KNEE DISLOCATIONS

Current Concepts

Margaret Lynch, DMSc, PA-C, ATC-R.
Sports Center
OrthoCarolina

Outline

- Clinical Presentation
- Acute and Subacute Management
- Posteromedial Corner
- Posterolateral Corner
- Outcomes
- Complications


Clinical Presentation

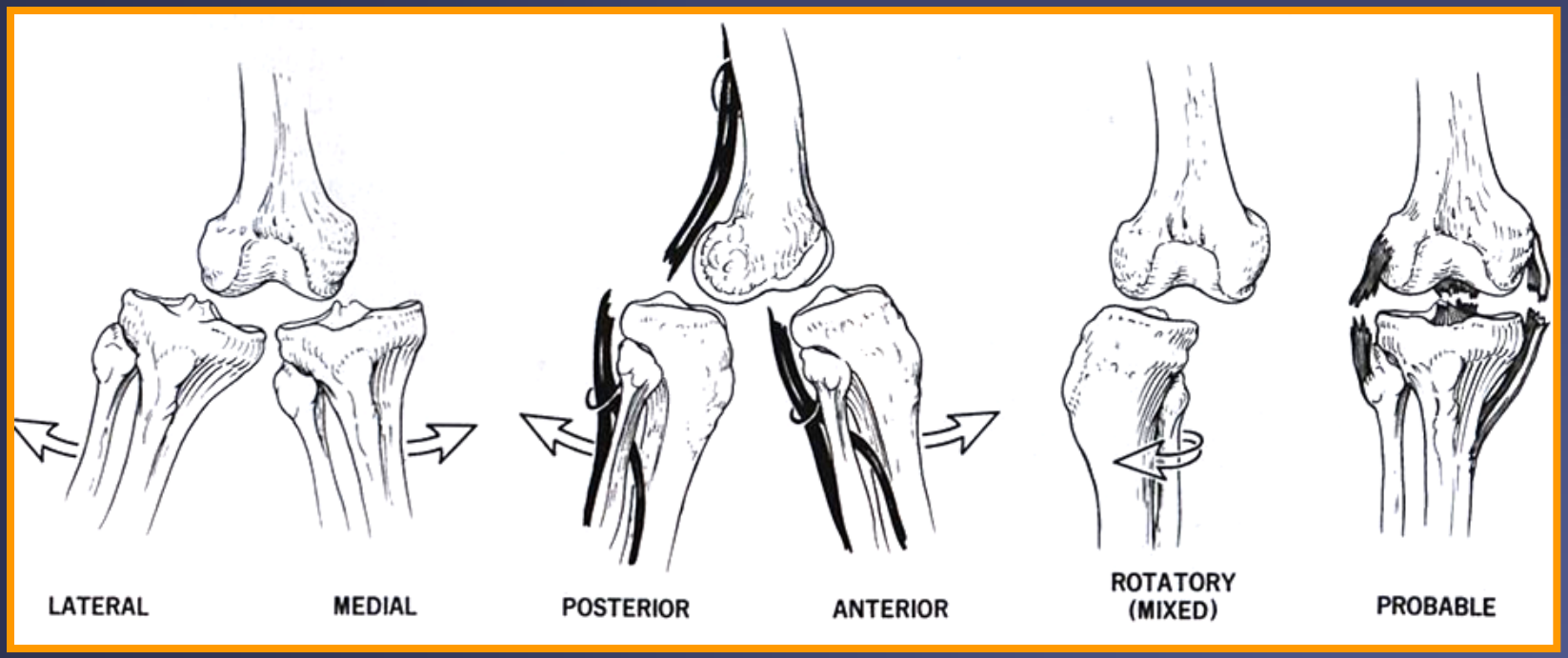
Clinical Presentation

- **Significant injuries**
  - 20-30% vascular injury
    - 85% limb loss if not addressed w/in 8 hours
  - 30-40% neurologic injury
    - only 30% with full recovery
  - With non-op treatment: only 50% RTW, 15% return to sport

Cooper et al 1825: "…recommend immediate amputation for irreducible or open dislocations"

Clinical Presentation
Classification

- **Direction**
  - *Tibia relative to femur*



Clinical Presentation
Anterior

- **Most common**
- **30-50%of dislocations**
- **Usually due to hyperextension**
  - *Kennedy et al JBJS 1963*: capsule ruptures beyond 30 deg
    - Popliteal artery ruptures beyond 50 deg (tethered at adductor and popliteal hiati)

Clinical Presentation
Posterior

- **30-40%of dislocations**
  - *Usually due to dashboard mechanism*
  - PCL is always torn
  - Vascular injury is common (up to 50%)
    - Usually an intimal injury secondary to contusion

Clinical Presentation
Medial/Lateral

- **~10-20% of dislocations**
  - Usually involve one collateral and one or both cruciates
    - Often associated with plateau or SC fractures
  - Lateral dislocations with high rate of peroneal nerve injury
  - *Medial dislocations with 25% rate of vascular injury*

Clinical Presentation
Rotatory

- **~3-5% of dislocations**
  - **Posterolateral dislocation may be irreducible**
    - MFC buttonholes through the anteromedial joint capsule
    - MCL falls into joint space (dimples skin) & blocks reduction

Clinical Presentation
Classification – *Schenck and Wascher*

- **Ligament injury pattern**
  - **KDI:** multilig without bicruciate
  - **KDII:** bicruciate
  - **KDIII:** bicruciate + medial or lateral side
  - **KDIV:** "round the world"
  - **KDV:** +fx

TABLE 1
Modified Knee Dislocation (KD) Classification System[a]

Class	Ruptured	Intact
KDI	Usually ACL and LCL PCL, ± MCL, LCL/PLC	PCL ACL
KDII	ACL and PCL	MCL, LCL/PLC
KDIII		
M	ACL, PCL, MCL	LCL/PLC
L	ACL, PCL, LCL/PLC	MCL
KDIV	ACL, PCL, LCL/PLC, and MCL	None
KDV		
.1	Periarticular fracture with PCL intact	
.2	Periarticular fracture with bicruciate injury	
.3M	Periarticular fracture with tears of ACL, PCL, and posteromedial corner	
.3L	Periarticular fracture with tears of ACL, PCL, and LCL	
.4	Periarticular fracture with tears of ACL, PCL, LCL, and MCL	

Clinical Presentation
Classification

- **Mechanism**
  - High velocity (MVAs)
  - Low velocity (sports)
  - Ultra-low velocity/high energy (morbid obesity)


Acute and Subacute Management

Acute Management

- Closed reduction
  - Pre and post NV exam
  - Immobilize post-reduction (usually a hinged knee brace)
- Spanning ex-fix if…
  - Open dislocation
  - Vascular injury
  - Inadequate reduction or poor tolerance of brace (obese, burns)

Vascular Injuries

- Common
  - Rate of vascular injury
    - *Stannard et al JBJS 2004*: prospective cohort 126 patients
      - 0% KDI and II
      - 2% KDIII
      - **16% KDIV**
      - 3% KDV
  - Potentially devastating
    - Battlefield data: >50% limb loss if not addressed within 8 hours

Vascular Injuries
Assessment

- **Physical Exam**
  - *Stannard et al JBJS 2004*: prospective cohort, 19 mo F/U
    - "+" exam = ANY decrease in pulses, color or temperature, expanding hematoma, or abnl exam noted in ED
      - If exam +, arteriogram obtained
      - If exam -, admitted for serial exams x 48 hrs (if change in exam, arteriogram obtained)
  - *Miranda et al JOT 2002*: prospective cohort
    - "+" exam = "hard signs" of absent pulses, distal ischemia, active hemorrhage
      - If exam +, arteriogram
      - If exam -, admitted for serial exams x 24 hrs

Vascular Injuries
Assessment

- What about non-occlusive (ie. Normal exam) intimal tears?
  - *Lohmann et al 1990*: normal exam with 2 cases of pulseless leg after tourniquet let down
    - Progression of intimal tear
  - *Johansen et al*: occur in 6%
  - *Sawchuk et al*: 3% of these progress to clinical significance

Conclusion: Physical Exam is extremely valuable, but is not perfect

Vascular Injuries

- Which imaging studies to get?
  - Arteriogram:
    - Sensitivity 95%, specificity 90%
    - Cons: pseudoaneurysm, renal contrast load
  - Magnetic Resonance Angiogram (MRA)
    - *Tocci et al JKS 2010*: an acceptable alternative to angio
    - Cons: takes longer, not readily obtainable in unstable patients
  - CT Angiogram
    - >90% sensitive/specific
    - Cons: radiation exposure, contrast

Neurologic Injury

- Typically Common Peroneal
  - Recovery is variable, but generally poor (30%)
  - If no recovery by 6 wks, consider EMG
    - Repair if evidence of transection

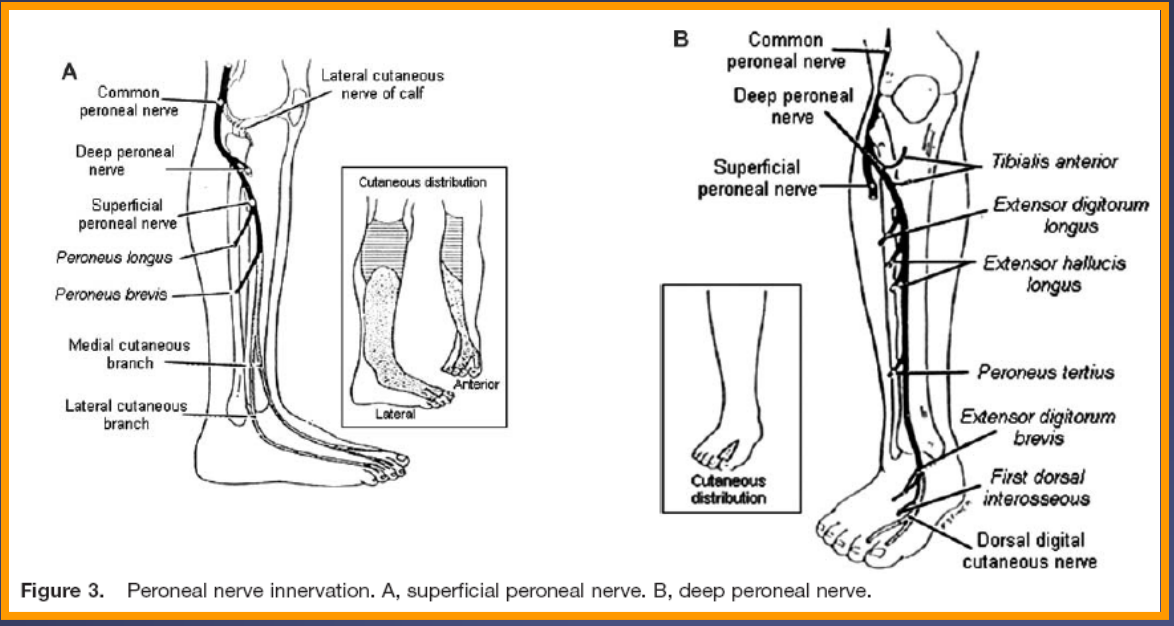


Figure 3. Peroneal nerve innervation. A, superficial peroneal nerve. B, deep peroneal nerve.

TABLE 2
Seddon Classification of Nerve Injuries

Classification	Description	Anatomic Lesion	Time to Recovery
Neurapraxia	Mild: local loss of nerve conduction without axonal degeneration.	Normal-appearing nerve	Full recovery in hours to days usually, possibly as long as 6-12 weeks.
Axonotmesis	Moderate: axonal damage without damage to axonal supporting structures. Wallerian degeneration occurs.	Nerve in gross continuity may appear stretched or contused.	Full recovery in several weeks to months; regeneration at 1 mm per day.
Neurotmesis	Severe: complete transection of the nerve.	Epineurium may be intact or nerve is completely transected.	Spontaneous recovery very unlikely.

Subacute Management
Op vs. Non-op

- **For younger, active patients, operative management results in improved outcomes…**
  - *Dedmond et al 2001, Wong et al 2004, Harner et al 2004*:
    - Improved stability, Lysholm/IKDC scores in surgically treated patients
    - Some loss of motion
  - *Richter et al 2002*:
    - Improved instrumented laxity, Lysholm/Tegner
    - Improved RTW (85% vs. 50%), return to sports (56% vs. 17%)

Subacute Management
Op vs. Non-op

…best outcomes in sports dislocations:

- *Hirschmann et al AJSM 2010*: 26 elite athletes with sports-related KDIII dislocations
  - 79% returned to sport at median 5.5 months
  - 13% with >15 degree loss of flexion, 8% with >10 deg loss of ext
  - Only 30% reached pre-injury level of play

- **Worst outcomes track with older, higher energy injuries:**
  - *Richter et al*: pts >40 with 65% poor outcomes (Lysholm)
  - Be wary of the unhealthy elderly, obese dislocation
    - Risk/benefit ratio favors non-op in many of these

Subacute Management
Timing of Reconstruction

- Usually dictated by other injuries
  - -Recovery and clearance from Vascular
  - -Meniscus, non-op MCL

- Several studies suggest early reconstruction/repair results in best outcomes…
  - *Chabra et al, Harner et al JBJS 2004*:
    - Subjectively: 85% G/E results in pts treated in < 3 wks vs. 60% G/E in delayed mgmt
    - Higher rate of MUA in acute group, but no diff in motion at 5 yrs
  - ***Hirschmann et al AJSM 2010:* higher return to sport if addressed within 40 days**

In House Protocol

What do you do to get it ready for referral?

- Acute management
  - Closed reduction, figure out vascular status
- Immobilization + DVT prophylaxis
  - Hinged knee brace if not ex-fixed
  - ASA or Lovenox
- Imaging
  - MRI
  - Vascular study (MRA or CTA, whichever is more convenient), if possible
- PT
  - IF NO EX-FIX: WBAT and START ROM (in brace)

In House Protocol

What do you do to get it ready for referral?

FOLLOW-UP APPT. WITHIN

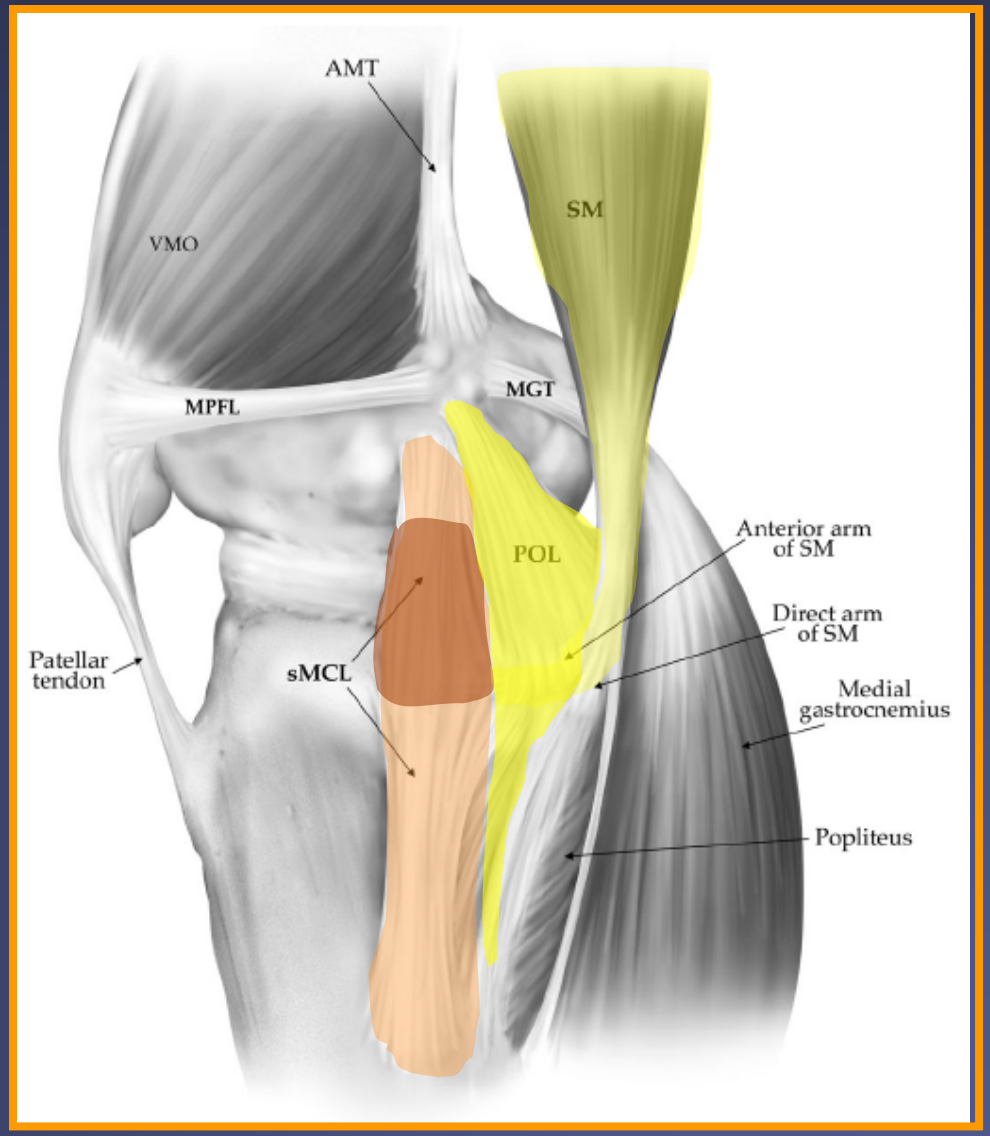
2 WEEKS OF INJURY

******Especially if no MRI***


Posteromedial Corner

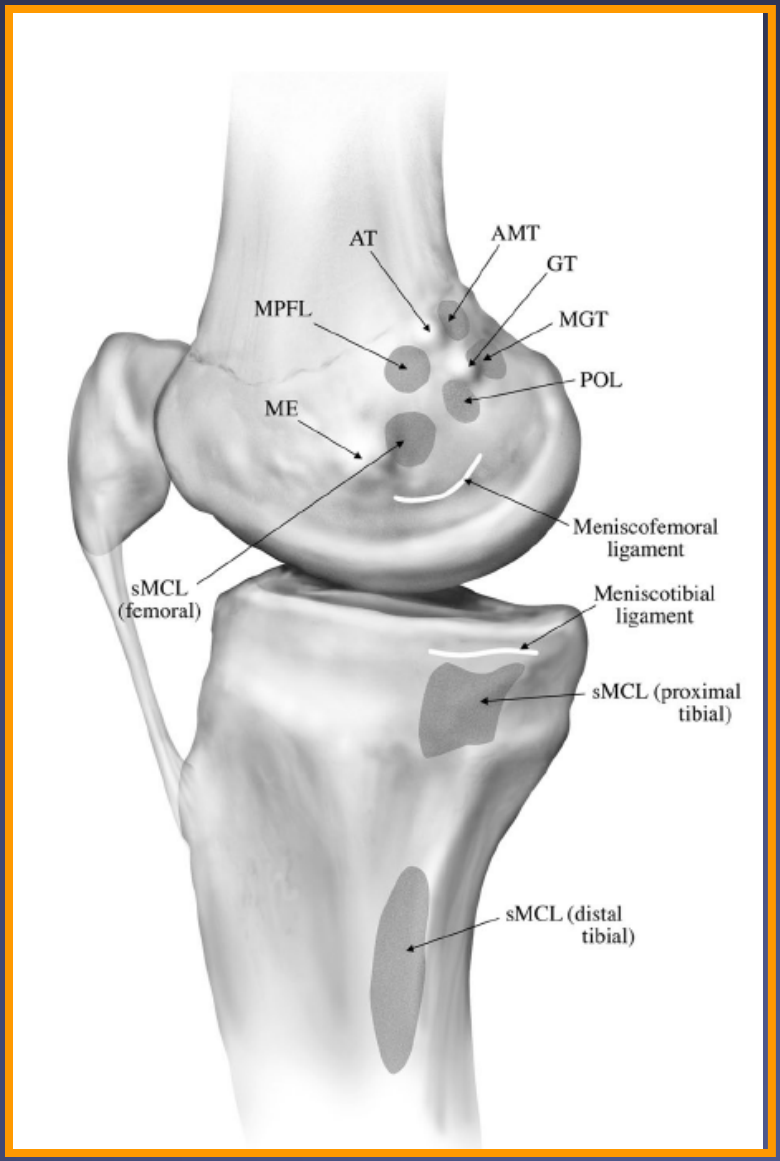
Posteromedial Corner
MCL, POL, Semimembranosus

- Primary components
  - MCL (superficial and deep)
  - Semimembranosus
  - Posterior Oblique Ligament (POL)



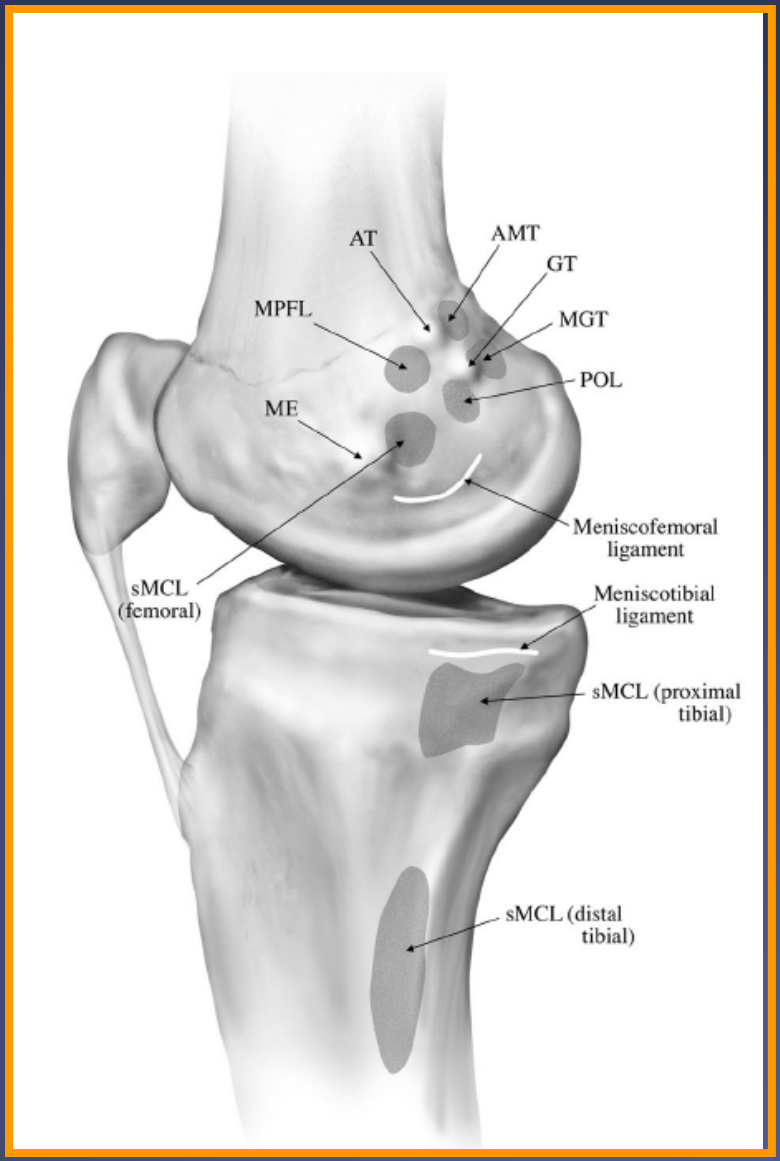
Posteromedial Corner
Biomechanics

- Primary restraint to valgus loading
  - in extension: POL, posterior sMCL
    - Greatest load in extension is posterior femoral attachment of sMCL (most common injury location)
  - In 30 deg flexion: remaining sMCL and dMCL
- Secondary restraint to excessive tibial ER



Posteromedial Corner
Biomechanics

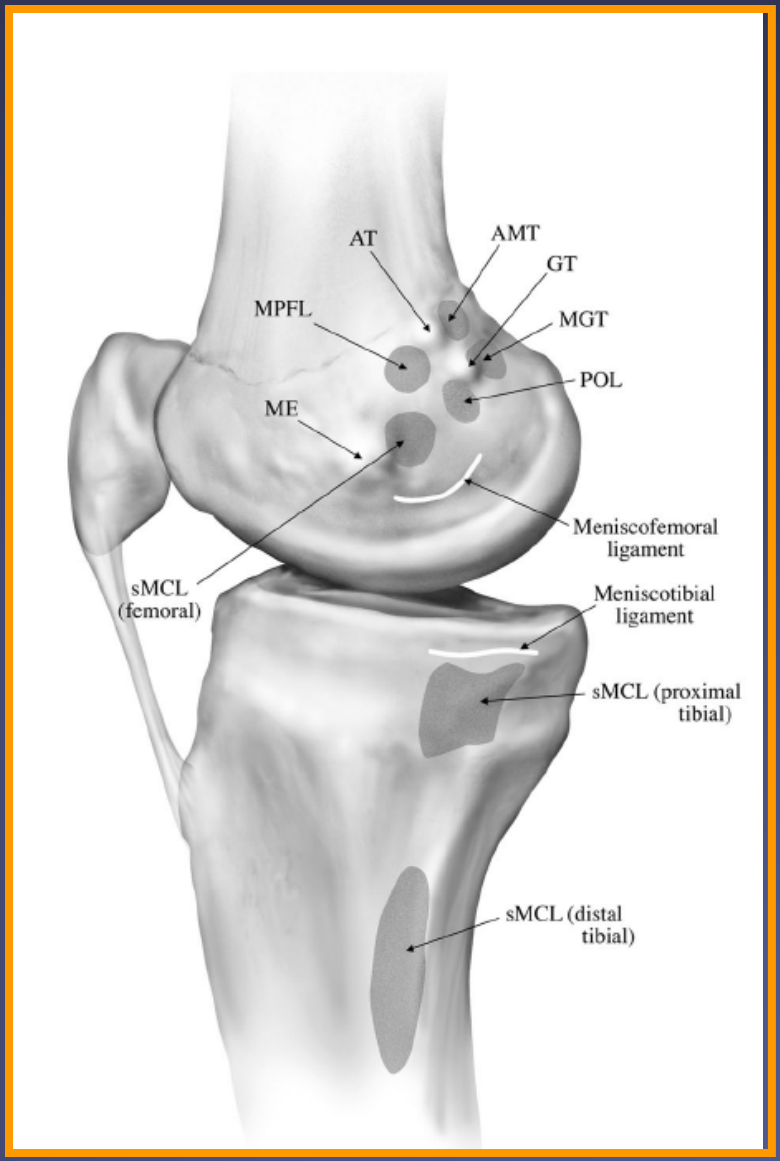
- Likely protects the ACL
  - *Battaglia et al AJSM 2004*: grade II MCL injuries increase load on ACL 50-60%
  - *Sims et al AJSM 2006*: ACL tears associated with grade III MCL injuries in ~80%



Posteromedial Corner

Biomechanics

- Grading
  - Valgus loading at 0 and 30 deg of flexion
    - Grade I: 0-5 mm opening
    - Grade II: 5-10 mm opening
    - Grade III: >10 mm opening
  - Increased opening in extension suggests POL laxity
  - Increased opening only in 30 flexion suggests isolated MCL



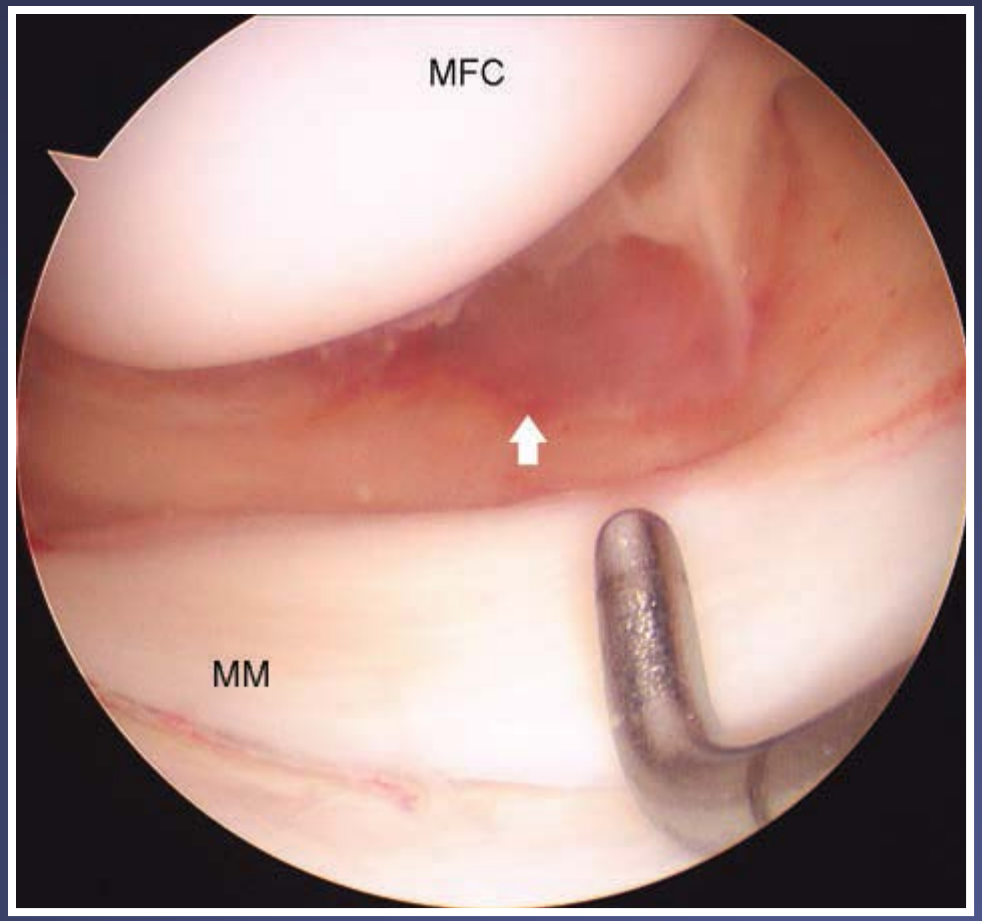
Posteromedial Corner
Biomechanics

- Valgus Stress 0 and 30
- Anteromedial Rotatory Instability (AMRI)
  - *Anterior drawer in ER*
    - Look for increased anterior translation of MTP

Positive findings suggest injury to POL

Posteromedial Corner
Arthroscopy

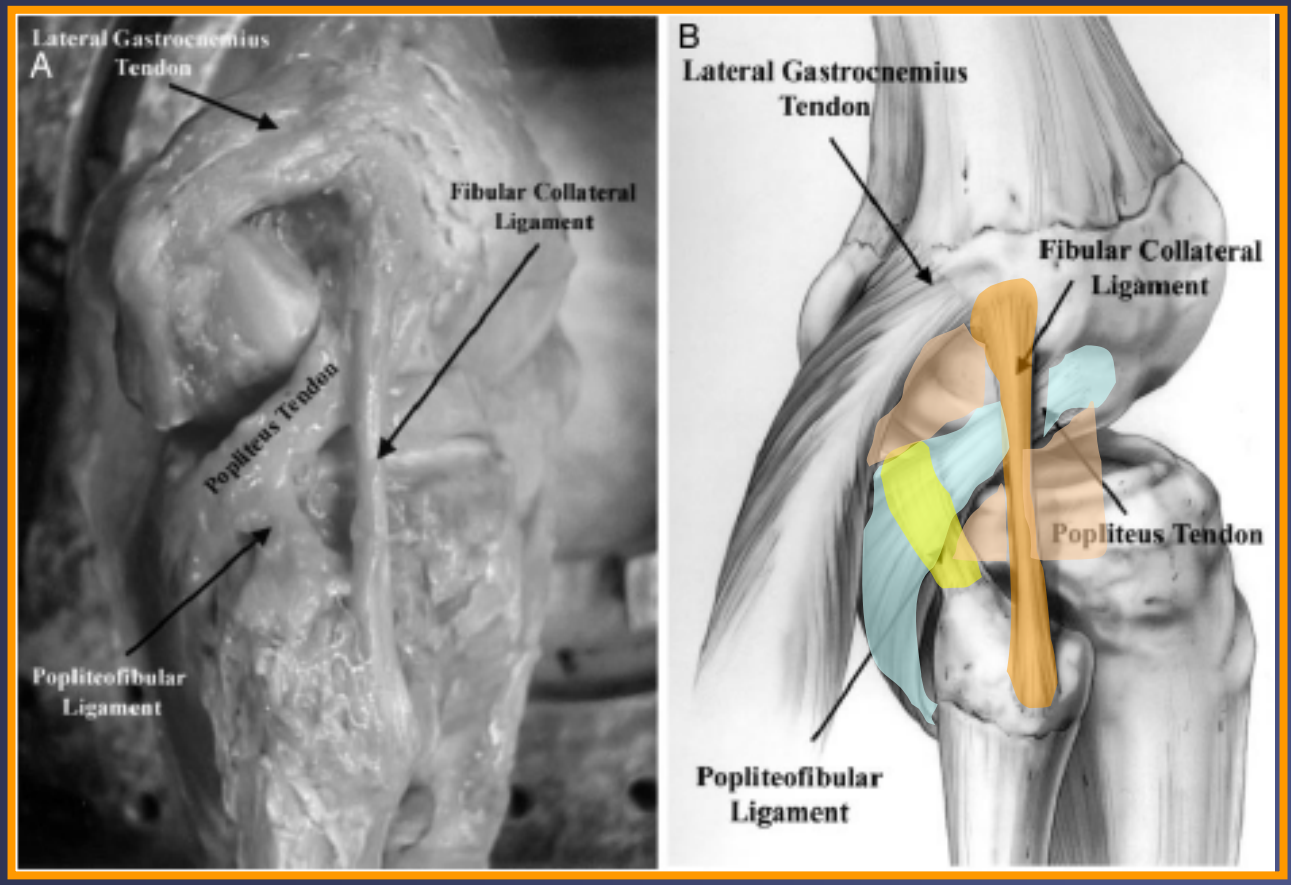
- Medial “gap” test
  - Valgus stress at 30 causes lift-off of the MM




Posterolateral Corner

Posterolateral Corner

LCL, PFL, Popliteus, Lateral Capsule



Posterolateral Corner
Biomechanics

Resists combined posterior tibial translation, varus and ER

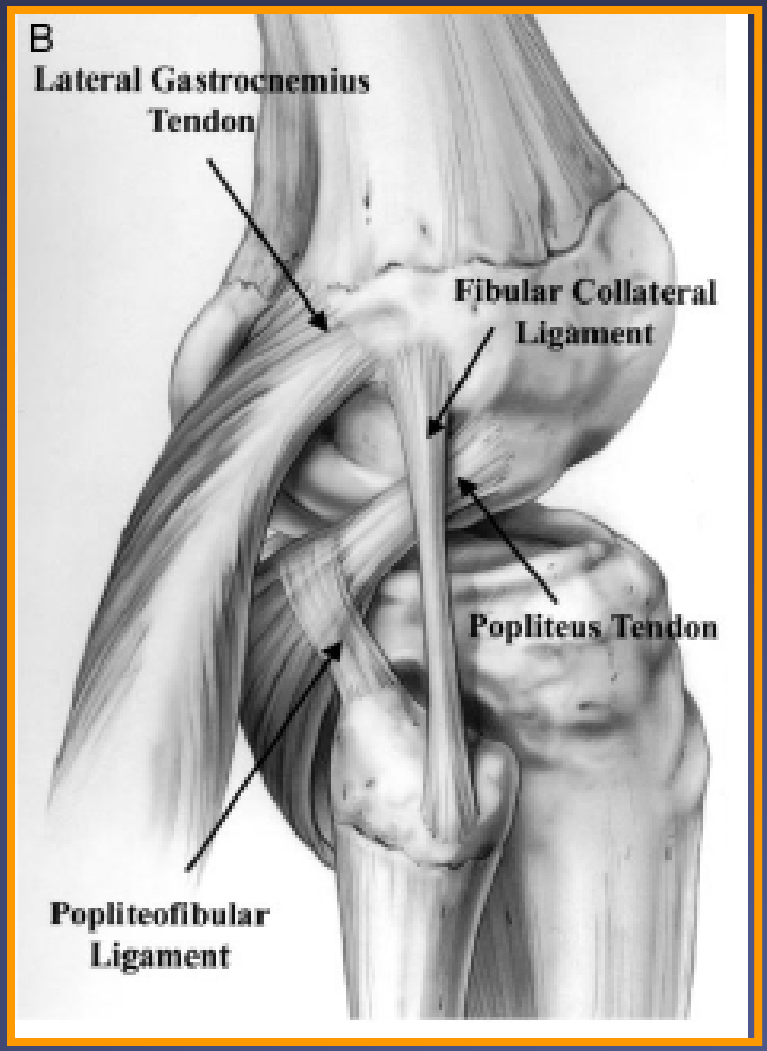
- **Varus**:
  - LCL is the primary restraint to varus, maximal effect at 30 deg flexion
  - Posterolateral capsule resists varus in 0 deg flexion

- **External rotation**:
  - LCL is the primary ER restraint at 0-30
  - Popliteus and PFL at 60-90
  - *Notes:*
    - *Isolated PCL insufficiency will not increase tibial ER at any angle (ie. Increased ER spin with a posterior drawer indicates more than just a PCL injury)*

Posterolateral Corner
Biomechanics

Backs up the ACL

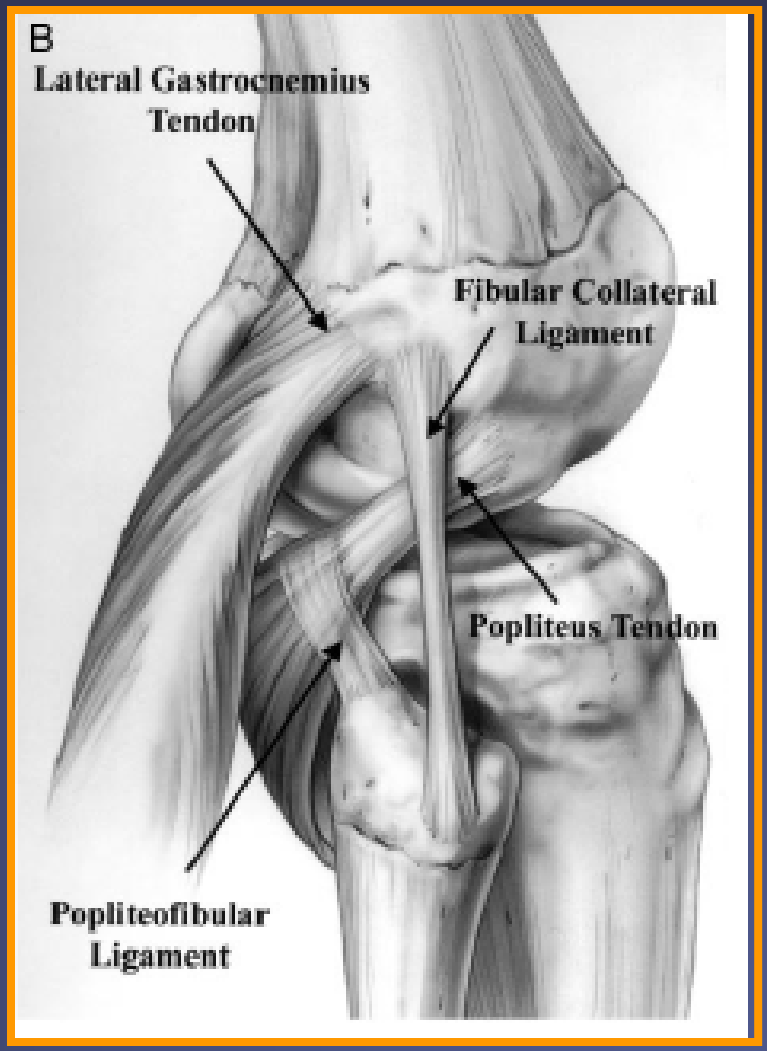
- ***LaPrade et al AJSM 1999***: sectioning the PLC significantly increases graft forces on reconstructed ACL
  - Greatest effect in extension
- ***Kannus et al, LaPrade et al***: Increased failure rates noted in primary ACL reconstruction with unrecognized PLC deficiency



Posterolateral Corner
Biomechanics

Backs up the PCL

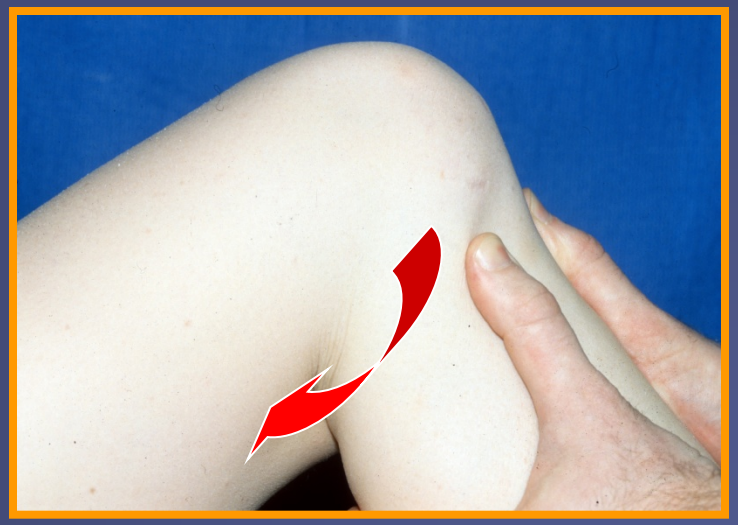
- ***Harner et al***: significant strain on reconstructed PCL after injury to the PLC (150% increase in graft forces)
  - Popliteus is most important component
    - *Markolf et al*: PCL graft forces not returned to normal unless LCL reconstruction combined with either popliteus or PFL graft
- ***Noyes et al AJSM 2005***: most common cause of failed PCL reconstructions = unrecognized PLC deficiency



Posterolateral Corner

Physical Exam

- Varus:
  - Varus loading at 0 and 30 deg of flexion
    - Grade I: 0-5 mm opening
    - Grade II: 5-10 mm opening
    - Grade III: >10 mm opening
- Tibial ER:
  - Dial or ER spin at 30 and 90 deg
    - Grade I: <10 degrees TFA Asymmetry
    - Grade II: 10-20 degrees TFA Asymmetry
    - Grade III: >20 degrees TFA Asymmetry



Posterolateral Corner
The "Dial Test" Explained

- ***Gollehon et al, Grood et al:***
  - Isolated PCL injury = no change in ER at any flexion angle
  - Isolated Posterolateral Corner injury = increased external tibial rotation at all angles
    - Max effect at 30 deg of knee flexion (13 deg, vs. 5 deg ER at 90 of flexion)
  - Posterolateral Corner PLUS PCL = increased external tibial rotation at all angles, but increased MORE at higher flexion
    - Max effect at 90 deg of knee flexion (20 deg)

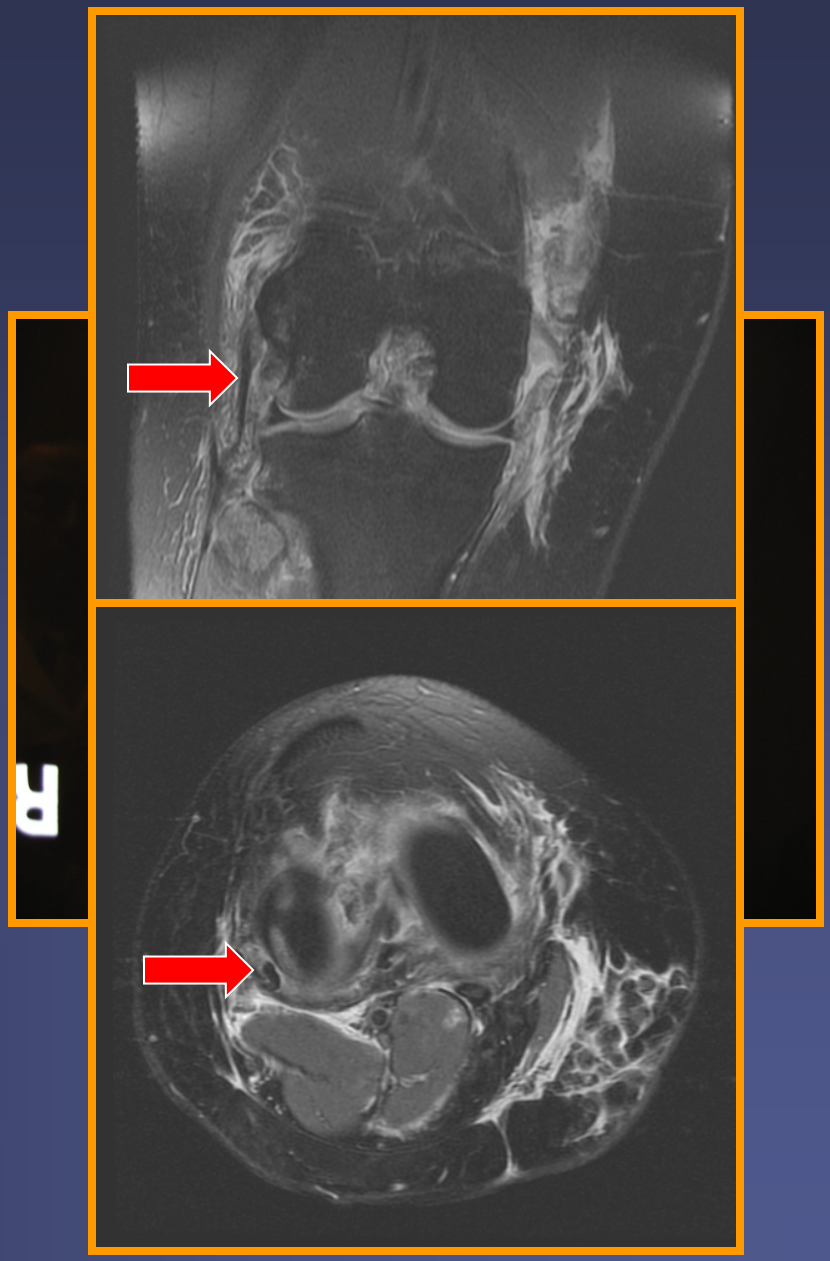
Posterolateral Corner
Physical Exam

- **Reverse Pivot Shift**
  - Start with tibia subluxed (flexion, ER, valgus)
  - As knee is brought into extension, ITB reduces tibia
- **ER Recurvatum**
  - Extension of knee results in PL tibial subluxation

Posterolateral Corner

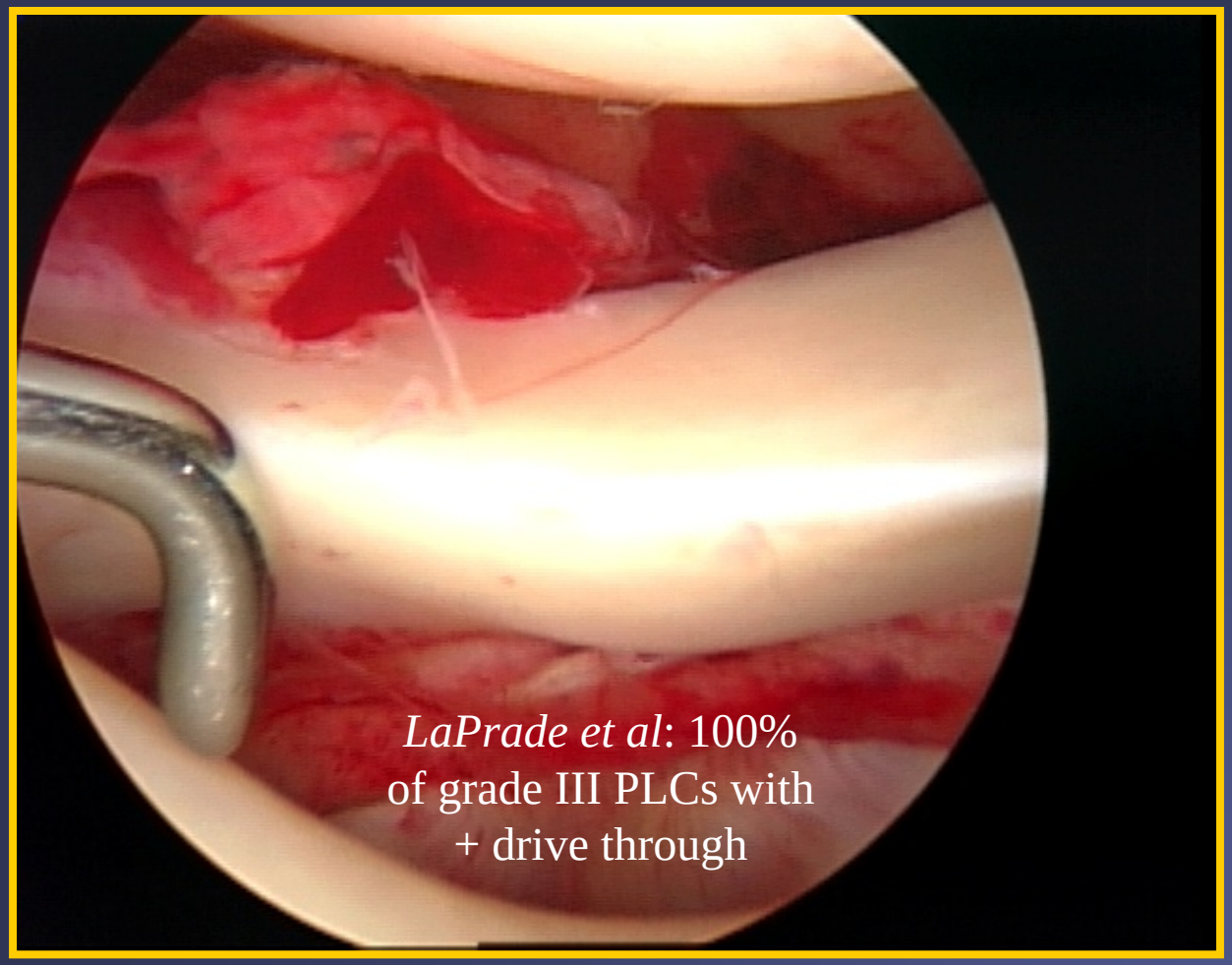
Imaging

- **Plain films**:
  - Look for lateral joint space widening (+/- varus stress views)
  - Fibular head avulsion
- **MRI**:
  - LCL on coronal cuts
  - Try to determine location of popliteus injury (axial cuts)



Posterolateral Corner

LCL, PFL, Popliteus, Lateral Capsule



≥10 mm opening


OUTCOMES

- **Motion**
  - 0-125 degrees (*Noyes et al, Walker et al, Shelbourne et al*)
  - Up to 60% requiring MUA+/- LOA (esp. in acute with MCL)

- **Stability**
  - Most studies show instrumented laxity within 5 mm of the other side for ACL, MCL, PLC in more than 70% of patients
    - Most variability is with the PCL
      - *Fanelli et al*: mean 2.6 mm difference on posterior drawer
      - *Noyes et al*: 30% with >3 mm difference

Outcomes

- **Pain**
  - Persistent pain in up to 10% (chondral, motion)
- **Return to work**
  - 50-70% (*Levy et al*)
- **Return to sports**
  - Variable, largely dependent on patients
    - *Levy et al*: high energy = 30%
    - *Hirschmann et al*: sports related KDIIIs = 79% (but most at a lower level)

Index of Suspicion

- 31 yo male
- Presented to ED 3 times in one week with dislocation but self-reduction
- KDIV with subsequent DVT

Summary

- **Potentially limb-threatening injuries**
  - Early management is focused on stable reduction with a focus on vascular status and treatment of associated injuries
- **Combined repair and reconstruction usually results in improved outcomes**
  - If conditions allow, operative intervention in the first month is preferable
- **Always balance risk/benefit**
  - Outcomes are NOT the same as after an ACL
  - Some patients will do better without surgery


Thank You