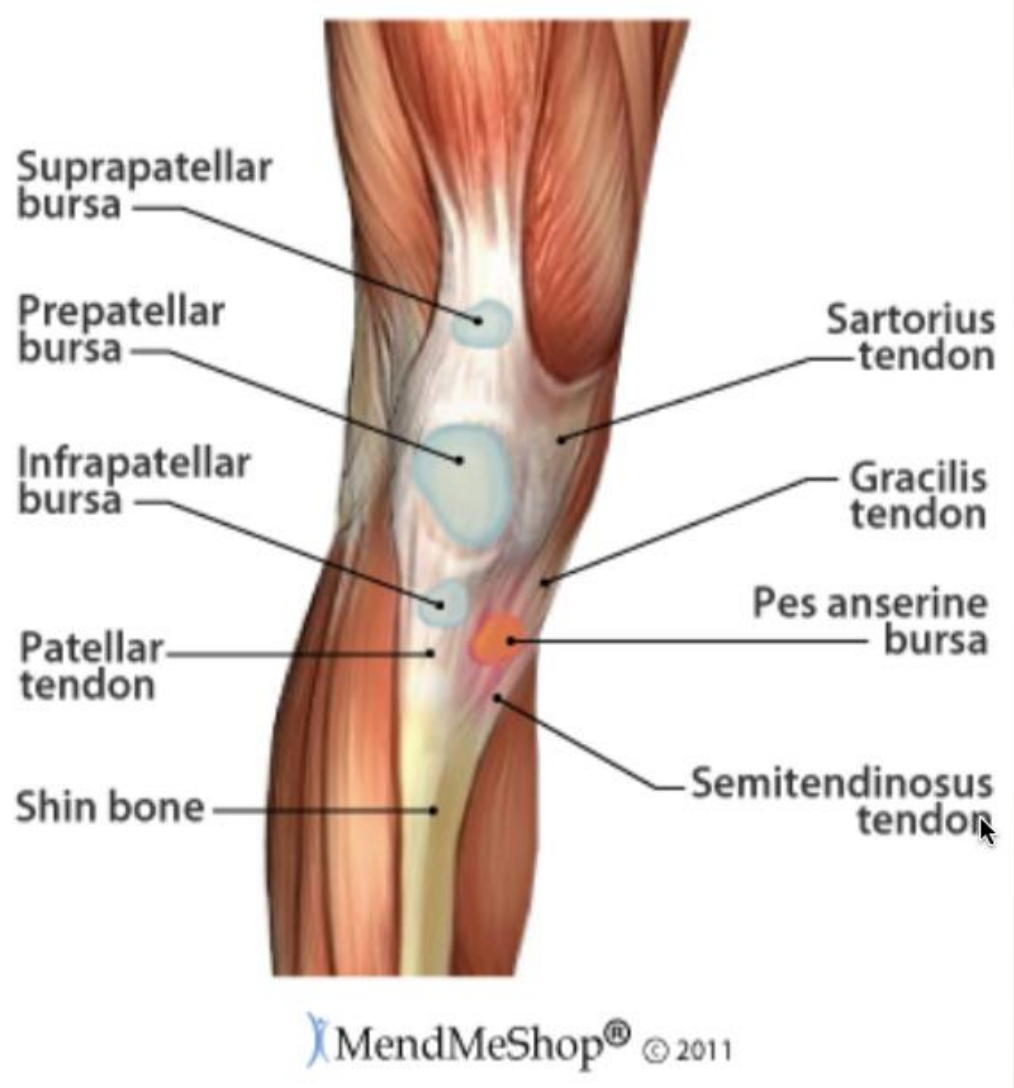
# Pes Anserine Bursitis

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# Pes Anserine Bursitis

**History**

- Pain at anterior/medial tibial plateau
- Worse with incr. activity, sitting, or upon standing/ start-up

**Exam**

- TTP at pes anserine bursa at medial tibial plateau
- Weakness in hip abductors, gluteus medius/deep hip rotators
- Weak on affected side with Trendelenburg Stance or Single-Leg Squat tests

# Pes Anserine Bursitis

**Imaging**

- Bilateral Standing AP, Bilateral Sunrise and Lateral of affected side
- Findings = Normal
  - r/o Stress Fracture or Medial Compartment DJD that can radiate pain to medial tibial plateau

**Treatment**

- Rehab
  - PT for hip/core/quad strengthening
  - Quad/hamstring flexibility
- Voltaren gel
- CS Injection
- RICE
- Activity as tolerated

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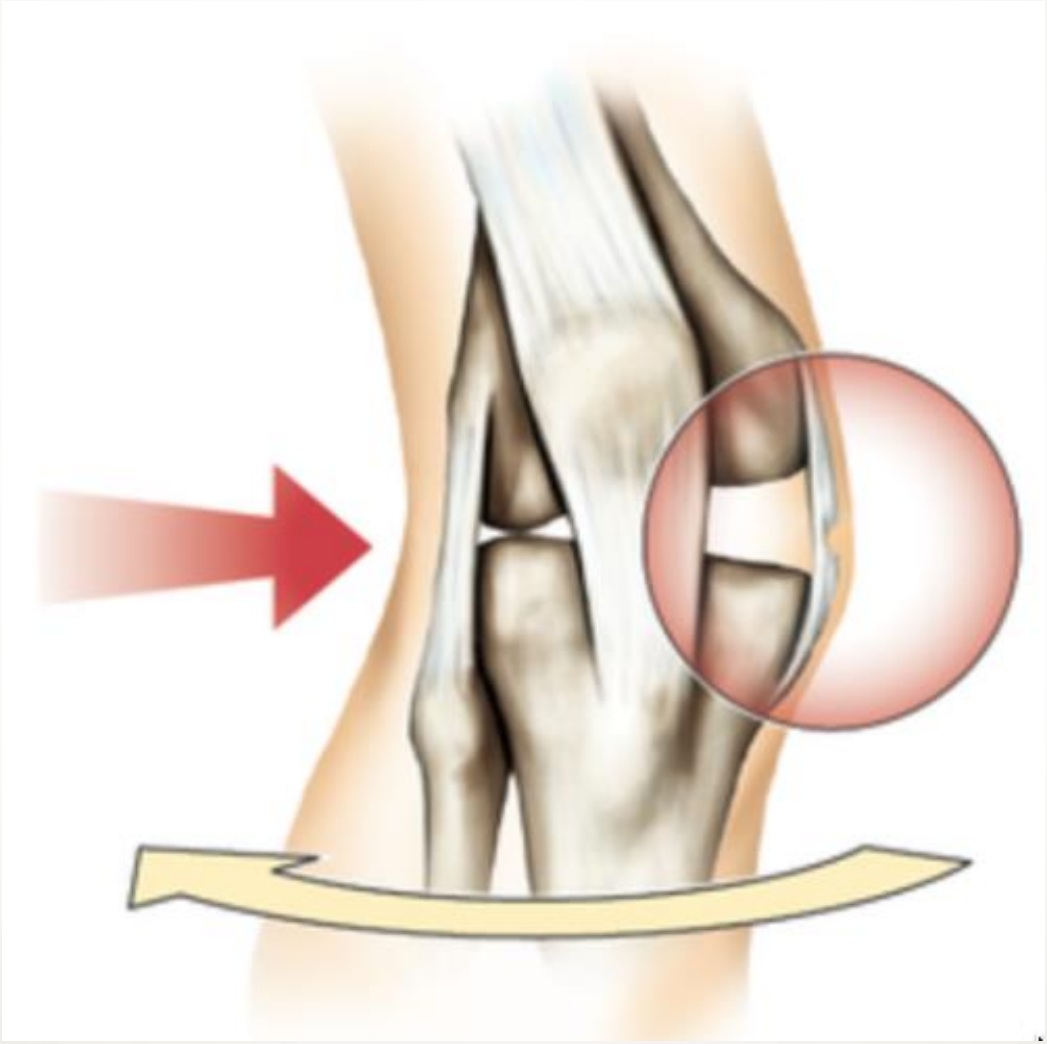
# Medial Collateral Ligament Sprain



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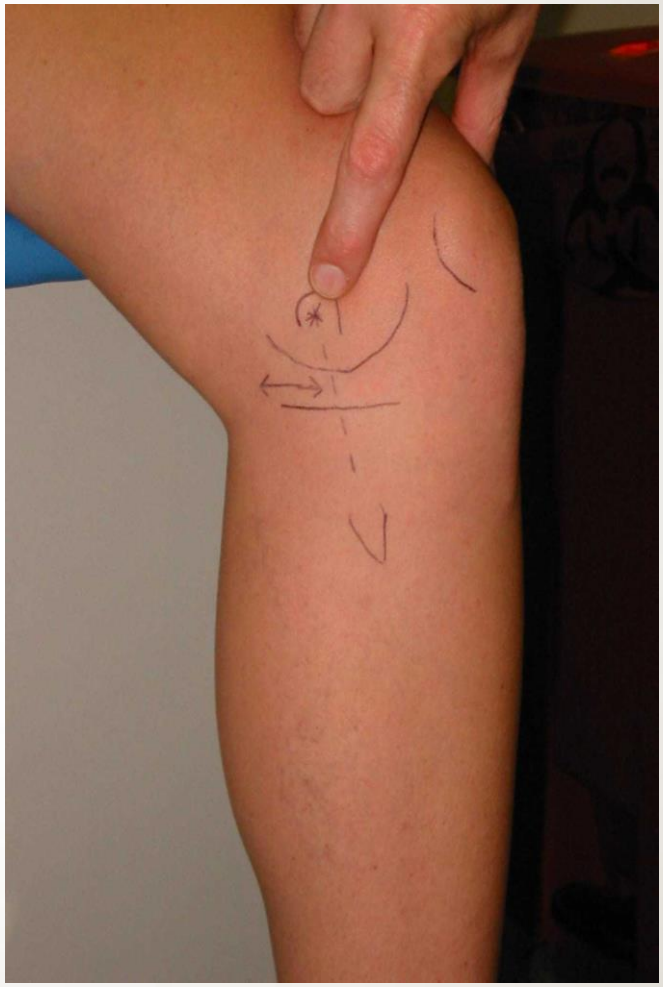
# Medial Collateral Ligament Sprain

## History

- Pain at medial knee
- Relieved by resting leg on lateral foot with ER hip
- Usually with lateral blow to knee or fall with knee falling into valgus

## Exam

- TTP at MCL on medial joint line and/or above or below joint line
- Graded based on degree of laxity on valgus stress
  - Grade 1 – Pain but No Laxity
  - Grade 2 – Pain and Laxity at 20° flexion
  - Grade 3 – Laxity in Full Extension +/- Pain



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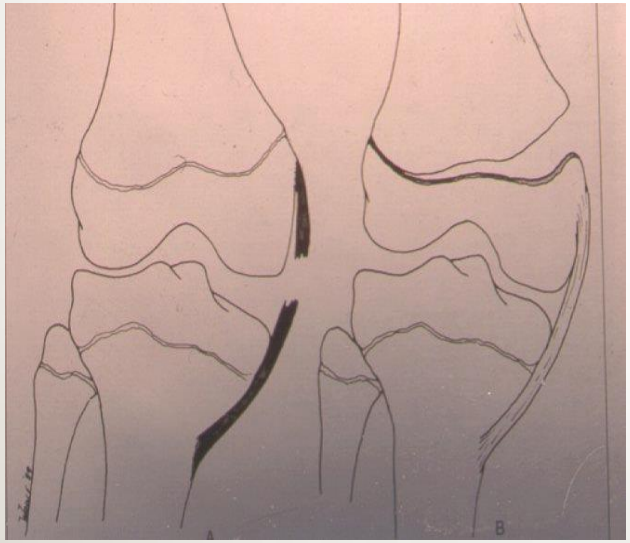
# Medial Collateral Ligament Sprain

**Imaging**

- Bilateral Standing AP, Bilateral Sunrise and Lateral of affected side
- Findings = Normal
  - r/o fracture, esp. in skeletally immature



**Treatment**

- Initial Therapy
  - Straight leg raises and full range of motion
  - Double-hinged knee brace
    - Not Knee Immobilizer
- PT for hip/core/quad rehab
- Return To Play
  - Full Strength, ROM, & Speed for all things activity requires
    - Grade 1 – 2-4 weeks
    - Grade 2 – 4-6 weeks
    - Grade 3 – 6-8 weeks; ? Surgery

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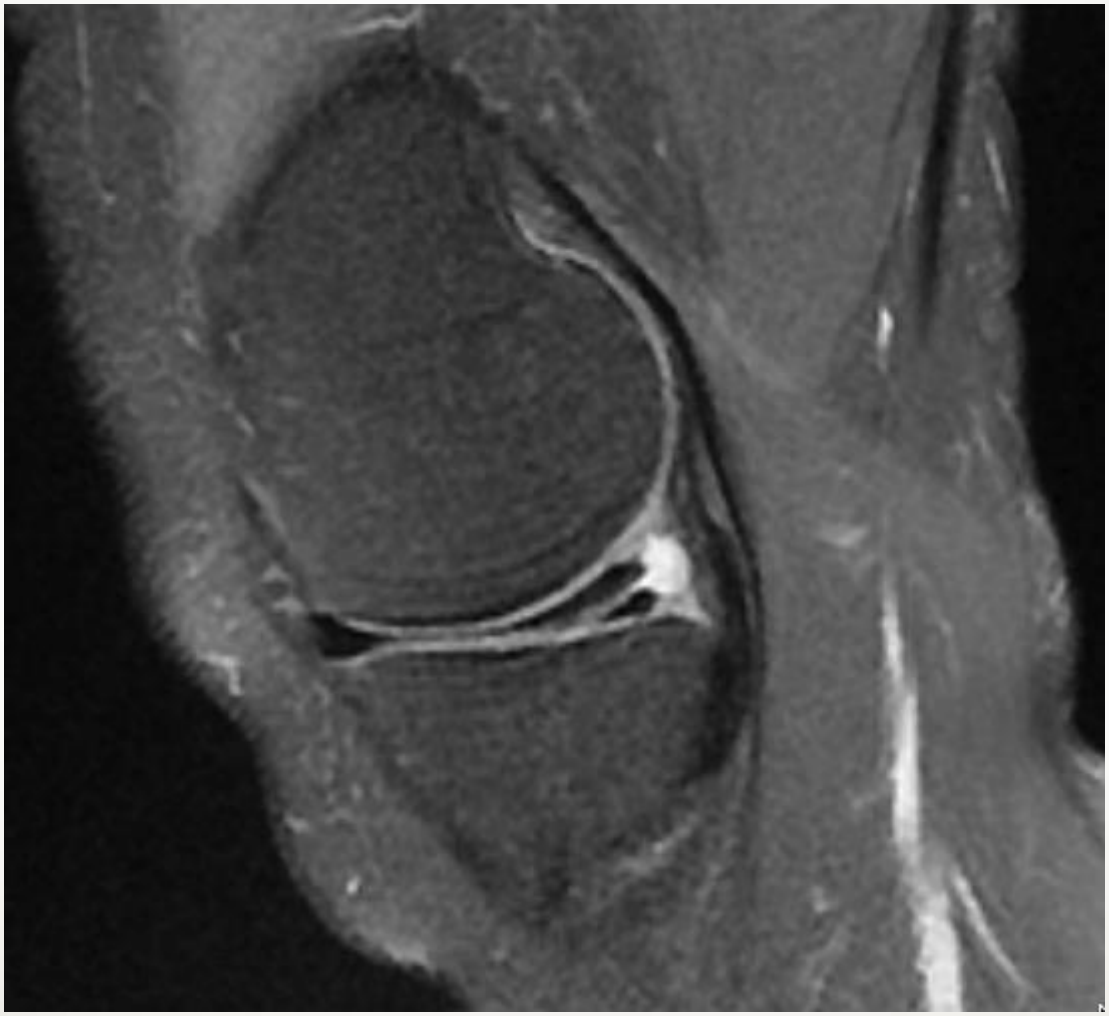
# Medial Meniscus Tear



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# Medial Meniscus Tear

**History**

- Pain at affected joint line
- Worse with incr. activity, sitting, or upon standing/start-up
- May have catch/release/locking symptoms
- Usually starts with weight bearing + twist injury
- May result from both an event or a process

**Exam**

- TTP at posterior medial (NOT anterior medial) joint line
- Consider Duck Walk test if Hx convincing but exam equivocal
- McMurry's is only 50-60% sensitive and specific
- May or May Not have an Effusion

# Medial Meniscus Tear vs. MCL Sprain

- MCL Divides Medial Joint Line Into Ant/Post
  - MCL Pain tracks Vertical or Perpendicular joint line
  - MMT Pain tracks Horizontal or Parallel to joint line
- ≥ 95% of MMT are in the POSTERIOR Horn

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# Medial Meniscal Tear

**Imaging**

- Bilateral Standing AP, Bilateral Sunrise and Lateral of affected side
  - r/o or determine severity of DJD
- Consider MRI if joint line tenderness AND <50% joint space narrowing on XR
  - Don't Create an MRI Bomb!

**Treatment**

- PT for hip/core/quad strengthening and quad/hamstring flexibility,
- CS Injection
- Arthroscopy
  - If >50% medial joint space narrowing, MMT Tx changes from:
    - Non-Op
      - 75% symptom relief ➔ 50%
    - Surgery
      - 90% symptom relief ➔ 70%

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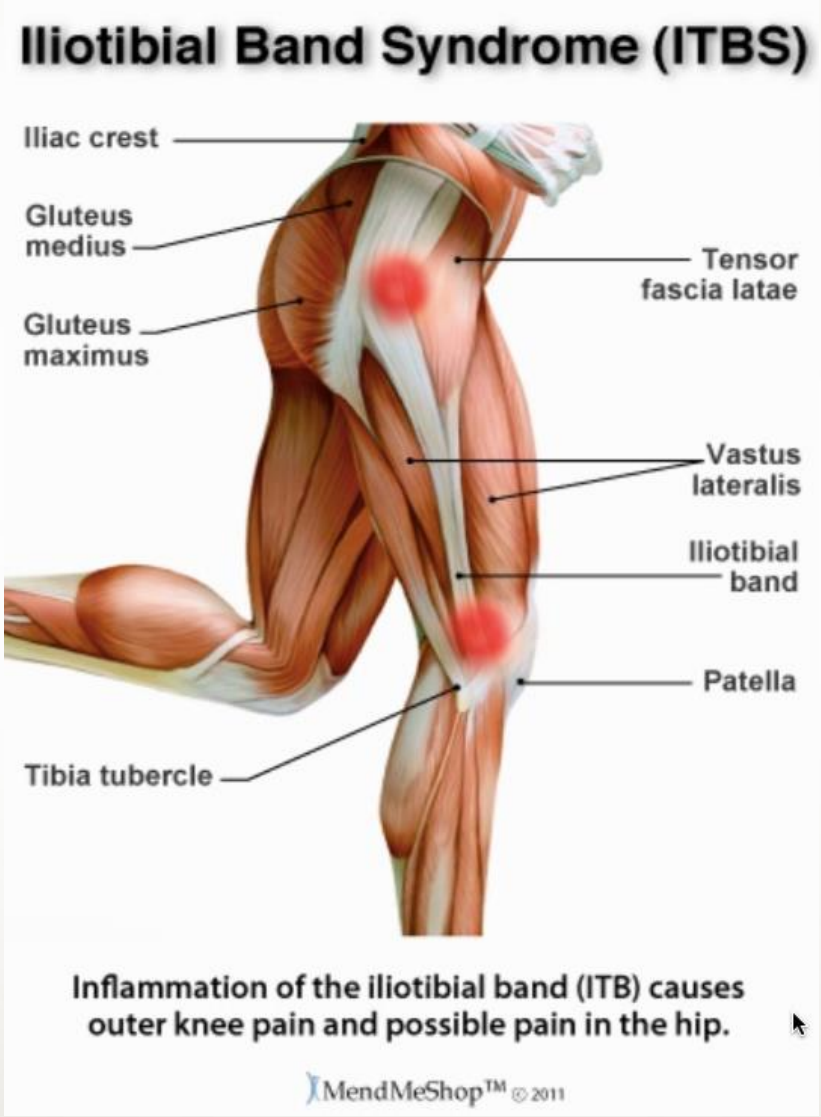
# Iliotibial Band Friction Syndrome

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# Iliotibial Band Friction Syndrome

## History

- Pain at lateral knee
- Worse with incr. activity, sitting, or upon standing/start-up
- Worst in mid-range of motion
- Prefer to walk down stairs/hills with peg/straight leg
- May radiate to lateral leg or distal/lateral thigh
- Common in runners

## Exam

- TTP at lateral femoral condyle or Gurdy's tubercle
- Weak Hips/Core
- Weak on affected side with Trendelenburg Stance or Single-Leg Squat tests

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# Iliotibial Band Friction Syndrome

**Imaging**

- Bilateral Standing AP, Bilateral Sunrise and Lateral of affected side
- Findings = Normal


**Treatment**

- PT for hip/core strengthening and IT band stretching
- Foam Rolling
- CS Injection at IT Band and Lateral Femoral Condyle Bursa

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# Lateral Meniscal Tear

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# Lateral Meniscus Tear

**History**

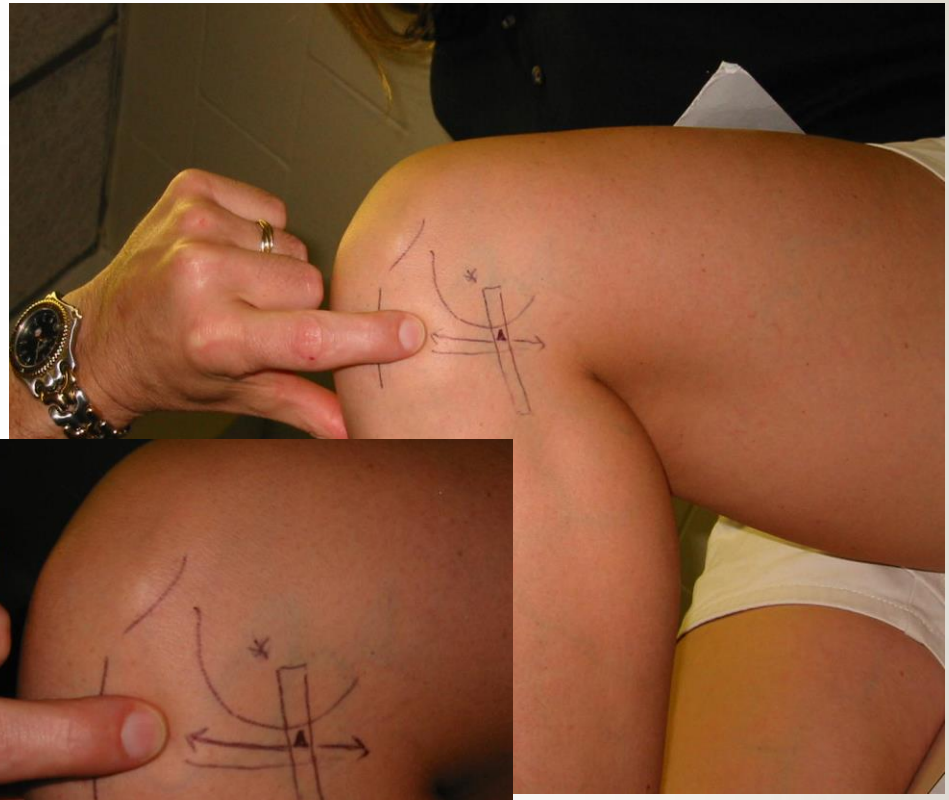
- Pain at affected joint line
- Worse with incr. activity, sitting, or upon standing/start-up
- May have catch/release/locking symptoms
- Usually starts with weight bearing + twist injury
- May result from both an event or a process

**Exam**

- TTP at Anterior OR Posterior Lateral Joint Line (different than MMT)
  - 50% Anterior & 50% Posterior
- Consider Duck Walk test if Hx convincing but exam equivocal
- McMurry's is only 50-60% sensitive and specific
- May or May Not have an Effusion

# Lateral Meniscus Tear vs. LCL Sprain vs. IT Band Syndrome

- LCL Divides Medial Joint Line Into Ant/Post
- Examine in "Figure 4" position
  - LCL and IT Band Pain track Vertical or Perpendicular joint line
  - IT Band is anterior LCL
    - Cross Lateral Femoral Condyle and Gurdy's Tubercle
    - Ant. LMT vs. ITB Synd.
  - LMT Pain tracks Horizontal or Parallel to joint line
- Lateral Meniscal Tears
  - 50% Anterior, 50% Posterior



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# Lateral Meniscal Tear

**Imaging**

- Bilateral Standing AP, Bilateral Sunrise and Lateral of affected side
  - r/o or determine severity of DJD
- Consider MRI <u>if joint line tenderness</u> <u>AND</u> <u><50% joint space narrowing</u> on XR
  - Don't Create an MRI Bomb!

**Treatment**

- PT for hip/core/quad strengthening and quad/hamstring flexibility,
- CS Injection
- Arthroscopy
  - If >50% lateral joint space narrowing, LMT Tx changes from:
    - Non-Op
      - 75% symptom relief ➔ 50%
    - Surgery
      - 90% symptom relief ➔ 70%

# Meniscus Tears Therapy

- Evidence – Level 1
  - **Arthroscopic surgery for degenerative tears of the meniscus: a systematic review and meta-analysis.** Khan et. al. *CMAJ*. 2014 Aug 25
    - Conclusion – There is moderate evidence to suggest that there is no benefit to arthroscopic meniscal debridement for degenerative meniscal tears in comparison with nonoperative or sham treatments in middle-aged patients with mild or no concomitant osteoarthritis. A trial of nonoperative management should be the firstline treatment for such patients.

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# XR Review

## Meniscus Tears and Arthritis


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### Clinical Meaningful Difference

>50% Joint Space Narrowing (JSN) = Changes Arthroscopic outcomes & favors rehab as initial Tx

- Favors Non-Op
  - ≥ 50% JSN
  - No Injury
  - Less Active
  - No Mechanical Symptoms
- Favors Surgery
  - <50 % JSN
  - Injury/Event
  - Active &/or Young
  - Mechanical Symptoms

**Avoid ordering a knee MRI for a patient with anterior knee pain without mechanical symptoms or effusion unless the patient has not improved following completion of an appropriate functional rehabilitation program.**

**Avoid recommending knee arthroscopy as initial management for patients with degenerative meniscal tears and no mechanical symptoms.**

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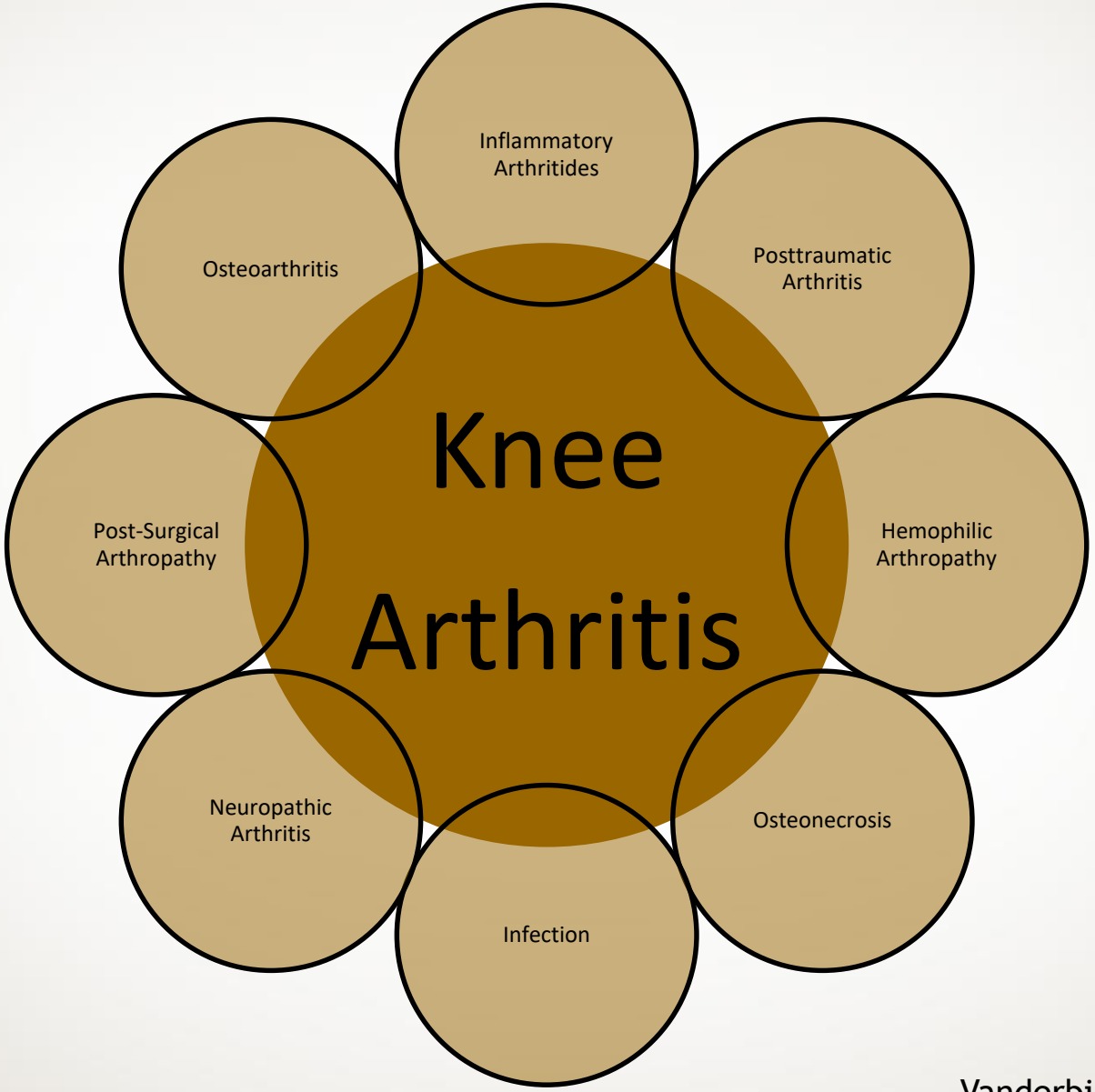


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# Description & Background

- Most common joint disease
  - 60 Million patients
    - Estimates of radiographic evidence of DJD range from 33-90% of people over age 65
    - Leading cause of disability over age 65
- Previously thought to be a normal consequence of aging

- Complex interplay of multiple factors
  - Joint integrity and alignment
  - Muscle and Connective Tissue related to joints
  - Genetic predisposition
  - Local inflammation
  - Mechanical forces
  - Cellular and biochemical processes

# Risk Factors & Possible Causes

- Age > 50
- Female vs. Male
- Obesity
- Occupation
- Sports activities
- Previous injury
- Muscle weakness
- Proprioceptive deficits
- Genetic elements

# Knee DJD

## History

- Pain at anterior/medial knee
- Worse with incr. activity, sitting, or upon standing/start-up
- (+/-) h/o trauma
- May radiate into tibial plateau
- Medial compartment most common

## Exam

- TTP at anterior/medial joint line or patellar facets
- Limited A/PROM usually lacking extension
- Weakness in hip abductors, gluteus medius/deep hip rotators
- Weak on affected side with Trendelenburg Stance or Single-Leg Squat tests
  - Often present bilateral but asymmetric
    - Worse on sympt. side

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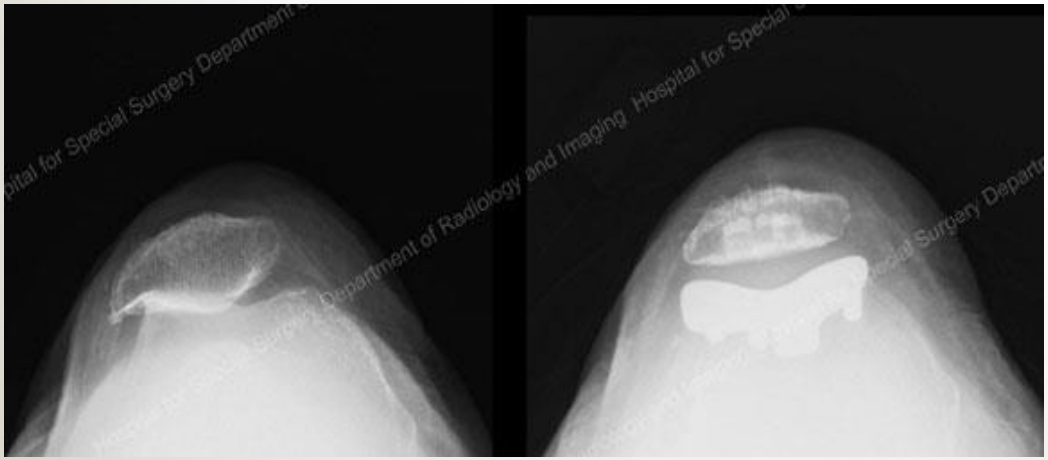
# Knee DJD Imaging

- 2-3 views of the Knee
  - Order = Bilateral Standing AP, Bilateral Sunrise and Lateral of affected side
  - Findings = joint space narrowing, marginal osteophytes, and/or flattening of femoral condyles

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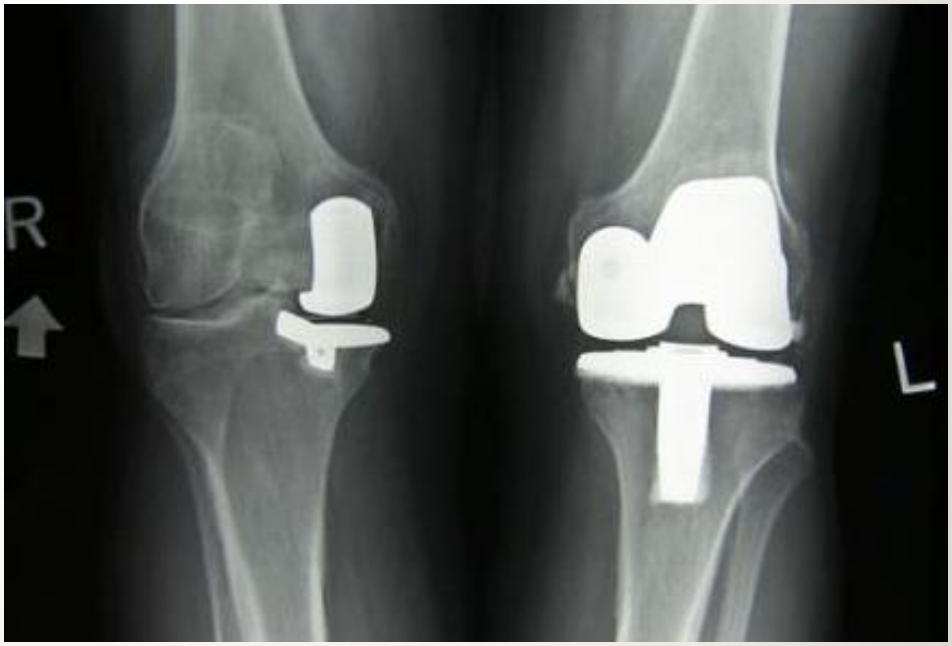
# Knee DJD

**Non-Operative**

- PT for hip/core/quad strengthening and quad/hamstring flexibility
- Weight loss
- Pain Medicine
  - NSAIDs
  - Tylenol (APAP)
  - Narcotics
- Bracing
- Steroid Injections
- Viscosupplementation

**Operative**

- Non-Joint Replacement
- Partial Joint Replacement
- Total Joint Replacement

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# Treatment Goals & Guides

- Goals
  - Control pain and swelling
  - Minimize disability
  - Prevent progression
  - Improve the quality of life
- Guides
  - Individualized to patient expectations
  - Level of function & activity
  - Joints involved
  - Severity of disease
  - Vocation & avocations
  - Other medical conditions
  - Subjective complaints
  - Objective findings

# Western Ontario and McMaster University Osteoarthritis Index (WOMAC)

- Measures/Quantifies pain and overall function of the knee
- Widely used in evaluation of knee osteoarthritis as outcome measure
  - Valid, Reliable, & Responsive
- Used worldwide, validated linguistically
- Takes 5-10 minutes to complete

# Summary of Non- Op Treatment for Knee Osteoarthritis

- Level I Evidence
  - Patient education (psych outcomes only)
  - Physical therapy (WOMAC pain and function)
  - Weight loss (WOMAC pain and function)
  - Unloader brace (WOMAC pain)
  - Cryotherapy (pain)
  - Corticosteroid injection (VAS pain x 1-2 weeks)
  - Viscosupplementation (WOMAC pain)
  - Glucosamine and chondroitin sulfate (effect size diminished by high-quality or large trials)

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# Physical Therapy and Exercise

# Evidence – Level I

**Effects of Physical Therapy on Osteoarthritis Through the Lens of the WOMAC: A Systematic Review**

Contributors:
Anupam K. Pradhan, Laura J. Huston, Kurt P. Spindler

Vanderbilt University Medical Center, Department of Orthopaedics and Rehabilitation; Nashville, TN 37232-8774

- Systematic review of effects of PT on Knee OA
  - Randomized controlled trials
  - WOMAC as outcome measure
  - > 80% patient follow-up at time of final data collection
- Conclusions
  - Physical therapy improves pain and function and has minimal adverse effects

# Weight Loss
# Evidence – Level I

- Each weight-loss unit was associated with a 4-unit reduction in knee-joint forces
  - 10 lbs. off = 40 lbs. of pressure off knees
- Weight loss:
  - 10% weight reduction results in 28% decline in knee OA trouble
- Body fat:
  - 5% reduction in body-fat results in 50% in knee OA trouble
- NNT calculated on the basis of > 50% reduction in total WOMAC was 4 patients
  - NNT to prevent lung cancer by smoking cessation is 16

Messier et. al., *Arthritis & Rhumatism*, Vol. 52, No. 7, July 2005
Christiansen et. al., *Osteoarthritis Cartilage*. 2005 Jan;13(1):20-7

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# Core Stability Defined

- Foundation of kinetic chain
- Aids in posture and stability
- Comprised of lumbo-pelvic and hip complex
  - Transverse Abdominus
  - Multifidus
  - External/Internal obliques
  - Pelvic floor
  - Erector spinae
  - Gluteals
  - Rectus abdominus
- Key components – strength, endurance flexibility and motor control

# Clinical Significance of Core Stability

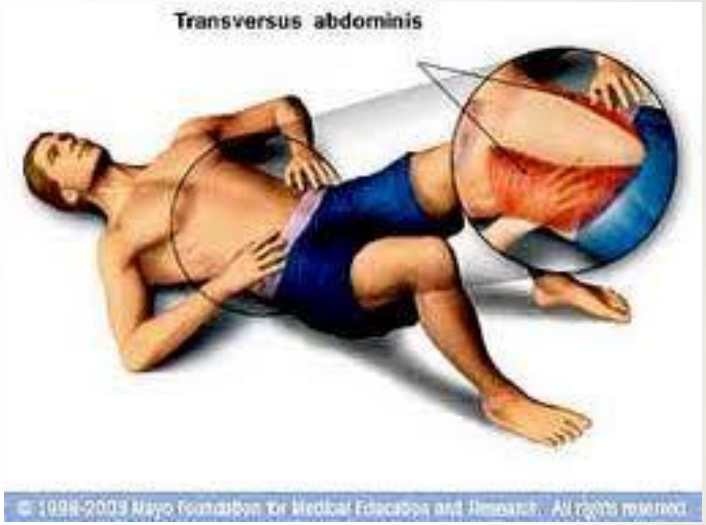
- Lack of core stability can lead to:
  - Low back pain
  - Upper extremity injuries
    - Overhead athletes
  - Lower extremity injuries
    - Ankle Sprains
    - Hamstring Strains
    - Patellofemoral Pain Syndrome
    - ACL  Injuries

# Conclusion About The Core

- Key component of rehab
  - Sports/ADL's
- No gold standard to assess core strength
  - Single leg squat/Box step down test
  - MMT
- Numerous core exercises
  - Transverse abdominus is the starting point

# Treatment

- Transverse abdominus
  - Pull belly button to spine
  - “Suck in your gut”
  - Hold 10 seconds
- Multifidus
- Rectus abdominus
- Internal/External obliques



# Treatment

- Hip extensors
  - Bridging
  - SL Bridging
  - Prone hip extension
- Hip abductors
  - SL abduction
  - Clamshells
  - Sidestepping

# Treatment

- Lateral step ups
- Forward step downs
- Single leg deadlifts
- Planks
- Side Planks

- Unstable surface
  - Increases difficulty

# Summary

- The Knee is often the victim of the Hip
- Sports and Work require strong cores, but don't develop them
- Where does it hurt?  Where does the pain go?
  - History and Physical Exam are key
  - Tendonopathy hurts with palpation, stretch, and contraction
  - Anterior-medial joint line pain is NOT a meniscus tear (95%)
- Appropriate XR will adequately address most knee pain
  - Always include Bilateral Standing AP, Bilateral Sunrise, and Lateral
  - Consider MRI if (+) joint line tenderness AND <50% joint space narrowing, especially in active/young pts. with mechanical symptoms
- Conservative therapies, including PT and Weight Loss, are effective and safe and supported by good Level 1 evidence

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# Comments & Questions

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# Thank You

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# References and Source List


- All surface anatomy instructional photos courtesy of Dr. Kurt Spindler
- Knee Anatomy- http://www.christuslivewell.org/what-hurts-less-a-total-knee-replacement-or-a-total-hip-replacement-surgery/knee-anatomy/
- Labeled Knee XR- http://www.wikiradiography.com/page/Knee+%28non+trauma%29+Radiographic+Anatomy
- Normal and Arthritic XR - AP/Lat - http://millsteinorthopedics.com/knee-xray/
- Logos and Chose Wisely Statements - https://www.amssm.org/Content/pdf%20files/Choosing_Wisely.pdf
- Patellofemoral Pain Syndrome Graphics - http://blog.bodyhelix.com/2012/04/runners-knee-patellofemoral-pain.html#.VCDelUtykds and http://www.kneepaindiagnosis.net/knee-diagnosis/
- Patellar and Quad Tendonitis Graphics - http://orthoinfo.aaos.org/topic.cfm?topic=a00512
- Osgood Schlatter's XR - http://emedicine.medscape.com/article/411842-overview
- Patellar Tendon Strap Graphics - http://users.rowan.edu/~woodwa77/PatellarTendonitis.html and http://www.ezcaremedical.com/store/index.php?main_page=product_info&cPath=546_38_47&products_id=381

# References and Source List


- Pes Bursitis Graphic – http://www.mendmyknee.com/knee-and-patella-injuries/pes-anserine-bursitis-treatments.php
- MCL Sprain Graphic - http://www.humankinetics.com/excerpts/excerpts/many-ligaments-make-up-knees-structure
- Medial and Lateral Meniscus Tear MRIs - http://www.kneeclinic.info/VBMRIGallery.php
- IT Band Synd Graphic - http://sierrarunco.com/2013/10/07/it-band-syndrome-treat-it-and-beat-it/
- IT Band Foam Rolling - http://www.runningwithhaynes.com/2012/09/06/it-band-syndrome/
- IT Band Stretch - http://www.onhealth.com/iliotibial_band_syndrome/page3.htm
- Patellofemoral Knee Arthroplasty - http://www.hss.edu/conditions_patellofemoral-arthritis-in-the-knee-overview.asp#.VCShWktykds
- Knee Arthroplasty Uni and Total - http://www.carpaltunnelrelief.net/Knee%20Replacement%20for%20Arthritis
- Scale - http://www.sears.com/search=doctors%20scales