Overview Knee Dislocations and Tibial Plateau Fractures

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CONFLICTS

- No conflicts regarding this discussion

Acknowledgements

OTA Resident Core Curriculum lectures made by the Orthopaedic Trauma Association for Education were used as the foundation of this presentation.

I wish to acknowledge all of the many OTA Authors' work that prepared me today.

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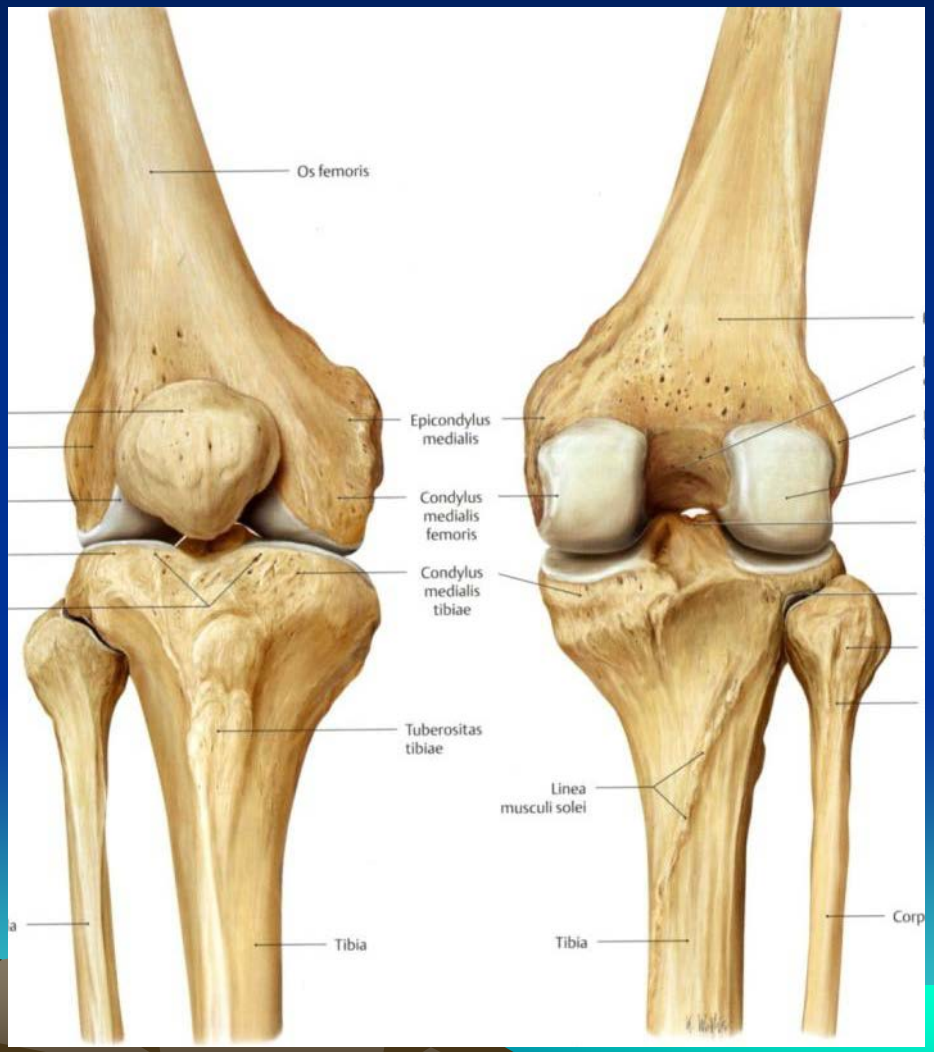
At the end of this session, participants will be able to:

- Identify common pitfalls with knee dislocations and fractures of the proximal tibia and shaft.
- Identify injury patterns, physical exam techniques/evaluation, and care.
- Explain imaging modalities and some of their limitations.

Anatomy: Tibiofemoral Joint

- Bones
  - femoral condyles
  - tibial plateau
- Dissimilar surfaces
- Little/No inherent bony stability
- May be cause of additional instability if fractured

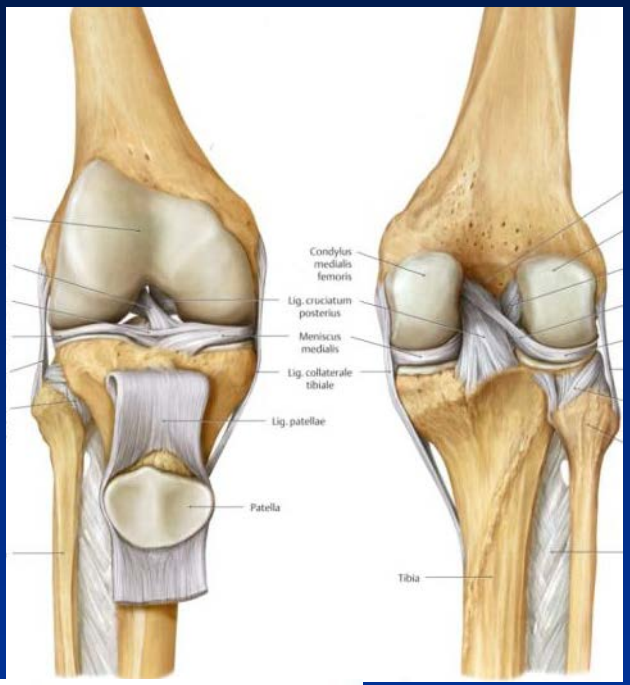


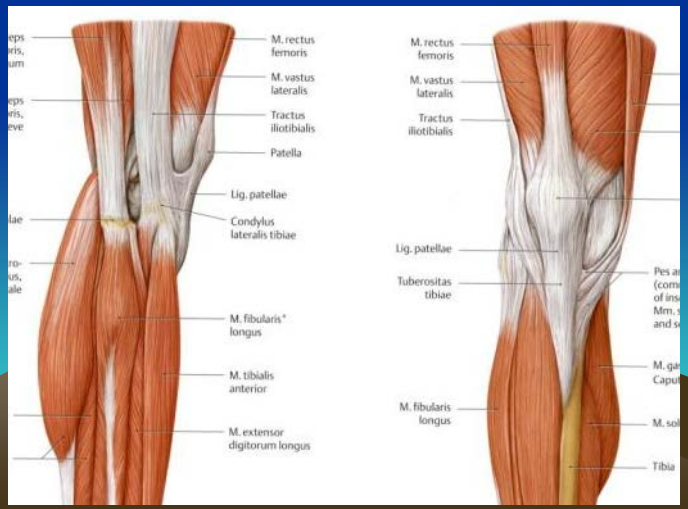
Anatomy of the Tibial Plateau

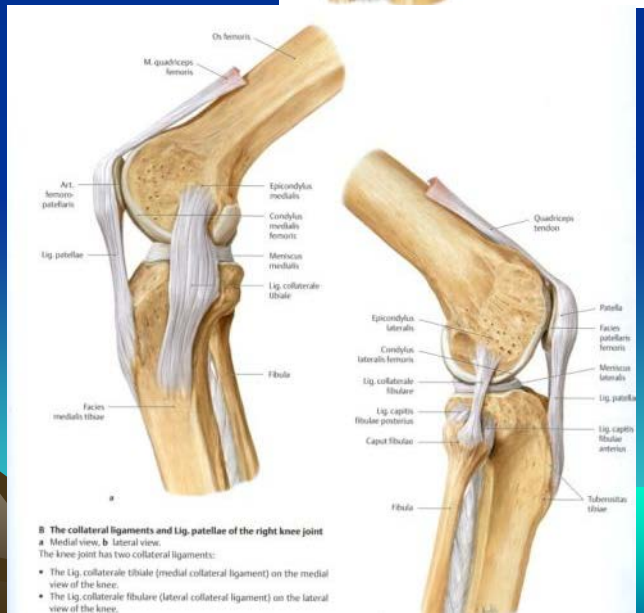
- Proximal Tibia
  - Medial and lateral plateau or condyles
  - Bony prominences (attachments)
    - Tibial Spine or Intercondylar eminence (ACL/PCL)
    - Tibial tubercle (Patellar Tendon)
    - Gerdy's tubercle (ITB)
  - Joints
    - Tibiofemoral
    - Patellofemoral joint
    - Proximal tib/fib joint

Stabilizers of the Tibiofemoral Joint

- Soft tissues: stabilize while allowing ROM
  - Ligaments
  - Joint capsule
  - Menisci
  - Musculotendinous units (DYNAMIC)







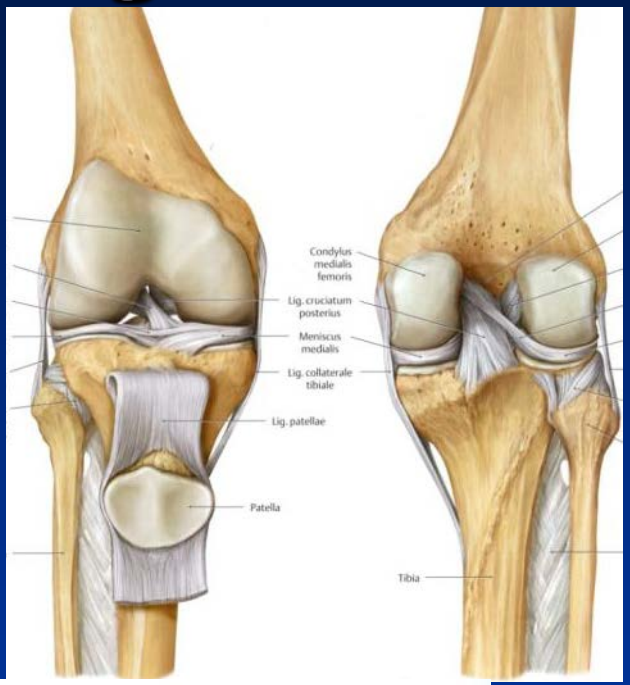
Anatomy of the Tibial Plateau

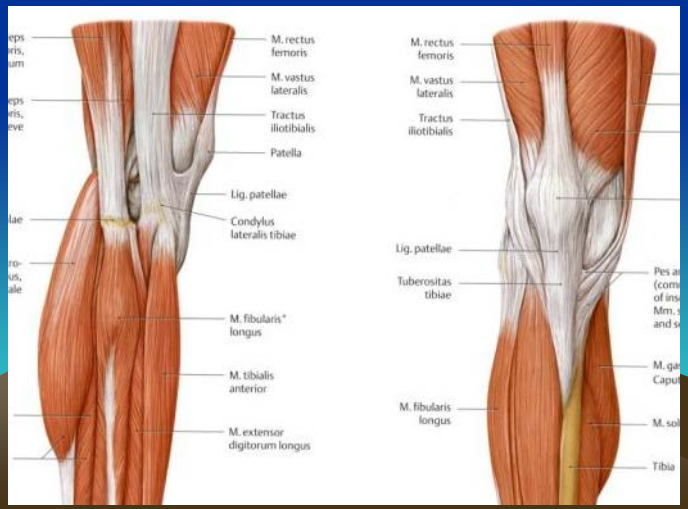
- Medial Plateau
  - Concave
  - Larger
  - Cartilage thick ~ 3 mm
  - Posterior slope of 10°
- Lateral Plateau
  - Convex
  - Higher on lateral view
  - Larger meniscus
  - Cartilage thick ~ 4 mm
  - Posterior slope of 7°

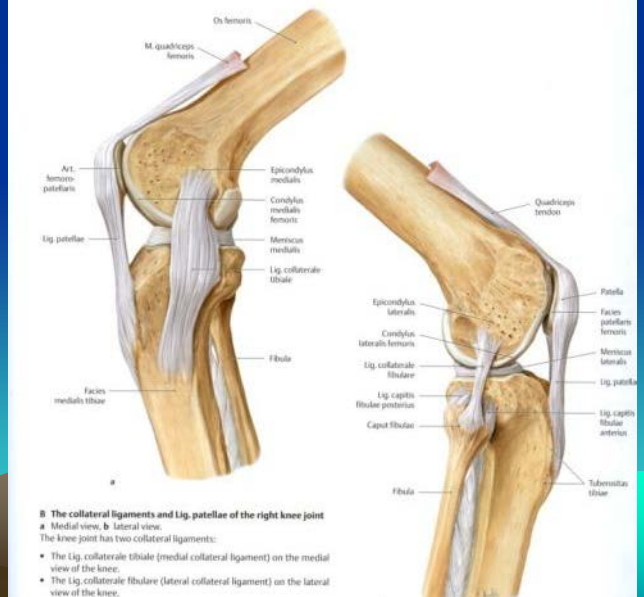
MCL, ACL, LCL, Popliteal artery, peroneal nerve are all potentially at risk for injury

Anatomy – 4 groups of ligaments

- ACL
- PCL
- MCL, posteromedial capsule
- LCL
- PLC (popliteofibular ligament, popliteus, capsule, ITB, biceps femoris)







B The collateral ligaments and Lig. patellae of the right knee joint
a Medial view, b lateral view.
The knee joint has two collateral ligaments:
- The Lig. collaterale tibiale (medial collateral ligament) on the medial view of the knee.
- The Lig. collaterale fibulare (lateral collateral ligament) on the lateral view of the knee.

Vascular Anatomy

- Popliteal artery at risk for being tethered
  - Adductor hiatus
  - Soleus arch
- If blood flow through popliteal artery disrupted Inadequate blood supply

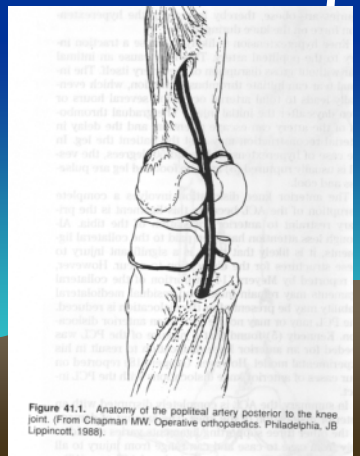
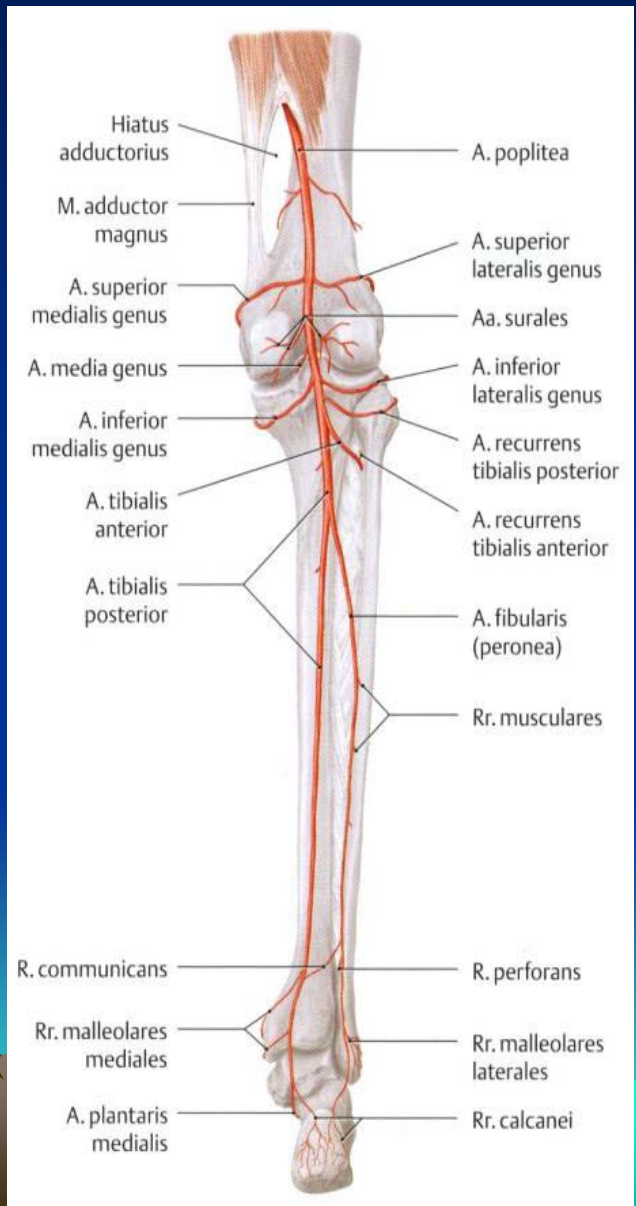
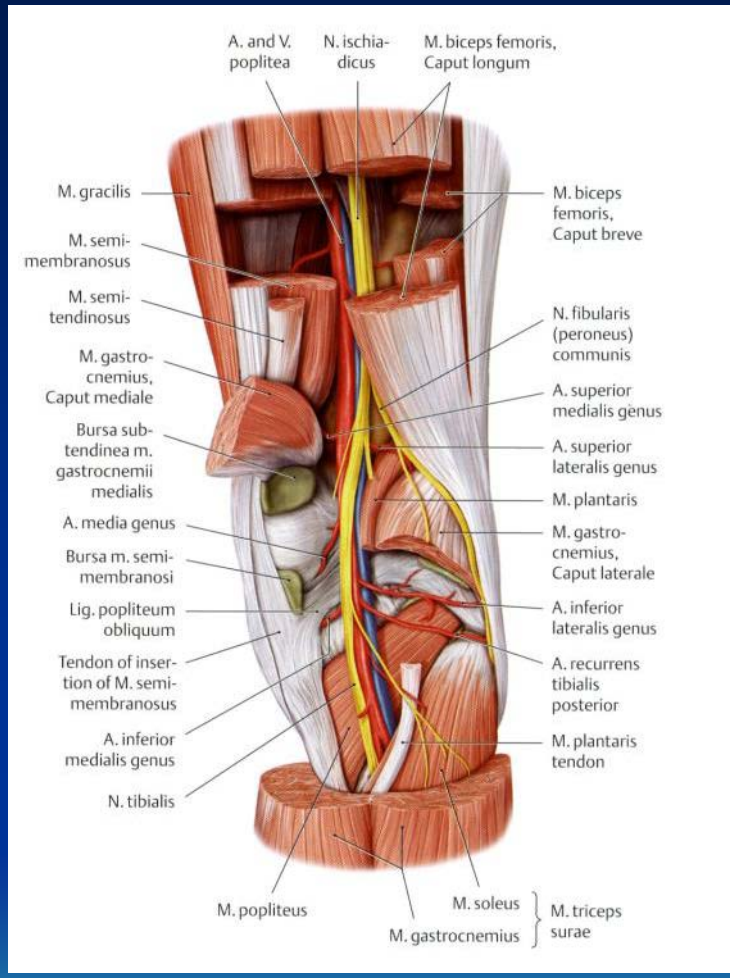


Figure 41.1. Anatomy of the popliteal artery posterior to the knee joint. (From Chapman MW. Operative orthopaedics. Philadelphia, JB Lippincott, 1988).



Anatomy: Nerves

- Influences Long-Term Outcome
  Peroneal nerve
  - More commonly injured
  - Tethered around the fibular neck
  - Mechanism of injury
    - Tension-Varus ± hyperextension
    - Translation-Anterior /Posterior dislocation
    - Direct impact
    - Iatrogenic (aggressive varus/hyperextension during EUA (!)
- Tibial nerve



Knee Dislocation- Multiligamentous Injury

- Disruption of normal relationship of tibiofemoral joint
- Usually requires the injury to 2 of the 4 major groups of ligaments

Dislocation Pathomechanics

- May occur not only with high energy but also with low energy
- Low energy
  - Athletic activity (more with contact sports)
  - Fall down stairs
  - Jump of the low height
  - OBESITY
- High energy
  - MVA
  - PVA
  - Fall from height

Dislocation Epidemiology

- True incidence is underreported
  - Spontaneous reduction
  - Definition (documented complete dislocation vs. ≥1 cruciate + one collateral injury)
  - Obesity interferes with exam and mechanism
- Presented in a variety of clinical practices
  - Trauma Center
  - Sport Medicine
  - General Orthopaedics

BEWARE OF THE PEDIATRIC TIBIAL PLATEAU FRACTURE CAUSED BY UNRECOGNIZED DISLOCATION

Dislocation Epidemiology

- 0.2 % of all orthopaedic injuries
- Young ♂
- MVA, sports trauma
- 14-44 % associated w multiple trauma
- Bilateral 5 %

Robertson A et al. 2006

Dislocation Diagnosis

If any of the following present r/o Multiligamentous injury (Spontaneous reduction UNDERDIAGNOSED)

- Hyperextension
- Popliteal ecchymosis
- Vascular insufficiency
- Peroneal nerve deficit
- Diffuse tenderness but Absence of hemarthrosis (capsular disruption)
- Obese & low energy fall

Physical Examination

- Evaluate soft tissues
  - Open
  - Puckering (irreducible dislocation)

Mechanisms and Associated Injuries

- **High energy**
  - Popliteal artery injury (14-65%)
  - Nerve injuries (16-40%)
  - Multiple fractures (41%)
  - Head, chest trauma
  - Compartment syndrome

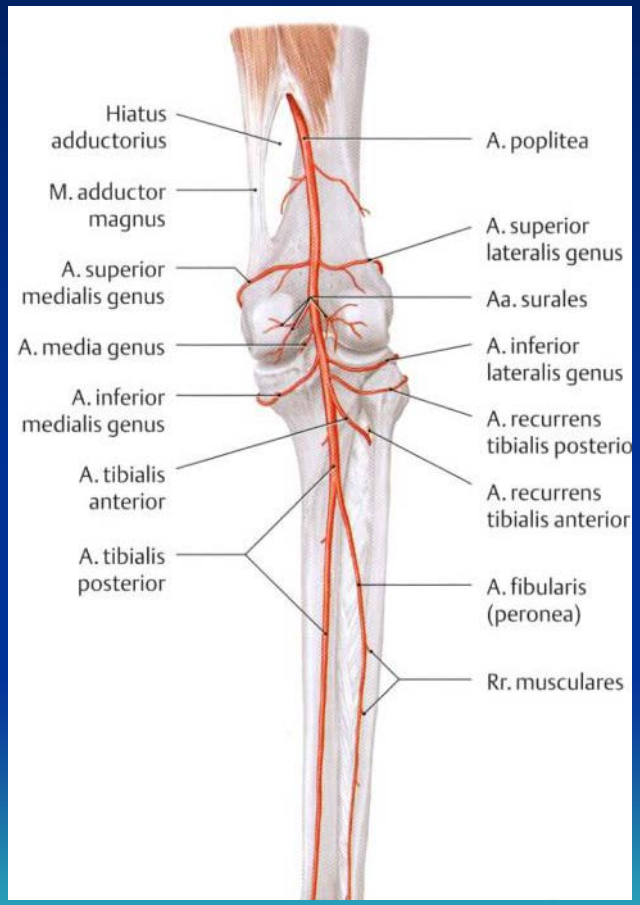
- **Low energy**
  - Popliteal artery injury (<5%)
  - Meniscal injury (20%)
  - Osteochondral fracture

Vascular Examination

- Color, temperature, Pulses
- ABI (Ankle Brachial Index)
- DP Systolic/Brachial Systolic
  - ≥0.9: Serial examination
  - <0.9: further study/explore
  - Johanson, K, JT
- Reduce if dislocated and Re-examine

Vascular Examination

- ABI ≥0.9 & no signs of vascular injury: Arterial study may not be necessary if
  - Serial examination q 2-4 hrs for 48 hrs can reliably be performed
- If not, arterial study may be ordered to r/o vascular injury



Mills WJ 2004, Stannard JP 2004

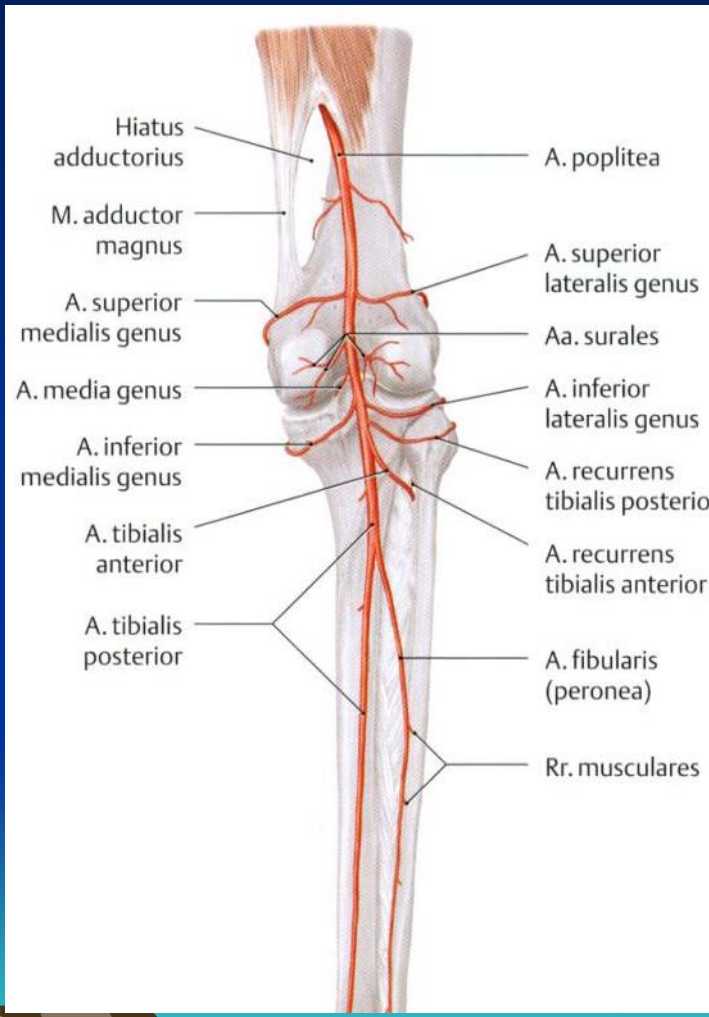
Vascular Examination

- ABI <0.9 OR
- Temperature, Color, OR
- Expanding swelling (hematoma) around the knee

- Arterial study
  - Arteriography in OR (on table by surgeon)
  - Angiography (radiology suite)
  - CT- Angiogram

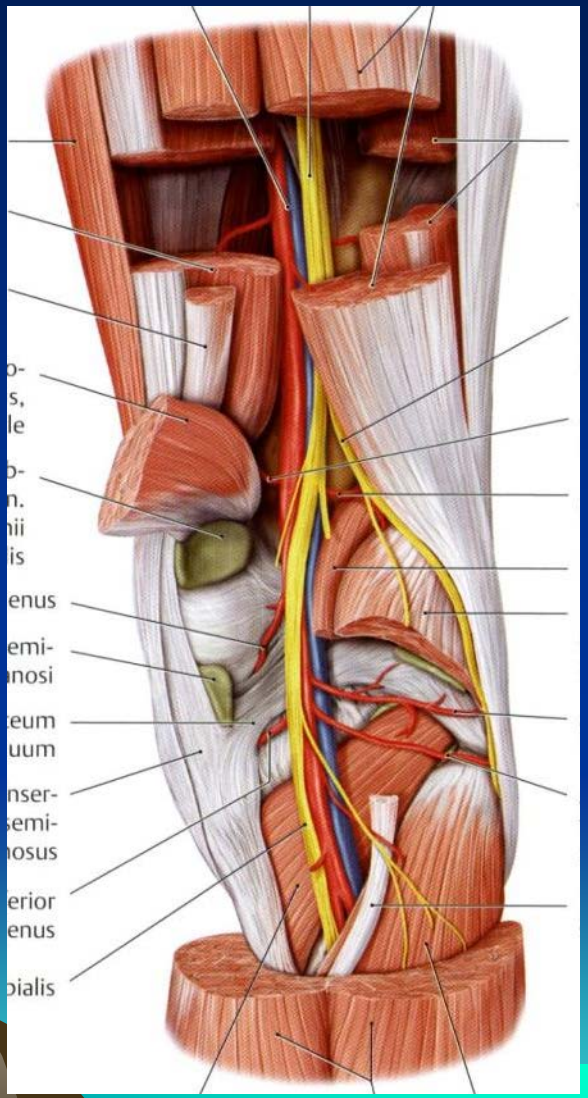
Vascular Injury

- ~20% (5-30%) of all dislocations
- EMERGENCY if NO distal perfusion
- Patterns of Vascular injury
  - rupture
  - incomplete tear
  - intimal injury
    - (may cause thrombosis)



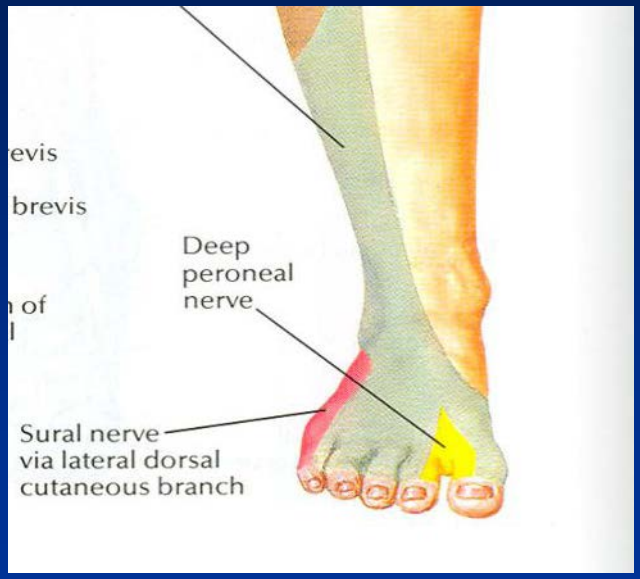
Neurologic Injury

- Common peroneal nerve palsy
- Incidence ~20% (10-40%)
- Most Common with varus injury
- Usually axonothmesis
- PROGNOSIS is POOR
- Complete recovery ~ 20%

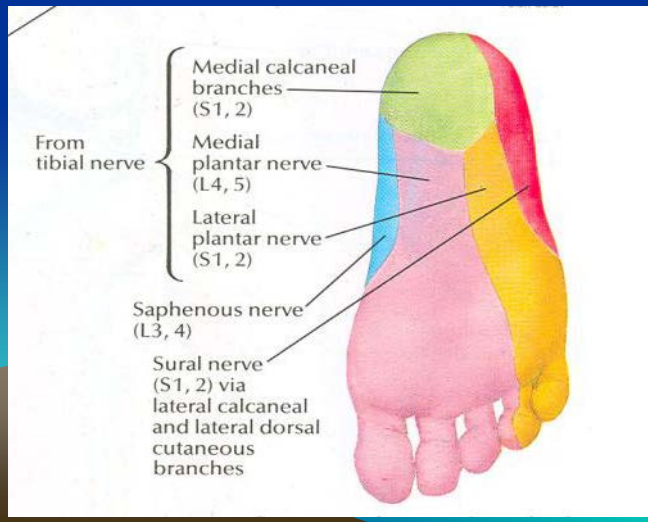


Neurologic Examination

- Peroneal Nerve
  - Motor: EHL, Tib. Anterior, Peroneals
  - Sensory: dorsum of the foot and 1st web space



- Tibial Nerve
  - Motor: FHL, Gastrosoleus, Tib Posterior
  - Sensory: Plantar surface and lateral border of the foot



Tibial Plateau Demographics

- 1% of all fractures
- 8% of all fractures in the elderly
- Lateral plateau involved 55-70%
- Medial plateau involved 10-20%
- Both involved 10-30%

Plateau Classification

Schatzker, Clin Orthop, 1979

- Type I - Split Lateral Tibial Plateau Fx
- Type II - Split/Depression Lateral Plateau Fx
- Type III - Pure Depression Lateral Plateau Fx
- Type IV - Medial Tibial Plateau Fx (Fx Dislocation)
- Type V - Bicondylar Split Fx
- Type VI - Tibial Plateau Fx with Metaphyseal - Diaphyseal Separation

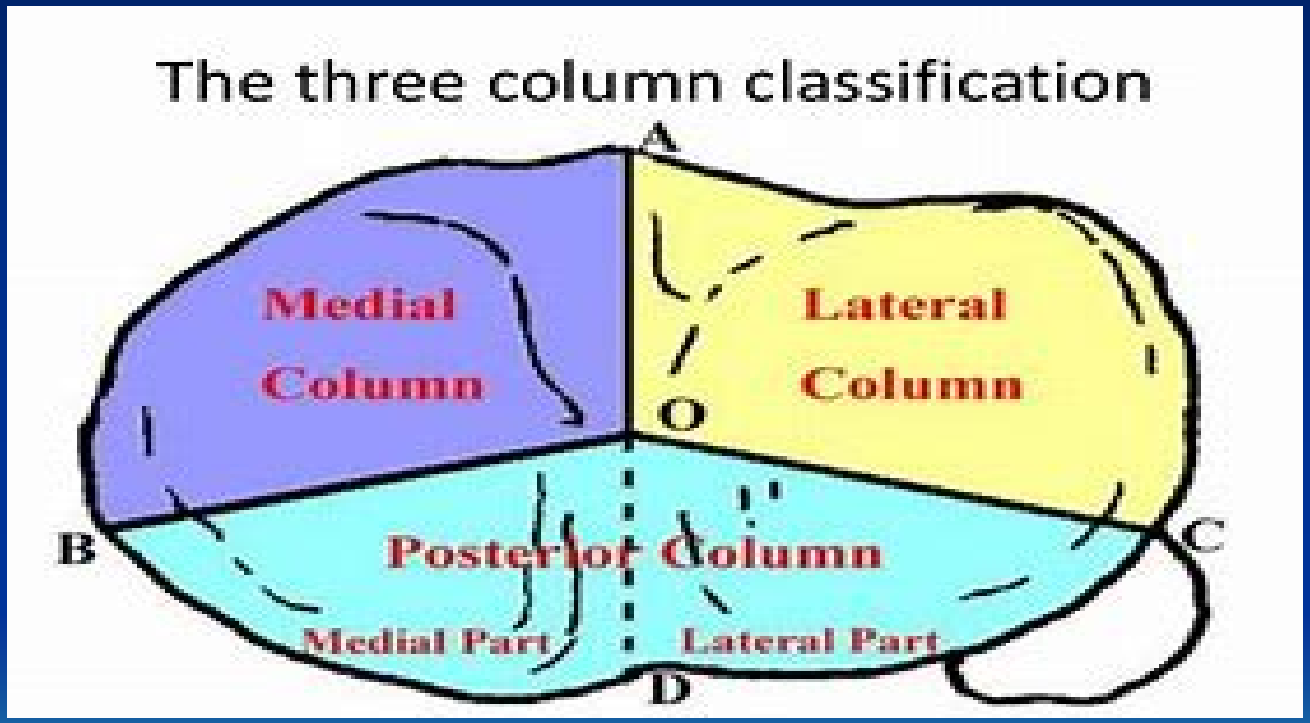
AO/OTA Plateau Classification

- Type A - Extraarticular
- Type B - Partial Articular
- Type C - Intra-articular and Metaphyseal

Plateau Radiographic Evaluation

- AP, Lateral on Large Cassettes
- Obliques
  - Internal rotation view
  - Shows postero-lateral fragment
- Traction Films
  - Defines fragments
  - Bridging Ex-fix can provide traction
- CT scan with reconstruction
  - Obtain AFTER ex fix if using
  - Coronal
  - Sagittal
- Arteriography when necessary (or check ABI > 0.9)
- ? MRI – unsuspected fxs or soft tissue injury

Current Discussion on 3 Columns of Plateau Fractures



Surgical Techniques

- Ligamentotaxis
  - Helps with Condyle Architecture
  - Does not reduce Joint Depression
- Joint Distraction
  - Temporary Bridging ExFix
  - Femoral Distractor
- Indirect Reduction

Surgical Consensus

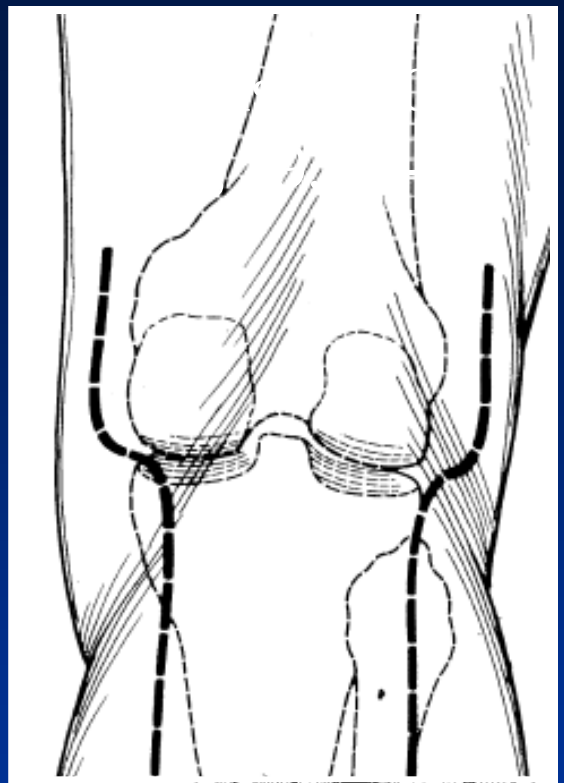
- Joint Depression
  - Reduce From Below
  - Bone Graft Defects
- Compress with Lag Screws
- Repair Associated Ligament Avulsions
  - Restore ligamentous stability
- Preserve Meniscus
- Restore Alignment of Proximal Tibia

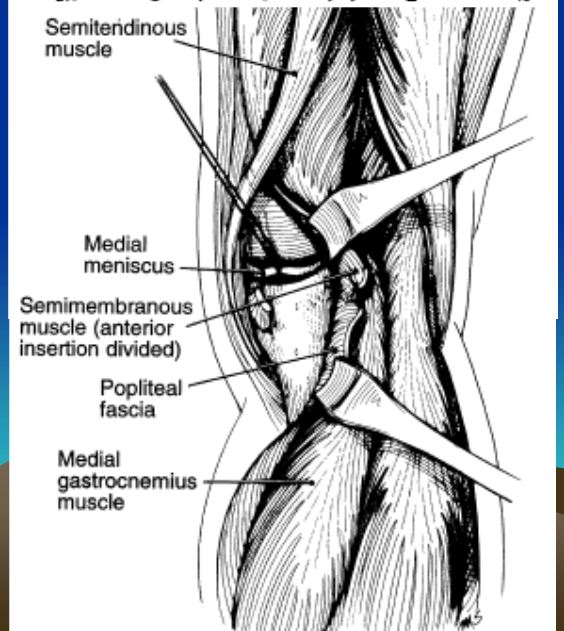
Posteromedial and Posterior Column Fragments

BEWARE !!

- Often missed
- Must Identify
- Must Reduce
  - -Direct
  - - Indirect
- Must Stabilize with Orthogonal fixation

Posterior Approach(es)





Combination Reduction aka "PlaNail"

Priorities

- ABC'S
- Assoc Injuries
- Tetanus
- Antibiotics
- Soft Tissue Management
- Fixation
- Long term issues

Knee/Plateau/Tibia Physical Exam

- Neurologic and vascular exam of extremity including ABI's if indicated Johansen K, *J Trauma* April 1991
- Wounds should be assessed once in ER, then covered with sterile gauze dressing until treated in OR- digital camera / cell phone
- True classification of wound best done after surgical debridement completed

"Damage Control Orthopaedics"

- Temporary Stabilization
  - Soft Tissue Rest
  - Bony Stabilization
- Bridging ExFix
  - Across the Knee
  - Pins Out of Zone of ORIF in Tibia
  - Multiligamentous or Types V & VI Primarily
- ORIF When Soft Tissues Allow
- Compartment Syndrome

Advantages of External Fixator

- Can be applied quickly in polytrauma patient
- Allows easy monitoring of soft tissues and compartments
- Modifiable
- No long term deep HW
- Evolution: More Commonly used for Temporary Damage Control

Timing of Surgery

- Stable, resuscitated patient
- Define fracture
- Soft tissue envelope
  - Swelling
  - Ecchymosis
  - "Damage Control Orthopaedics"
- Positioning of patient
  - Other injuries

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