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Sports Injuries A Guide for Rheumatologists: Focus KNEE

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Disclosures Kurt P Spindler

- Current FUNDING
  - NIH R01 = MRI MOON (Li/Spindler co-PI)
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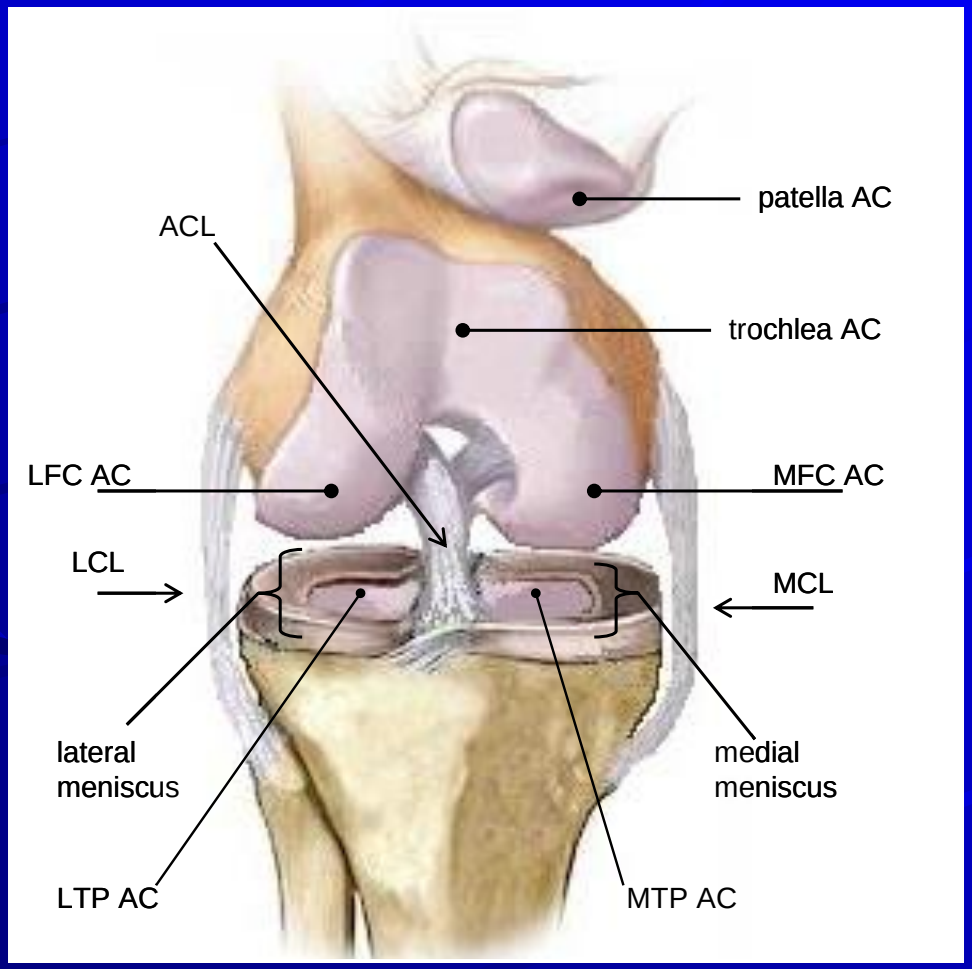
Introduction

1. Accuracy = characteristics of XR or MRI
2. Clinical Value = appropriate use of image for clinical decision making or prognosis
3. Example: MRI is >95% accurate ACL is "torn" but can't always differentiate between NEW vs OLD
4. Evaluation Injured "joint" use knee as example is stepwise algorithm including History, PE, Imaging, DDx and initial Treatment

Normal Knee Anatomy

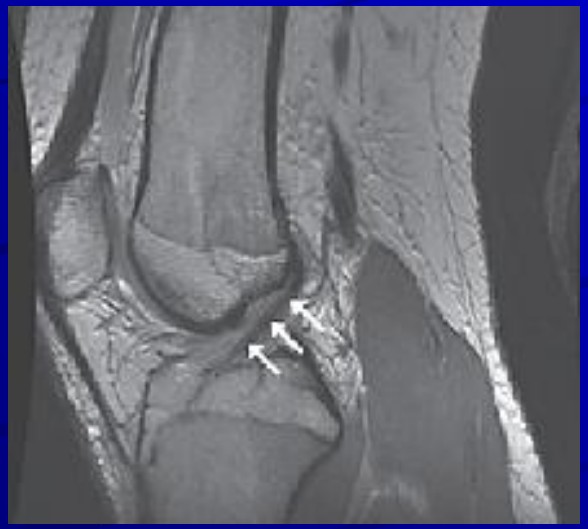


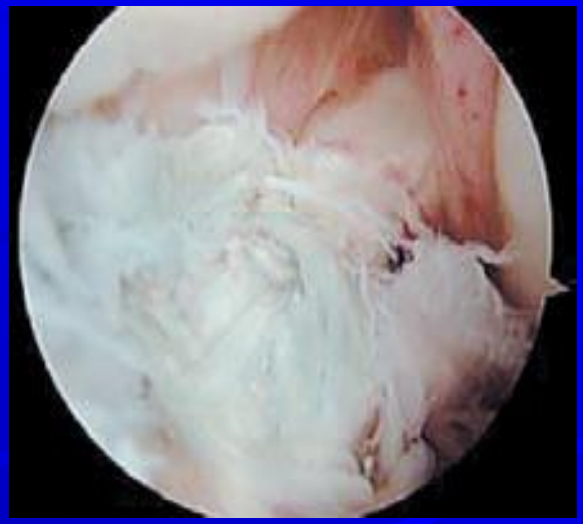
Function, Type of Injury, and Initial Evaluation of Commonly Injured Knee Structures

Knee Structure	Biomechanical Function	Clinical Function	Injury Type	Symptoms*	Signs
Anterior cruciate ligament	Prevents anterior and rotational motion of tibia relative to femur	Stabilizes knee for cutting and pivoting	Tear (primarily rupture)	"Giving out" while cutting and pivoting	Positive Lachman test and pivot shift test
Meniscus (medial and lateral)	Decreases force per unit area on articular cartilage (distributes load)	Protects articular cartilage from premature degeneration or osteoarthritis	Tear (both partial and complete)	Mechanical symptoms (e.g., catching, locking)	Joint-line pain, effusion
Articular cartilage	Allows for nearly frictionless gliding surface and impact dissipation	Allows for painless and nearly effortless active motion and impact	Focal defect or osteoarthritis†	Focal defect: no symptoms or possible pain; osteoarthritis: pain, stiffness, swelling	Focal defect: no symptoms or loose piece of cartilage; osteoarthritis: joint-line pain, effusion

Spindler and Wright. *N Engl J Med* 359(2): 2135-2142, Nov 2008

Anterior Cruciate Ligament (ACL)





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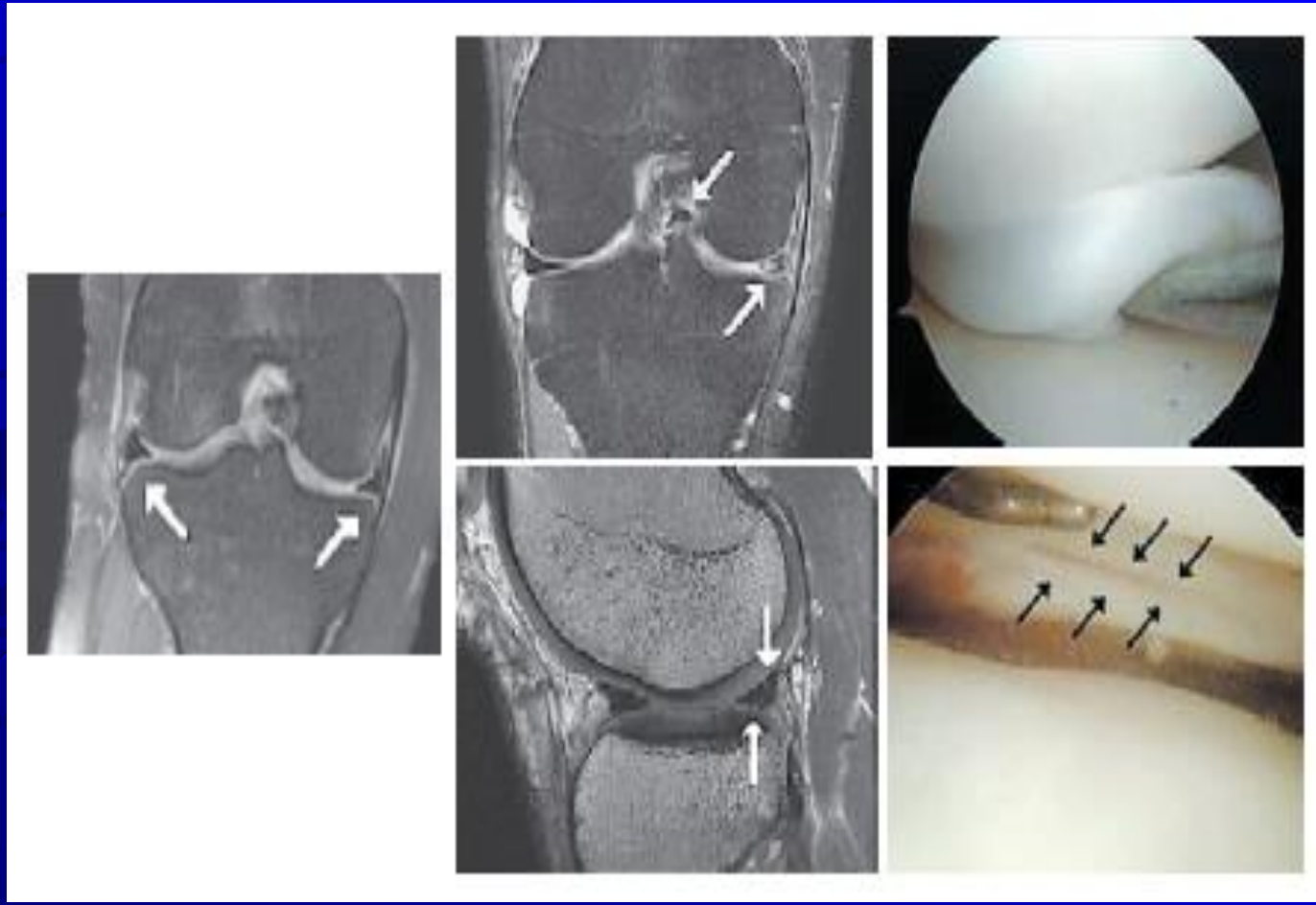
Medial and Lateral Meniscus



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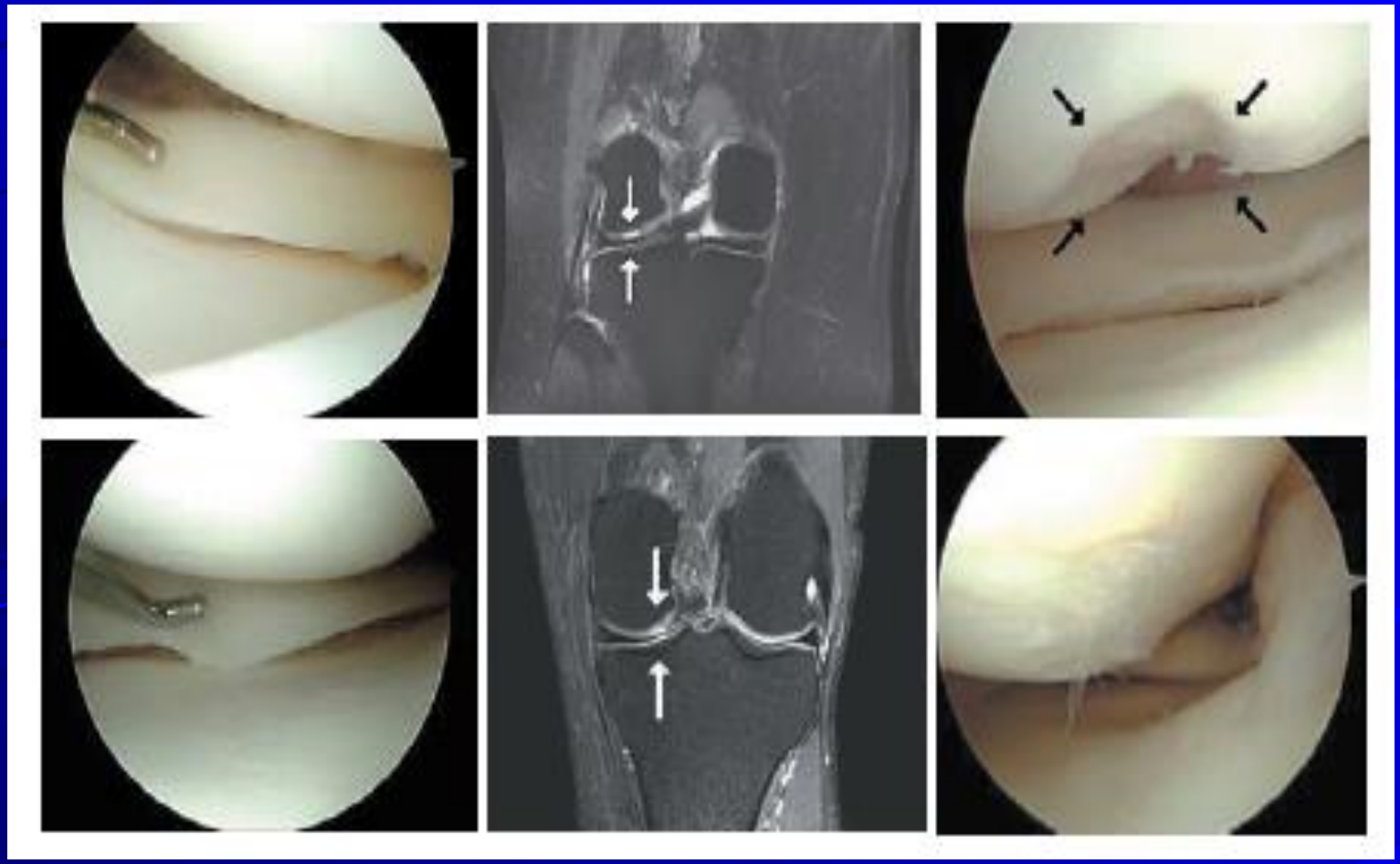
Articular Cartilage



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Critical Assumptions

1. MD directly takes brief focused history
2. MD PERFORMS comprehensive PE
3. Standing Bilateral AP or PA in 45 degrees are obtained to evaluate OA
4. MRI is at least 1.5T preferred 3T with designated surface coil and musculosletal trained radiologist reading. Caveat that MD above reads and interprets findings on MRI.
5. MD has ample experience with arthroscopic findings as they relate to both history, PE, imaging and injury

Knee Injury Algorithm:
HISTORY and PE

ACUTE

INJURY → **HISTORY** → **EXAM** →

WORK
Sport
MVA

Traumatic?
Contact?
Pop?
Swelling/timing?
Walk?
Giving way

PHYSICAL

Gait
Effusion
Point tender
Meniscus
AP stability
Varus/valgus
PF
NV

IMAGING

Knee Injury Algorithm: IMAGING

Routine XR's

- Standing AP, lat, PF
- Skeletal maturity?
- R/O Fracture
  - GP vs apophysis
  - Cruciate avulsion
  - Patella
  - Segond
- OCD

Advanced Imaging

- MRI
  - GP Fx
  - ACL
  - Meniscus
  - OCD
  - Occult Fx
- Stress XR's
  - ? Role
- Diagnostic scope
  - Very limited

PRIMARY DIAGNOSIS or Ddx

KNEE MECHANSIM of INJURY ?

TRAUMATIC

1. Fracture
2. Dislocation/subluxation
3. Ligament tear
4. Meniscus tear
5. Chondral injury

ATRAUMATIC

1. Overuse
2. Tendinitis
3. Arthritis
4. Degenerative meniscus tear
5. Inflammatory arthritis

General Guidelines

1. **INJURIED STRUCTURE**

articular cartilage

meniscus tear

ligament

1. **RESULT OR OUTCOME**

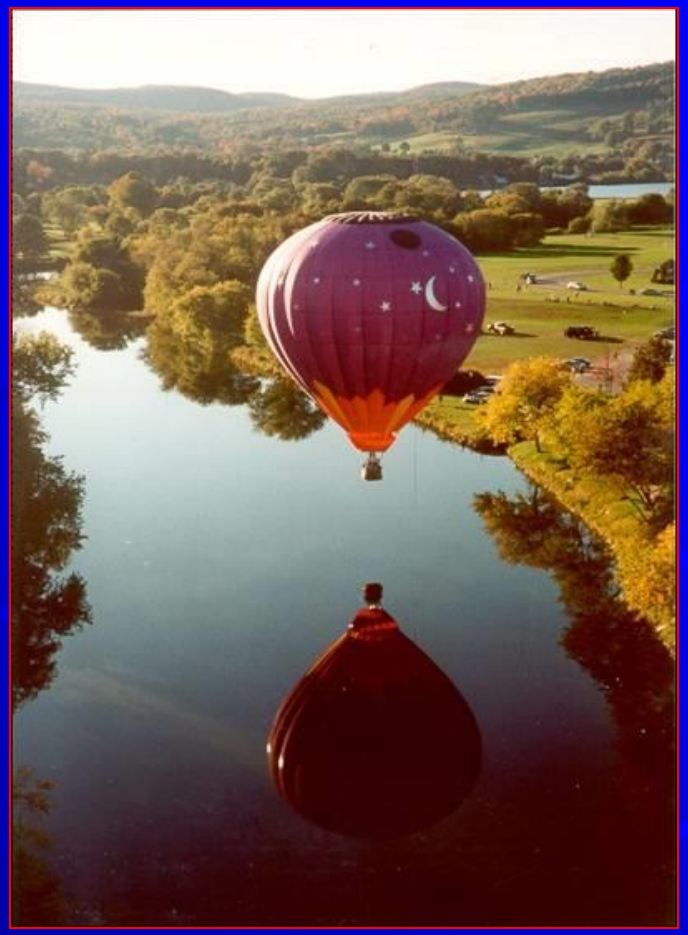
arthritis over time

mechanical symptoms

specific instability

EVALUATION STEPS

1. Injury – Sport or WORK
2. History
3. Physical Examination
4. Radiographs
5. MRI
6. Primary Diagnosis



HISTORY

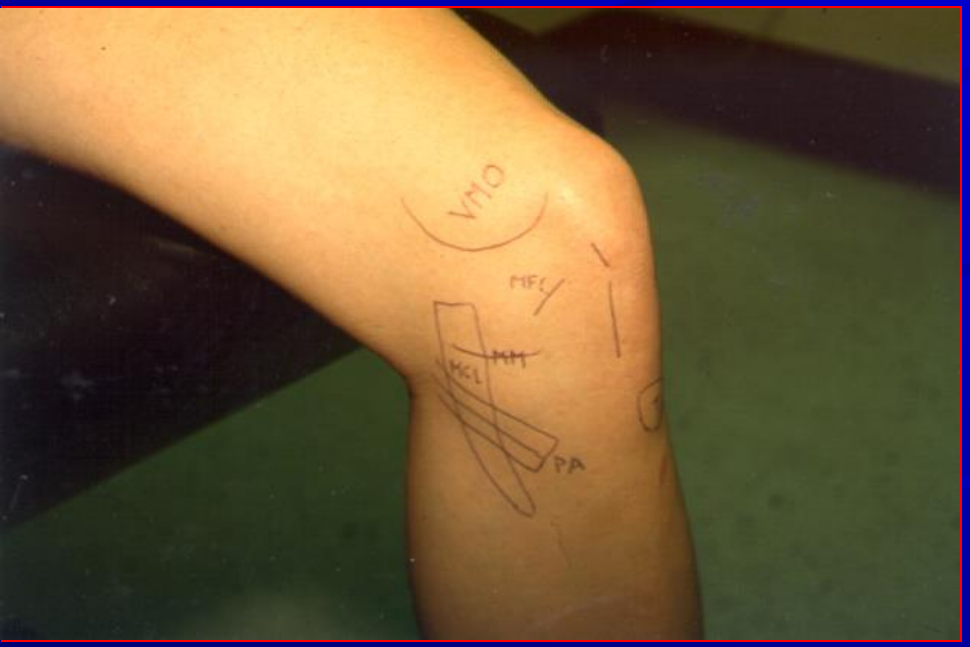
1. Acute -- Sport vs *WORK* vs MVA
2. FIVE QUESTIONS
    1. Contact?
    2. Swelling?
    3. Pop?
    4. Giving way?
    5. Walk?

PHYSICAL EXAMINATION

1. Inspection
2. Palpation
3. Range of motion
4. EFFUSION
5. Joint line pain meniscus
6. Lachman/Post drawer
7. Pivot shift
8. Varus/valgus 0°/20°
9. Patellofemoral (PF)

PALPATION
SUPERFICIAL ANATOMY

Medial



Lateral

EFFUSION

1. Direct palpation
    1. Feel femoral condyles at patella
    2. Compress suprapatella pouch
    3. Feel for fluid femoral condyles
1. FLUID WAVE
2. “Ballotable” patella = easily visualized!

DX ACL OR PCL TEAR

1. Normal (PE BOTH KNEES)
   a. “Centered” knee -- tibia anterior to femur
   b. Hard end points posterior (PCL) and anterior (ACL)
   c. Symmetric excursion contralateral
2. Tear
   a. Soft end point
   b. Increased excursion

DIAGNOSIS: HEMARTHROSIS

1. History -- rapid onset
2. Aspiration knee -- blood
3. MRI -- “layering” fat-fluid

DIFFERENTIAL DIAGNOSIS HEMARTHROSIS

1. ACL rupture
2. Patellar subluxation/dislocation
3. Peripheral meniscus tear
4. Osteochondral fx (can be occult MRI)
5. PCL rupture

Knee PE Pearls Meniscus (Must BILATERAL PE)

- R/o ACL tear
- Evaluate EFFUSION
- Detect joint line pain
- PRACTICE!

MM Tear vs MCL Sprain

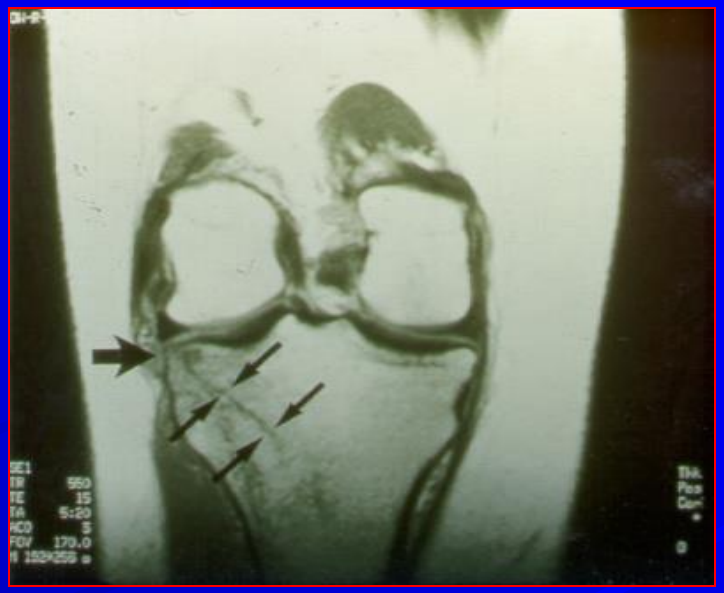
1. Concept
   - Horizontal orientation = meniscus
   - Vertical orientation = MCL
2. MM (medial meniscus) tear
   - ≥ 95% POSTERIOR HORN!
   - ONLY ~5% MCL and MM tear

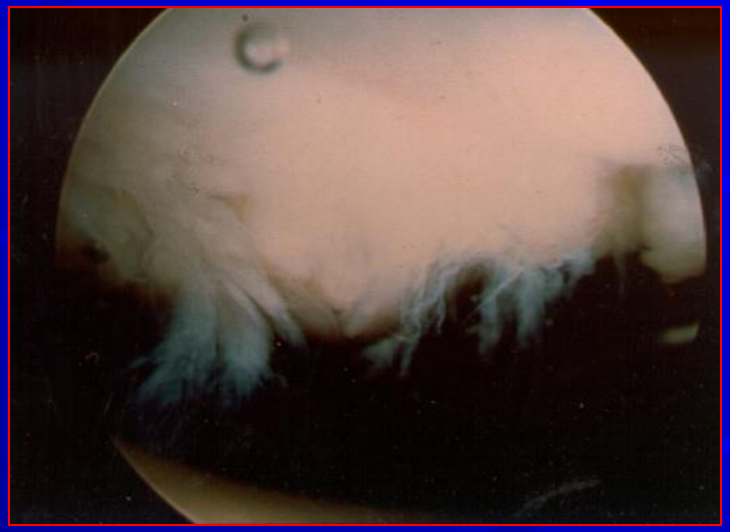
LM Tear: R/O LCL & ITB

1. Difficult distinction
2. Key PE position “Figure 4”
3. LM horizontal pain
4. Hx key
   - ITB -- runners
   - LM tr -- swelling
5. Palpation superficial
   LCL vs joint line

No Accurate PE:

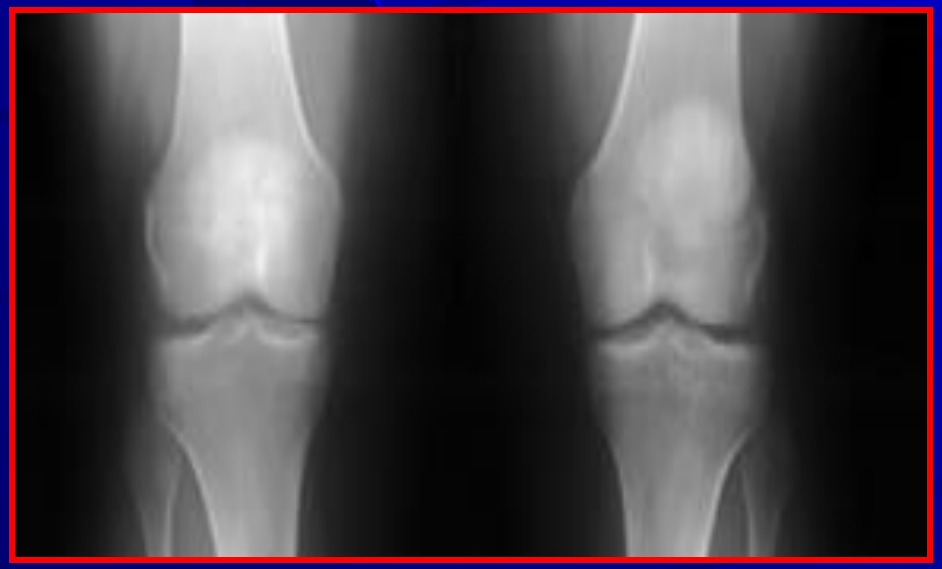
1. Articular Cartilage
   a. Focal Injury
   b. OA (osteoarhritis)
2. Occult fractures
3. Most Loose Bodies
4. OCD
5. Chondromalacia



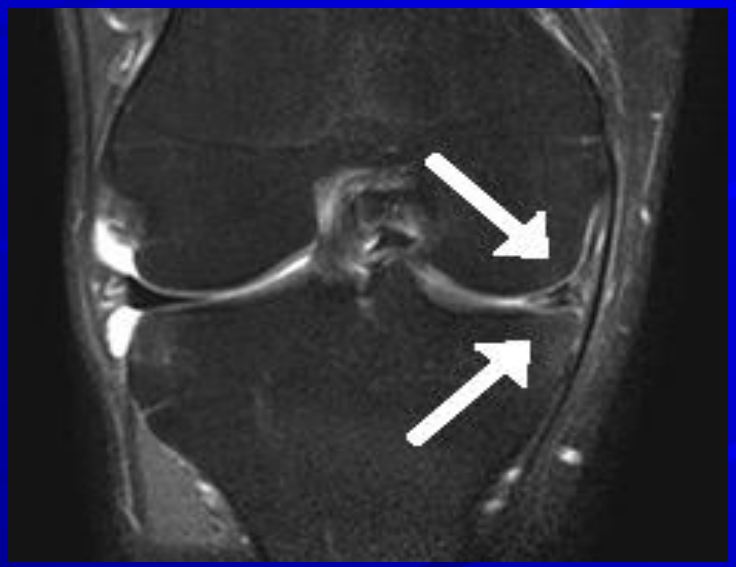


Imaging: XR & MRI

1. XR
2. First Imaging:
   a. fracture:
   b. OA: Bilat Standing



1. MRI
2. Definitive Dx
   a. meniscus
   b. OA
   c Ligament tear



DIAGNOSTIC EVALUATIONS OSTEOARTHRITIS (OA)

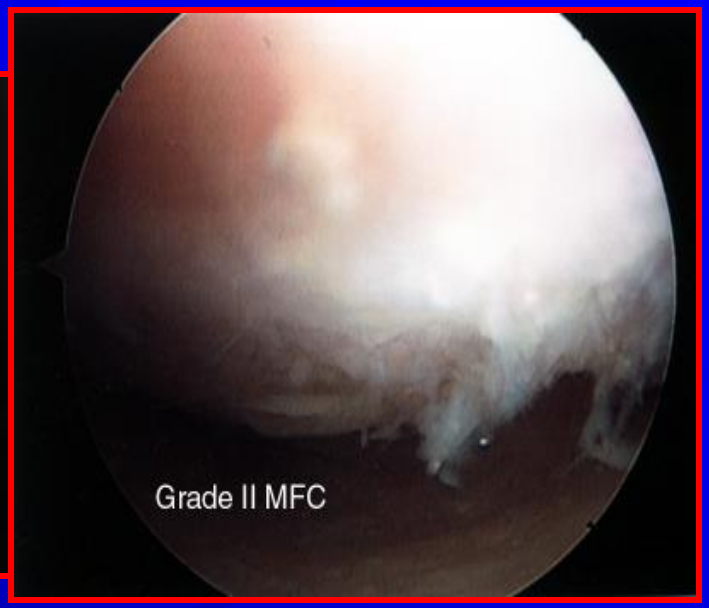
X-RAY

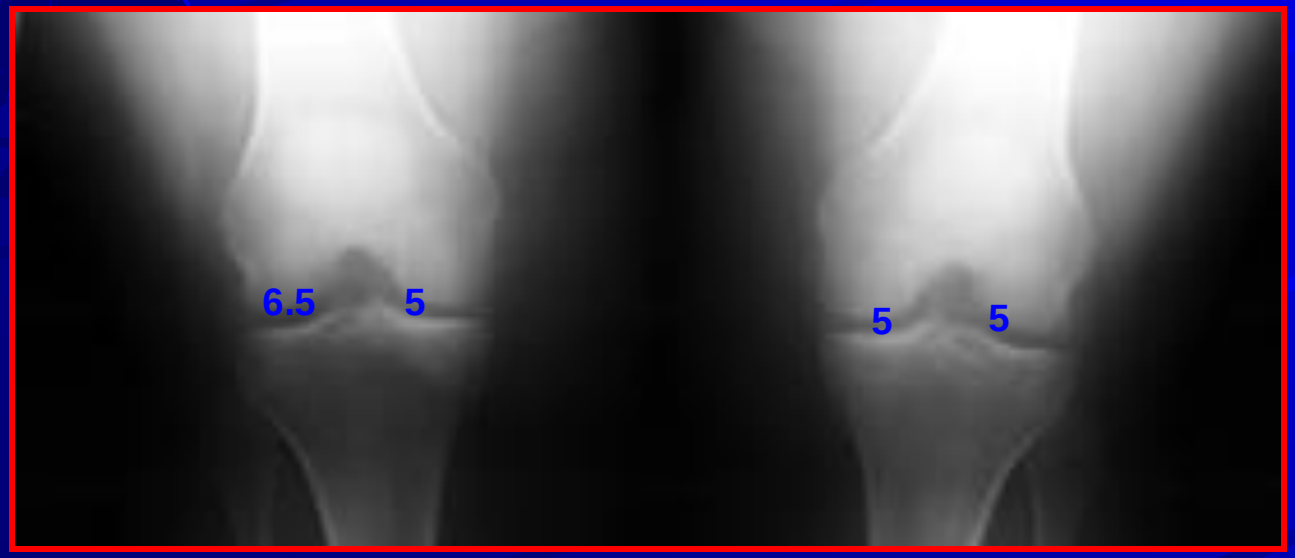
1. STANDING
2. AP vs PA flex
3. Less expensive
4. Poor sensitivity

MRI

1. Expensive
2. Role?
3. Articular cartilage sequences

FALSE NEGATIVE AP & PA





DEFINITIONS

1. Screening Test = High Sensitivity (goal identify disease state)
2. Diagnostic Test = High Specificity (goal exclude disease states)
3. Prevalence = % pop disease
4. Sensitivity and Specificity independent prevalence
5. PPV and NPV Prevalence Dependent

PROSPECTIVE XR ARTHROSCOPIC CONFIRMATION KNEE OA ROSENBERG PA VS AP

Wright et.al CORR 2006

1. n = 349 patients both XR
2. Chondromalacia (CM) I-IV modified Outerbridge
3. General sports medicine practice
4. Statistical analysis $p<0.05$
5. Power 0.88 $\geq$ 15% change

CONCLUSIONS

1. Standing AP equal Rosenberg PA
2. Both poor screening tests arthritis (low sensitivity)
3. Both good diagnostic tests arthritis (high specificity)
4. Investigate better screening test (high sensitivity) cost effectively identify early knee OA (outcomes?)

Systematic Review Spindler and Wright

1. SIX L I & II studies Standing XR and Arthroscopic confirmation OA grade
2. < 40 yo poor sensitivity and specificity
3. > 40 yo better sensitivity and specificity
4. No difference AP or PA 45 medial compartment
5. PA 45 better lateral compartment
6. Conclude MD choose one view unless issue lateral comp OA PA 45 better
7. **Both poor screening views i.e can't rule out but can rule in OA**

MRI (Best 3.0T)

1. If diagnosis is in doubt

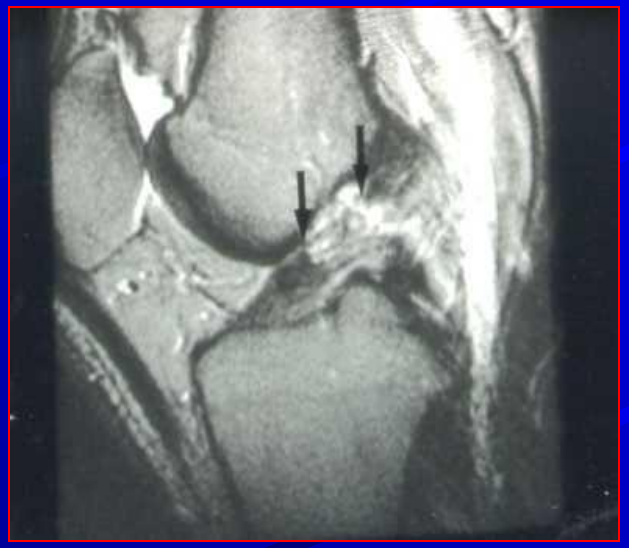
2. If results will alter treatment

3. Or if Insurance requires

MRI -- ACL TEAR

1. When?
   a. Hx + PE inconclusive

2. What frequency?
   a. 20-25%



MRI vs Arthroscopy in the Diagnosis of Knee Pathology, Concentrating on Meniscal Lesions and ACL Tears: A Systematic Review

1. Crawford, Walley, Bridgeman, and Maffulli *Brit Med Bulletin* 2006
2. LOE II: review level II studies
3. 59 articles:
   a. 43 = meniscus and ACL
   b. 23 = other knee pathology (BB, AVN, etc.)
4. Coleman scoring
5. Gold standard arthroscopic confirmation

MRI vs Arthroscopy in the Diagnosis of Knee Pathology, Concentrating on Meniscal Lesions and ACL Tears: A Systematic Review

Pathology	Accuracy	Sensitivity	Specificity	PPV	NPV
Medial Meniscus	86	91	81	83	90
Lateral Meniscus	89	76	93	80	92
ACL	93	87	95	83	96
Combined (mm,lm,acl)	89	86	91	82	93
Other Knee Pathology	91	69	98	91	91
TOTAL	90	83	93	84	92

MRI vs Arthroscopy in the Diagnosis of Knee Pathology, Concentrating on Meniscal Lesions and ACL Tears: A Systematic Review

1. Similar results to Oei with stricter inc/excl criteria
2. FYI 16% Asx people have + meniscus tears on MRI and 36% >45 yo have + meniscus tears

   Boden et al. *CORR* 282 p177
3. MRI NOT reliable recurrent men tr (only 66%)

Table 4 Comparison of the results by Oei *et al.*[69] and the results from the present study.

	Medial meniscus		Lateral meniscus		ACL	
	Sensitivity (%)	Specificity (%)	Sensitivity (%)	Specificity (%)	Sensitivity (%)	Specificity (%)
Oei *et al.*	93.3	88.4	79.3	95.7	94.4	94.3
Present study	91.4	81.1	76.0	93.3	86.5	95.2

Articular Cartilage Variables

(Marx Inter-rater Agreement AJSM 2005)

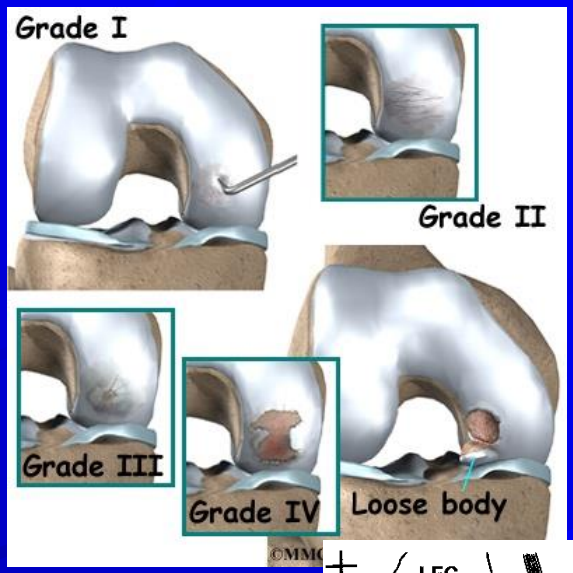
Modified Outerbridge Grading System

a. Grade I softening
b. Grade II superficial changes
c. Grade III deep changes
d. Grade IV bone

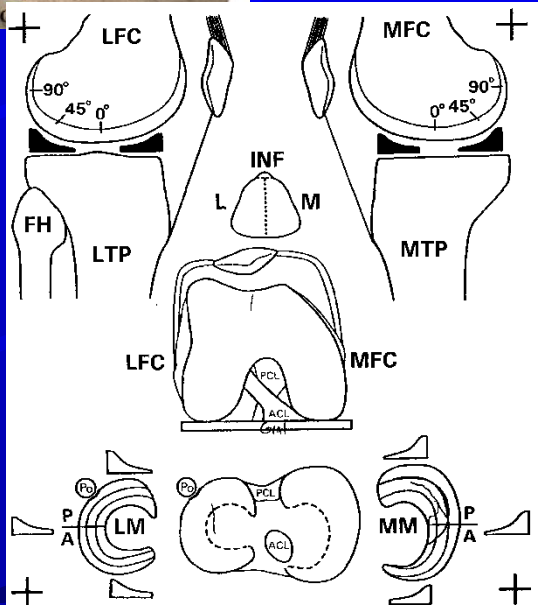
Compartmentalize Knee

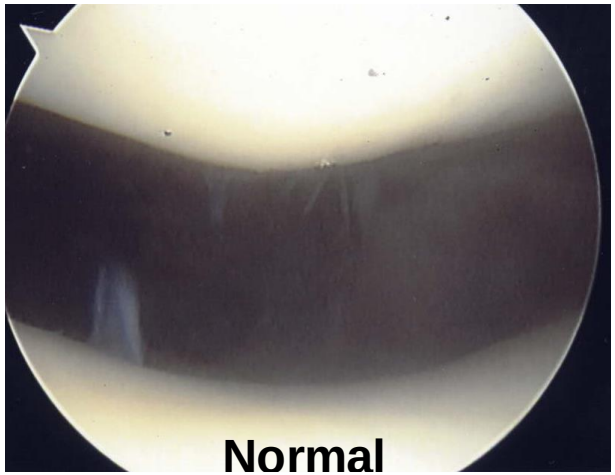
a. Entire knee (3 var)
b. 3 compartments (9 var)
c. 6 surfaces (18 var)

After arthroscopic partial meniscectomy OA graded as articular cartilage chondromalacia is one of the independent predictors of outcome!



http://www.eorthopod.com/public/patient_education/6517/osteochondritis_dissecans_of_the_knee.html

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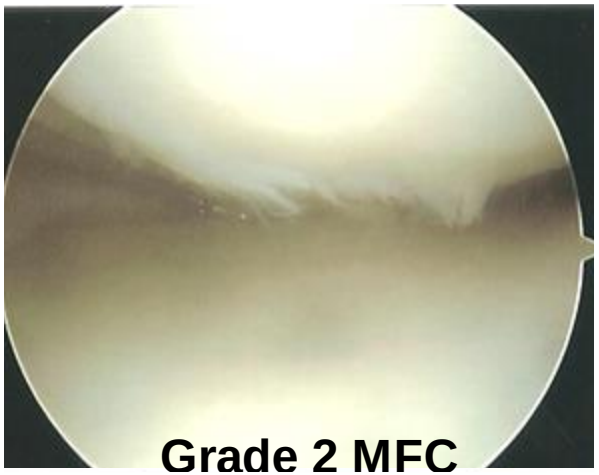
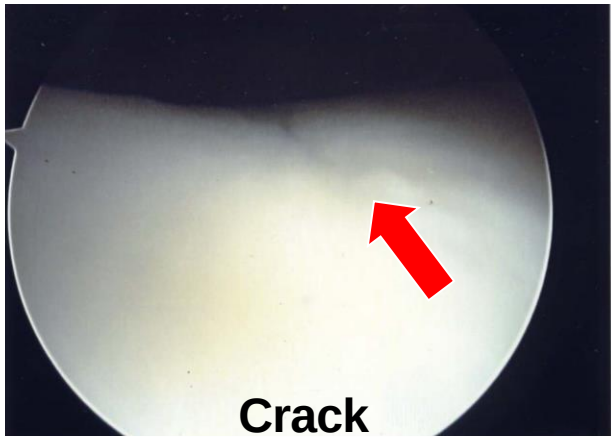
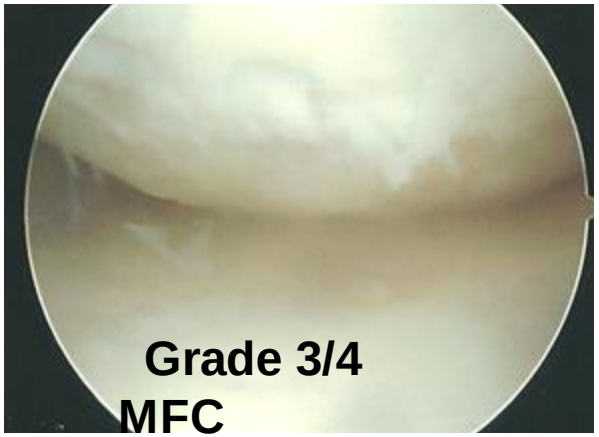
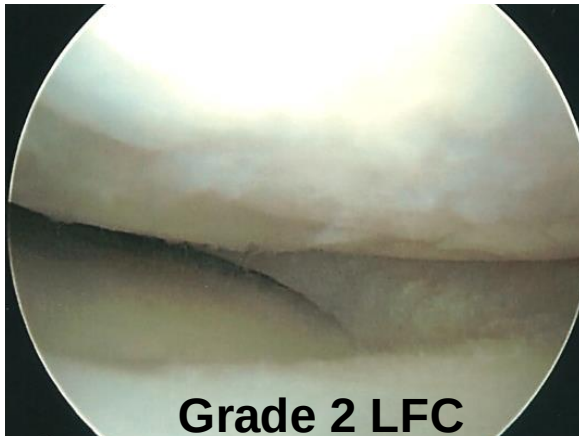
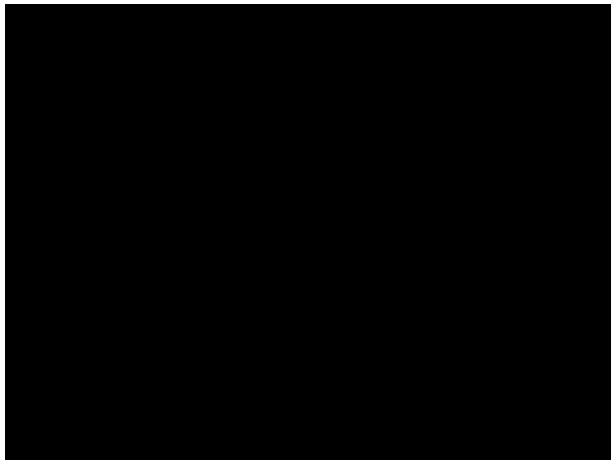

Grade 2 MFC

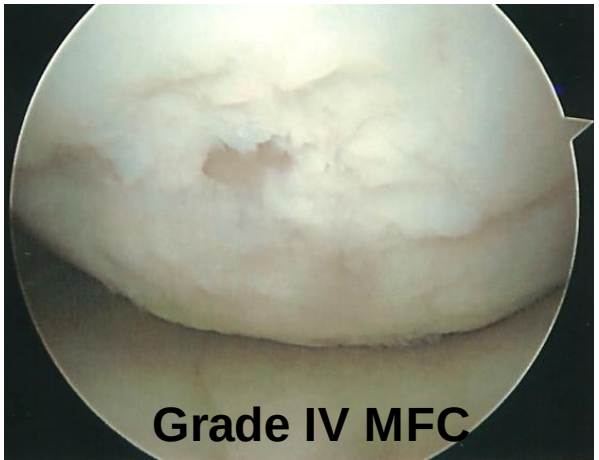

Grade 1 LFC

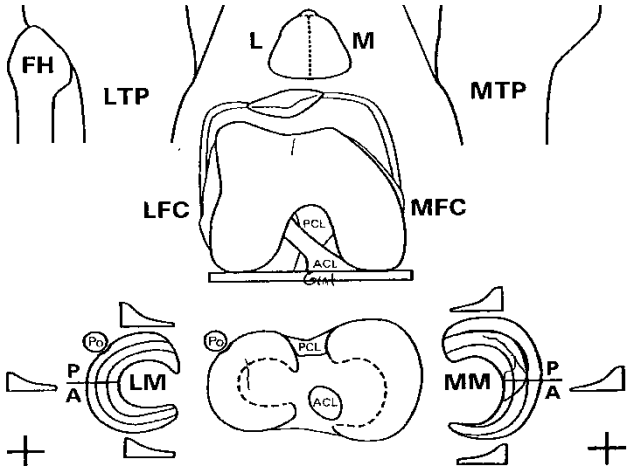

Crack


Grade 3/4
MFC


Grade 2 LFC




Grade IV MFC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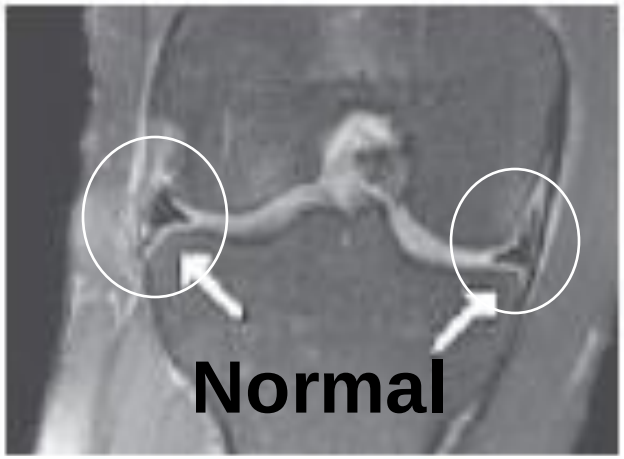
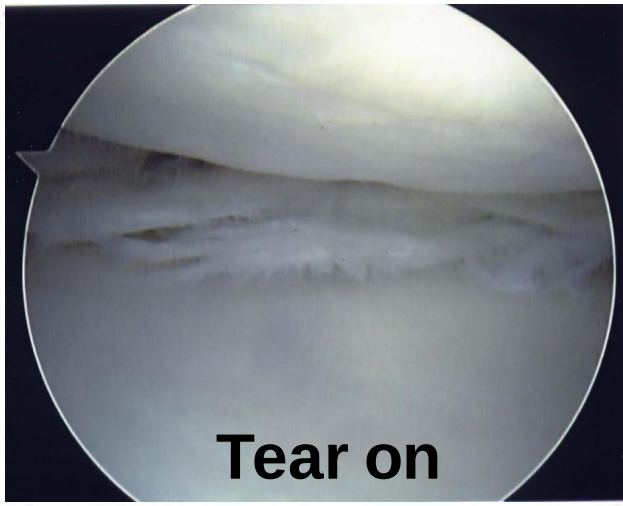
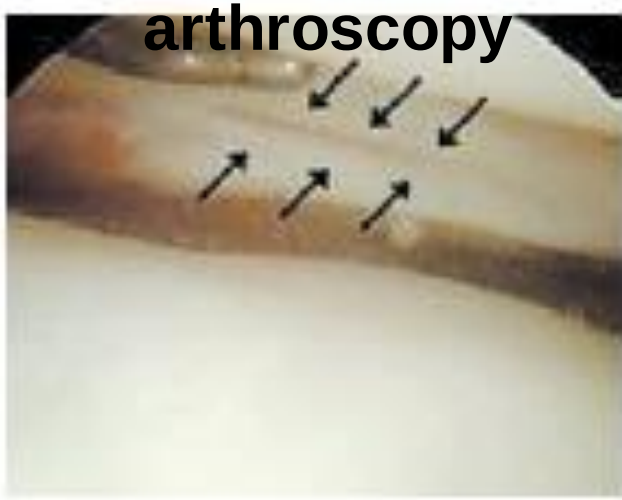
Medial and Lateral Meniscus







Spindler and Wright: *N Engl J Med* 359:20, 2135-2142, Nov 13, 2008

Value of History, PE, Imaging

Structure	HX	PE	Std Bilat XR	MRI (3T/ 1.5T)	Pearls
MENISCUS	yes	yes	no	yes	Match Sx, PE, and MRI
Articular Cartilage	maybe	maybe	no	yes	3T or Scope dx
ACL Ligaments	yes	yes	no	yes	Hx & PE 80%
Patella	maybe	maybe	no	maybe	Multifactorial entire LE Kinetic Chain
Quad/PT Rupture	yes	yes	maybe	yes	Self-evident
Other@	maybe	no	no	yes	

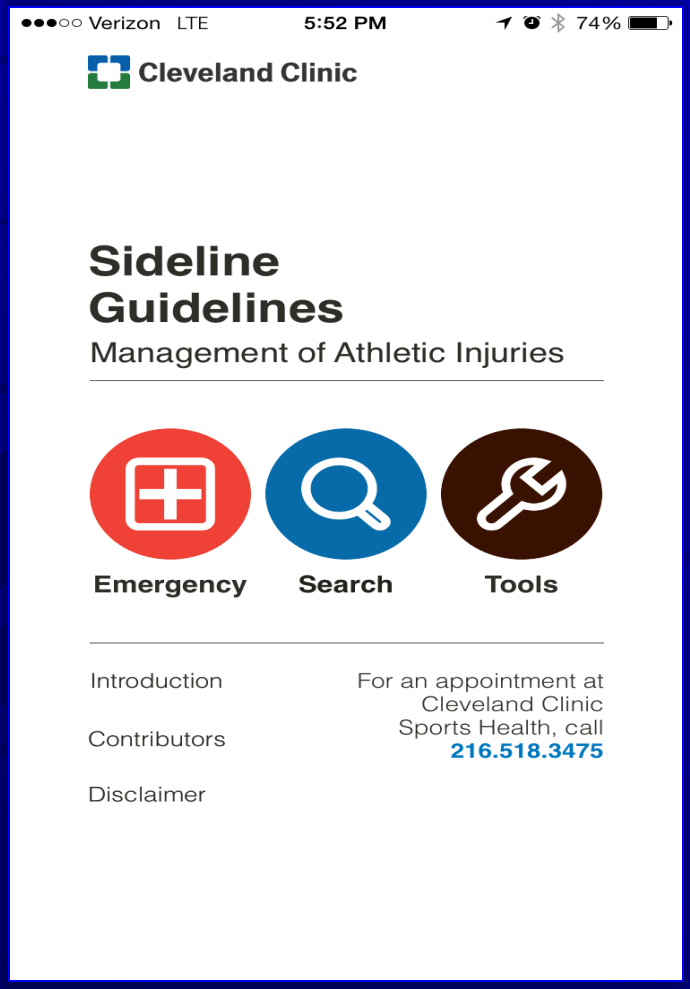
@= other occult fx, loose body, OCD

Conclusions

1. Operative lesions best results when Hx, PE, XR and MRI all “match”
2. Goal is to identify OA at evaluation since this is major determinant of OUTCOME
3. The evaluation MUST include brief hx by physician, complete joint evaluation by physician, and standing bilateral XR.
4. Minimum standard MRI = 1.5T BEST 3T
5. Understanding OA is not improved with arthroscopic surgery

Apps Knowledge at Fingertips

SIDELINE GUIDELINES



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Sideline Guidelines

Management of Athletic Injuries

Emergency Search Tools

For an appointment at Cleveland Clinic Sports Health, call **216.518.3475**

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< Main **Emergencies**

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Back

Knee Extensor Mechanism

Injury Diagnosis:

"Jumper's knee" Patella/Quadriceps…

History:

- **Initial localized pain after activity**
- **Later, more advanced pain during high impact loading**

Physical Examination Pearls:

- **Focal pain at: inferior pole > quadriceps tendon >> tibia tubercle**

Injury Diagnosis:

Patella Instability and Dislocation

History:

- **Acute vs. recurrent**

Physical Examination Pearls:

- **Apprehension**
- **Effusion**
- **Quadriceps firing or activation**

Injury Diagnosis:

●●●○○ Verizon LTE 5:52 PM 74%

Back

Diagnosis

Injury Diagnosis:

"Jumper's knee" Patella/Quadriceps Tendinosis

History:

- **Initial localized pain after activity**
- **Later, more advanced pain during high impact loading**

Physical Examination Pearls:

- **Focal pain at: inferior pole > quadriceps tendon >> tibia tubercle**

XR:

- **Usually normal**

MRI:

- **If symptoms severe or during activity when loading**
- **Identify if there are structural changes to tendon, i.e. "tendinosis"**

Return to Play and Treatment

Return to Play Current Game:

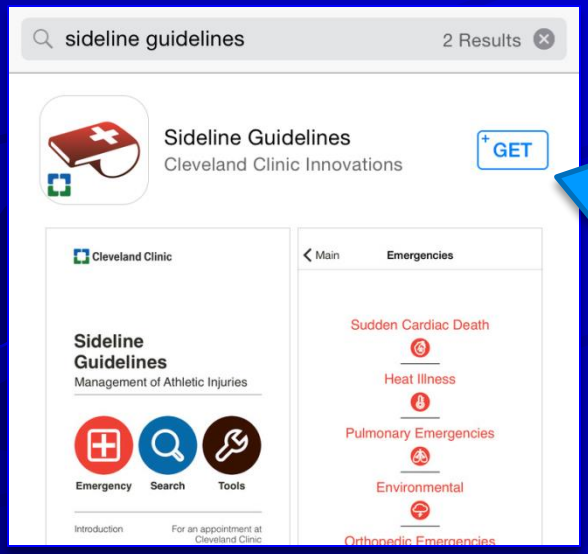
- **Yes**

Game Day Treatment:

- **NSAID**
- **+/- brace**

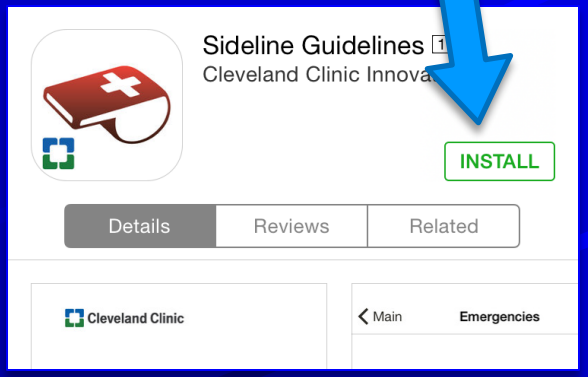
Download the App
SIDELINES GUIDELINES

1. Open the “App Store”



2. Search for “sideline guidelines” and tap “GET”

3. Provide your iTunes password and tap “INSTALL”



THANK YOU!

Courtesy of Rod Williamson and Vanderbilt Athletics