



# NOTES

## LOWER LIMB INJURY

### GENERALLY, WHAT IS IT?

#### **PATHOLOGY & CAUSES**

- Injury to ligaments, tendons, bony structures of lower extremities

#### **CAUSES**

- Trauma, sport

#### **SIGNS & SYMPTOMS**

- Pain, swelling in affected region/joint

#### **DIAGNOSIS**

#### **DIAGNOSTIC IMAGING**

- Imaging to confirm

#### **OTHER DIAGNOSTICS**

- *History*: traumatic event, risk factors review
- *Physical examination*: especially provocative (eponymous) musculoskeletal joint evaluation

#### **TREATMENT**

#### **MEDICATIONS**

##### **Acute**

- Analgesics (NSAIDs)

#### **SURGERY**

##### **Therapeutic**

- Surgical intervention (depending on disability, desire to return to sport/demanding activity)

#### **OTHER INTERVENTIONS**

##### **Acute**

- Rest, ice

# ACHILLES TENDON RUPTURE

osms.it/achilles-tendon-rupture

## PATHOLOGY & CAUSES

- Acute, complete disruption of achilles tendon
  - Commonly traumatic, but can be iatrogenic

## CAUSES

- **Recreational Sports:** > 80% of achilles tendon ruptures
  - Increased activity, shear stress on achilles, direct trauma to tendon
  - Sudden, forced dorsiflexion of ankle outside normal range of motion

## RISK FACTORS

- Age: 30–40 years old
- Biologically-male individuals
- Obesity
- **Fluoroquinolone use:** unknown mechanism
- Systemic corticosteroid use

## COMPLICATIONS

- **Re-injury:** 10% of individuals with rupture have history of previous rupture

## SIGNS & SYMPTOMS

- Ankle pain
- Poor ambulation

## DIAGNOSIS

## OTHER DIAGNOSTICS

### Physical inspection

- **History:** sudden, painful pop in lower leg; inability to walk; pain immediately after injury
- Calf muscles
  - Soft, lumped together toward knee

- Proximal achilles
  - Likewise collected proximally

### Physical examination maneuvers

- Calf squeeze test (Simmonds/Thompson test)
  - Squeezing calf of affected leg does not elicit plantar flexion (very high sensitivity, specificity)
- Palpable gap test
  - Posterior leg palpation at level of achilles to palpate gap in tendon
- Knee flexion test (Matles test)
  - Individual is prone with knees flexed at 90° → observe angle of ankle
  - Ruptured achilles → acute angle (unopposed dorsiflexion of foot by gravity)



**Figure 115.1** A positive Simmonds' test (left) in an individual with a ruptured achilles' tendon

## TREATMENT

### MEDICATIONS

#### Acute

- Analgesics (NSAIDs/acetaminophen)

### SURGERY

#### Curative

- Orthopedic tendon repair

### OTHER INTERVENTIONS

#### Acute

- Rest, ice



**Figure 115.2** A ruptured achilles tendon prior to surgical repair.

# ANTERIOR CRUCIATE LIGAMENT INJURY

[osms.it/ACL-injury](https://osms.it/ACL-injury)

## PATHOLOGY & CAUSES

- Damage/complete tear of anterior cruciate ligament (ACL) in knee; common in deceleration injuries

### CAUSES

- **Common mechanism:** twisting knee after planting foot
  - Typically, non-contact injury
  - Common athletic injury

### RISK FACTORS

- Biologically-female individuals
- Valgus knee angulation
- ↑ traction ability of field of play
  - **Wet surfaces:** rotation/shift of gravity results in slipping, rather than biomechanical injury to body

## COMPLICATIONS

- **Second fracture:** avulsion fracture of lateral aspect of tibial plateau; occurs in most ACL tears

## SIGNS & SYMPTOMS

- Immediate pain
- May have popping sensation/sound at time of injury
- Immediate knee swelling → hemarthrosis
  - Diagnostic maneuvers should be performed immediately after injury for clearest results
- Post-injury
  - Knee may “give out” when walking/standing

## DIAGNOSIS

### DIAGNOSTIC IMAGING

#### X-ray

- Rule out fractures (nondiagnostic for ligament tears)

#### MRI

- Preferred modality to evaluate ligament integrity
- Very high sensitivity, specificity

#### Knee arthroscopy

### OTHER DIAGNOSTICS

#### Physical inspection

- **History:** pivot sign (knee buckling phenomenon, especially at heel strike phase of walking cycle)
  - Tibia's ability to travel anteriorly (without intact ACL) when knee is flexed at 0–30° → snaps back around 40°+ of flexion
  - **Underlying this phenomenon:** role of iliotibial band in knee extension, flexion at different degrees of knee position

#### Physical examination maneuvers

- Anterior drawer test
  - **Supine individual:** affected leg flexes 90°, foot rests on end of bed → examiner sits on foot of affected leg (to stabilize) → grasps around proximal tibia with both hands → pulls anteriorly on tibia → observes anterior movement level
  - **Normal laxity:** < 1cm/0.4in anterior tibial subluxation; negative test, likely intact ACL
  - **↑ Laxity:** > 1cm/0.4in; positive test, likely torn ACL
- Lachman test
  - **Supine individual:** knee flexed around 20° → examiner flexes knee → grasps around proximal tibia with one hand while stabilizing ipsilateral thigh with other hand → pulls anteriorly on tibia → observes anterior movement level

- Similar endpoints to anterior drawer test
- Best sensitivity (85%), specificity (94%) compared to other diagnostic tests

## TREATMENT

### MEDICATIONS

#### Acute

- NSAIDs

### SURGERY

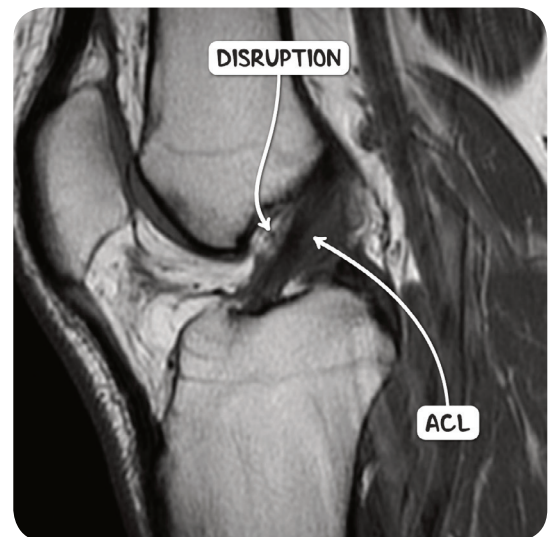
- Complete ACL tears
- Reconstruction with neighboring patellar ligament/semitendinosus tendon
- **Eligibility:** severity of symptoms, individual's future athletic ambitions
- Majority of individuals elect for surgical repair
- Increased risk of osteoarthritis

### OTHER INTERVENTIONS

- **Rehabilitation:** intensive physical therapy

#### Acute

- Rest, ice, compression of injured knee



**Figure 115.3** An MRI scan of the knee demonstrating partial disruption of the anterior cruciate ligament.

# ILIOTIBIAL BAND SYNDROME

osms.it/IT-band-syndrome

## **PATHOLOGY & CAUSES**

- **Painful overuse injury:** fibrous band of tissue connects muscles of proximal lower extremity to lateral tibia
- **Common injury for runners**

## **CAUSES**

- **Iliotibial band (ITB):** involved in knee flexion (at  $< 30^\circ$ ), knee extension at terminal extension (near  $0^\circ$  flexion); very active in heavy activity  $\rightarrow$  overuse causes inflammation
- Greatest tension across ITB occurs at  $30^\circ$ 
  - **Runners:** position of  $30^\circ$  at foot strike  $\rightarrow$  repeat  $\rightarrow$  inflammation, injury
  - **Cyclists:** position of  $30^\circ$  at down-pedal position  $\rightarrow$  repeat  $\rightarrow$  inflammation, injury

## **RISK FACTORS**

### **Intrinsic**

- Weak hip abductors/flexors
- Gastrocnemius, soleus inflexibility
- Leg length discrepancy

### **Extrinsic**

- Sudden training distance/intensity increase
- **Running:** overstriding, foot eversion (poorly fitted/raised shoes)
- Cold weather exercise

## **SIGNS & SYMPTOMS**

### **Knee pain**

- Sharp/burning, worse during exercise at knee flexion of  $30^\circ$
- Beyond exercise, pain may ache more/be deeper
- **Location:** lateral femoral epicondyle (LPE)

## **DIAGNOSIS**

### **OTHER DIAGNOSTICS**

#### **Physical inspection**

- **History:** Running/cycling with indolent course of lateral knee pain with training

#### **Physical examination maneuvers**

- Noble compression test (examiner attempts to recreate pain experienced during training)
  - Individual lays in decubitus position with affected leg above unaffected  $\rightarrow$  examiner puts one thumb proximal to LPE with pressure  $\rightarrow$  examiner uses other hand to passively move affected about the knee from  $0-60^\circ$  flexion  $\rightarrow$  pain  $\rightarrow$  positive test
- Ober test
  - Individual lies on uninvolved side  $\rightarrow$  flexes hip, knee  $90^\circ \rightarrow$  knee placed in  $5^\circ$  flexion angle  $\rightarrow$  examiner fully abducts lower extremity being tested  $\rightarrow$  allows force of gravity to adduct extremity until hip cannot adduct any further
- Palpation of knee (check for no effusion)
  - Rule out meniscal injury (lateral knee pain,  $\oplus$  effusion)

## **TREATMENT**

### **MEDICATIONS**

#### **Acute**

- Analgesics (NSAIDs/acetaminophen)

### **SURGERY**

- **ITB release:** individuals who have failed long-term physical therapy program

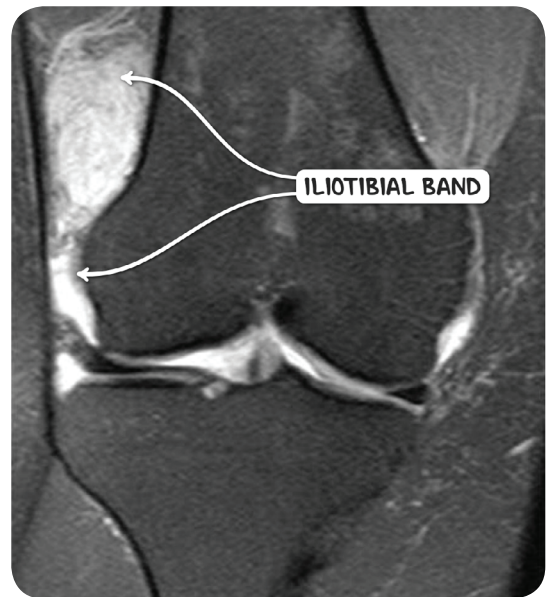
### **OTHER INTERVENTIONS**

- Exercise adjustment
  - Address extrinsic risk factors

- Correct leg length discrepancy with insole lift
- Physical therapy
  - Address strength of hip abduction/flexion, calf inflexibility

#### Acute

- Rest, ice



**Figure 115.4** An MRI scan in the coronal plane of the right knee of individual complaining of iliotibial band syndrome symptoms. The band is inflamed with surrounding edema close to its point of insertion.

## MENISCUS TEAR

[osms.it/meniscus-tear](https://osms.it/meniscus-tear)

### PATHOLOGY & CAUSES

- Injury to fibrocartilage (medial/lateral) knee pads (provide cushion, increase stability at tibiofemoral articulation interface)

### CAUSES

- **Pathophysiology:** planted foot → twisting force at knee → compressional, rotational, shear stress placed on meniscus → tear
  - Medial meniscus tears > lateral meniscus tears
  - Medial meniscus firmly attached to medial collateral ligament (MCL) → ↓ mobility of medial meniscus → ↓ force required to tear fibrocartilage
  - Poor blood supply to meniscus via geniculate arteries → poor healing/

regenerative capability post injury

#### Young, healthy athletes

- Forceful, sudden, decelerating movement while changing direction

#### Elderly

- Chronic injury requires less torsional force at knee

### RISK FACTORS

- Soccer, basketball, American football

### COMPLICATIONS

- Osteoarthritis



## SIGNS & SYMPTOMS

- Pain at time of injury
- Swelling within 24 hours
- Clicking/crepitus with walking/knee extension
- *Inability to fully extend/lock knee*: occurs in anterior meniscus tears > posterior meniscus tears

## DIAGNOSIS

### DIAGNOSTIC IMAGING

#### X-ray

- Non-diagnostic; commonly performed to rule out knee fracture

#### MRI

- Most sensitive imaging modality for detecting tears
  - **Medial meniscus**: very high sensitivity, specificity
  - **Lateral meniscus**: high sensitivity, very high specificity
- Indicated for surgical evaluation
  - Prevalence of MRI-positive meniscal tears in asymptomatic population increases with age

### OTHER DIAGNOSTICS

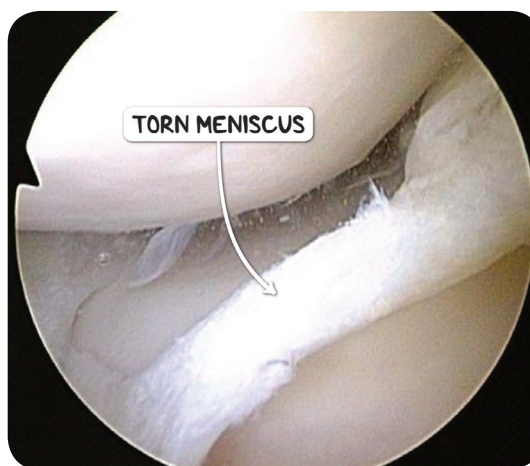
#### Physical inspection

- Joint line tenderness (at tibial-femoral interface) because synovial capsule/collateral ligament accompanies injury; less sensitive/specific finding
- Joint effusion likely present

#### Physical examination maneuvers

- **McMurray test**: tests medial, lateral meniscus
  - Individual is supine with affected knee fully flexed → examiner grasps heel with one hand, around tibial prominence with other hand → exerts rotational force while extending leg → evaluates pain/click/palpable crepitus
  - External rotation → medial meniscus moves under femoral condyle

- Internal rotation → lateral meniscus moves under femoral condyle
- Sensitivity (wide range), specificity (high–very high),  $\oplus$  likelihood ratio (LR) (4.0),  $\ominus$  LR (0.6)
- **Apley grinding test**: tests medial meniscus
  - Individual lays in prone position → examiner flexes affected knee to 90° → rotates foot laterally → while stabilizing thigh/femur (with examiner's knee), exerts downward force on tibia
  - **Pain**: likely medial meniscal tear
- **Thessaly test**: tests medial, lateral meniscus
  - Individual stands only on affected leg while holding onto examiner for stability → flexes knee to 20° → rotates knee, body externally/internally
  - **Pain/locking/clicking**: positive test
- **Childress duck-waddle test**: tests posterior horn of medial/lateral meniscus
  - Reserved for athletes fit to complete maneuver
  - Individual squats, walks forward in squatting position → knees are flexed fully → waddling steps exert posterior pressure on knee
  - **Pain/clicking**: positive test



**Figure 115.5** An arthroscopic view of a torn medial meniscus.

## TREATMENT

### SURGERY

- Arthroscopic/open surgery
- Meniscectomy/repair determined by amount of viable tissue intraoperatively, individual's timetable to return to sport/activity
  - **Meniscectomy:** faster timetable to return to baseline activity; long-term ↑ osteoarthritis risk

## OTHER INTERVENTIONS

- **Rest:** crutches for severe pain, avoidance of positions/activities that exacerbate pain
- **If knee commonly gives out:** patellar restraining brace; sign of poor quadriceps strength
- Physical therapy

### Acute

- Rest, ice

# PATELLAR TENDON RUPTURE

[osms.it/patellar-tendon-rupture](https://osms.it/patellar-tendon-rupture)

## PATHOLOGY & CAUSES

- Sudden, forced quadriceps contraction against flexed knee, fixed foot

### CAUSES

- Most common in individuals < 40 years old involved in heavy training regimens/sport
  - Landing from high jump, making sudden changes in direction at high speed
- **Traumatic injury (non-athletic):** foot/leg is stuck as individual falls backward
  - Body weight falls backward → large eccentric force on fixed leg → force transmitted to patellar tendon → rupture
  - Knee typically fully flexed when injury occurs → exposes tendon to most stress

### RISK FACTORS

- Recent glucocorticoid injection
- **Sports with explosive jumping:** basketball, weightlifting
- **Heavy training hours:** > 20 per week
- Biologically-male individuals

### COMPLICATIONS

- Tibial tuberosity avulsion fracture
- Patellar fracture/avulsion

## SIGNS & SYMPTOMS

- Painful, popping sensation
- Immediate swelling
- **Antalgic gait:** inability to bear weight on affected leg

## DIAGNOSIS

### DIAGNOSTIC IMAGING

#### Bedside Ultrasound

- Assists bedside diagnosis

#### X-ray

- Evaluation of patellar positioning, potential fracture/avulsion complication

#### MRI

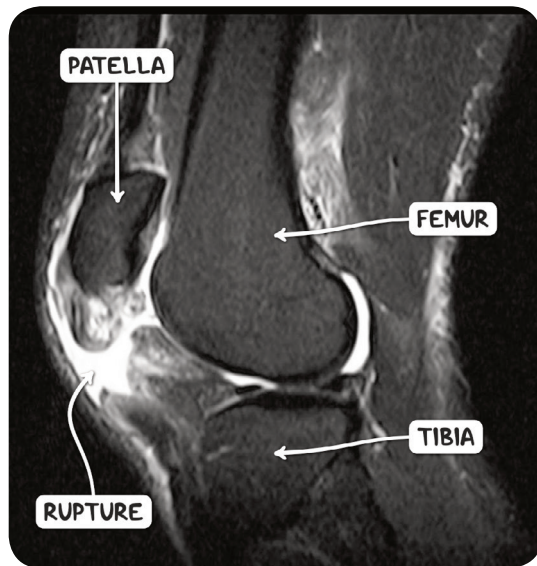
- **Reserved for unusual presentations:** constitutional signs that raise suspicion of tumor

## OTHER DIAGNOSTICS

### Physical inspection

- **Observation:** upward shift of patella (pathognomonic); swelling distal to patella
- **Strength:** inability to maintain straight leg, raise leg against gravity while supine





**Figure 115.6** An MRI scan of the knee in the sagittal plane demonstrating a patellar tendon rupture

## TREATMENT

### SURGERY

- Recommended within one week of injury for improved outcomes

### OTHER INTERVENTIONS

- Post-operative physical rehabilitation

# PATELLOFEMORAL PAIN SYNDROME

[osms.it/patellofemoral-pain-syndrome](https://osms.it/patellofemoral-pain-syndrome)

## PATHOLOGY & CAUSES

- Common overuse disorder
- Anterior knee pain that cannot be attributed to intra-articular (meniscus)/peripatellar (patellar tendinopathy) pathology

### CAUSES

- Multifactorial pathophysiology

#### Intrinsic, anatomical factors

- Leg length discrepancy
- Abnormal foot morphology
- Hamstring inflexibility
- Abnormal patellar mobility
- Hallux valgus

#### Extrinsic, athletic factors

- Exercise overload

## RISK FACTORS

- Biologically-female individuals (2:1)
- Active individuals; teens–20s
- Amount of training (ex. distance run) correlates with incidence of disease

## SIGNS & SYMPTOMS

- Anterior knee pain
  - Worsened with training, knee extension, especially with squatting, running exercises
  - May occur with prolonged sitting
  - May be present for years
- Knee occasionally buckles/gives way
- Knee clicks/grinds: most evident when climbing stairs

## DIAGNOSIS

### OTHER DIAGNOSTICS

#### Physical inspection

- History
  - Absence of traumatic inciting event
  - *Achy/sharp knee pain*: typically below patella
- Leg length discrepancy > 1cm/0.4in → poor biomechanics when running → predisposes individual to knee injury
  - < 0.5cm/0.2in leg length discrepancy is common → no increased risk of injury

#### Physical examination maneuvers

- Palpation
  - Nontender patella, patellar tendon, quadriceps tendon
- Tests
  - *Squatting*: most individuals experience pain
  - *Patellar glide with extended knee*: examiner moves patella laterally
  - Lateral movement ↑  $\frac{3}{4}$  patellar width abnormal

## TREATMENT

### MEDICATIONS

#### Acute

- NSAIDs (*naproxen*): short-term use (2–3 weeks) recommended

### OTHER INTERVENTIONS

- Lower extremity muscle strengthening
- *Stretching*: especially hamstrings
- Patellar bracing/taping

#### Acute

- *Pain control*: avoidance of painful exercise (stair/hill running); substitution of less stressful exercise (stationary bike exercises)

# SPRAINED ANKLE

[osms.it/sprained-ankle](https://osms.it/sprained-ankle)

## PATHOLOGY & CAUSES

- Common ankle injury from foot hyper-eversion/inversion

### TYPES

#### Lateral ankle sprain

- Most common
- Inversion of plantar-flexed foot → stretches ankle's lateral ligament complex
- *Lateral ligament*: anterior talofibular ligament (ATFL), calcaneofibular ligament, posterior talofibular ligament

#### Medial ankle sprain

- Infrequent injury
- Eversion of foot to medial deltoid ligament complex
- Ligament strong enough that medial malleolus fracture is more common than ligament sprain

#### Syndesmotic sprain

- AKA high ankle sprain
- Injury to interosseous membrane between tibia, fibula
  - Foot is dorsiflexed/ankle eversion
- Higher rate of injury in contact sports (American football)

- Higher rate of chronic ankle sprains → recurrent ankle sprains → ossification of interosseous membrane

## SIGNS & SYMPTOMS

- Pain over lateral/medial ankle (depending on eversion/inversion mechanism)
- Swelling hours after inciting event
- Inability to ambulate

## DIAGNOSIS

### DIAGNOSTIC IMAGING

#### X-ray

- Evaluate for malleolar, distal fibular, talar dome fracture, syndesmotic separation complication

### OTHER DIAGNOSTICS

#### Physical inspection

- History
  - Mechanism of foot inversion/eversion
  - Prior ankle injuries
  - *Ability to walk after injury*: correlates with fracture complication
- Observation: swelling/ecchymosis

#### Physical examination maneuvers

- Palpation
  - *Fibula, distal tibia*: syndesmotic injury
  - Foot: lateral, medial surface for evaluation of medial, lateral ligament complex pain
  - *Thompson test*: rule out achilles pathology
- Maneuvers of passive inversion/eversion (replicate pain)
  - *Squeeze test (syndesmotic evaluation)*: examiner compresses fibular against tibia at level of mid-calf → pain in region of ATFL → likely syndesmotic sprain
  - *External rotation stress test (syndesmotic evaluation)*: examiner stabilizes leg proximal to ankle → grasps plantar aspect of foot → externally rotated → pain in region of ATFL → likely syndesmotic sprain

- *Anterior drawer test (ATFL integrity test)*: individual places affected foot in neutral position (slightly plantar-flexed, inverted) → examiner stabilizes lower leg with one hand → grasps heel with other while foot rests on examiner's anterior arm → anterior pull of foot → ↑ laxity of joint (vs. unaffected foot) → likely lateral sprain, ATFL instability
- *Talar tilt test (calcaneofibular integrity test)*: individual places affected foot in neutral position → examiner grasps foot → passive inverts at ankle → ↑ inversion of ankle (vs. unaffected side) → likely lateral sprain, calcaneofibular instability

## TREATMENT

### MEDICATIONS

#### Acute

- NSAIDs

### SURGERY

- Reserved for ligament rupture in setting of chronic ankle instability

### OTHER INTERVENTIONS

- *Rehabilitation*: physical therapy

#### Acute

- Rest: limit weight bearing, use crutches if individual is unable to bear weight
- Ice
- Early application of compressive wrapping → ↓ swelling
- Elevation of ankle → ↓ swelling

# UNHAPPY TRIAD

osms.it/unhappy-triad

## PATHOLOGY & CAUSES

- Severe knee injury, typically after trauma, that results in trio of ACL, medial collateral ligament (MCL), lateral meniscus tears

## CAUSES

- During **contact sports**, forceful blow to posterolateral aspect of knee, with planted foot (lower body tackle from behind in rugby/American football)
- **Pathophysiology**: posterior force tears ACL → abnormal ↑ anterior glide of tibia relative to femur → medial rotation of tibia → tear of MCL with shearing force → further knee instability → increased rotational force → lateral meniscal tear

## COMPLICATIONS

- Osteoarthritis

## SIGNS & SYMPTOMS

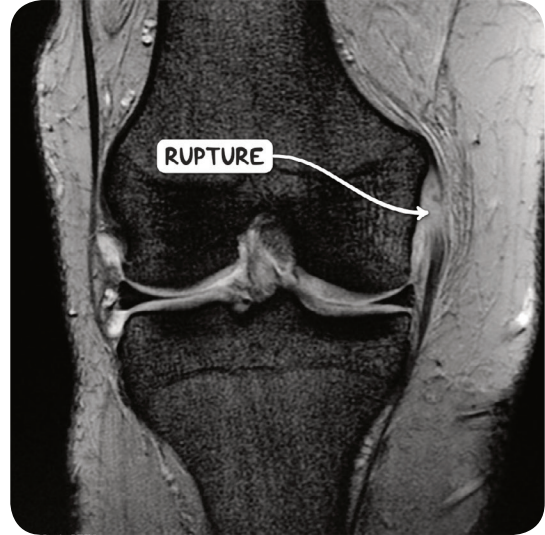
- Pain
- Hemarthrosis
- Popping/multiple pops

## DIAGNOSIS

### OTHER DIAGNOSTICS

#### Physical examination maneuvers

- ACL maneuvers
  - Anterior drawer test
  - Lachman test
- MCL maneuvers
  - Examiner stabilizes affected leg with one hand → exerts valgus stress on lateral aspect of knee → pain and ↑ laxity → likely MCL tear
- Lateral meniscus maneuvers
  - McMurray testing



**Figure 115.7** An MRI scan of the knee in the coronal plane demonstrating a complete tear of the medial collateral ligament. Injury to the medial collateral ligament is one part of the unhappy triad

## TREATMENT

### MEDICATIONS

#### Acute

- NSAIDs

### SURGERY

- **ACL repair**: athletes/ individuals who desire return to play/demanding activity
- Lateral meniscus repair vs. meniscectomy

### OTHER INTERVENTIONS

#### Acute

- Rest
- Ice
- Elevation/compression → ↓ swelling
- **Knee brace**: ACL, MCL recovery; overall knee stability