ACSM TPC Part 2

Functional Anatomy of the Knee and Leg



Mary Lloyd Ireland, MD
Associate Professor
Dept. of Orthopaedic Surgery & Sports Medicine
University of Kentucky
Lexington, Kentucky

Anatomy and Dissection Sources

- **www.primalpictures.com**
  [3D Human Anatomy Software – London, England]
  - Interactive Knee
  - Interactive Functional Anatomy

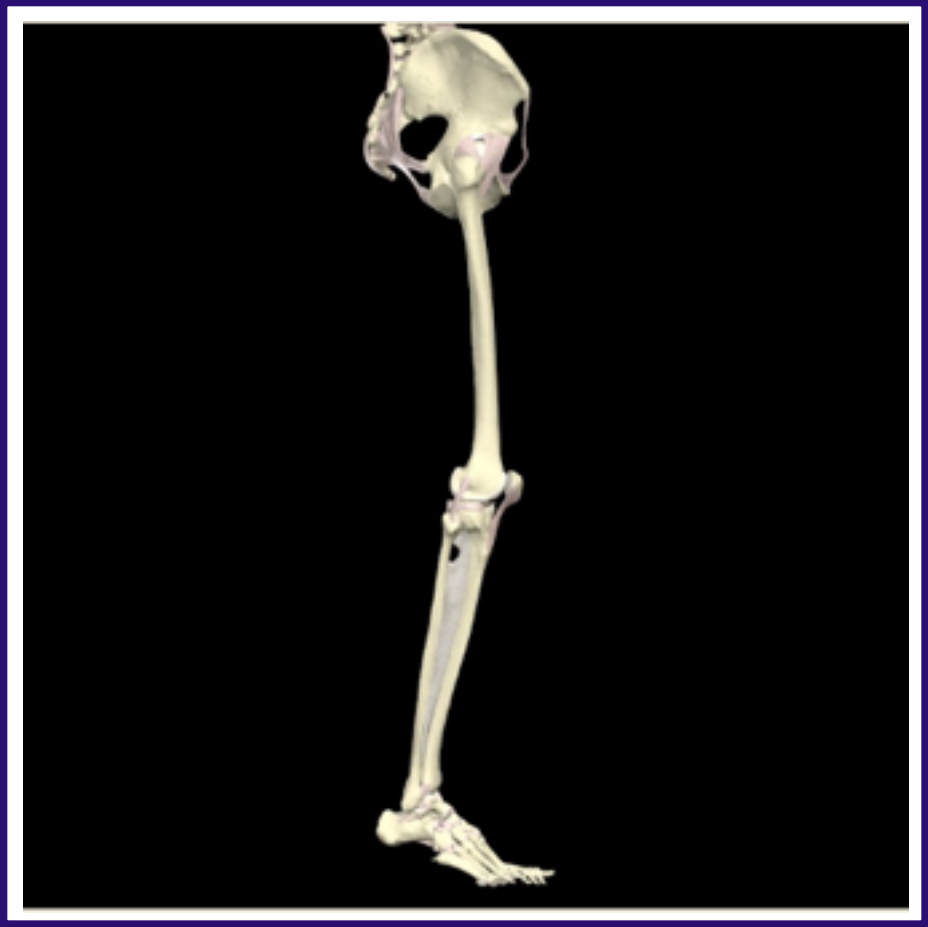
- **Mary Lloyd Ireland, MD**

Lower Limb model: Lateral View



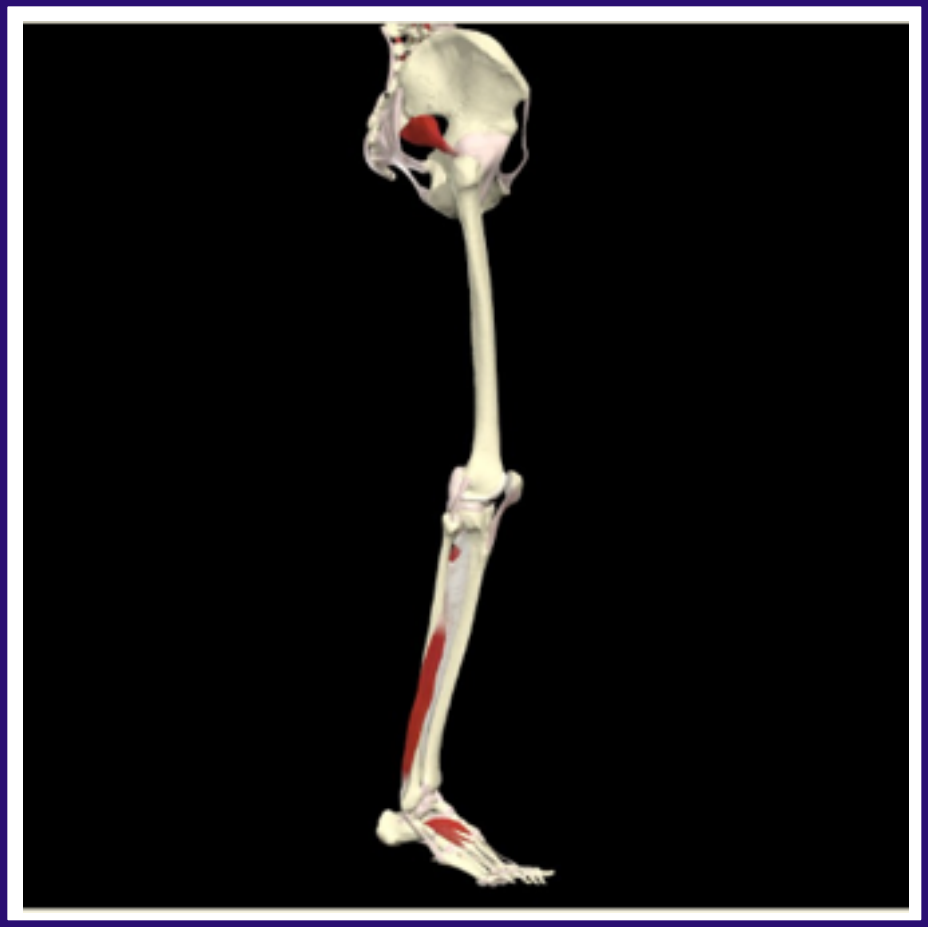
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Lower Limb model: Lateral View



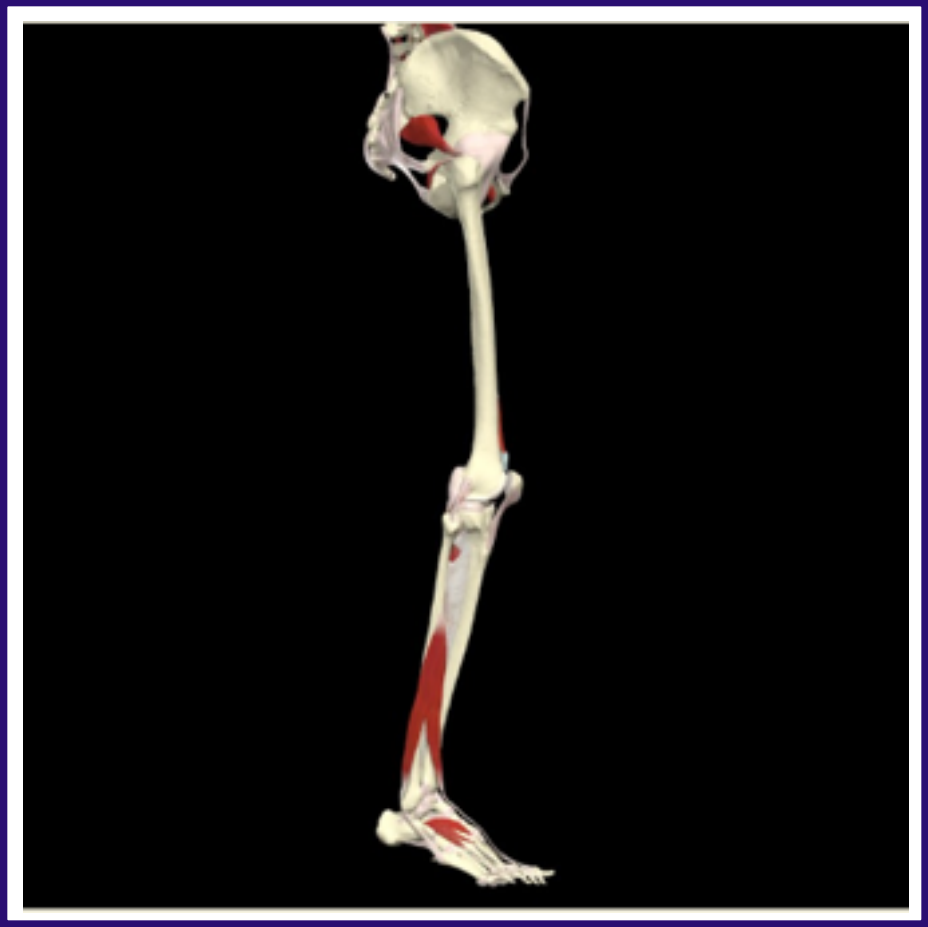
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Lower Limb model: Lateral View



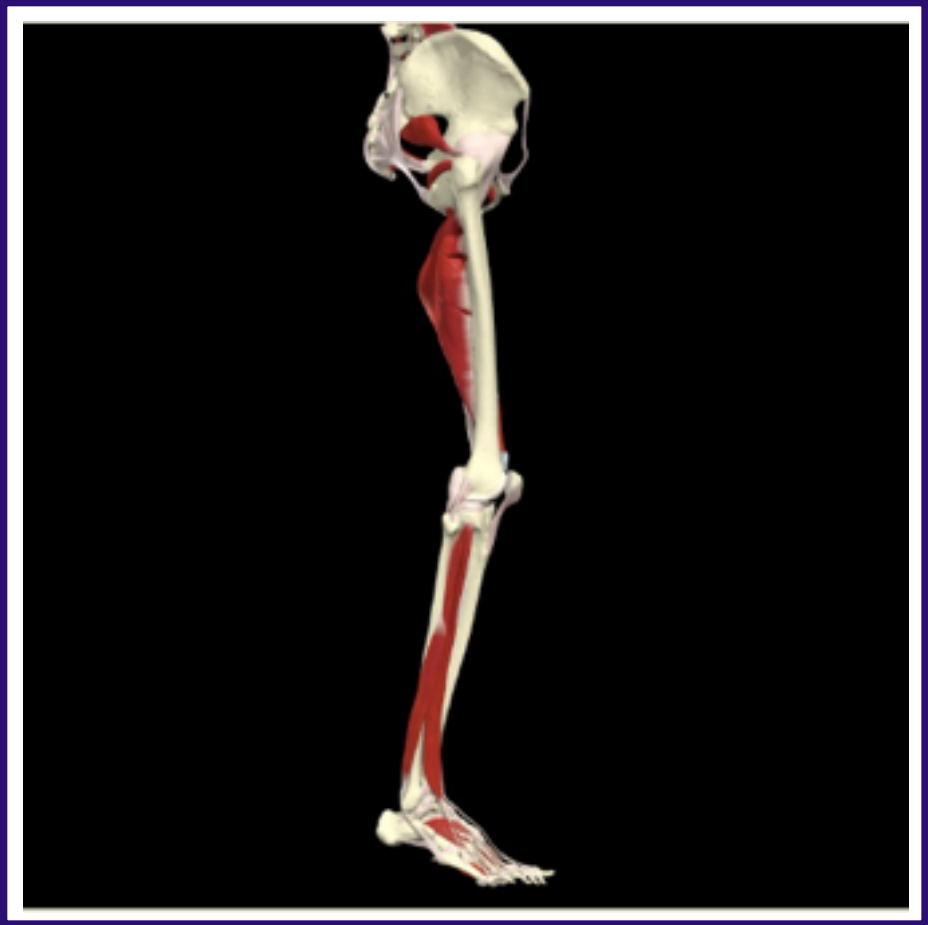
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Lower Limb model: Lateral View



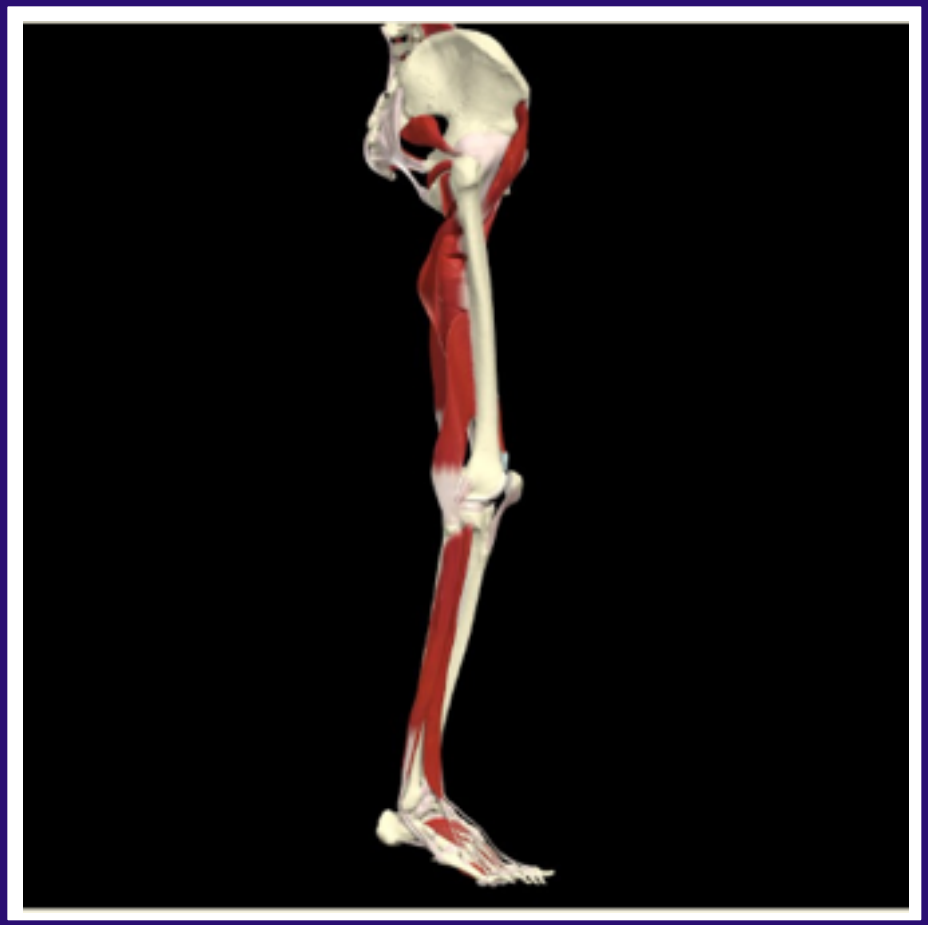
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Lower Limb model: Lateral View



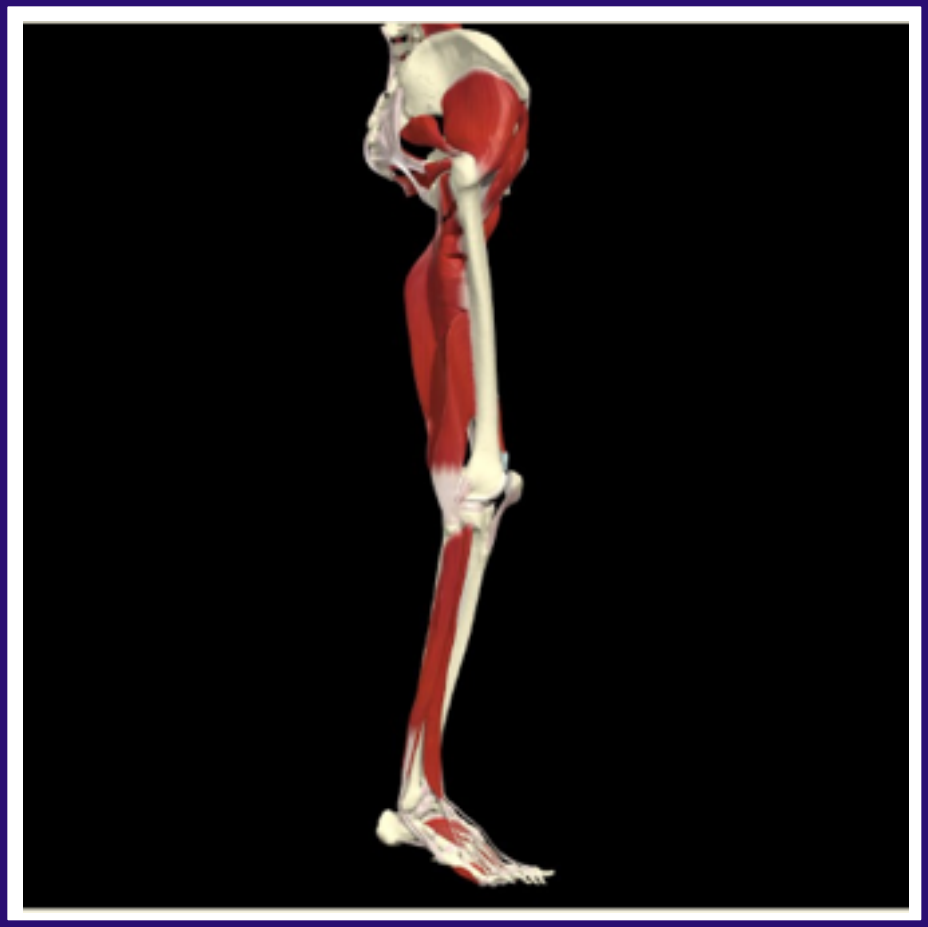
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Lower Limb model: Lateral View



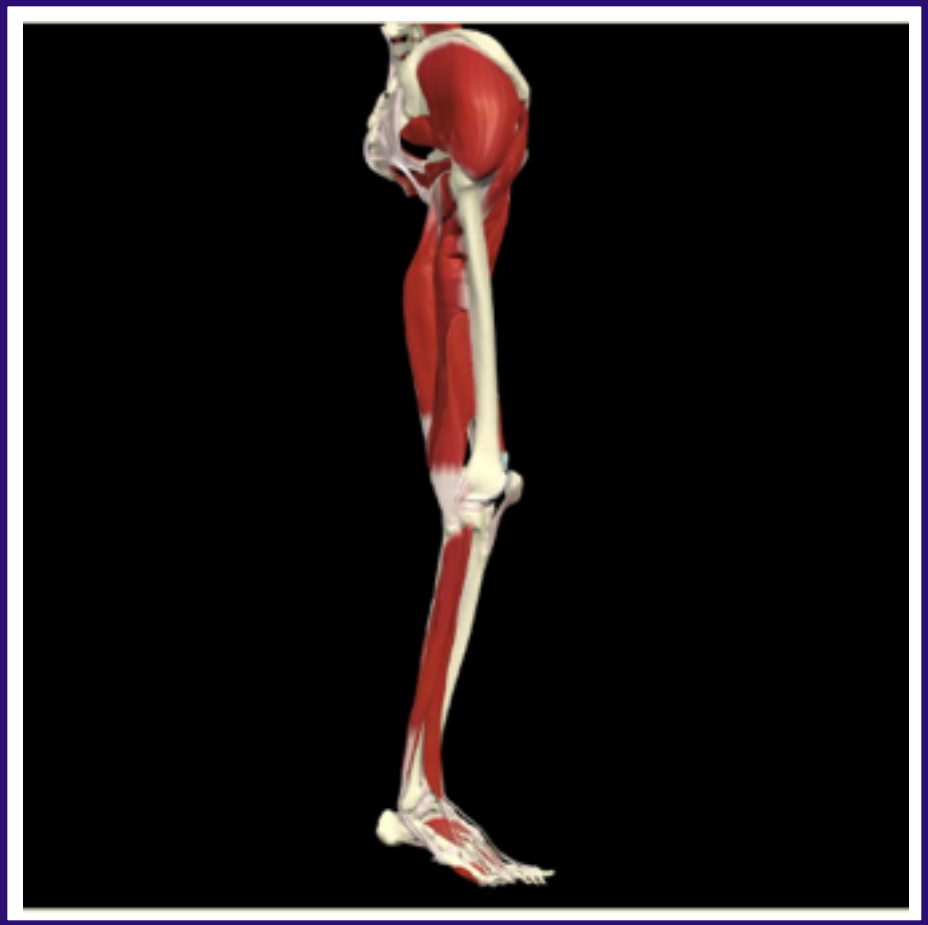
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Lower Limb model: Lateral View



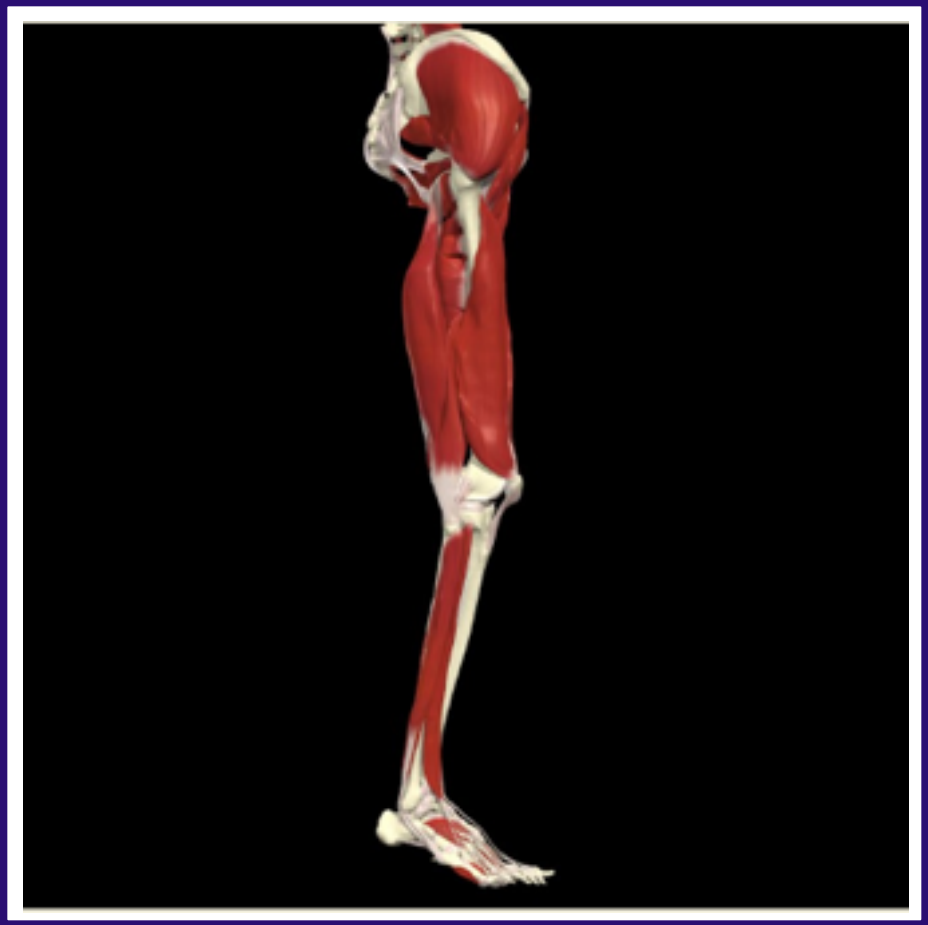
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Lower Limb model: Lateral View



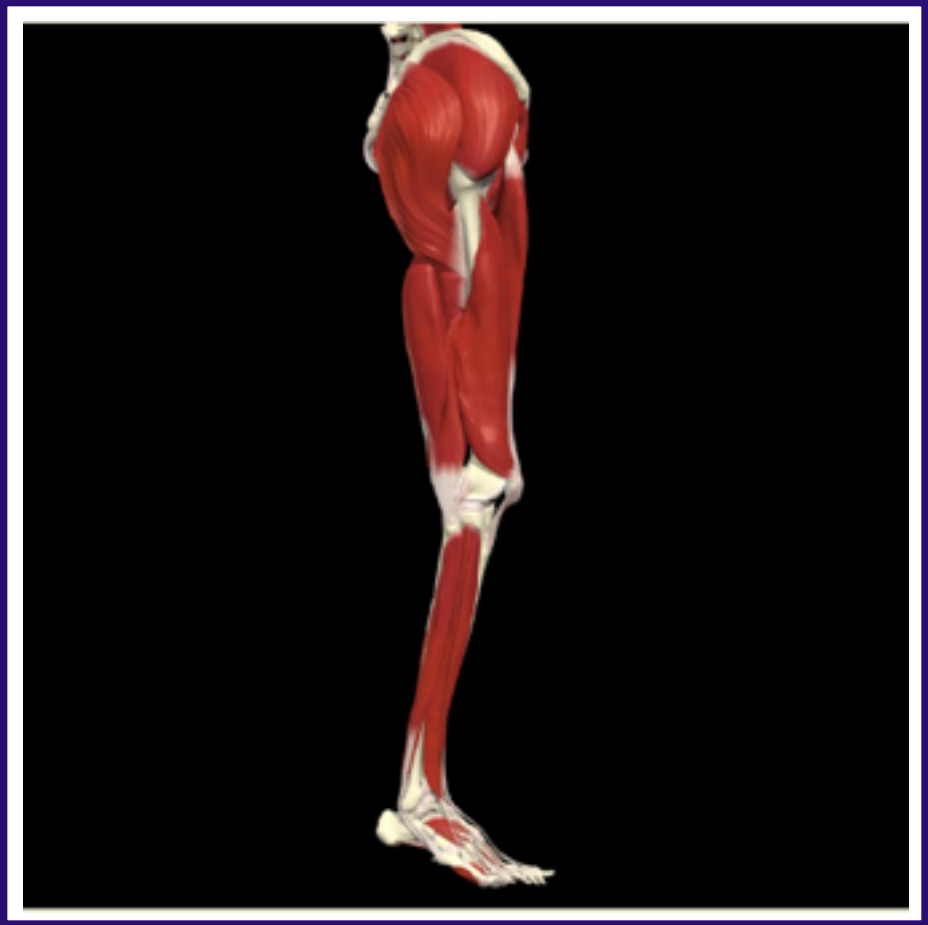
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Lower Limb model: Lateral View



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Lower Limb model: Lateral View



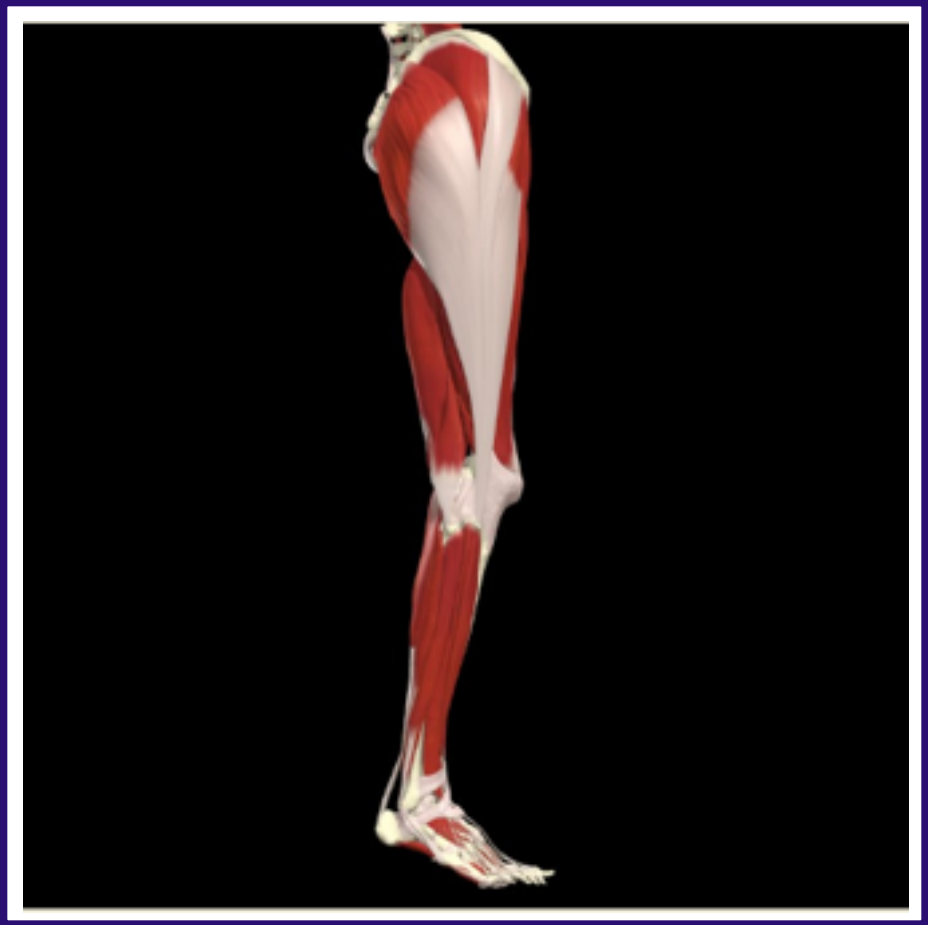
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Lower Limb model: Lateral View



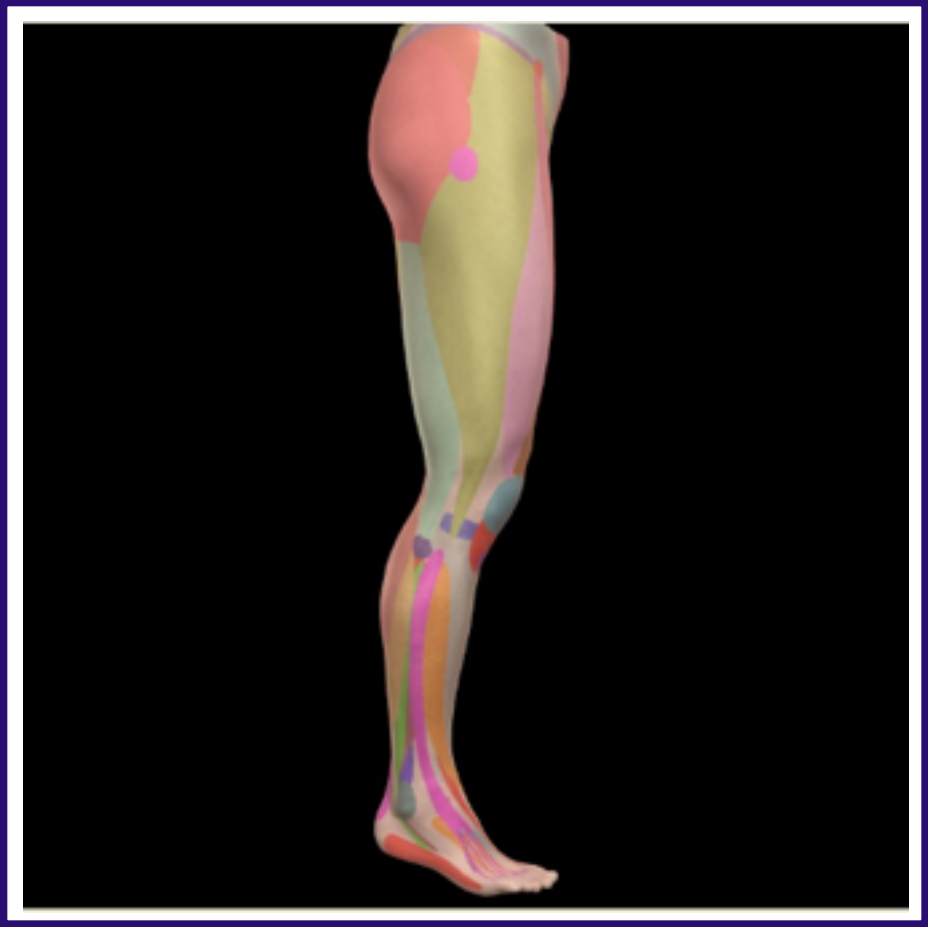
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Lower Limb model: Lateral View



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Lower Limb model: Lateral View



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Lower Limb model: Medial View



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Lower Limb model: Medial View



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Lower Limb model: Medial View



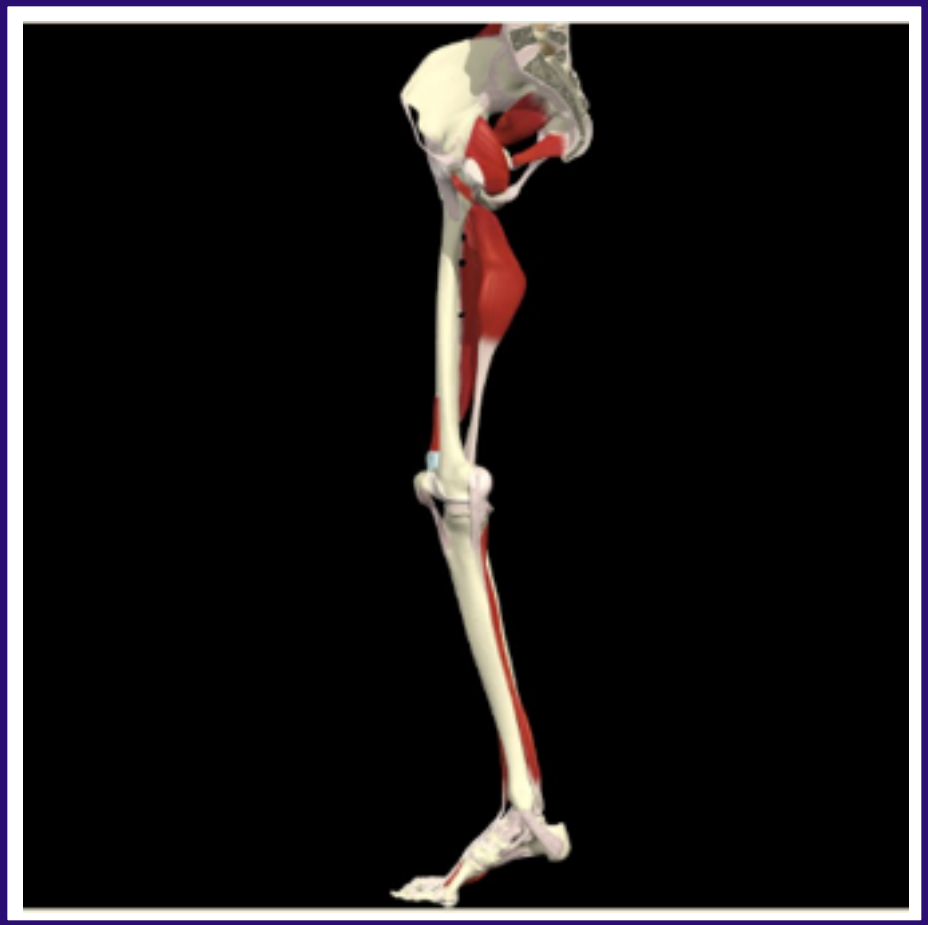
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Lower Limb model: Medial View



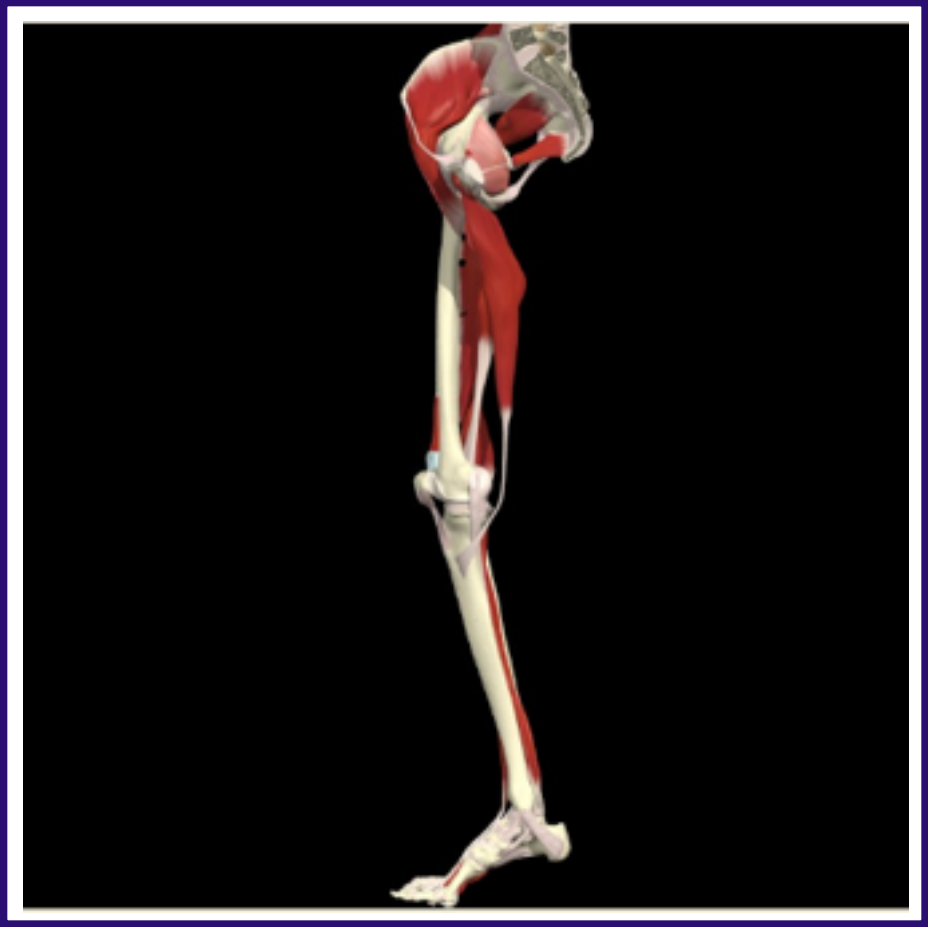
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Lower Limb model: Medial View



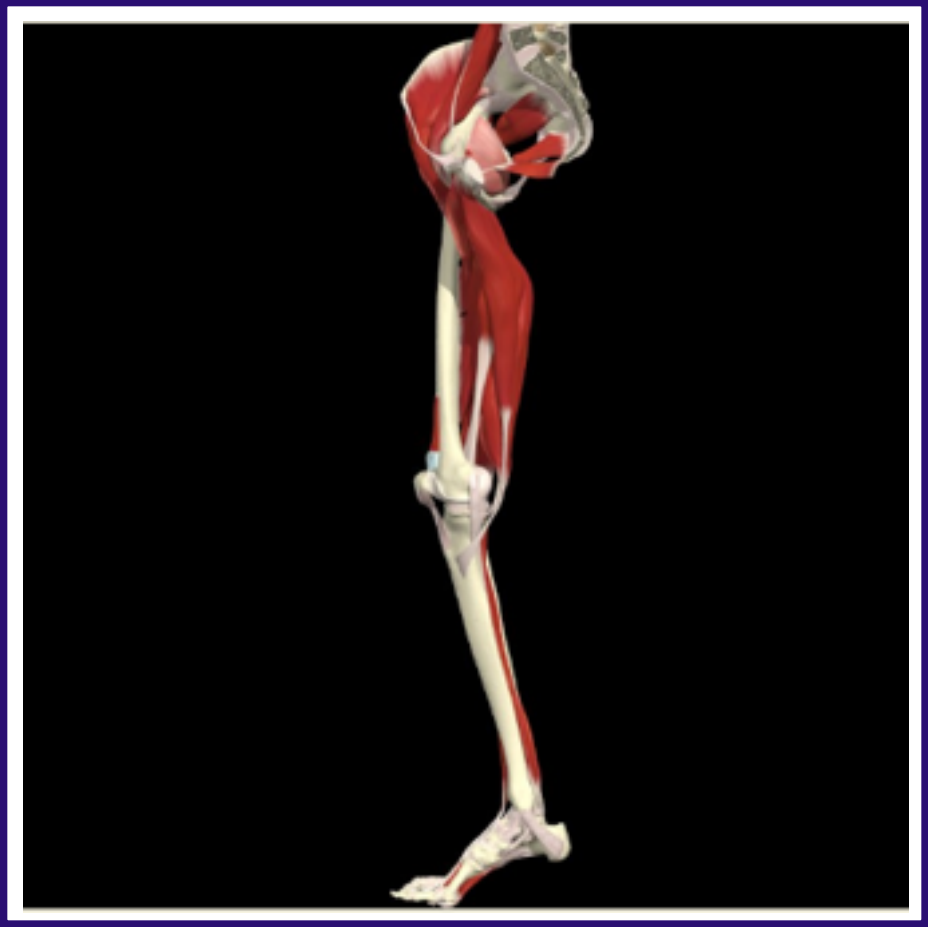
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Lower Limb model: Medial View



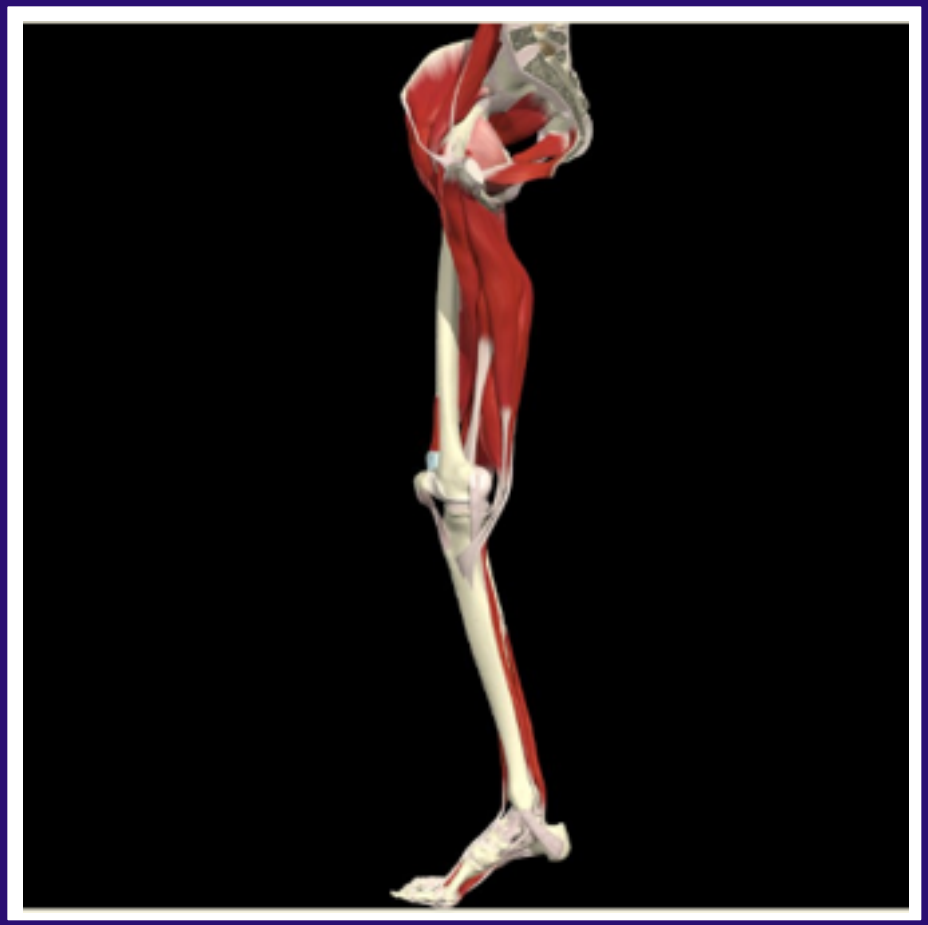
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Lower Limb model: Medial View



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Lower Limb model: Medial View



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Lower Limb model: Medial View



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Lower Limb model: Medial View



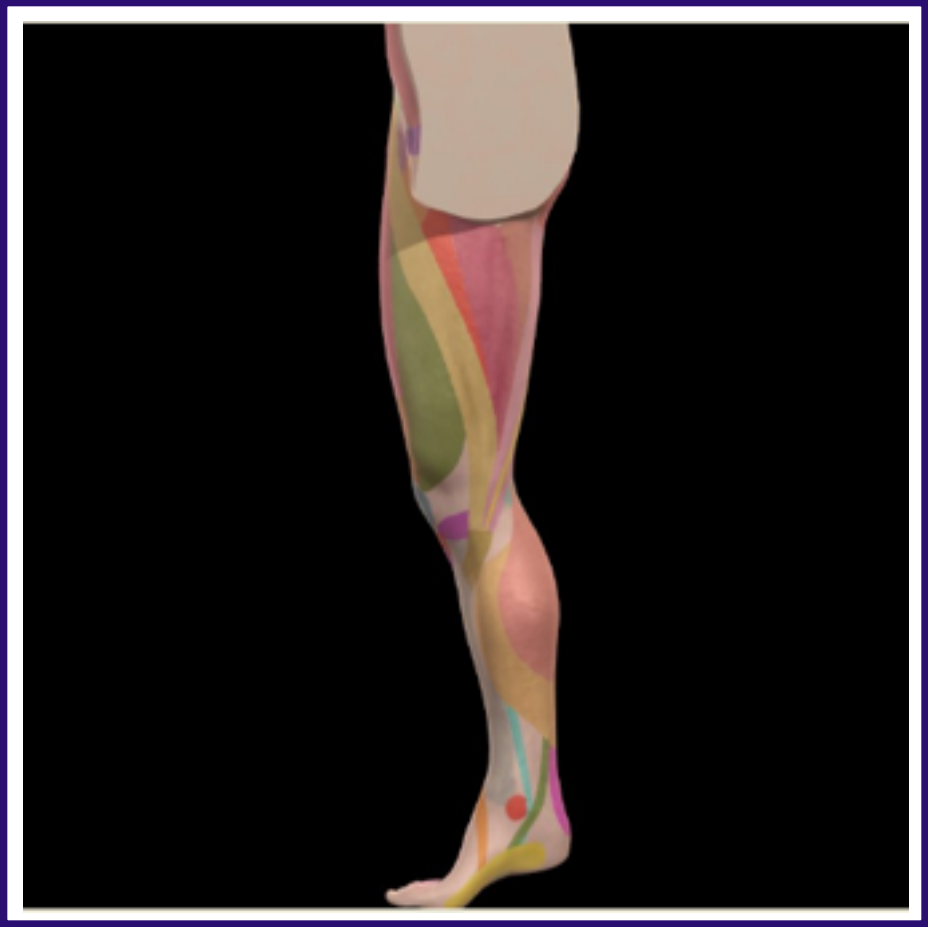
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Lower Limb model: Medial View



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Lower Limb model: Medial View



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Lower Limb model: Anterior View



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Lower Limb model: Anterior View



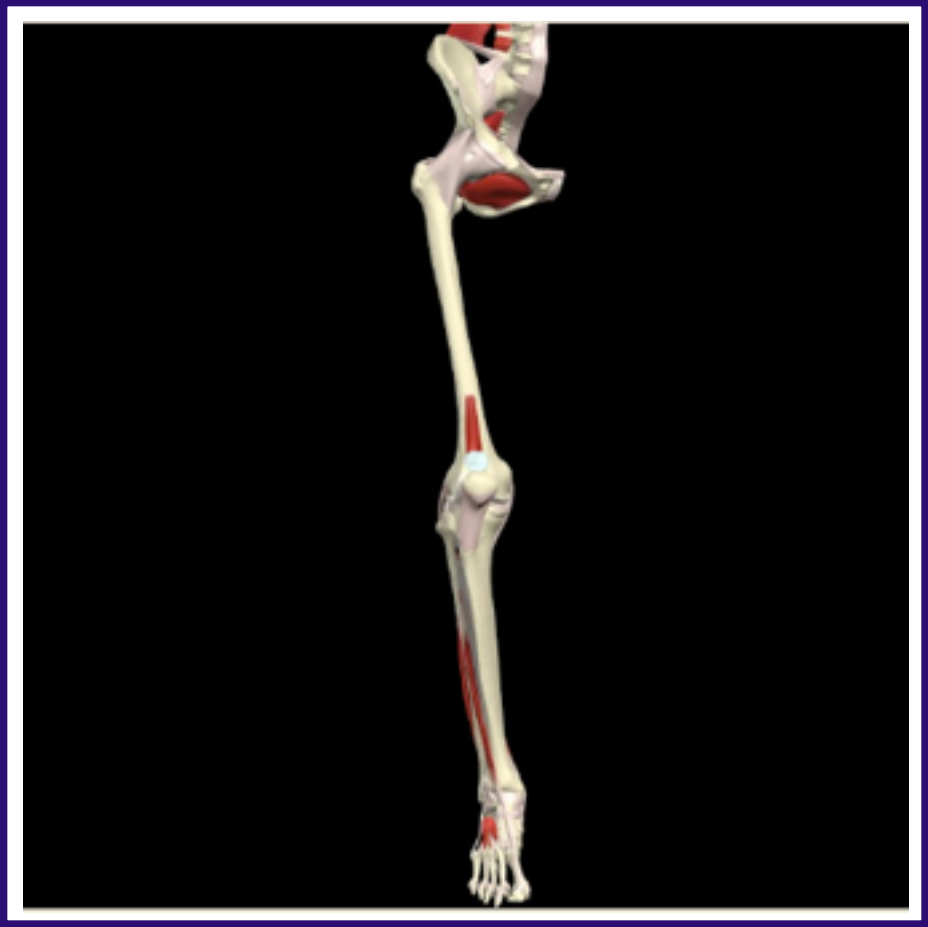
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Lower Limb model: Anterior View



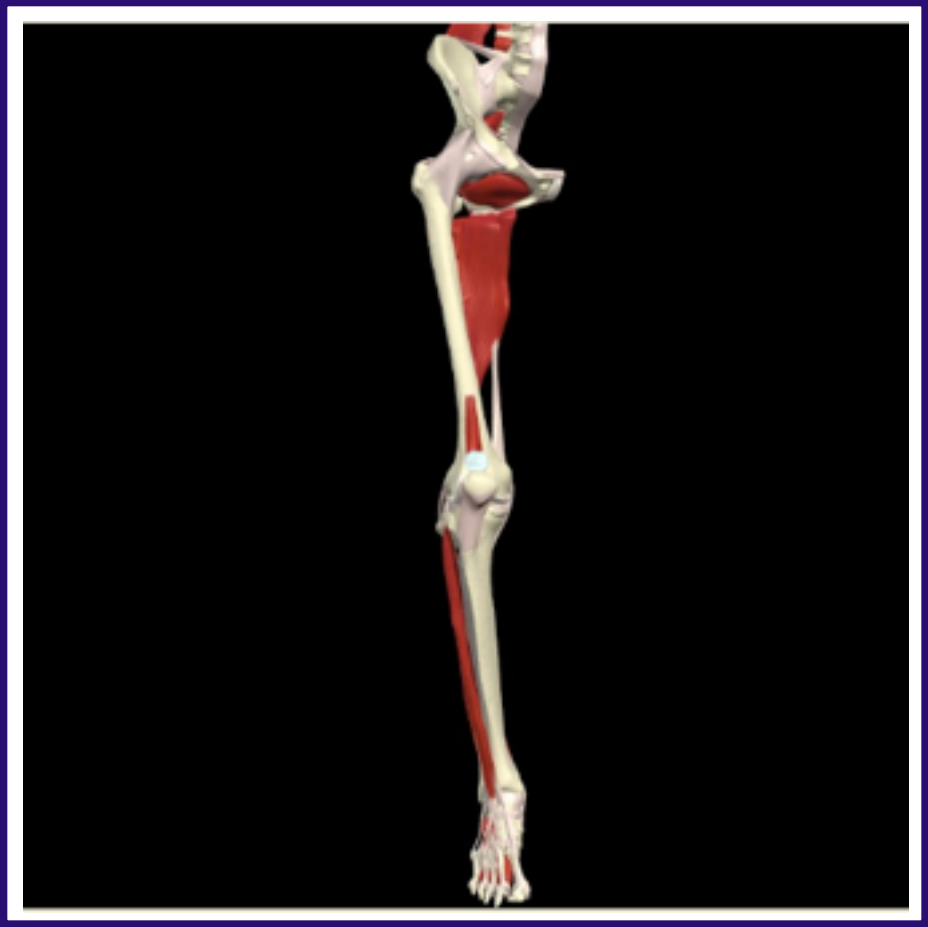
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Lower Limb model: Anterior View



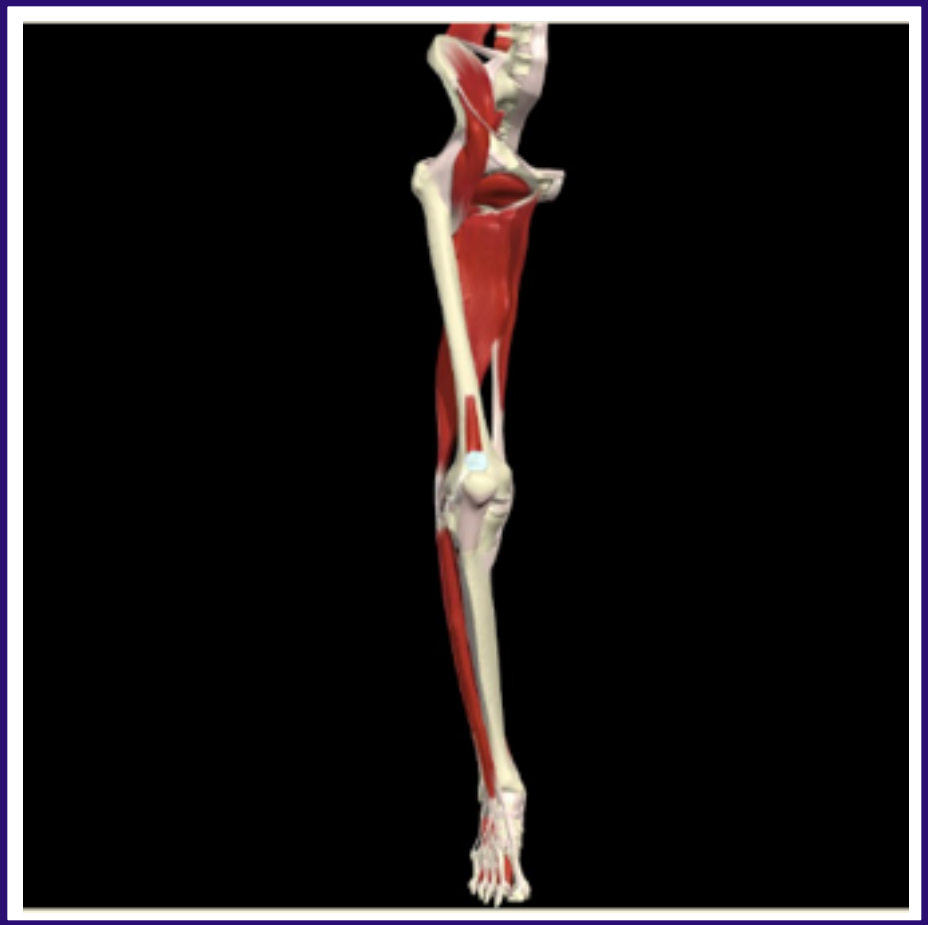
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Lower Limb model: Anterior View



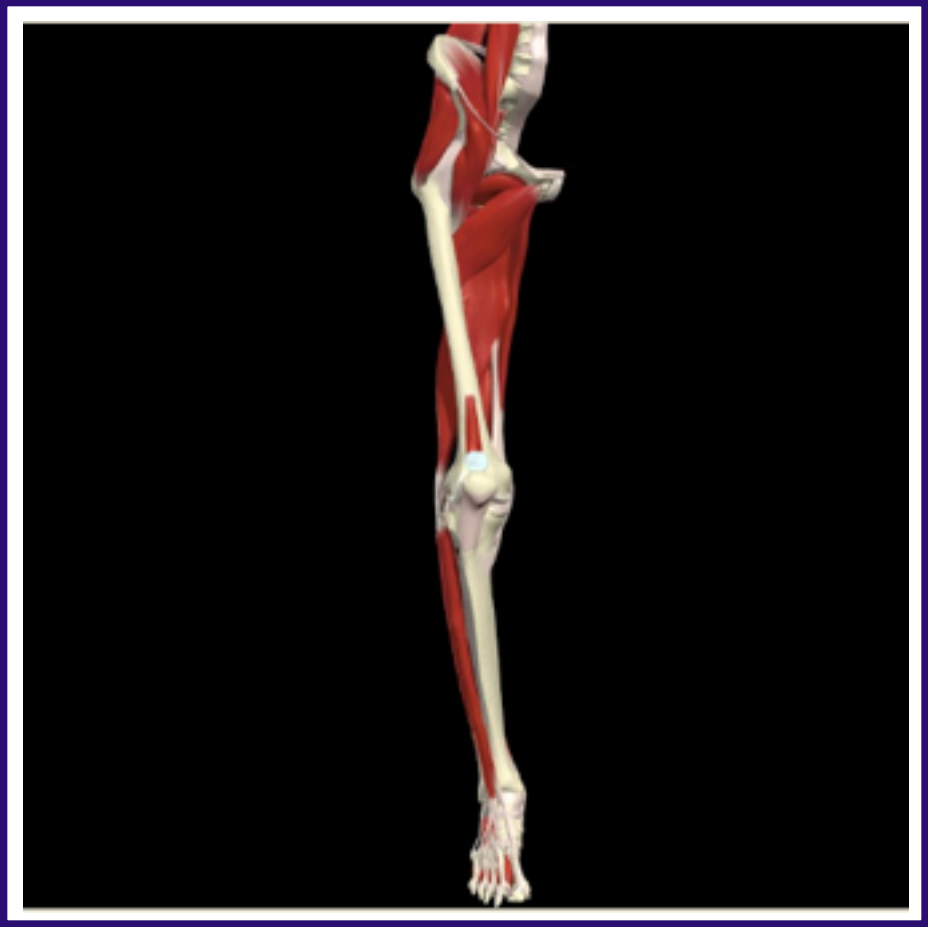
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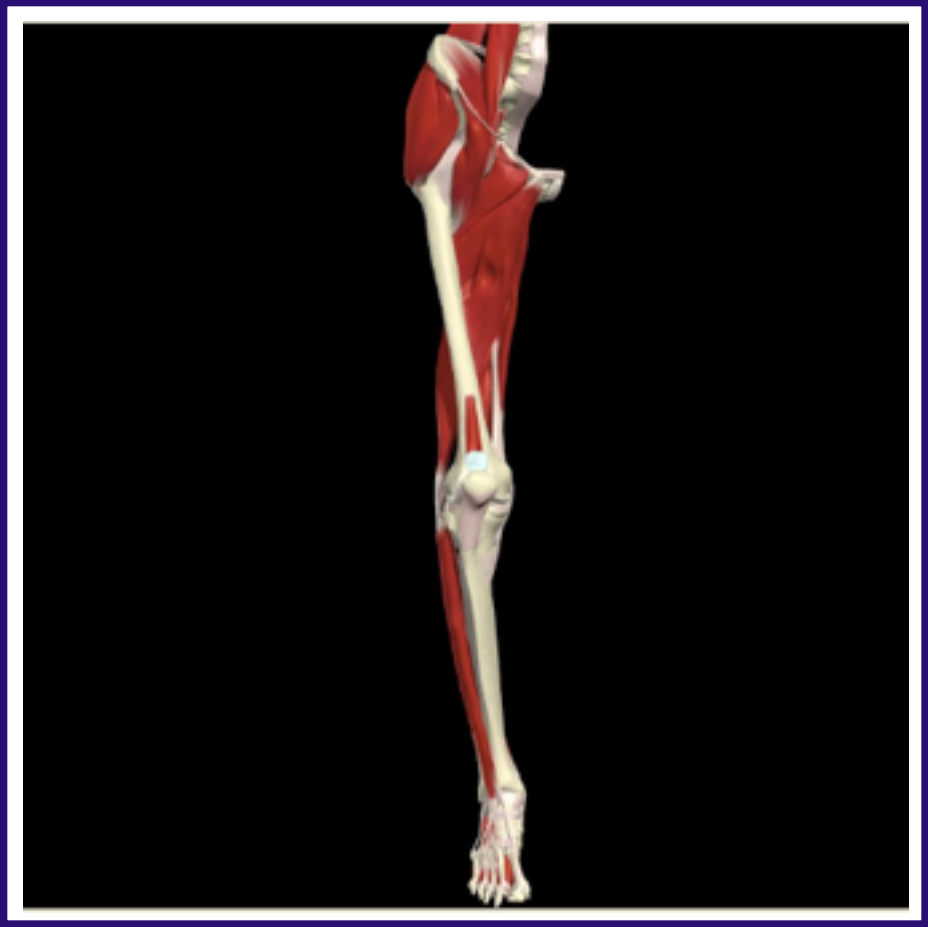
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Lower Limb model: Anterior View



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Lower Limb model: Anterior View



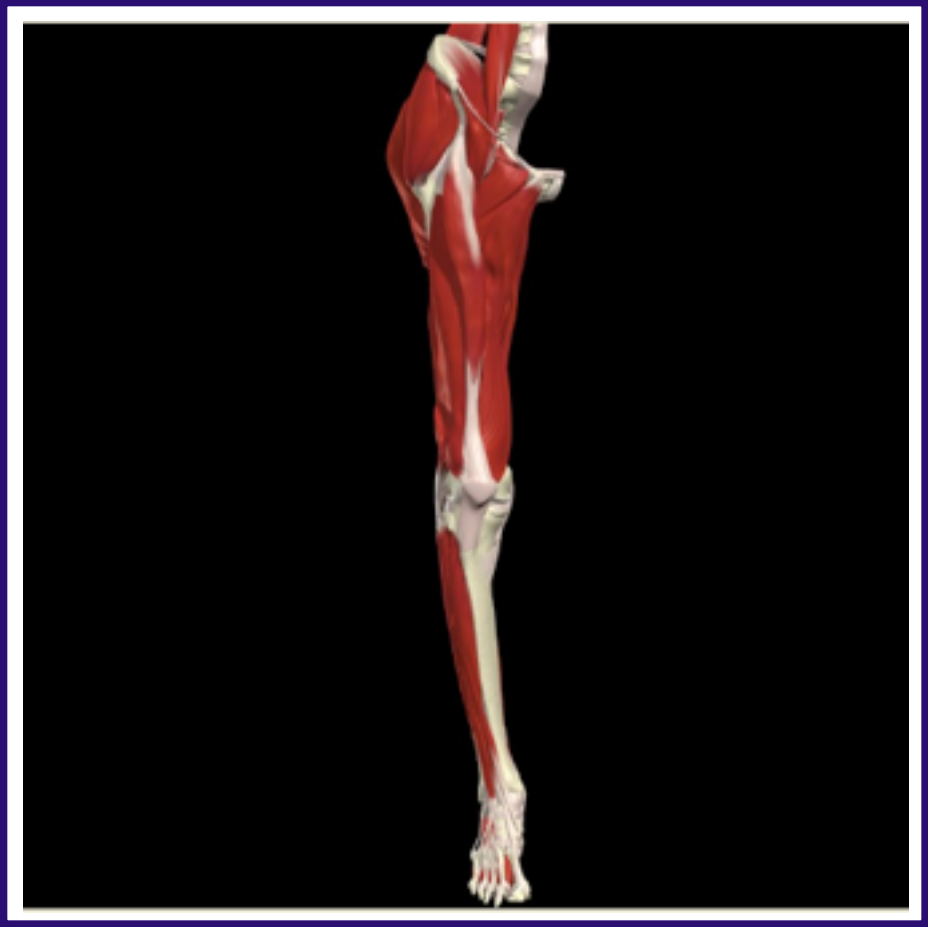
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Lower Limb model: Anterior View



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Lower Limb model: Anterior View



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Lower Limb model: Anterior View



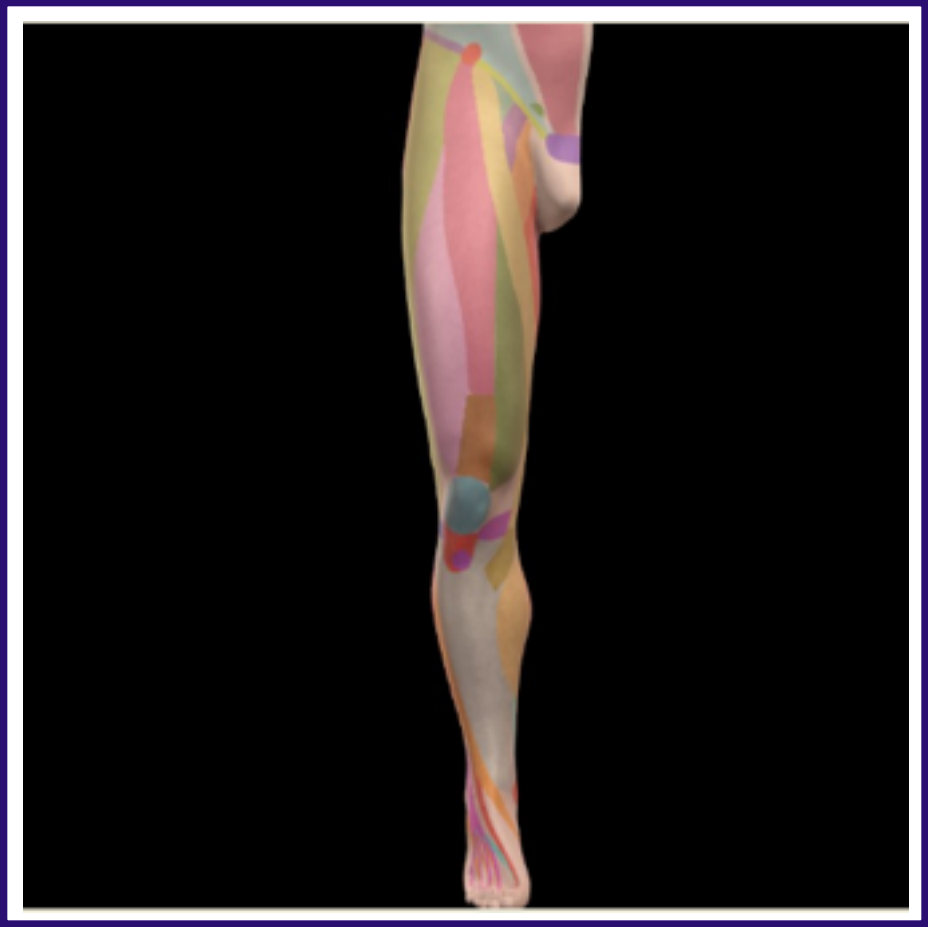
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Lower Limb model: Anterior View



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Lower Limb model: Anterior View



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Lower Limb model: Posterior View



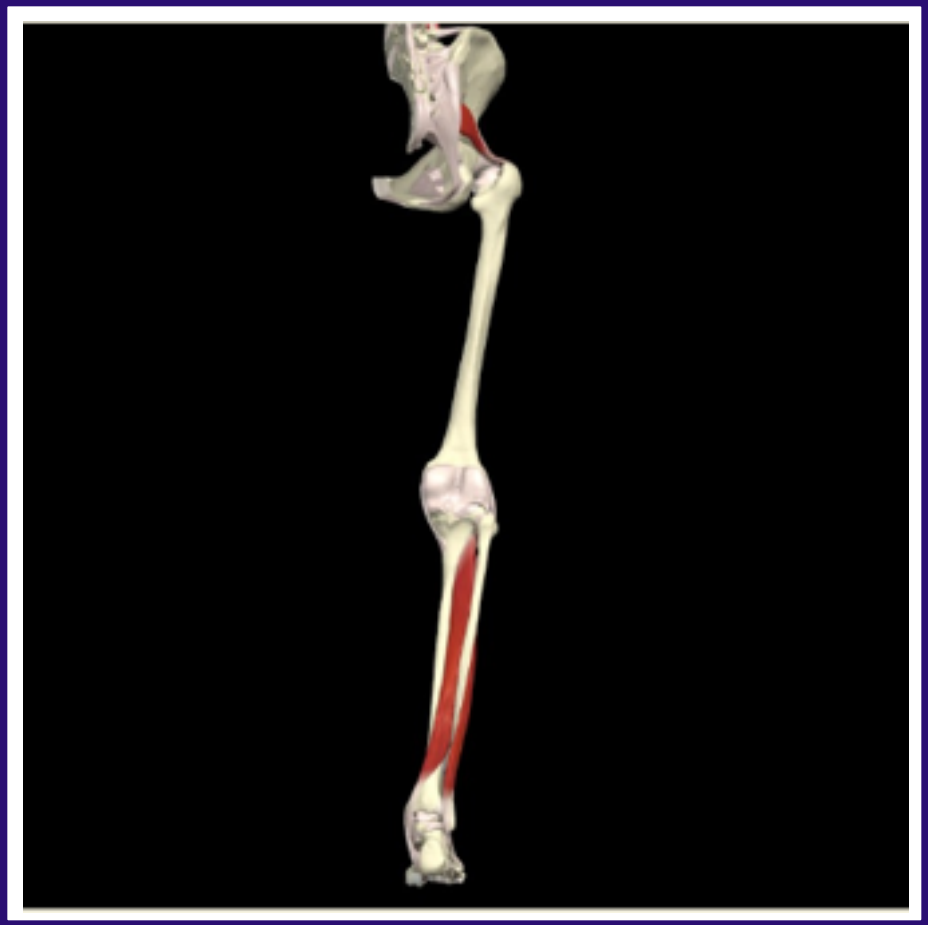
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Lower Limb model: Posterior View



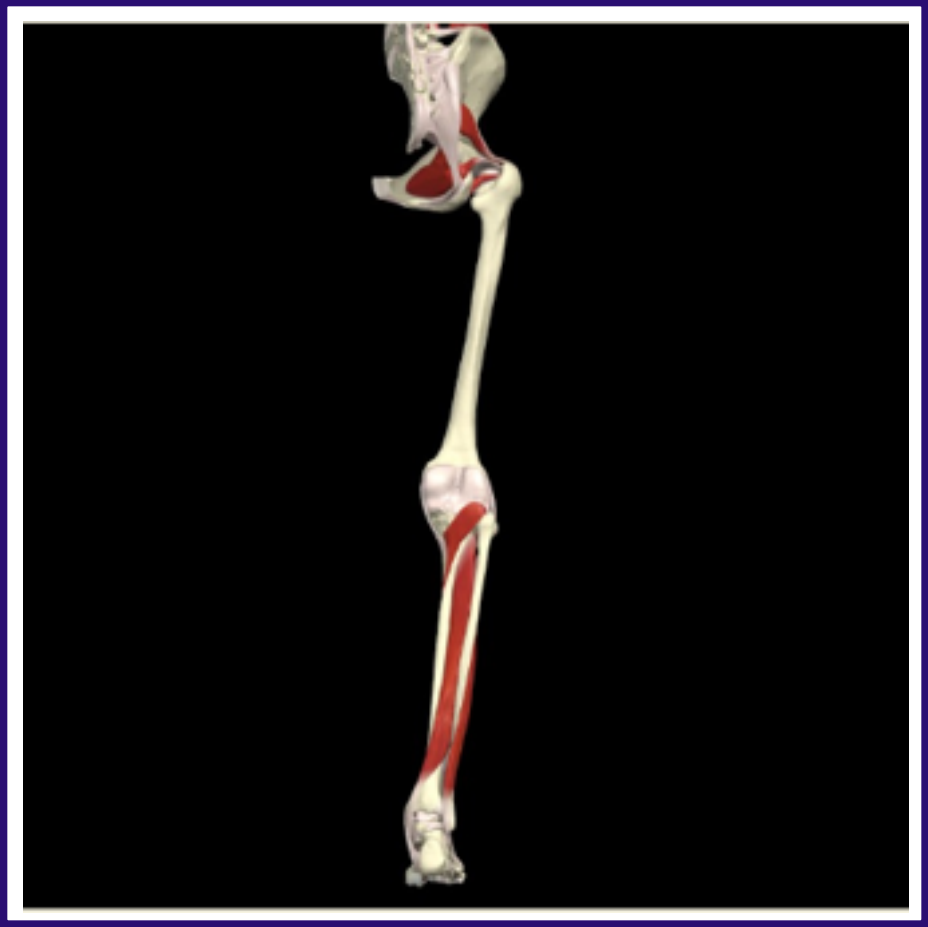
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Lower Limb model: Posterior View



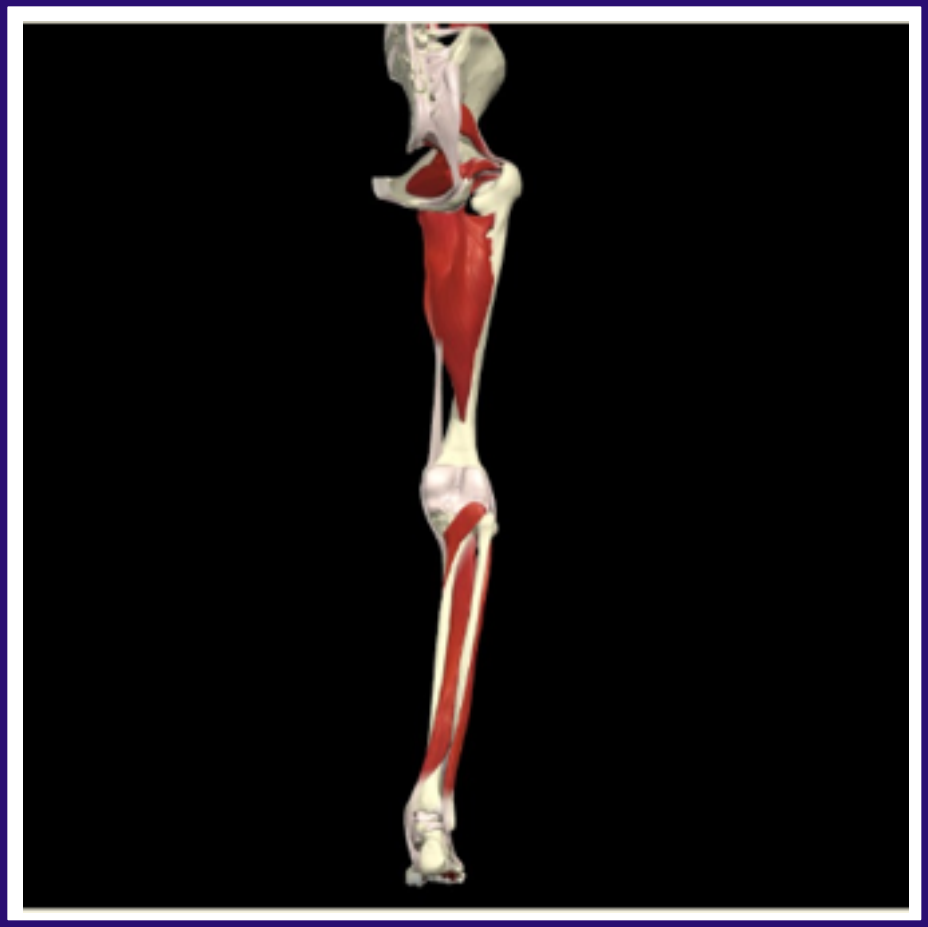
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Lower Limb model: Posterior View



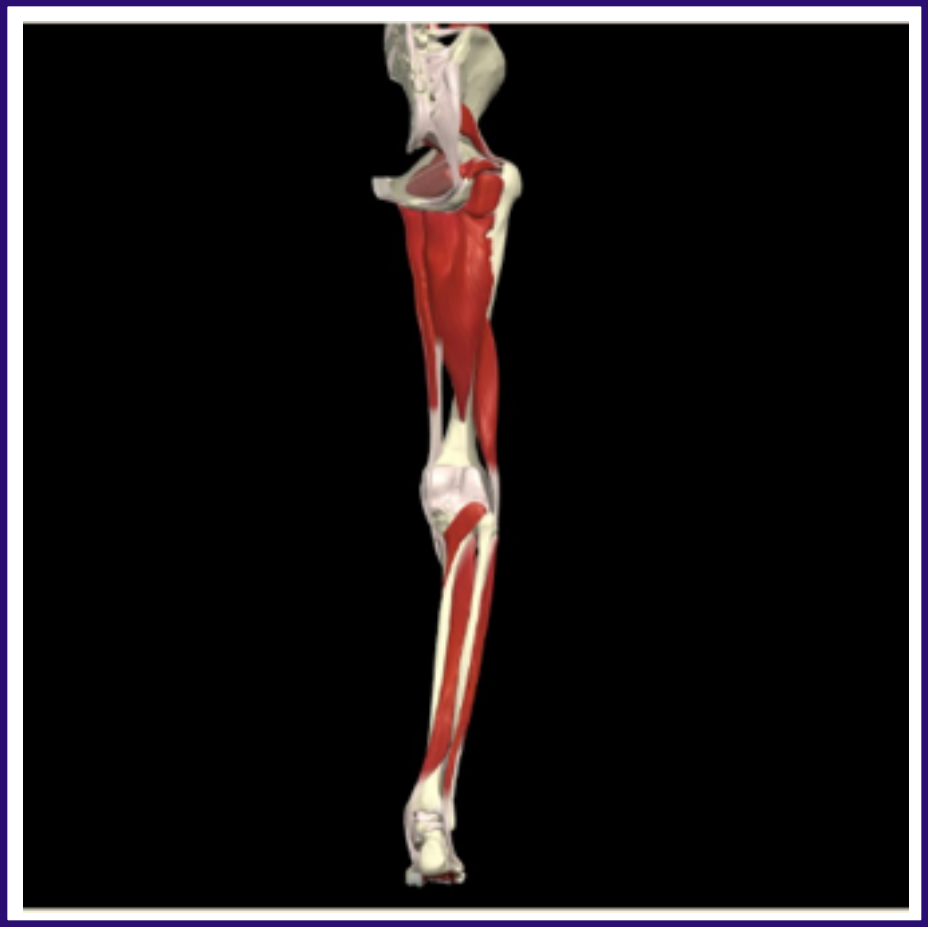
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Lower Limb model: Posterior View



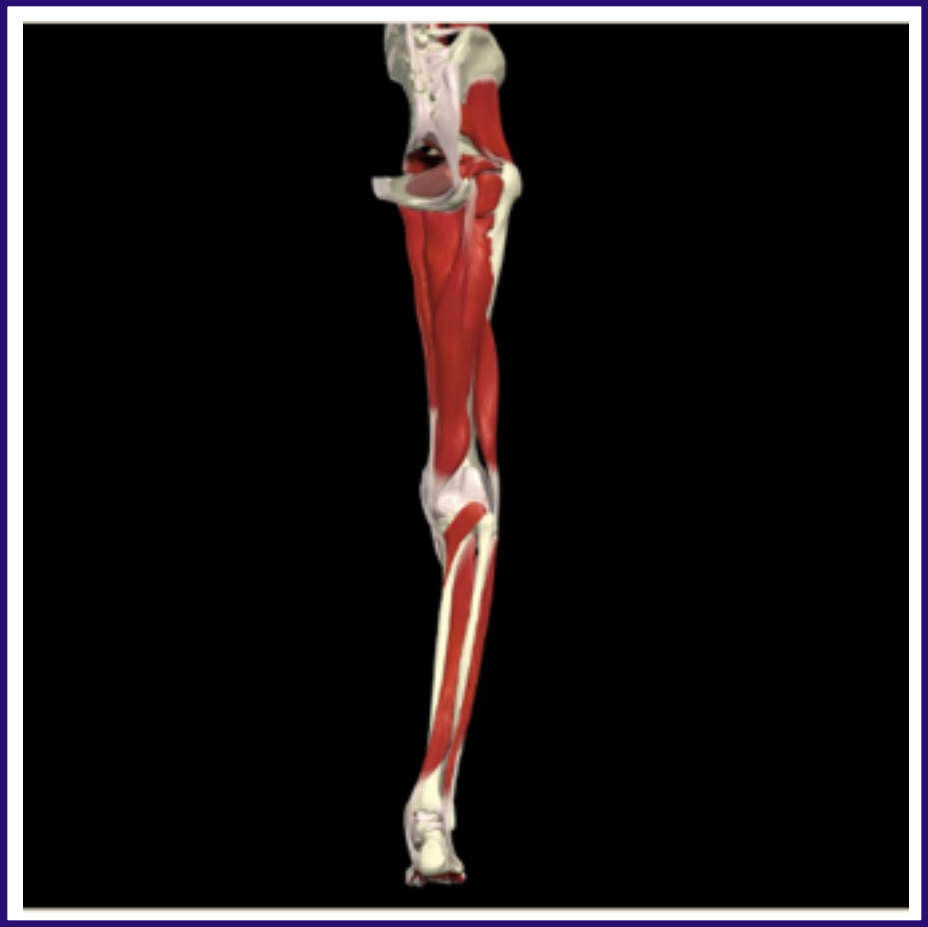
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Lower Limb model: Posterior View



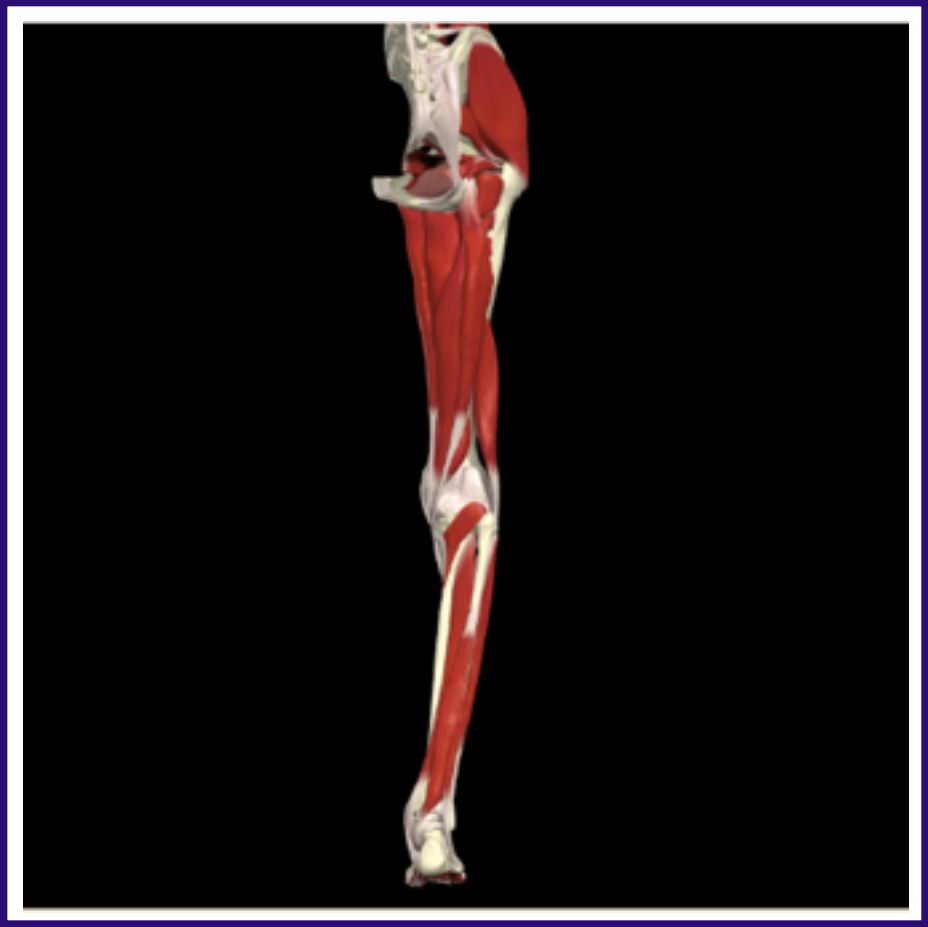
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Lower Limb model: Posterior View



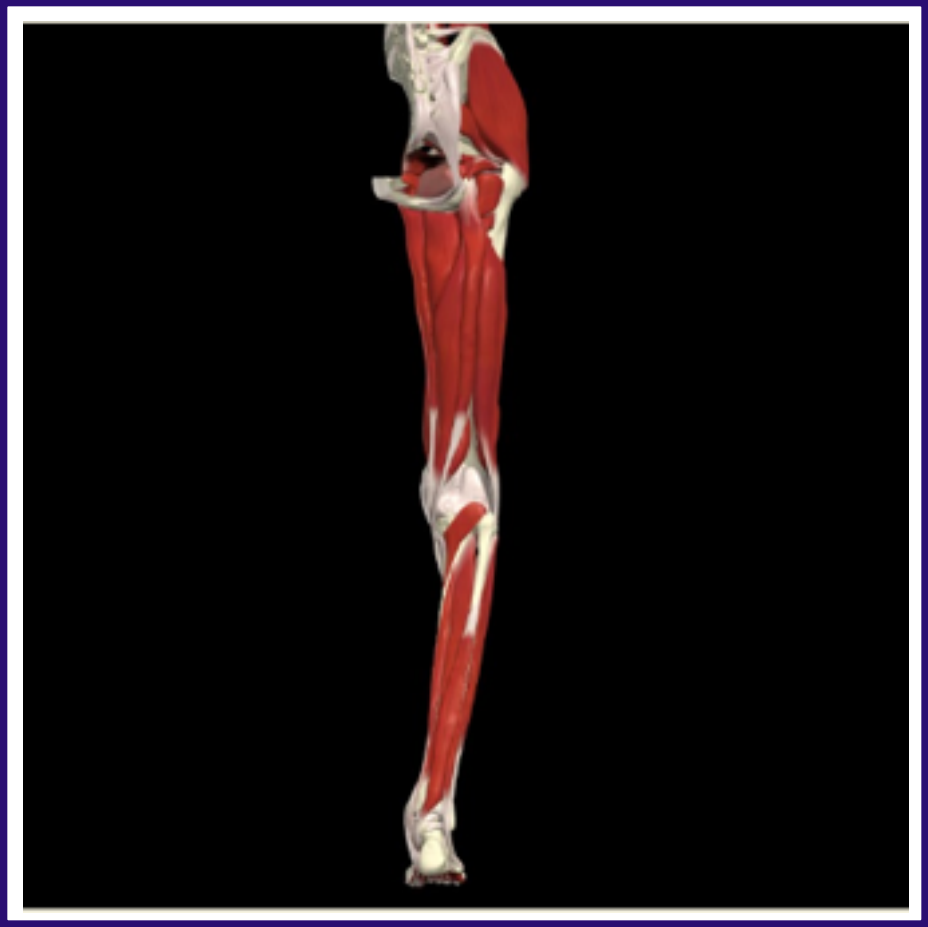
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Lower Limb model: Posterior View



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Lower Limb model: Posterior View



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Lower Limb model: Posterior View



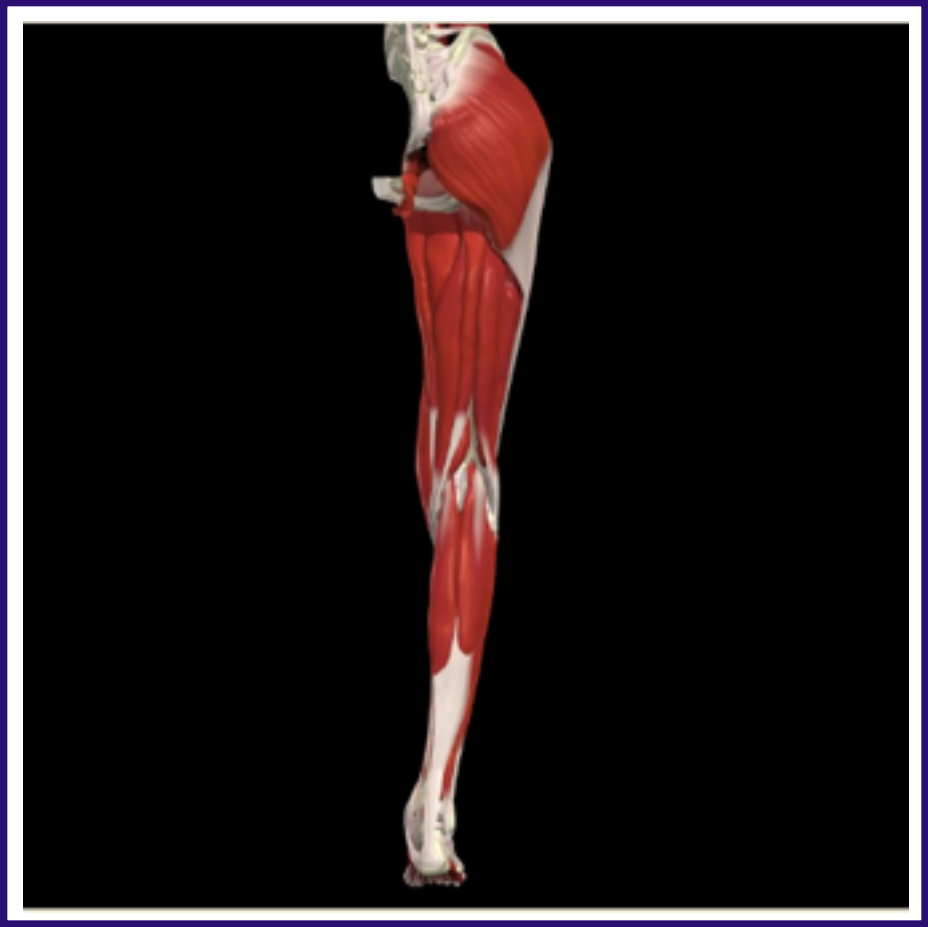
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Lower Limb model: Posterior View



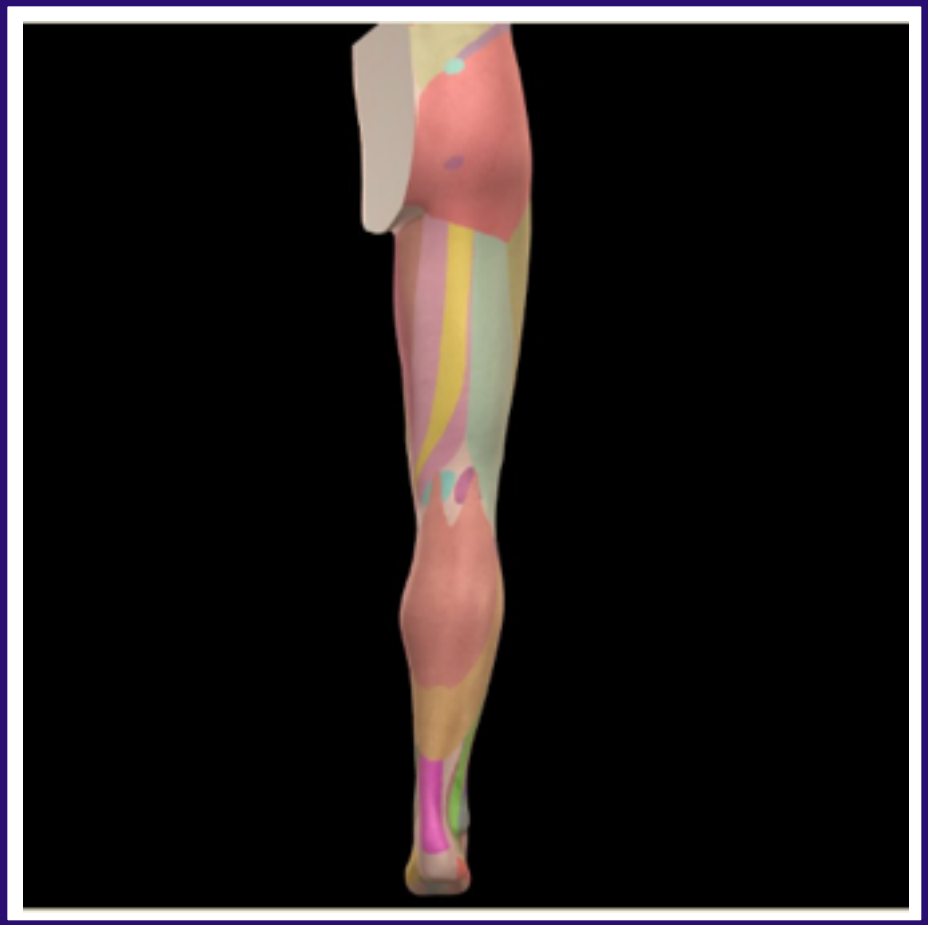
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Lower Limb model: Posterior View



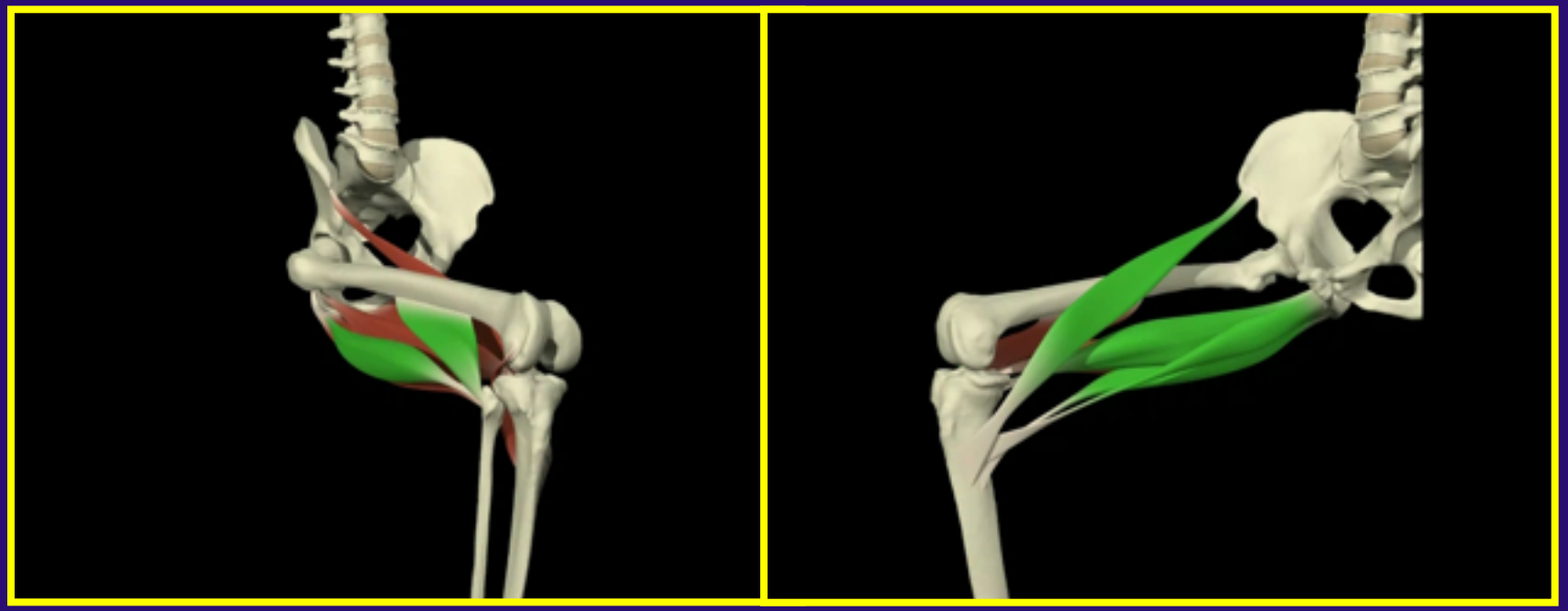
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Lower Limb model: Posterior View



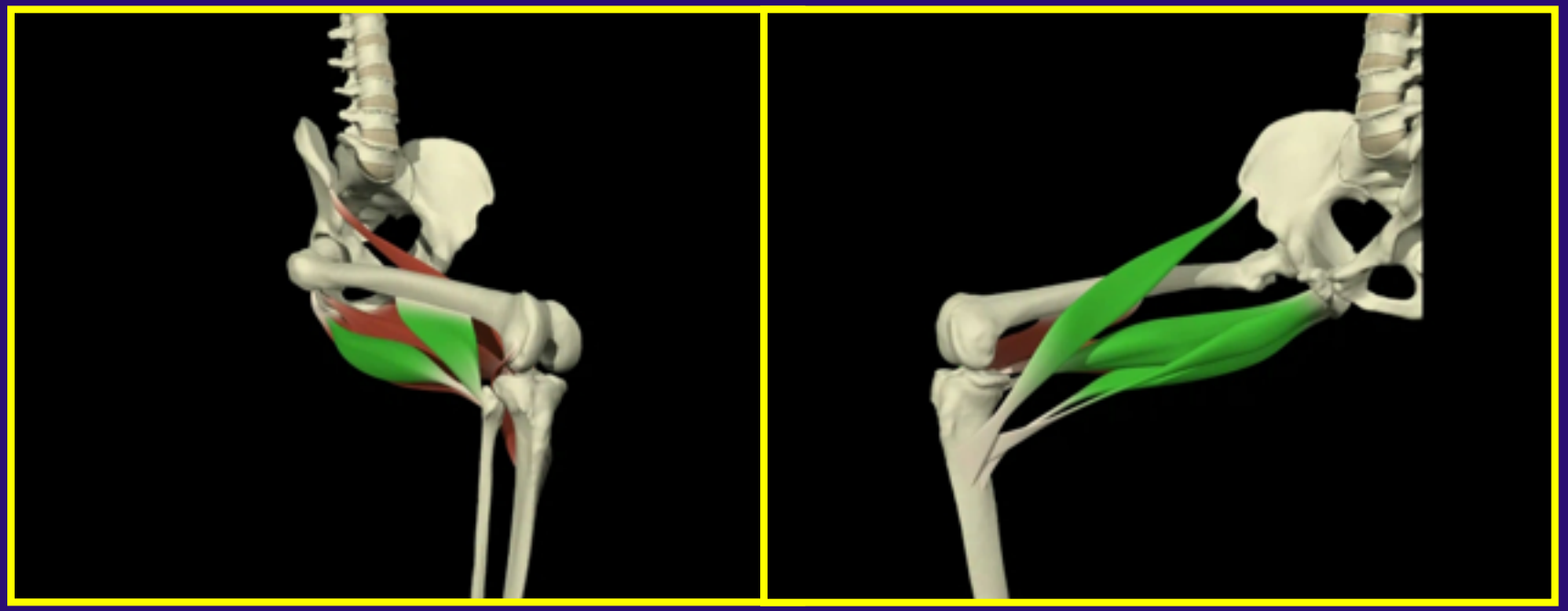
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Internal/External Rotation of Knee



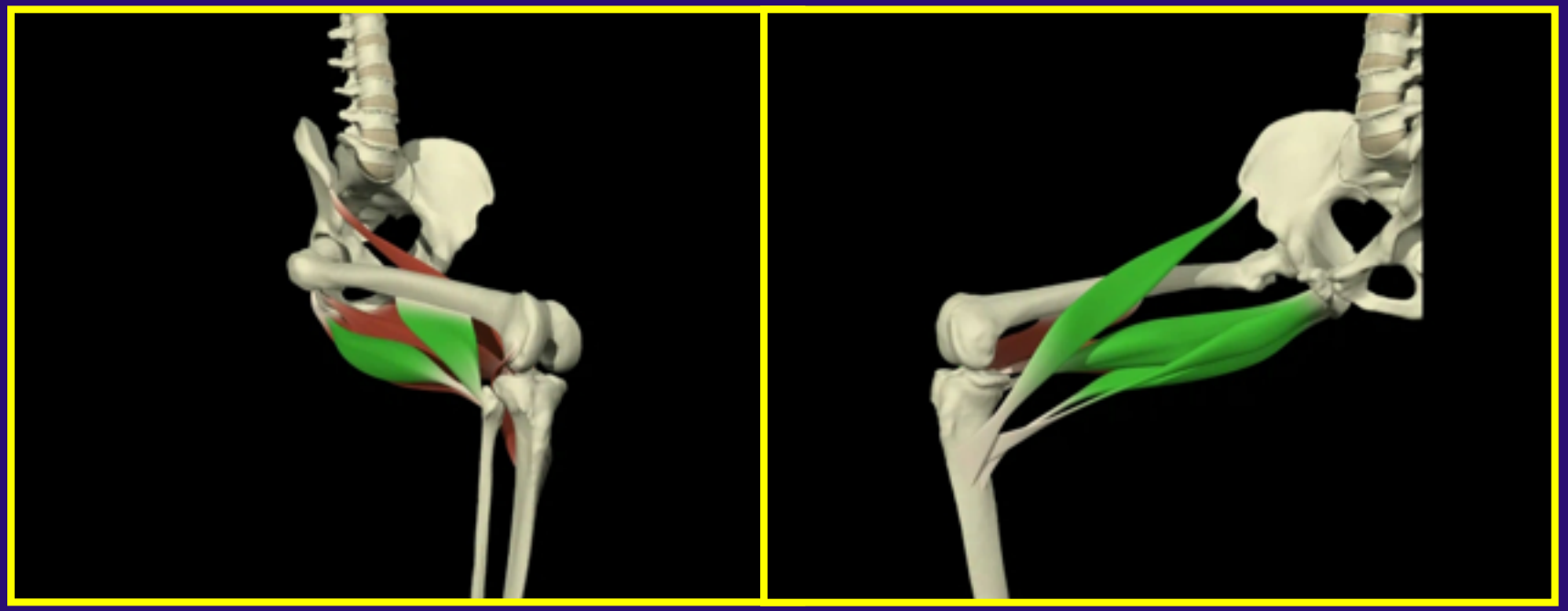
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Internal/External Rotation of Knee



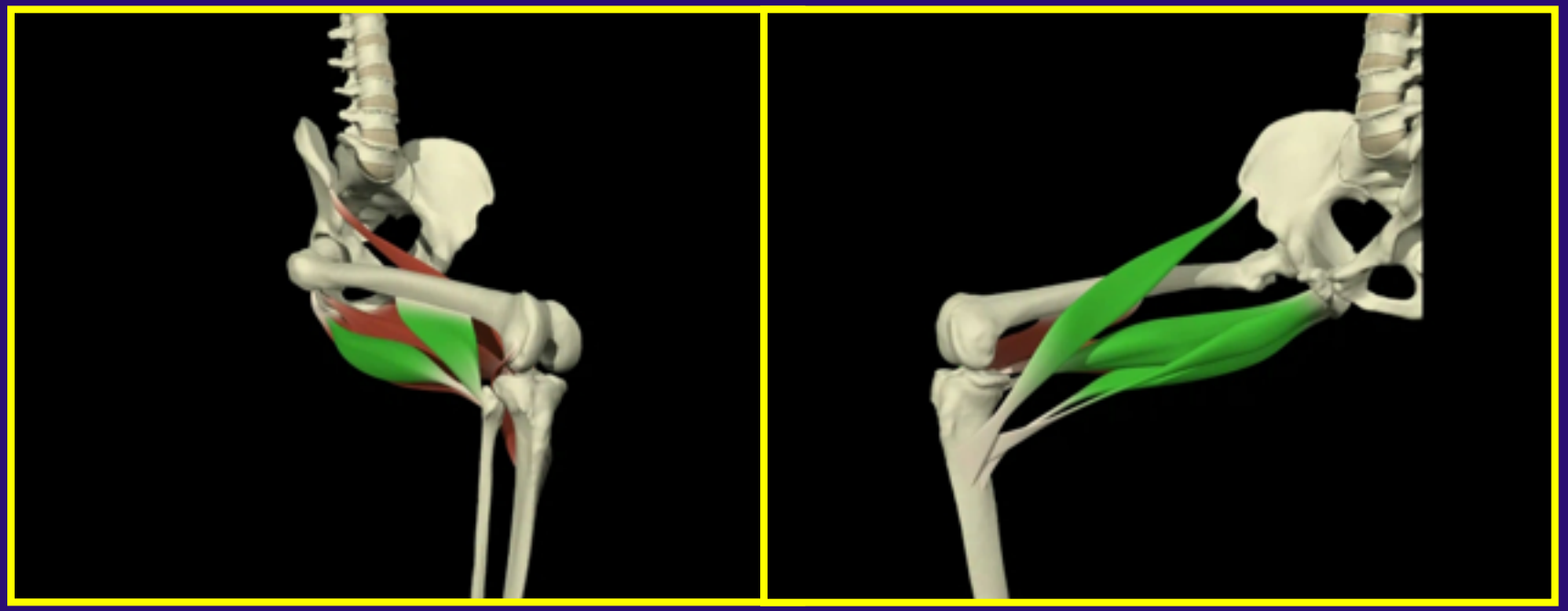
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Internal/External Rotation of Knee



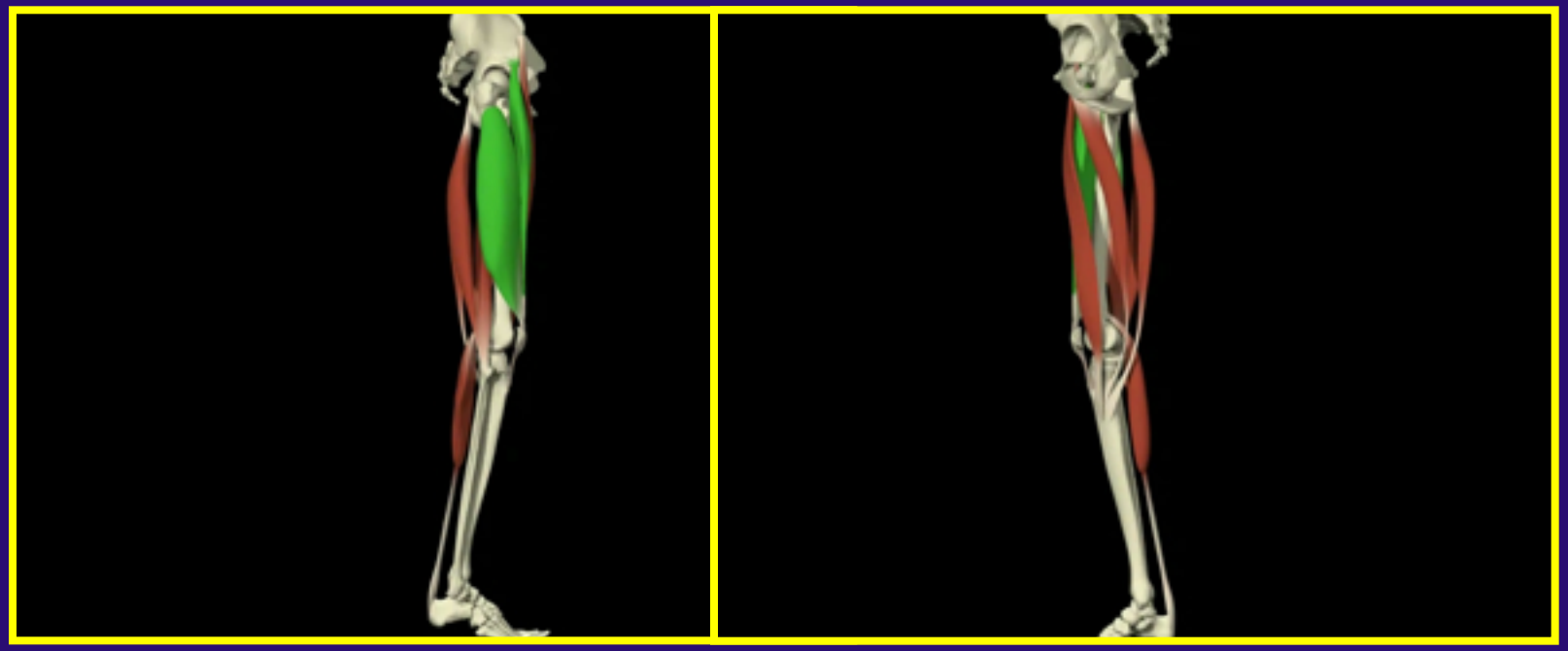
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Internal/External Rotation of Knee



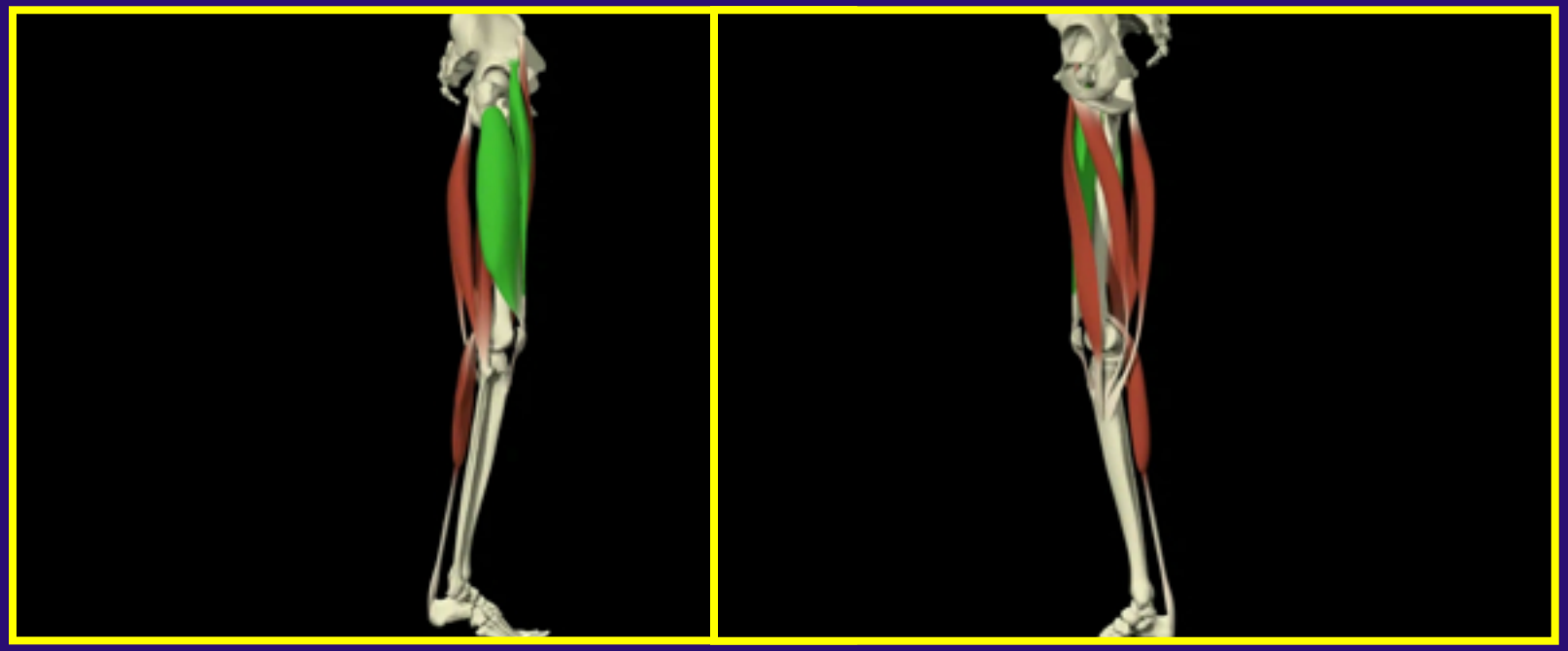
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Flexion/Extension of Knee



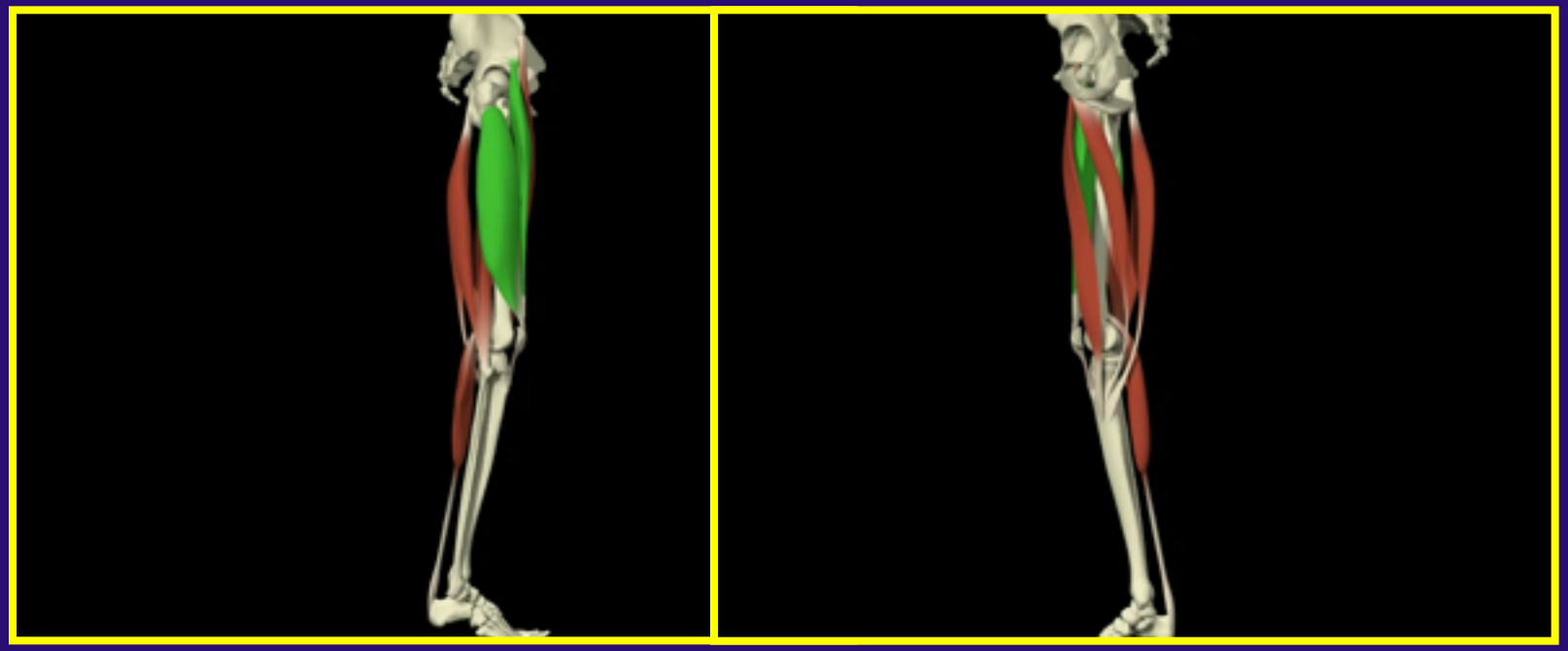
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Flexion/Extension of Knee



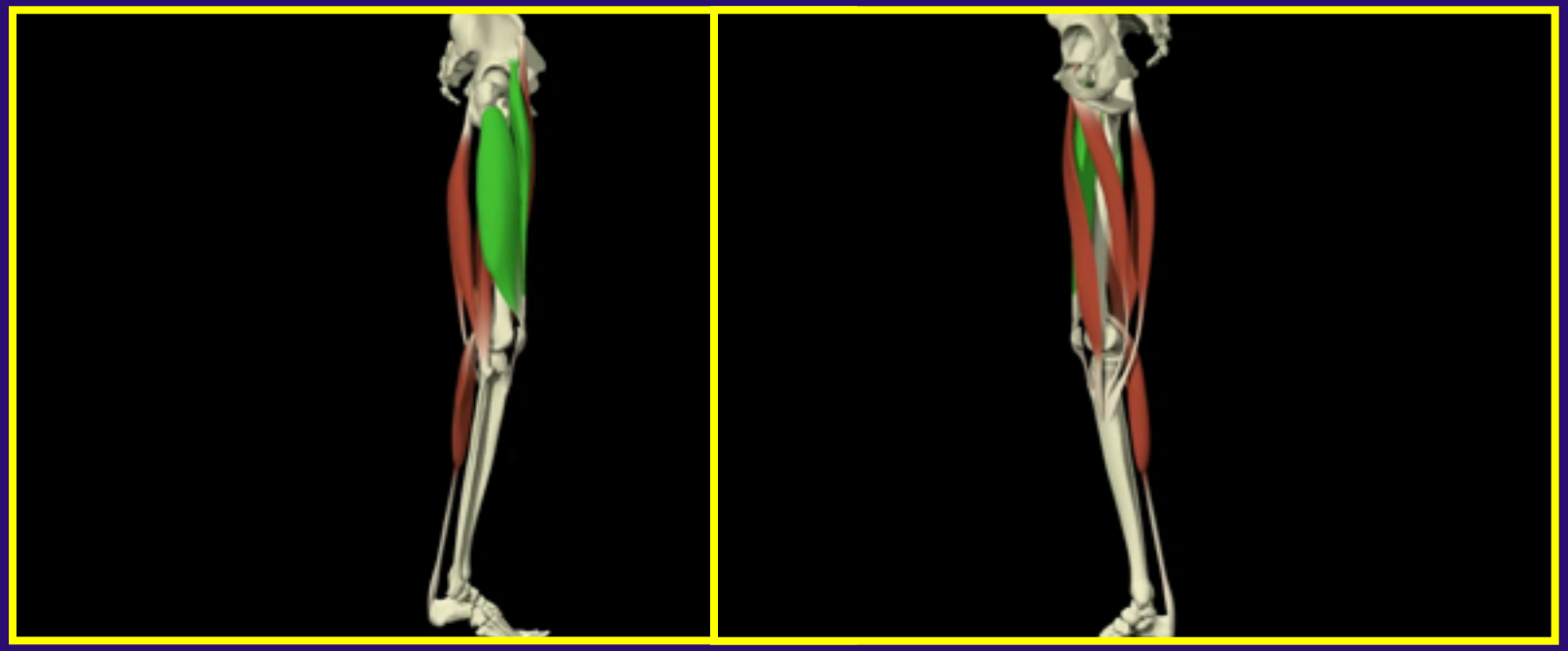
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Flexion/Extension of Knee



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Flexion/Extension of Knee



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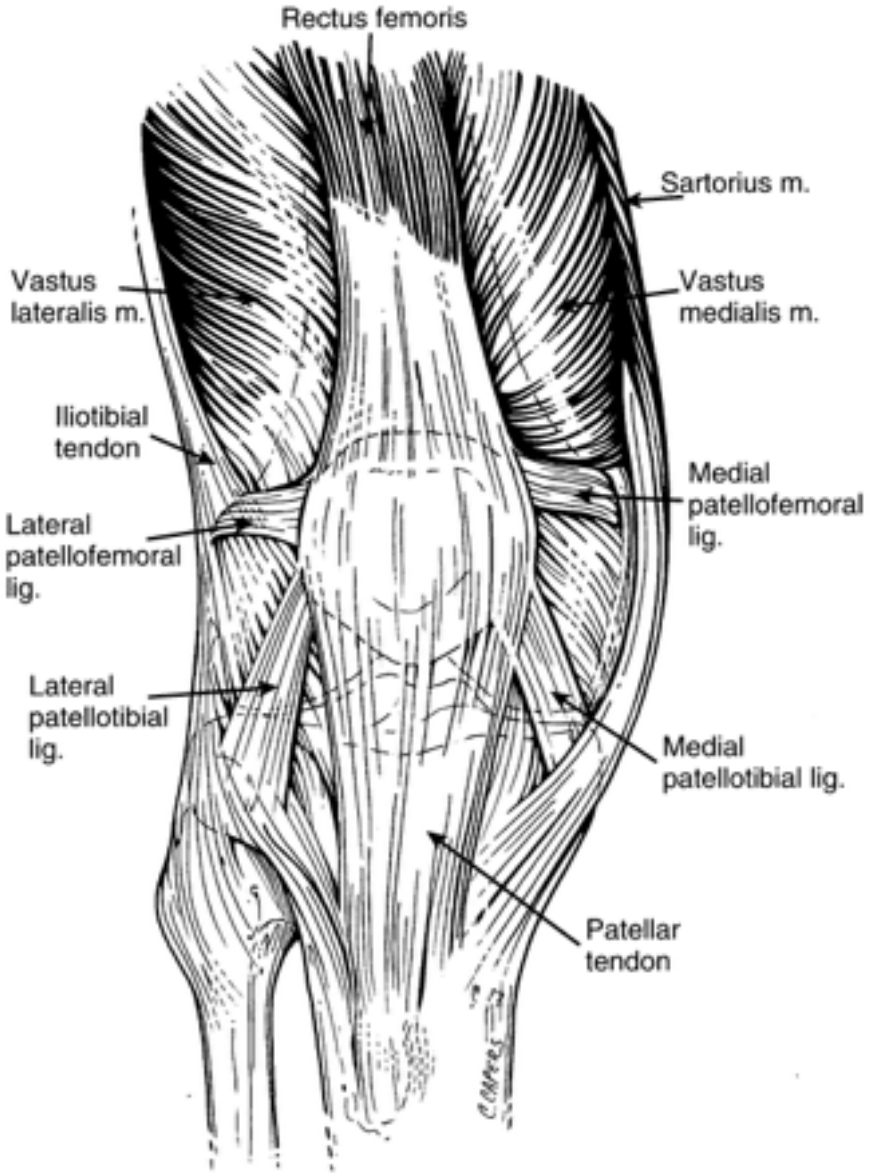
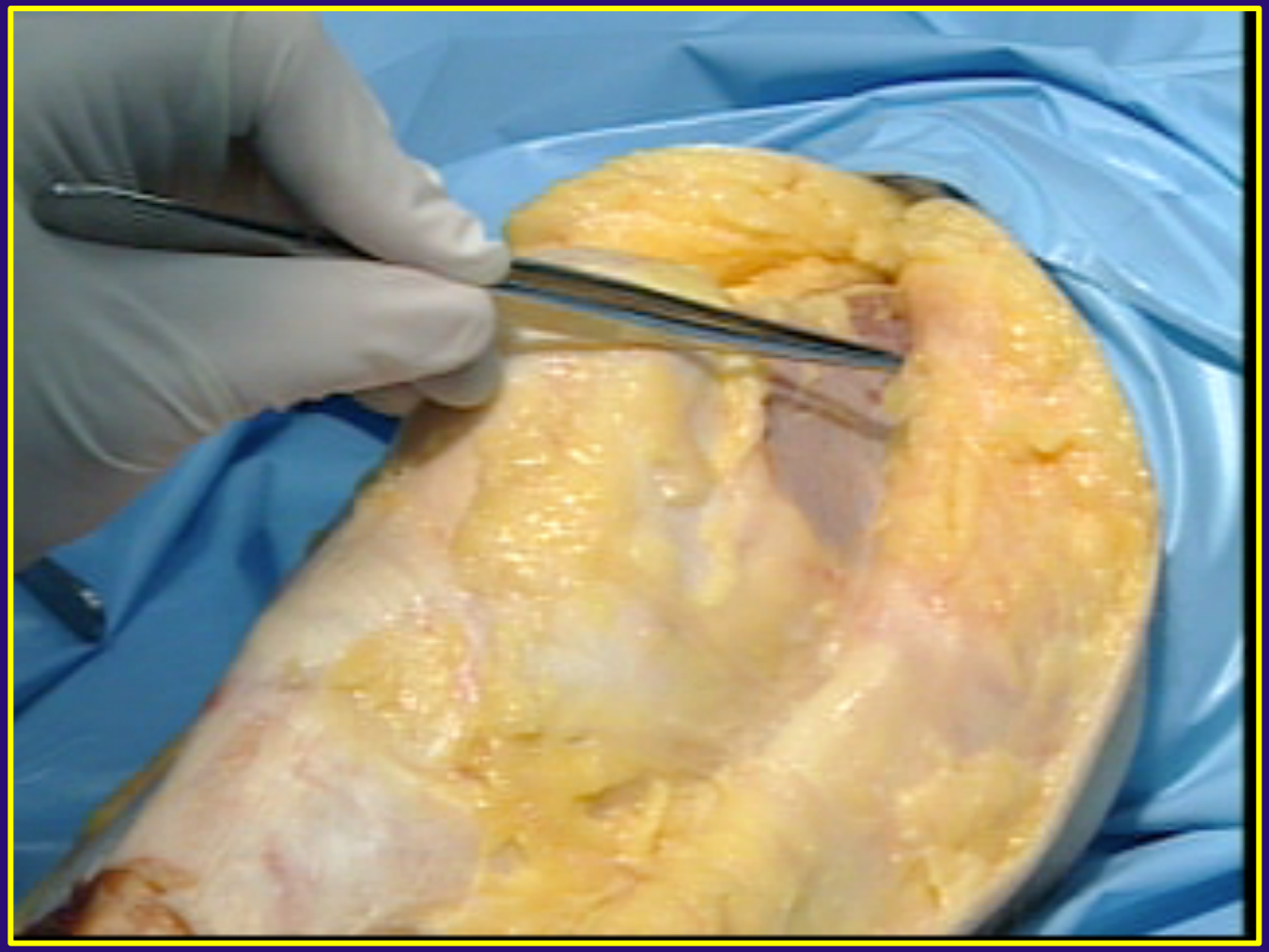
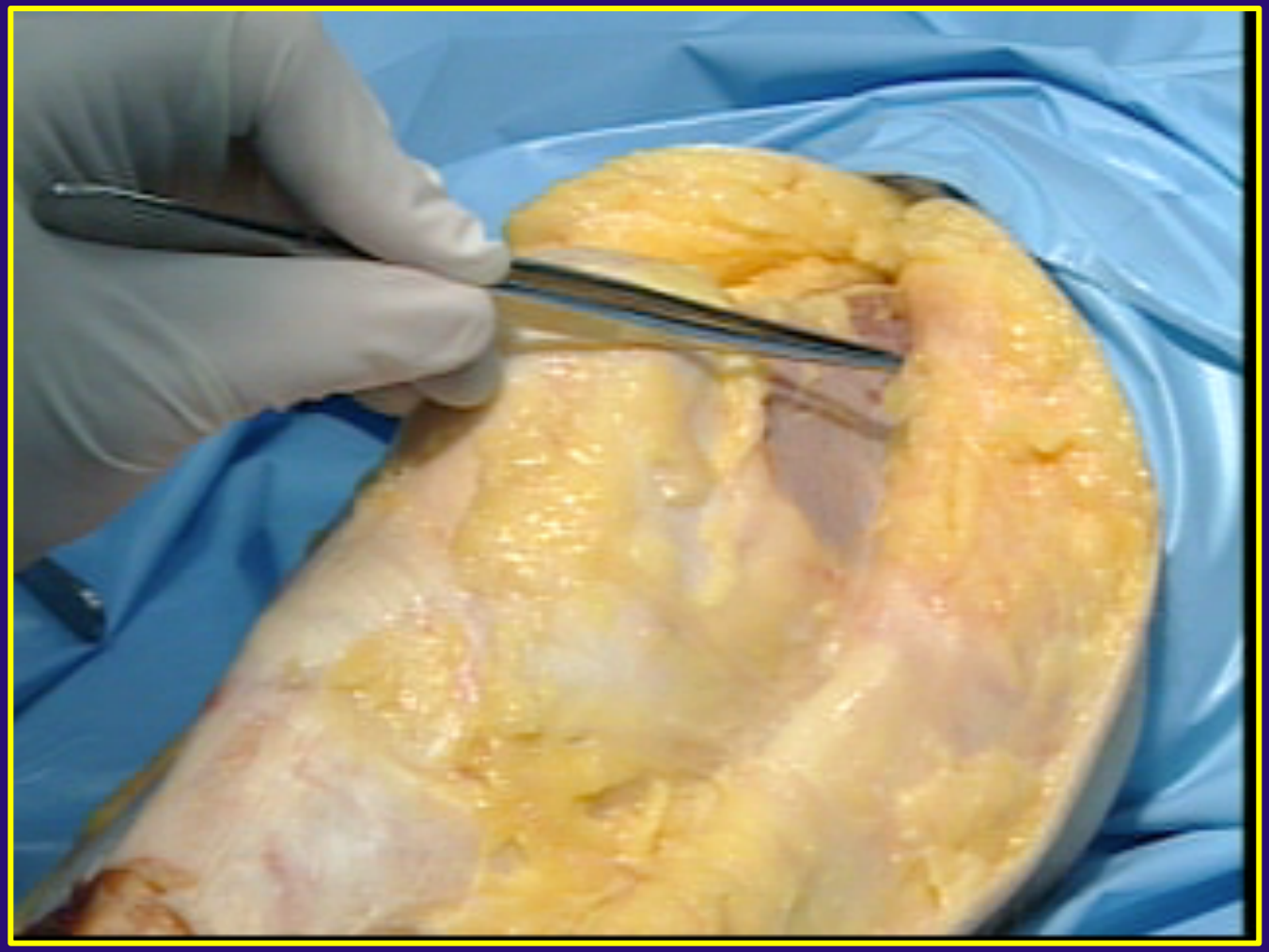
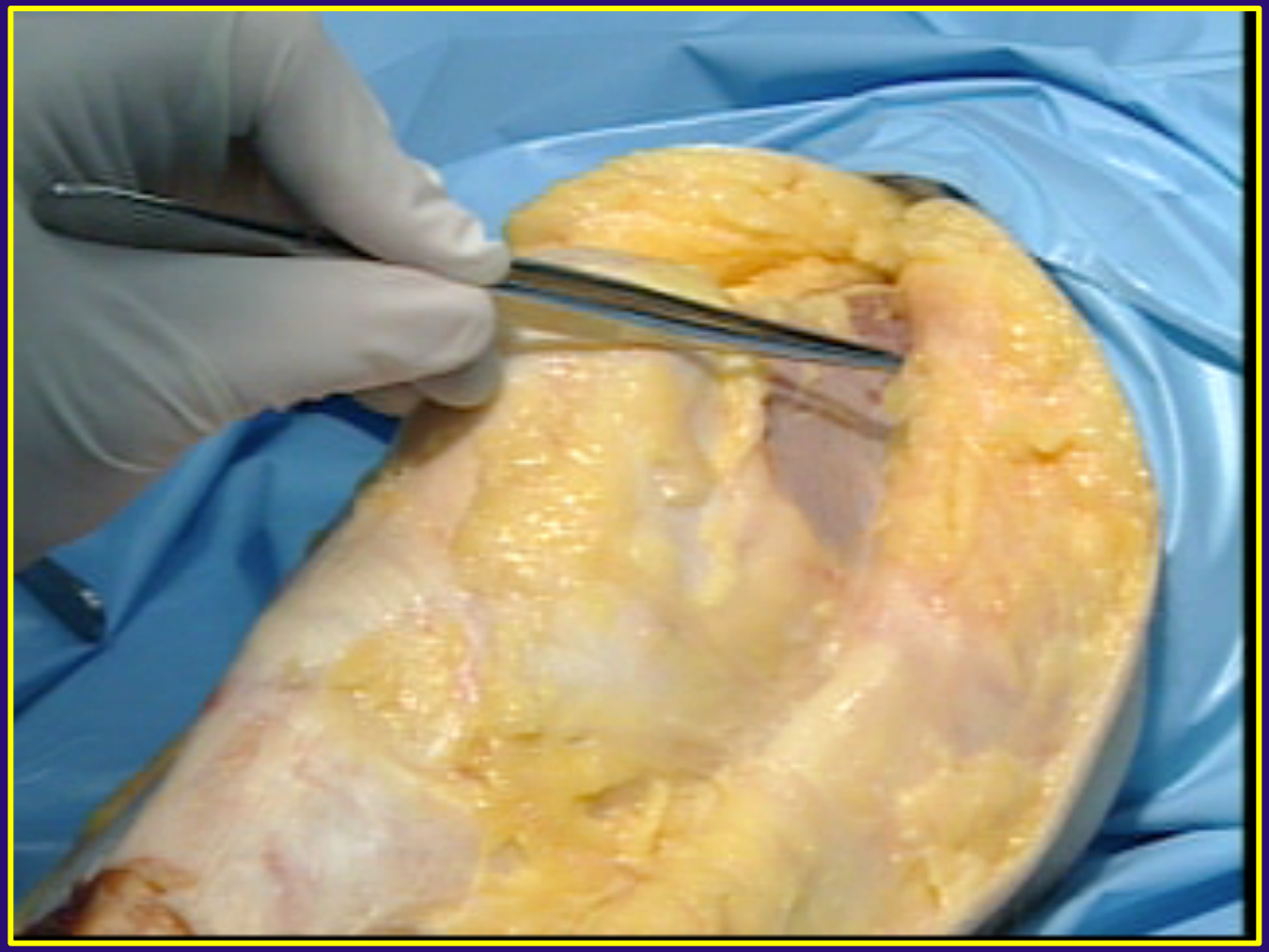
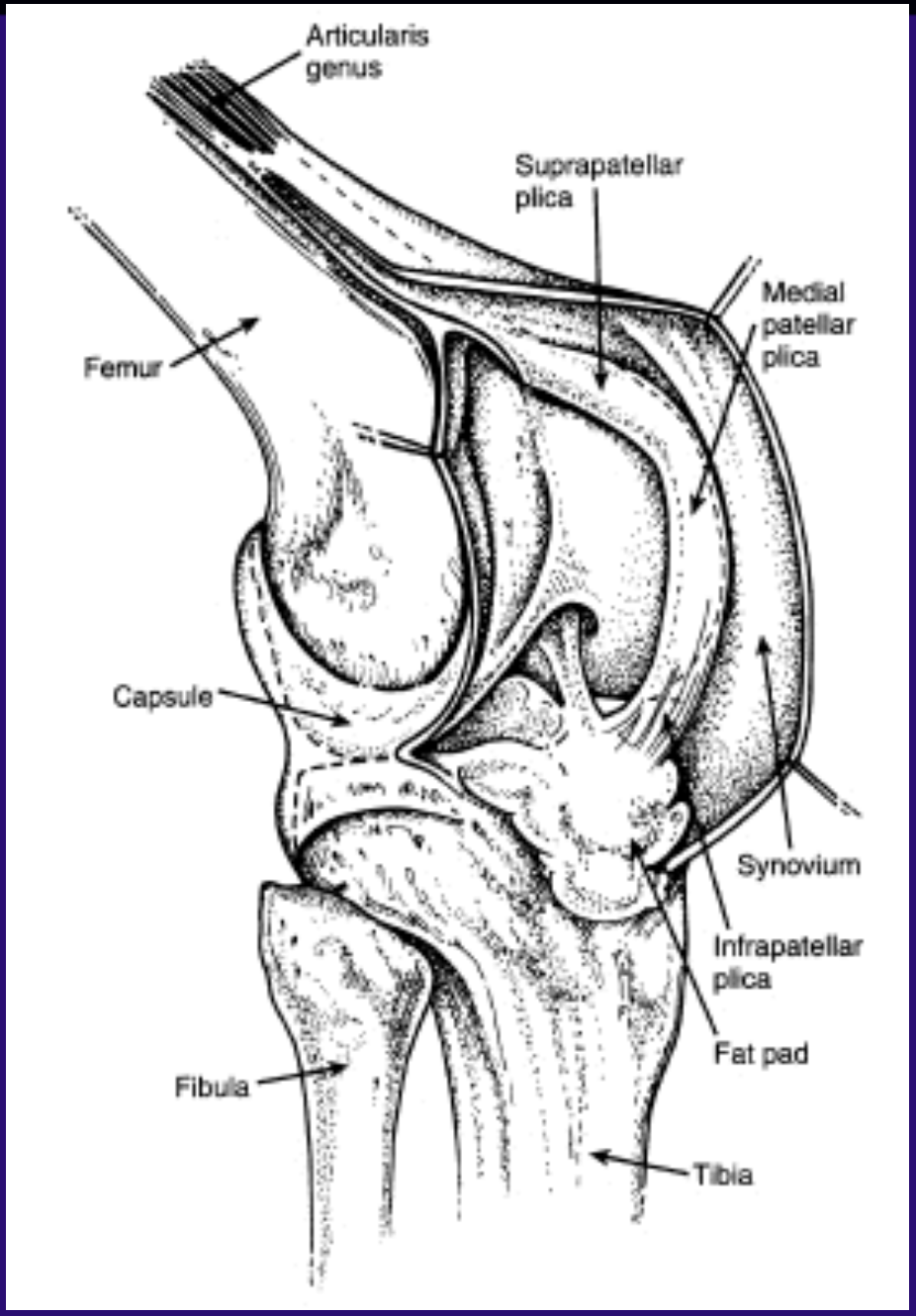


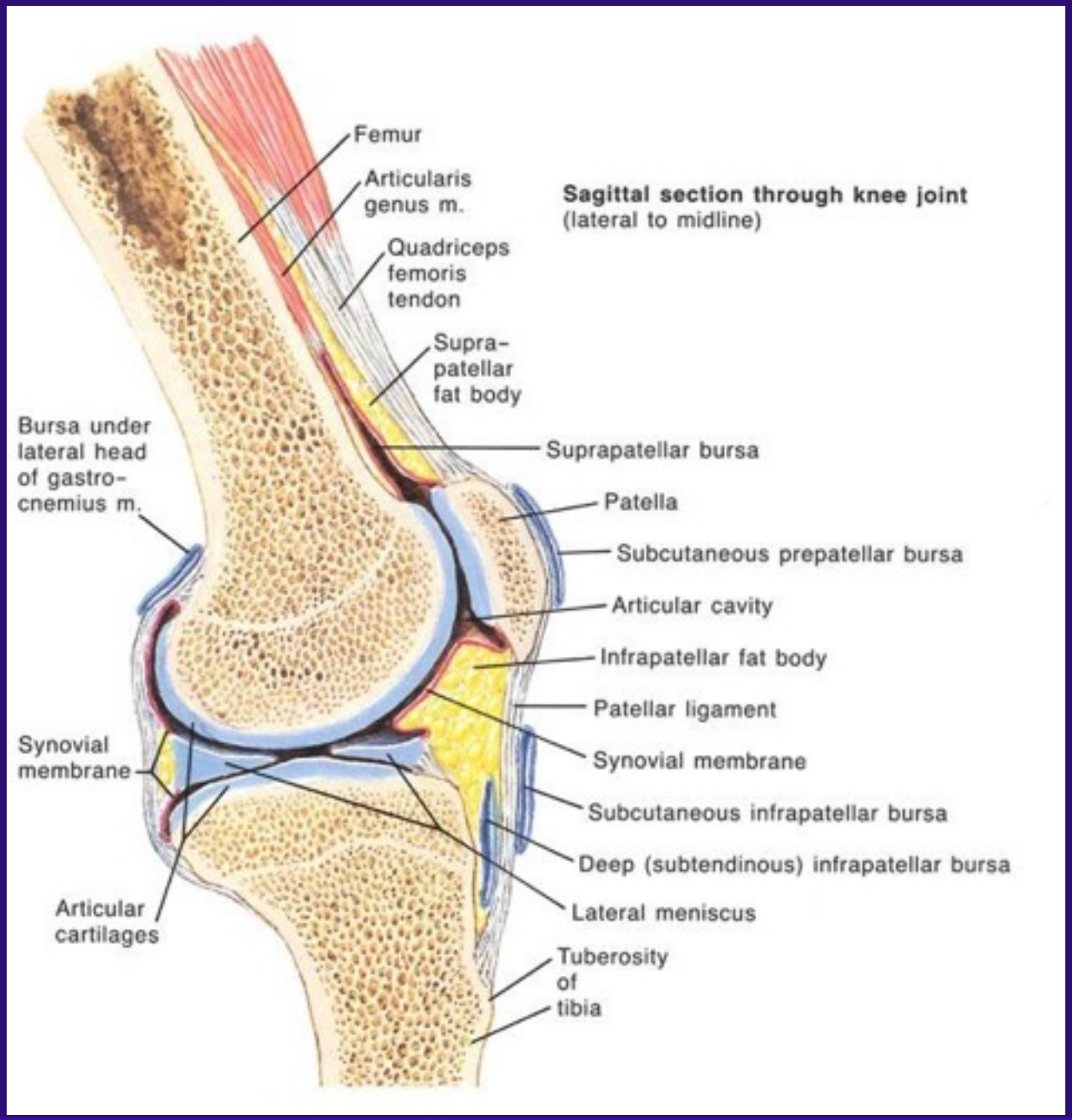
Fig. 63–8. Muscular anatomy of the anterior aspect of the knee.








Articularis genus
Suprapatellar plica
Medial patellar plica
Femur
Capsule
Synovium
Infrapatellar plica
Fat pad
Fibula
Tibia


Femur
Articularis genus m.
Quadriceps femoris tendon
Supra-patellar fat body
Bursa under lateral head of gastro-cnemius m.
Suprapatellar bursa
Patella
Subcutaneous prepatellar bursa
Articular cavity
Infrapatellar fat body
Patellar ligament
Synovial membrane
Synovial membrane
Subcutaneous infrapatellar bursa
Deep (subtendinous) infrapatellar bursa
Lateral meniscus
Articular cartilages
Tuberosity of tibia
Sagittal section through knee joint
(lateral to midline)

Knee model: Anterior View



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Knee model: Anterior View



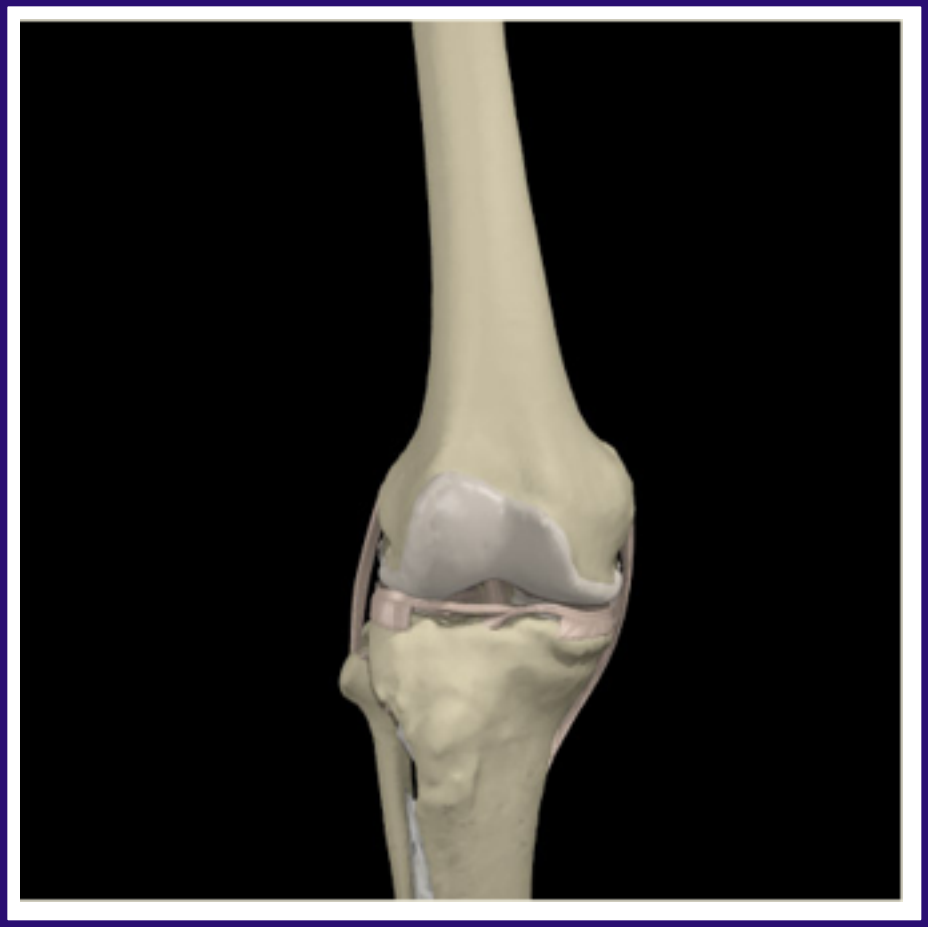
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Knee model: Anterior View



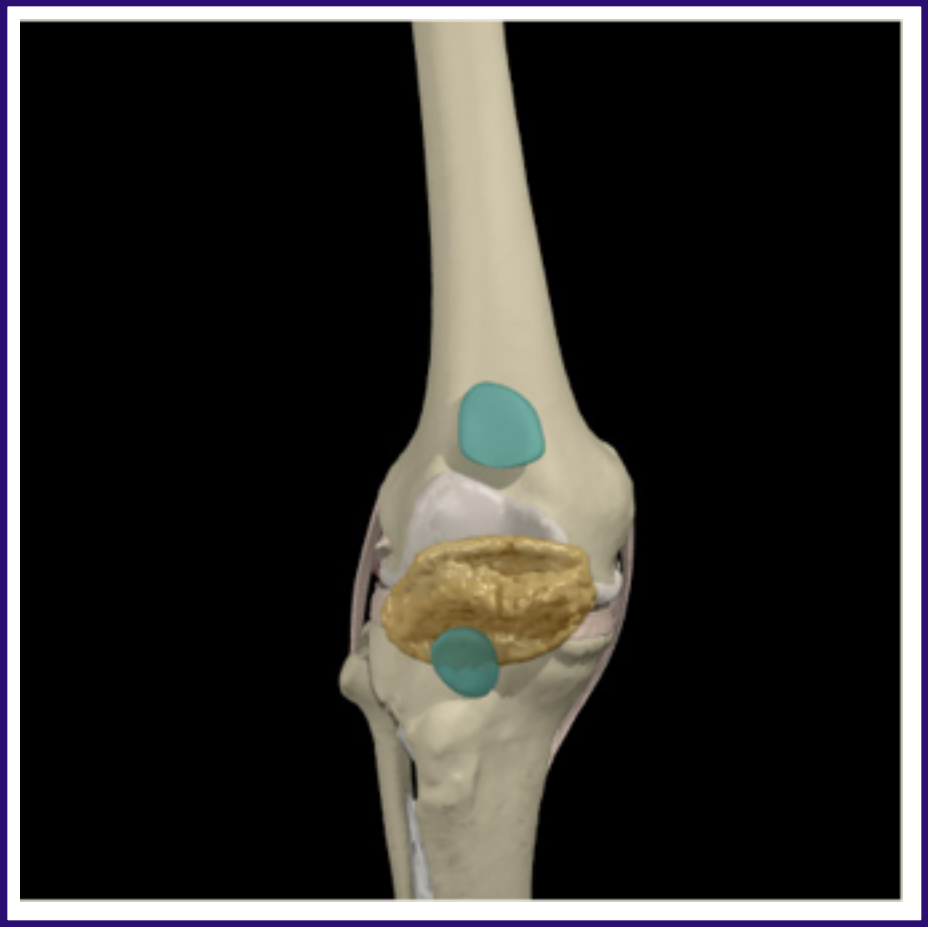
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Knee model: Anterior View



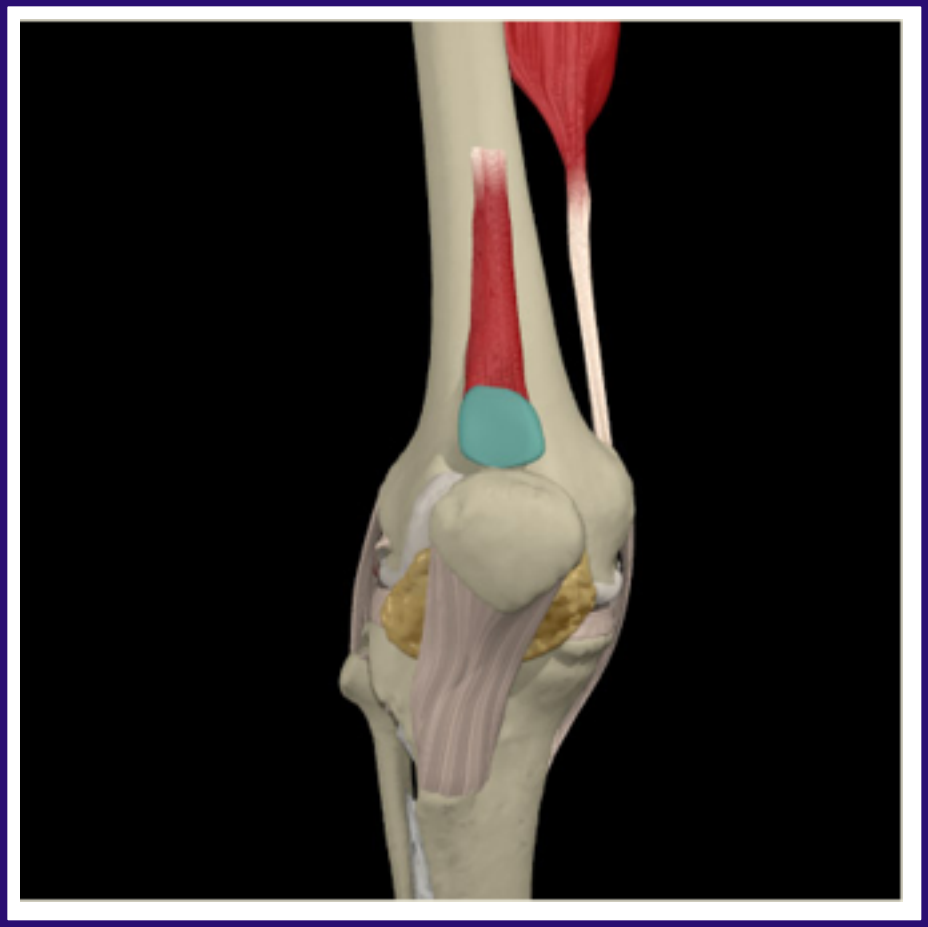
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Knee model: Anterior View



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Knee model: Anterior View



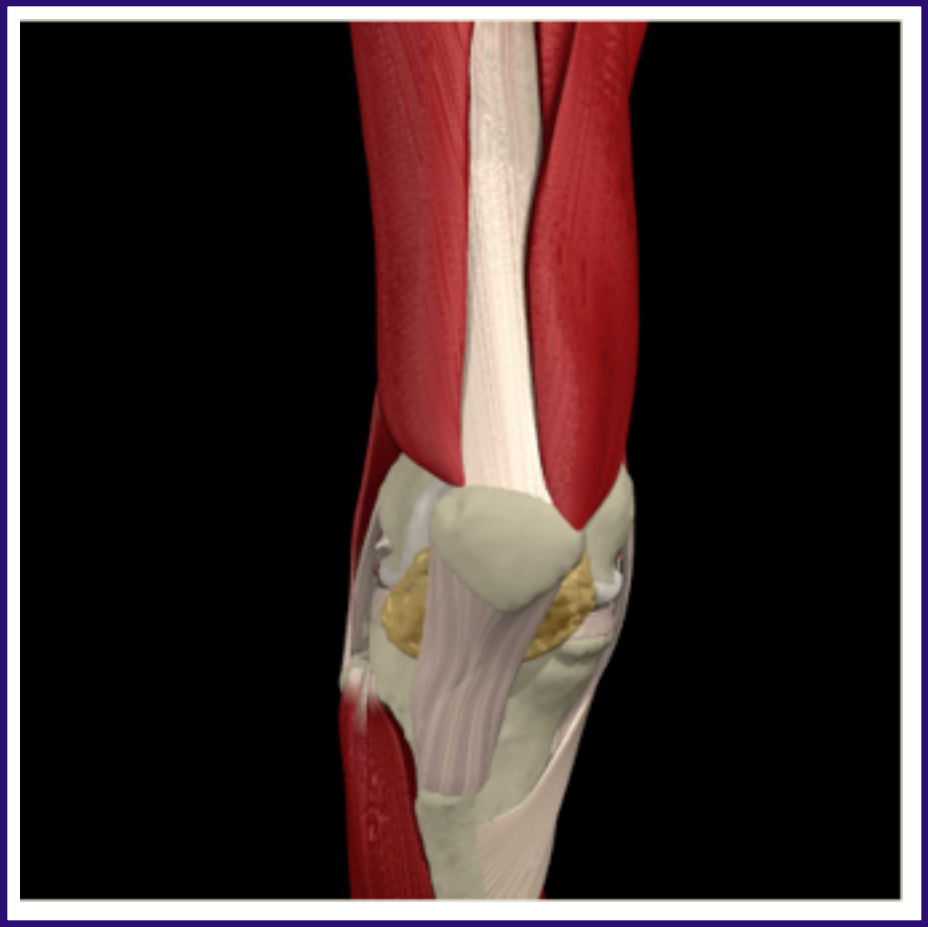
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Knee model: Anterior View



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Knee model: Anterior View



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Knee model: Anterior View



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Knee model: Anterior View



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Knee model: Anterior View



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Knee model: Anterior View



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Knee model: Anterior View



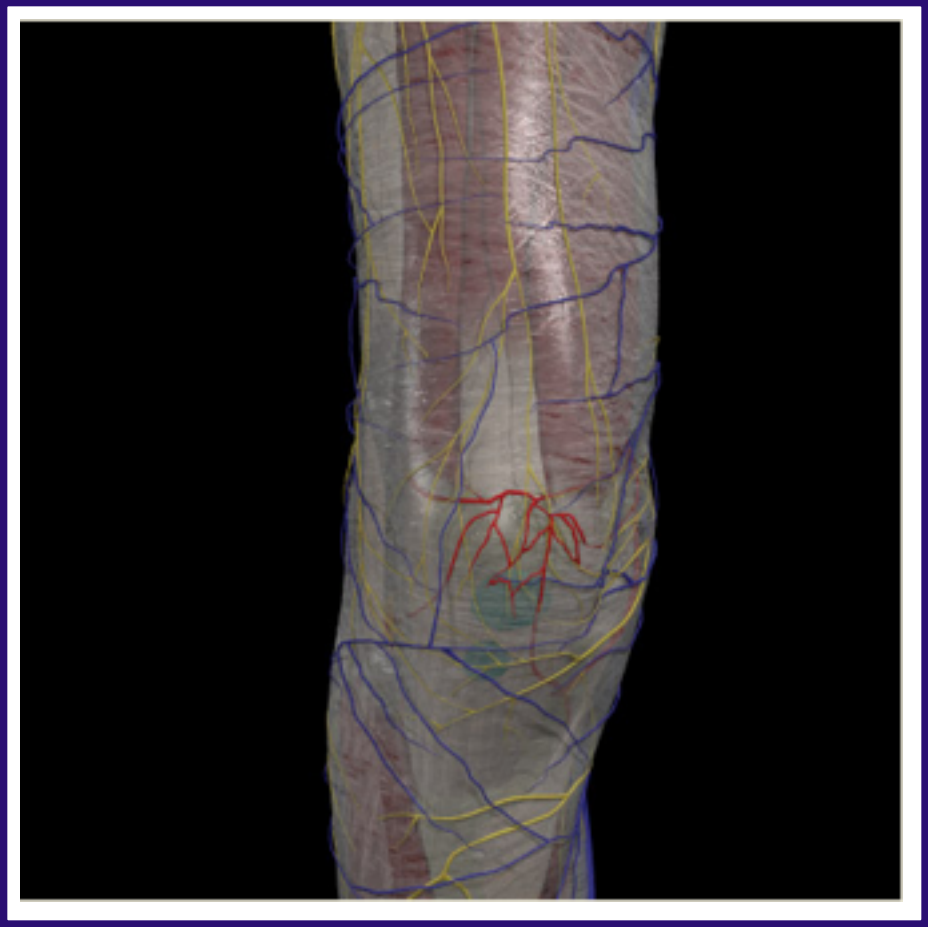
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Knee model: Anterior View



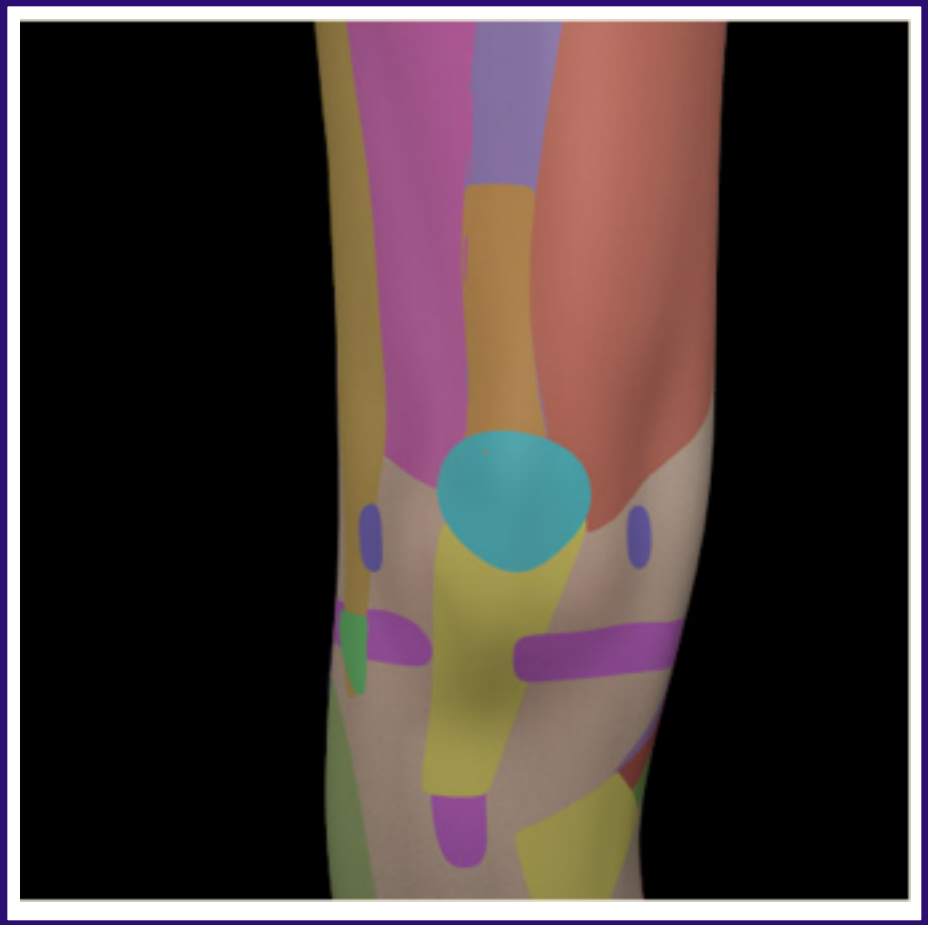
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Knee model: Anterior View



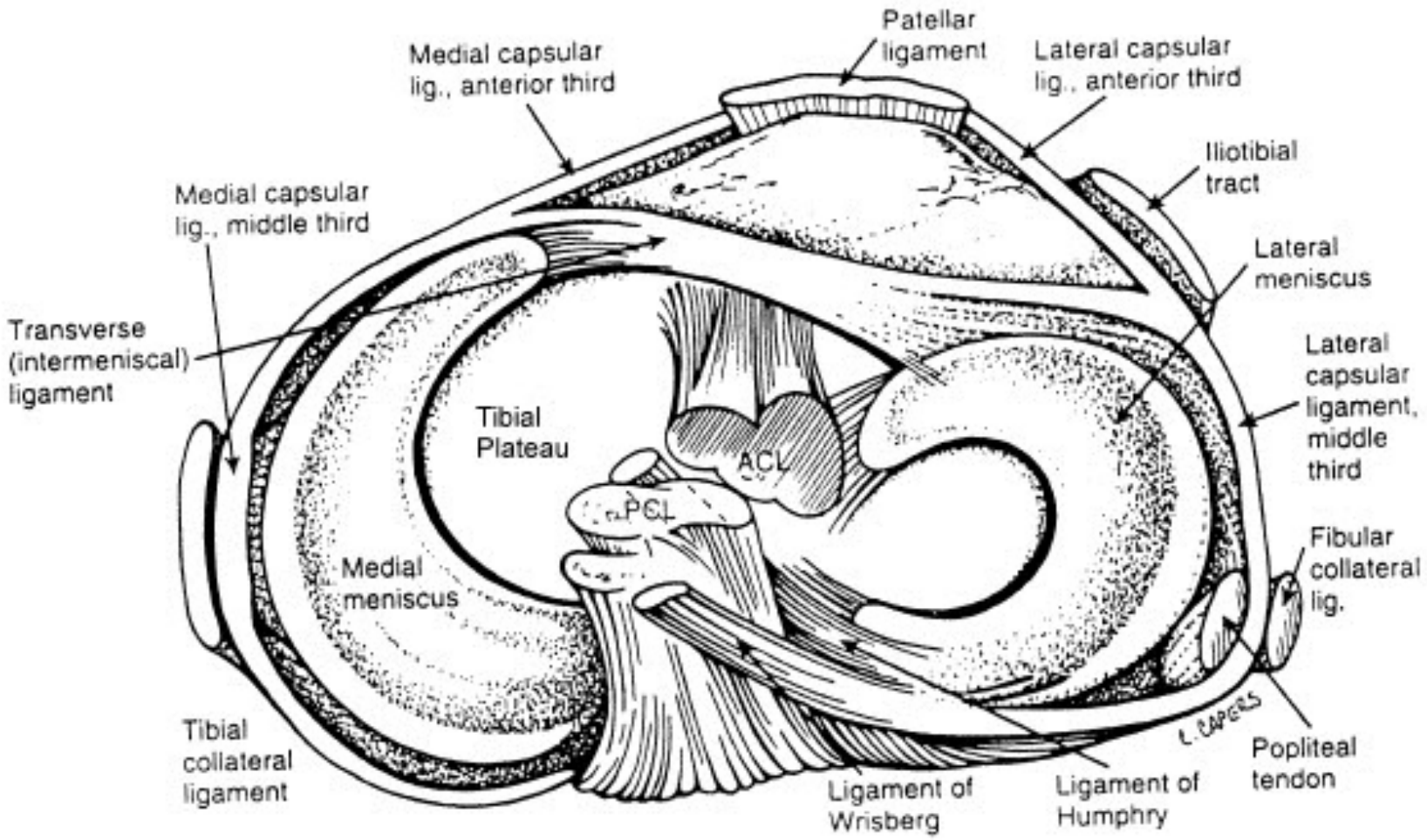
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Knee model: Anterior View



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FUNCTIONAL KNEE ANATOMY

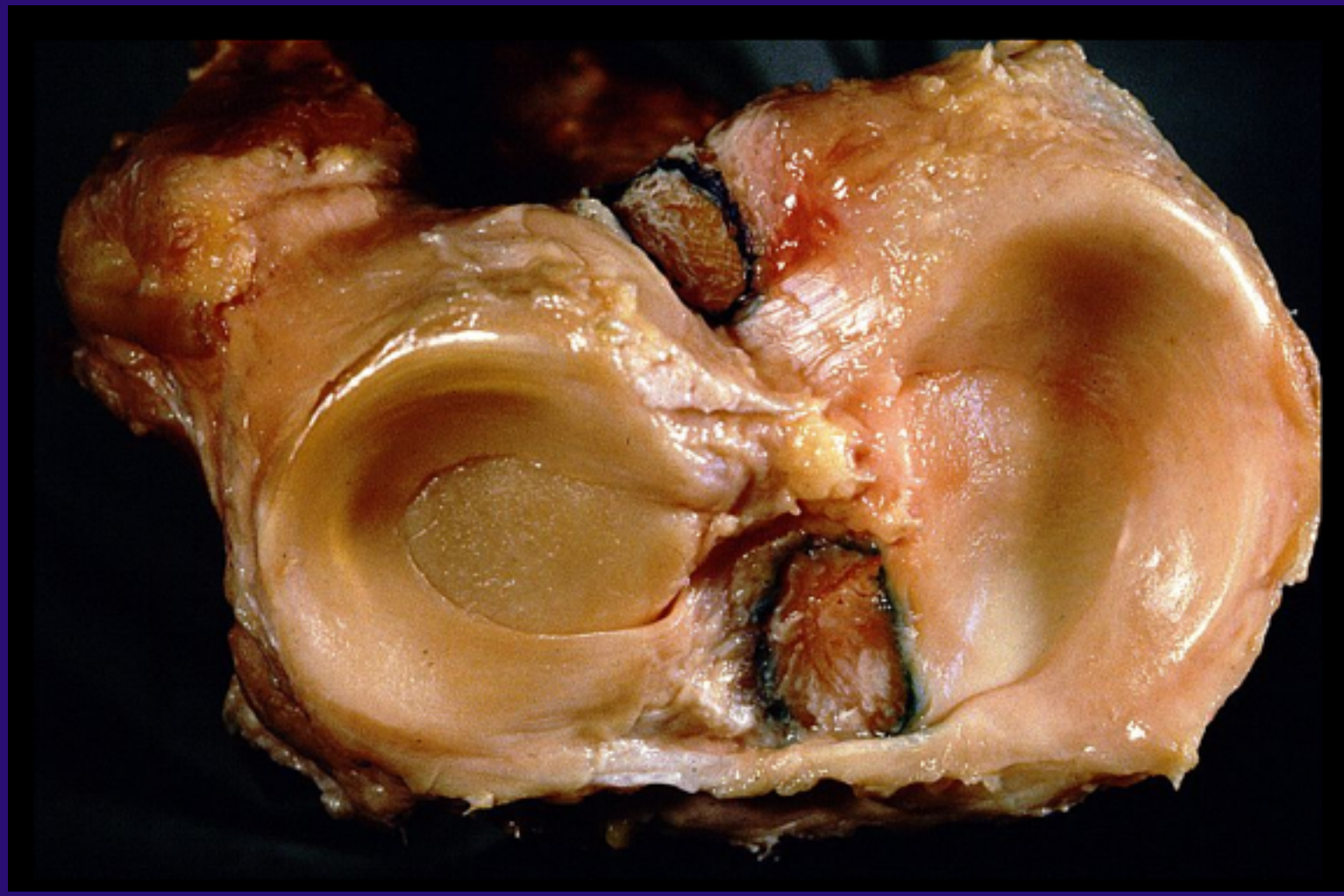


Left Knee Joint, Ligaments, from above



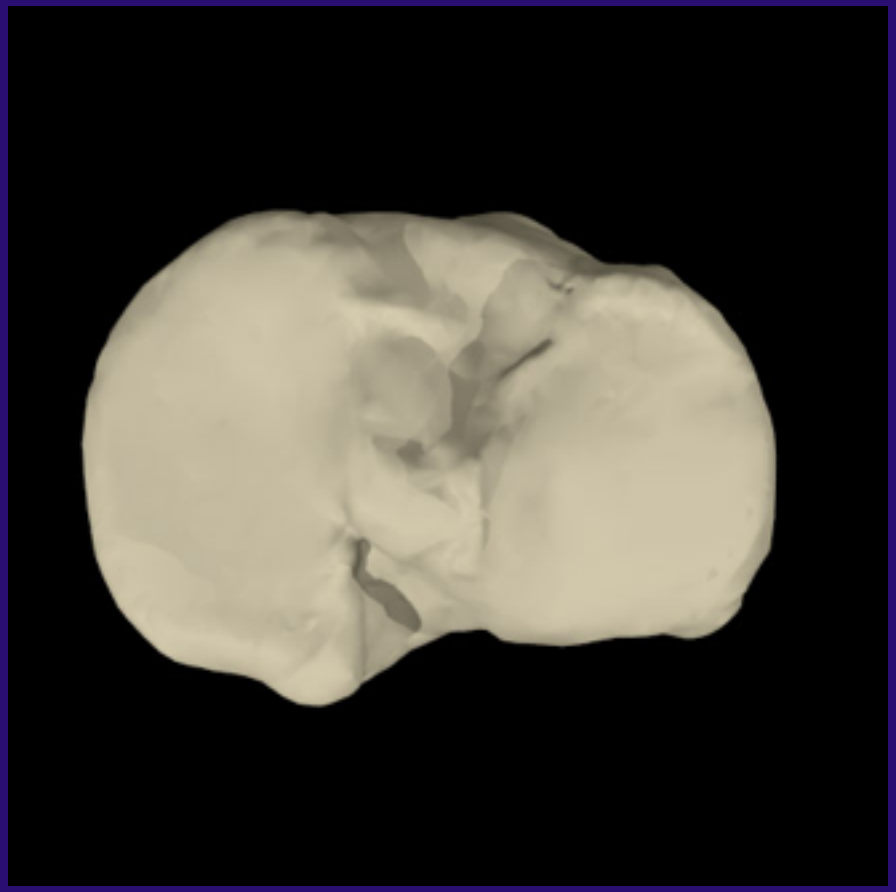
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Knee joint and menisci, from above



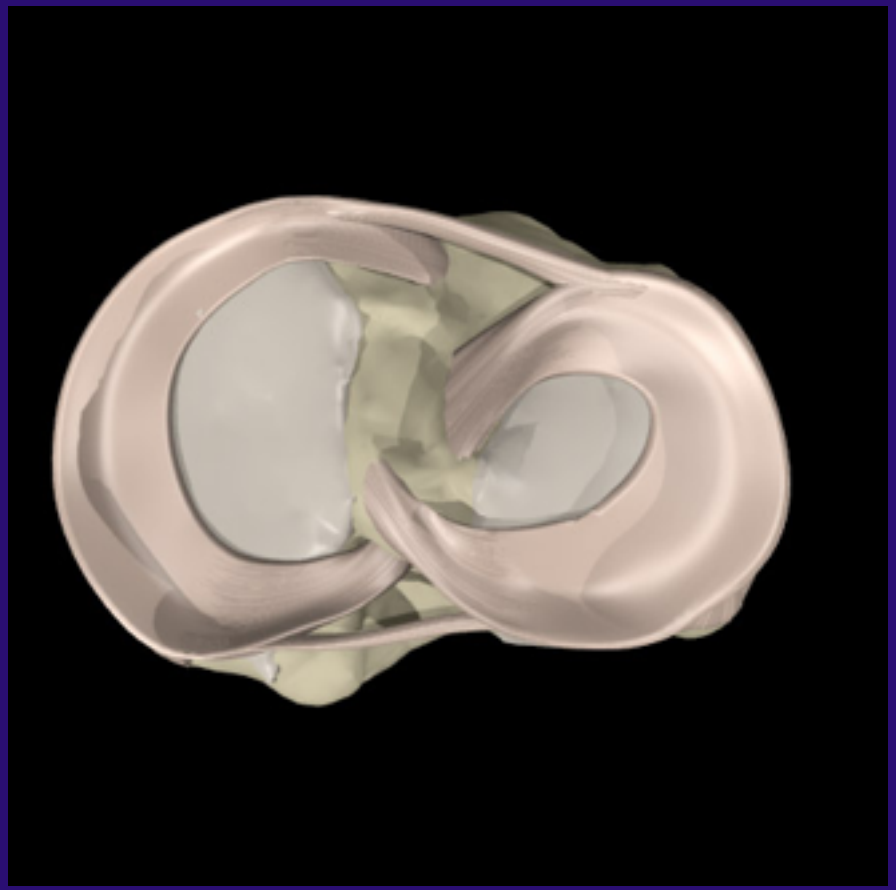
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Tibial plateau and menisci, from above

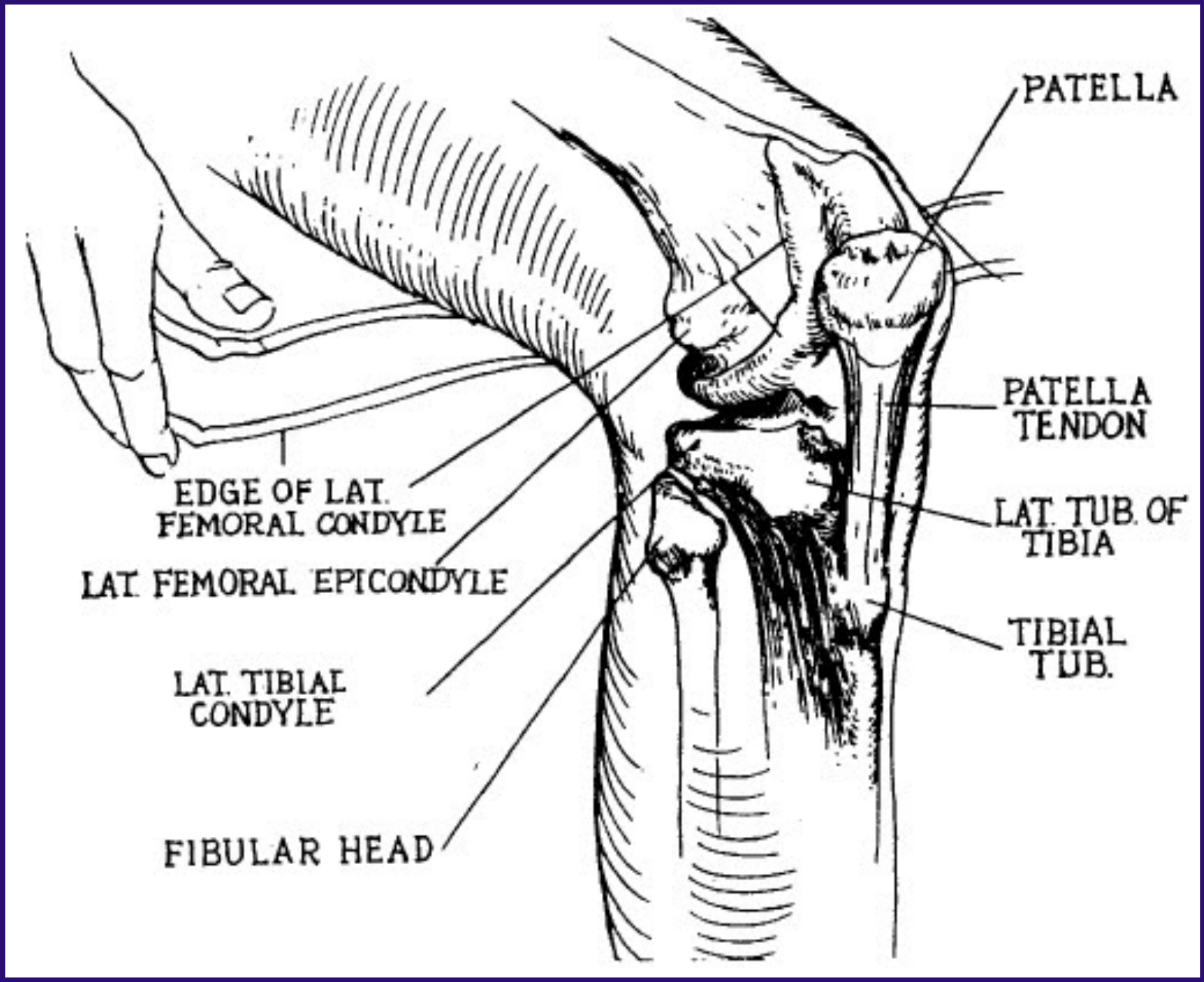


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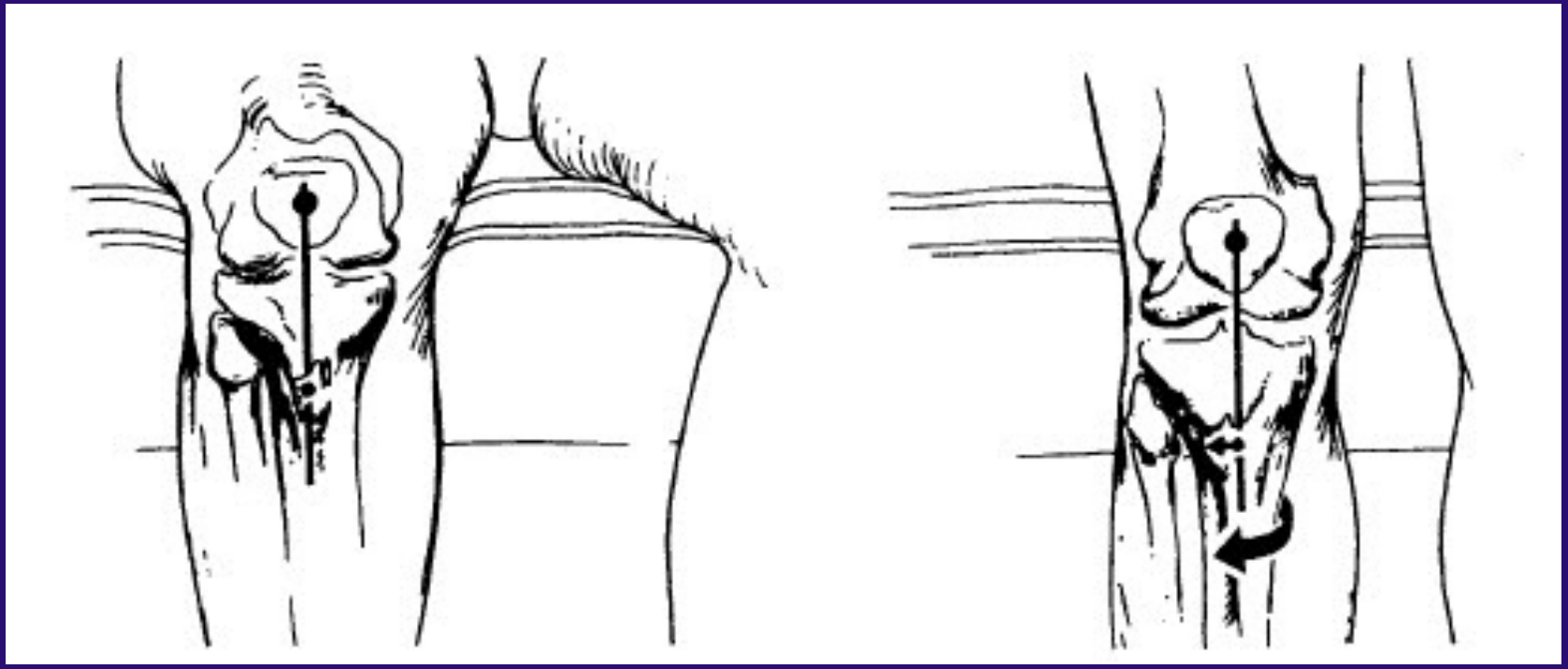
Tibial plateau and menisci, from above



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PATELLA
PATELLA TENDON
LAT. TUB. OF TIBIA
TIBIAL TUB.
EDGE OF LAT. FEMORAL CONDYLE
LAT. FEMORAL EPICONDYLE
LAT. TIBIAL CONDYLE
FIBULAR HEAD

Screw home mechanism (Smillie) tibial externally rotates in terminal knee extension



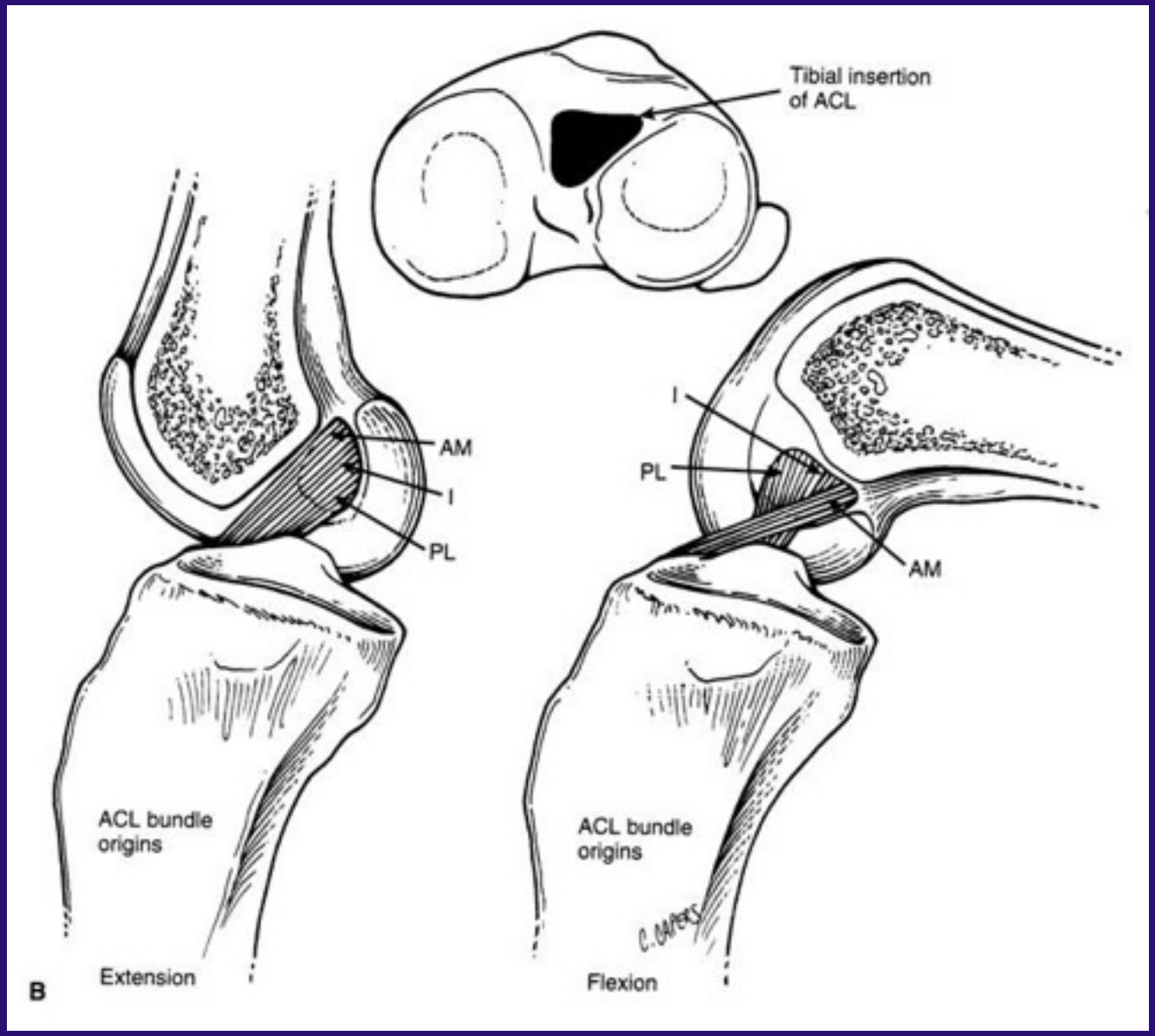
Joint line palpation with knee flexed should produce pain if meniscus is torn

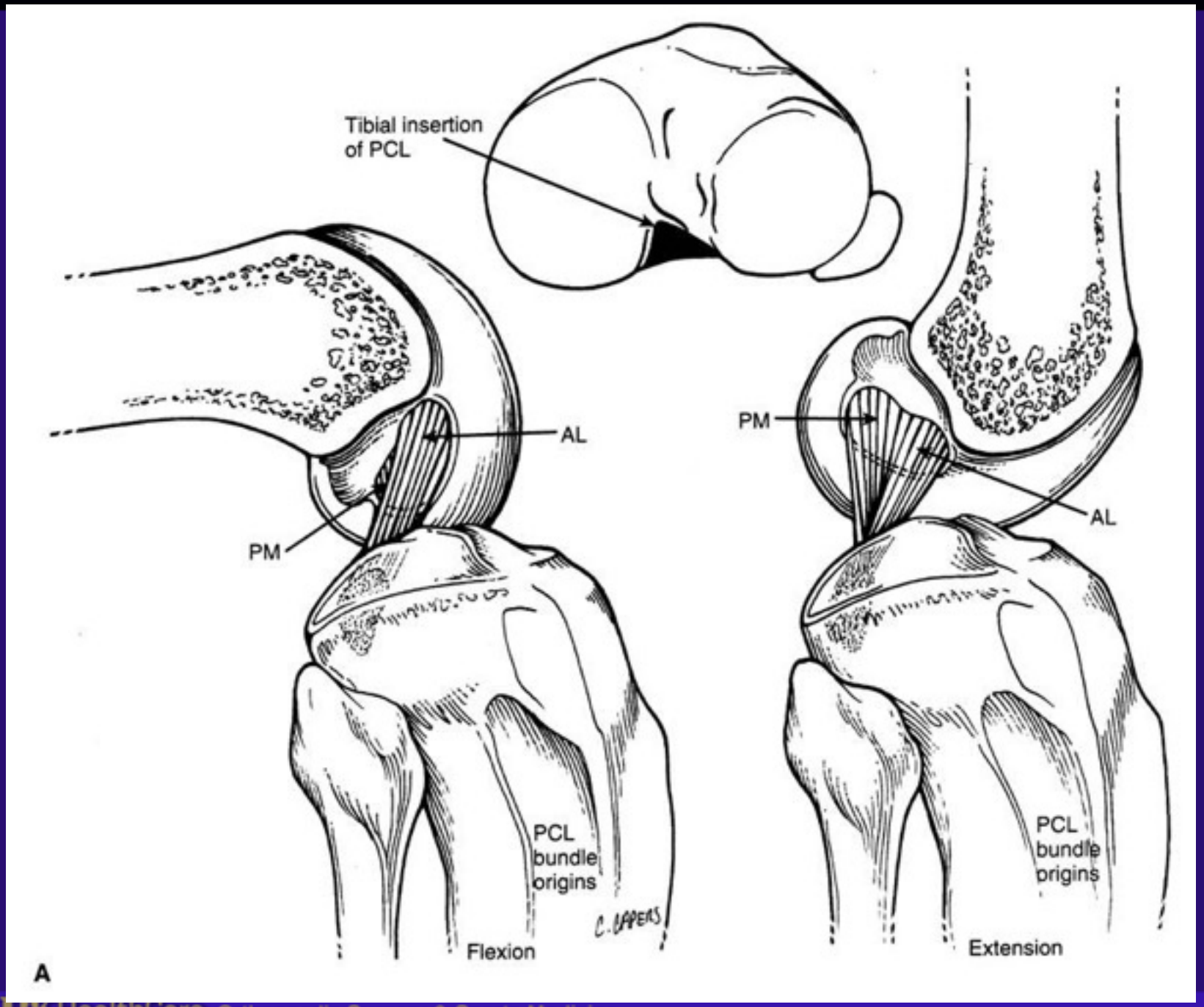


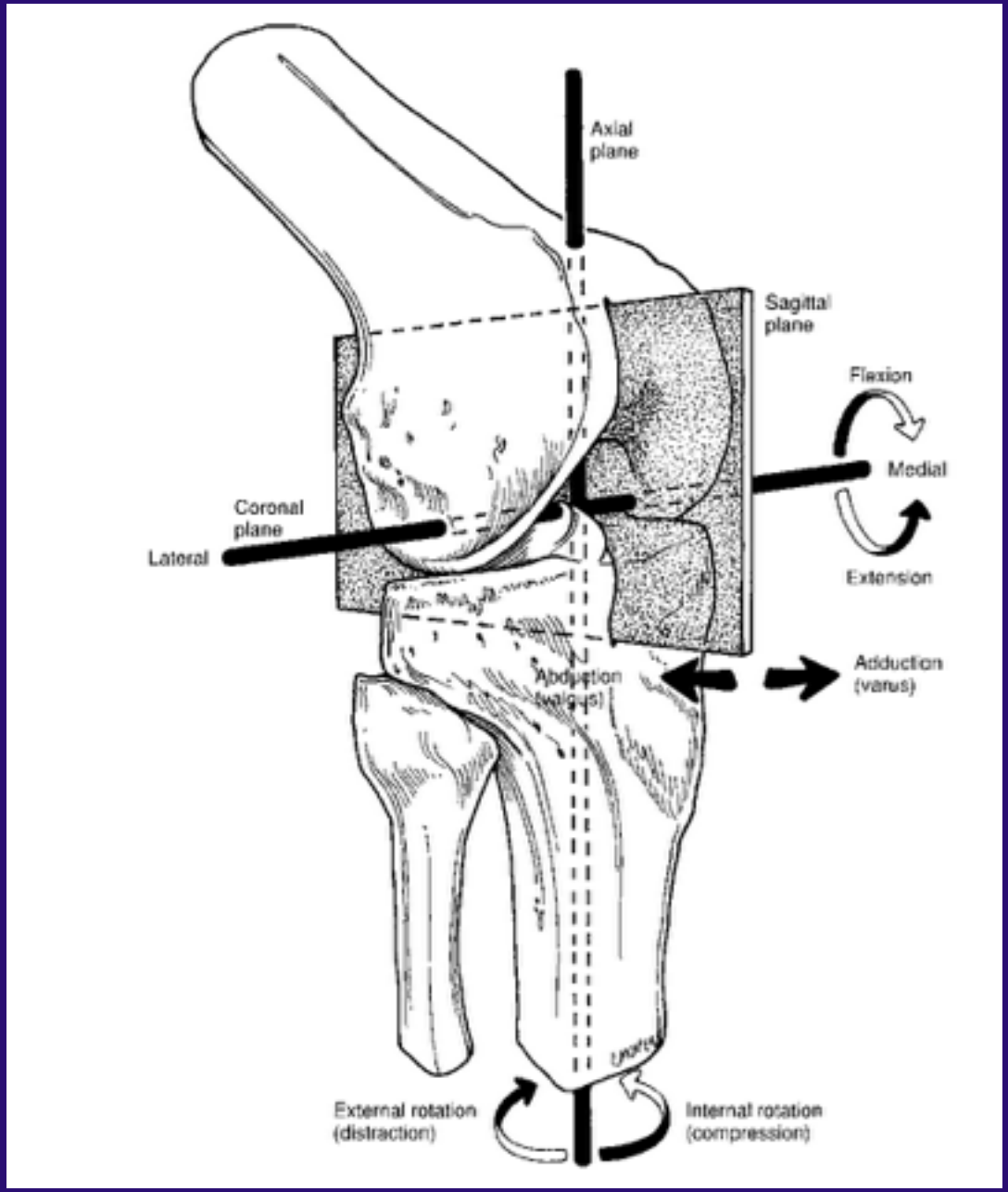


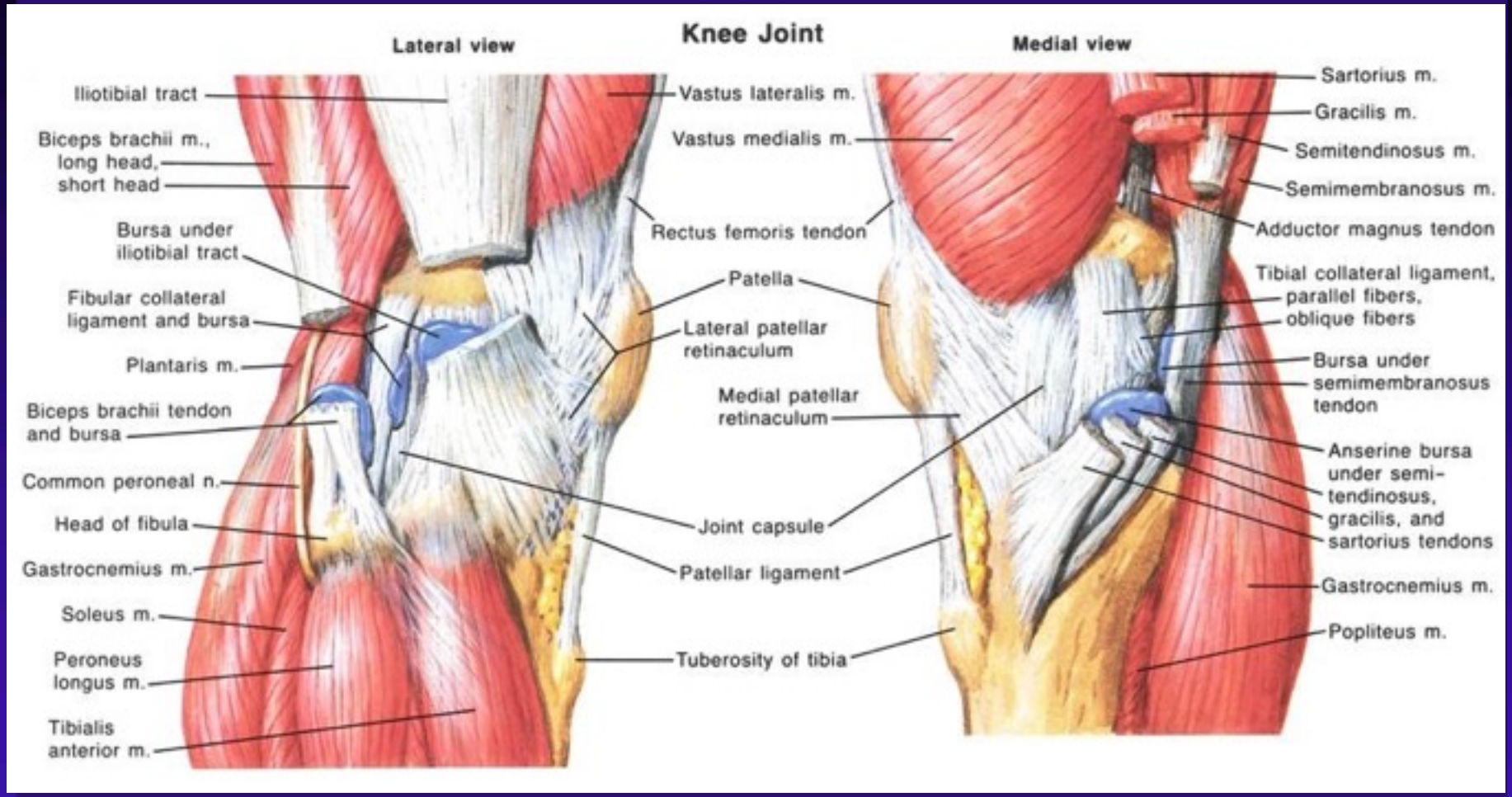


Externally rotate tibia for medial meniscus tears,
Internally rotate for lateral meniscus tears


Tibial insertion
of ACL
AM
I
PL
ACL bundle
origins
Extension
B
I
PL
AM
ACL bundle
origins
Flexion


Tibial insertion
of PCL
AL
PM
PCL
bundle
origins
Flexion
PM
AL
PCL
bundle
origins
Extension
A


Axial plane
Sagittal plane
Flexion
Medial
Extension
Coronal plane
Lateral
Adduction (varus)
External rotation (distraction)
Internal rotation (compression)


Knee Joint
Lateral view
Medial view
Iliotibial tract
Biceps brachii m., long head, short head
Bursa under iliotibial tract
Fibular collateral ligament and bursa
Plantaris m.
Biceps brachii tendon and bursa
Common peroneal n.
Head of fibula
Gastrocnemius m.
Soleus m.
Peroneus longus m.
Tibialis anterior m.
Vastus lateralis m.
Vastus medialis m.
Rectus femoris tendon
Patella
Lateral patellar retinaculum
Medial patellar retinaculum
Joint capsule
Patellar ligament
Tuberosity of tibia
Sartorius m.
Gracilis m.
Semitendinosus m.
Semimembranosus m.
Adductor magnus tendon
Tibial collateral ligament, parallel fibers, oblique fibers
Bursa under semimembranosus tendon
Anserine bursa under semi-tendinosus, gracilis, and sartorius tendons
Gastrocnemius m.
Popliteus m.

Knee model: Medial View



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Knee model: Medial View



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Knee model: Medial View



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Knee model: Medial View



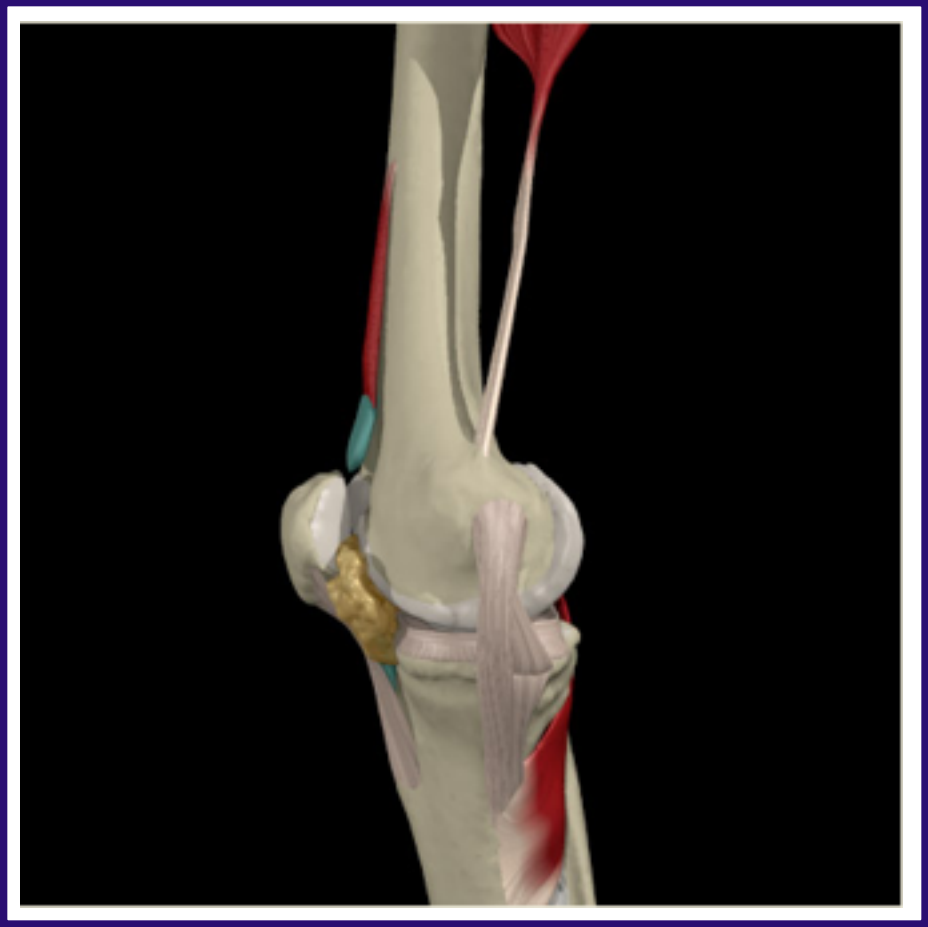
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Knee model: Medial View



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Knee model: Medial View



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Knee model: Medial View



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Knee model: Medial View



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Knee model: Medial View



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Knee model: Medial View



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Knee model: Medial View



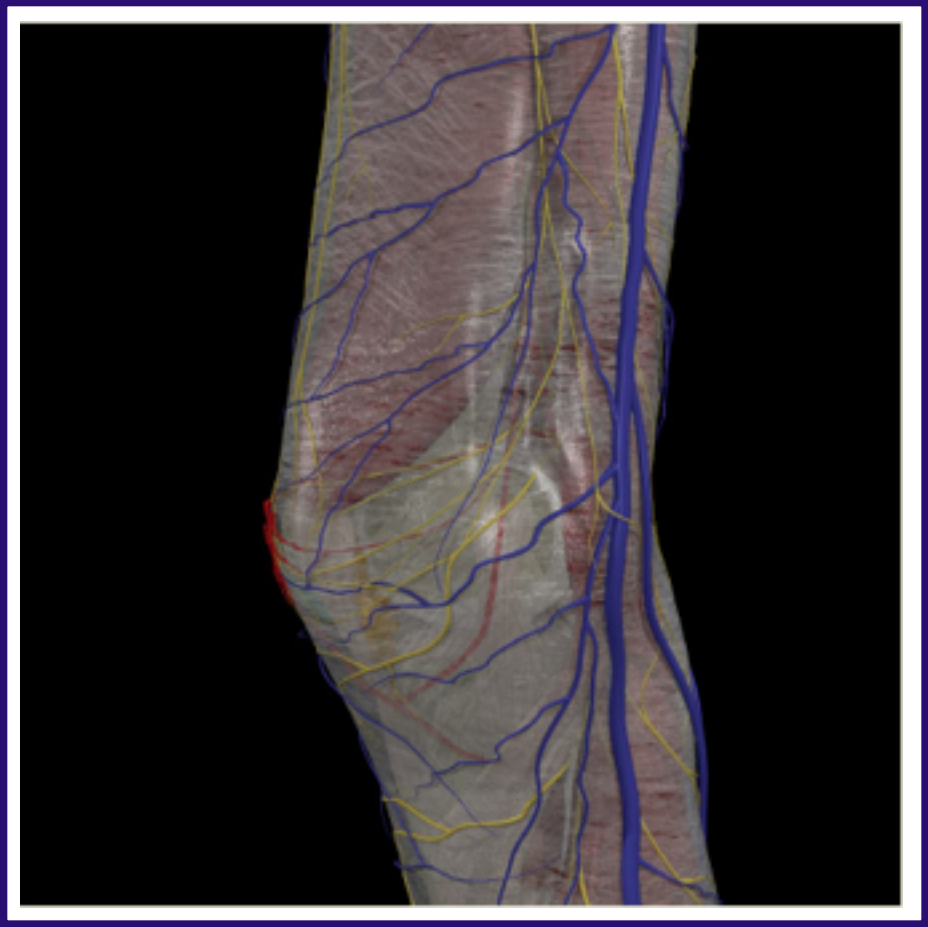
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Knee model: Medial View



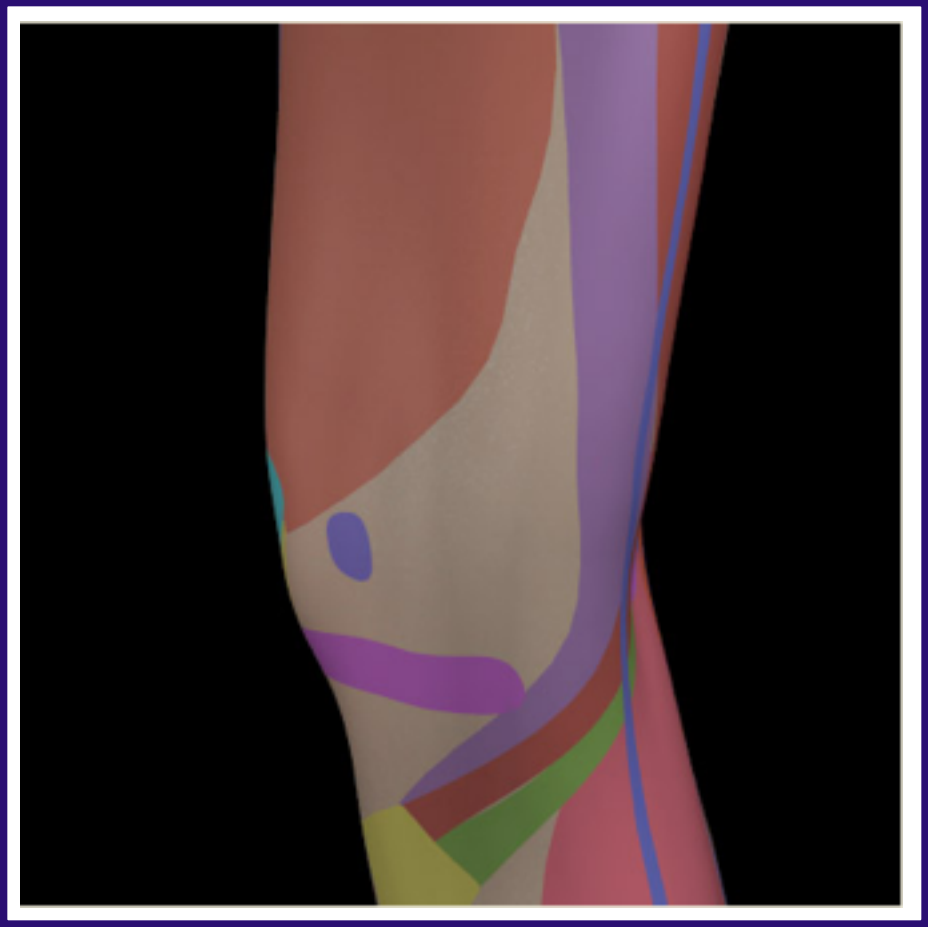
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Knee model: Medial View



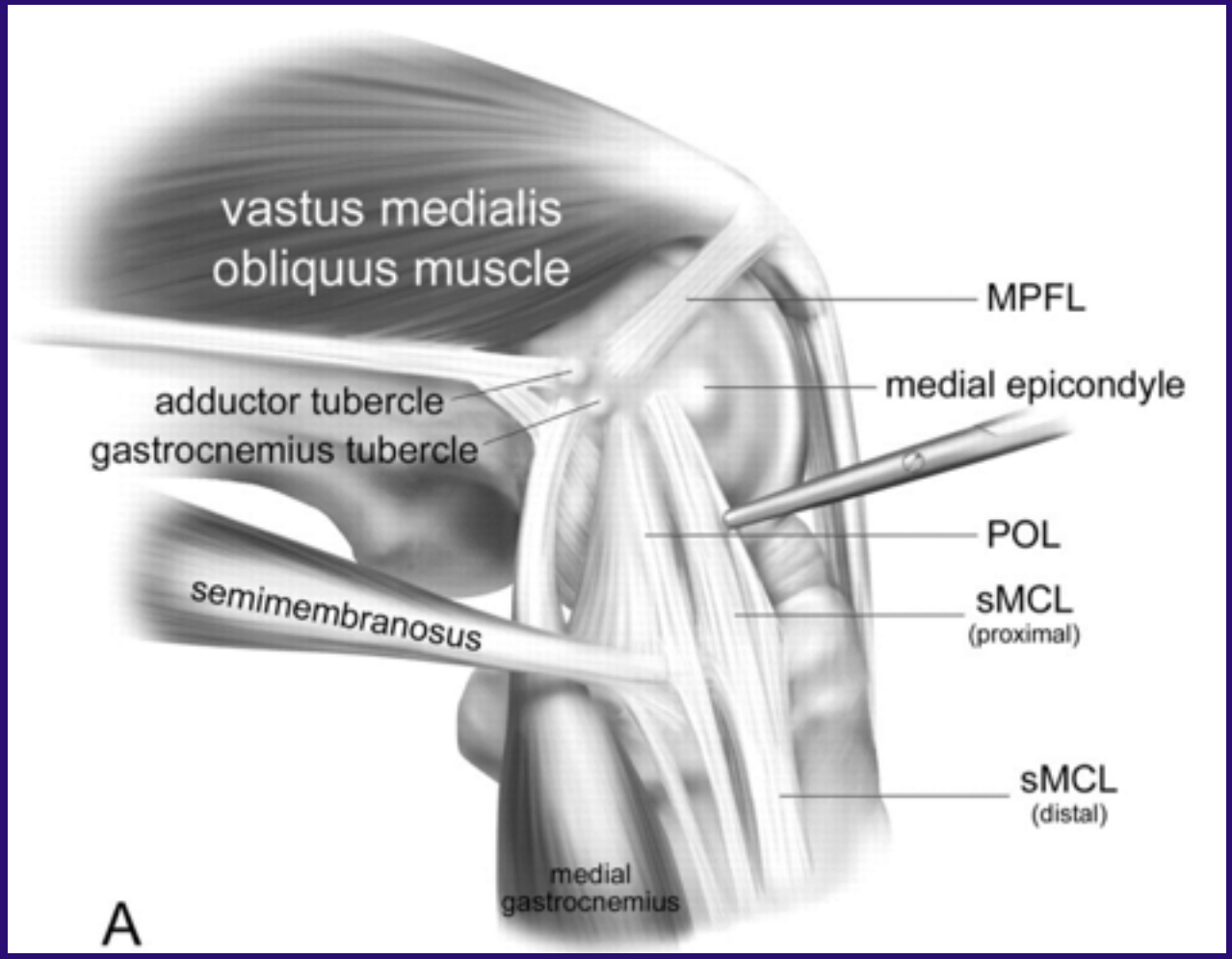
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Knee model: Medial View

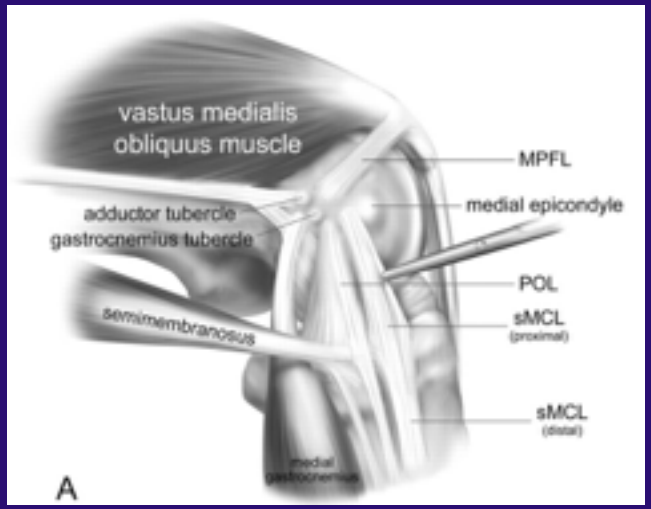


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OKU 10: “Soft Tissue Injuries About the Knee,” Kaar et. al., p. 455. Fig. 1A.



OKU 10: "Soft Tissue Injuries About the Knee," Kaar et. al., p. 455. Fig. 1A.



- Posteromedial corner:
  - Medial collateral ligament
    - Superficial and deep layers
    - Meniscotibial and meniscofemoral ligaments
  - Posterior Oblique ligament
    - Runs posterior to superficial MCL
    - Multiple bands attaching to posteromedial capsule, semimembranosus, and proximal tibia

Knee model: Lateral View



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Knee model: Lateral View



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Knee model: Lateral View



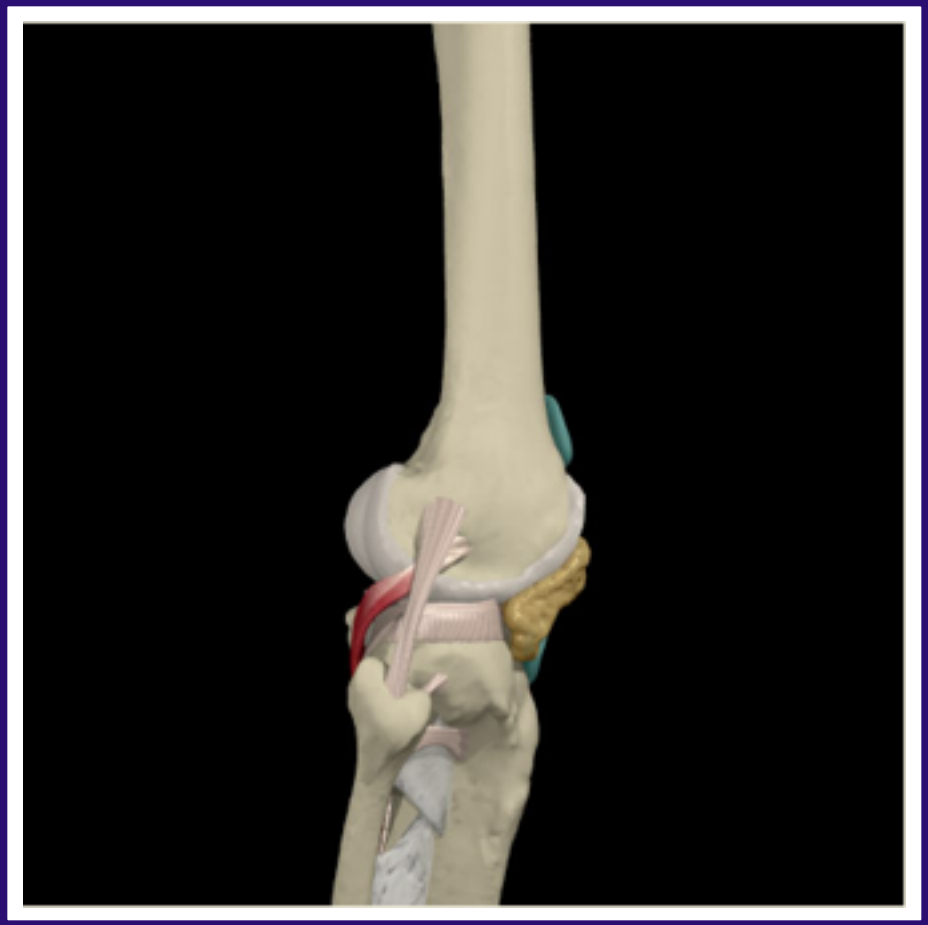
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Knee model: Lateral View



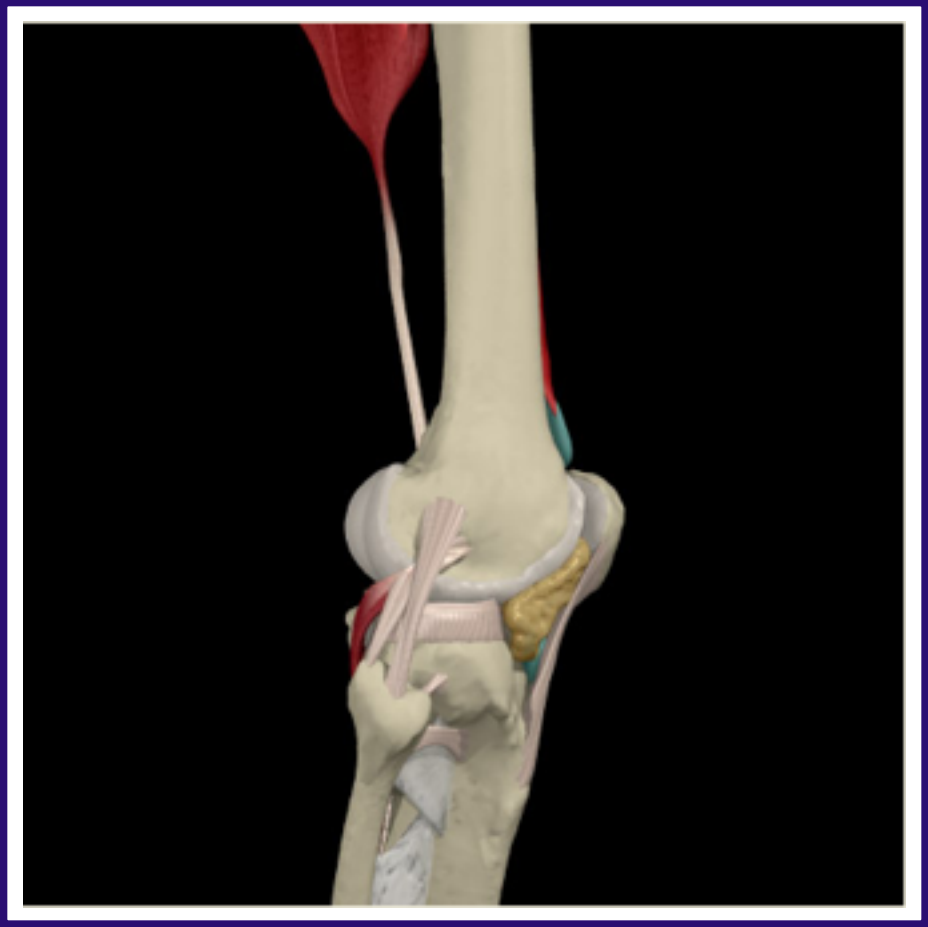
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Knee model: Lateral View



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Knee model: Lateral View



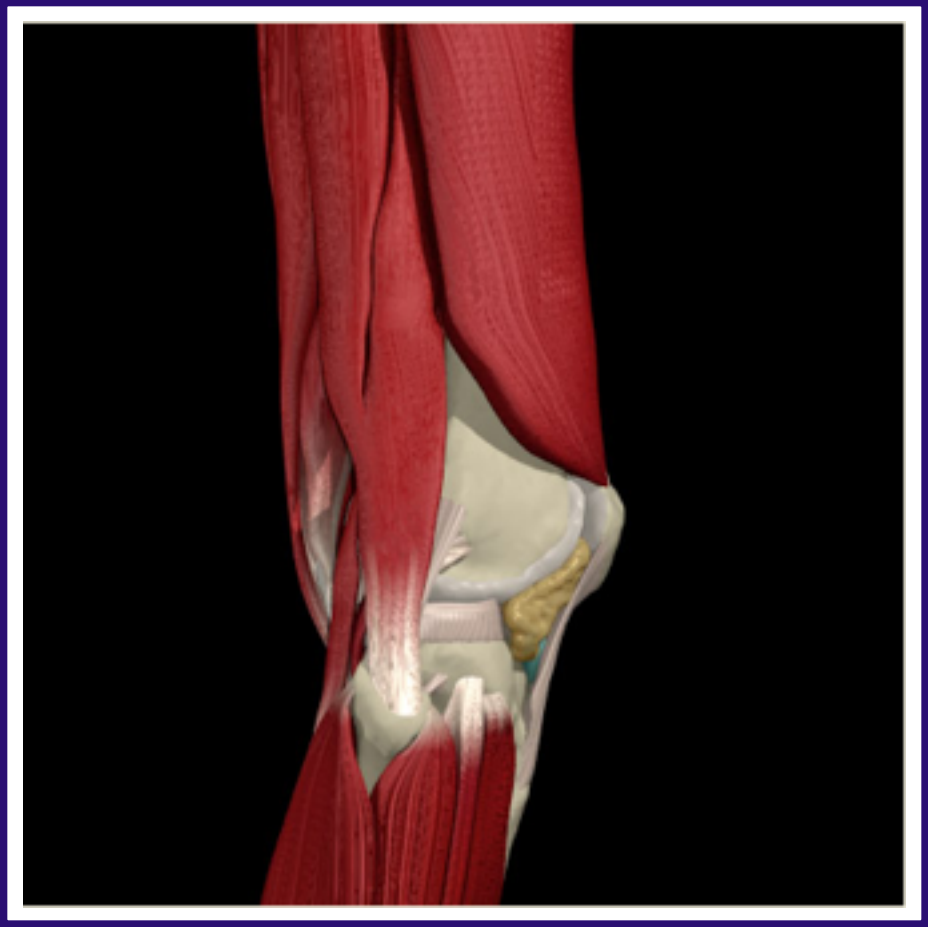
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Knee model: Lateral View



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Knee model: Lateral View



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Knee model: Lateral View



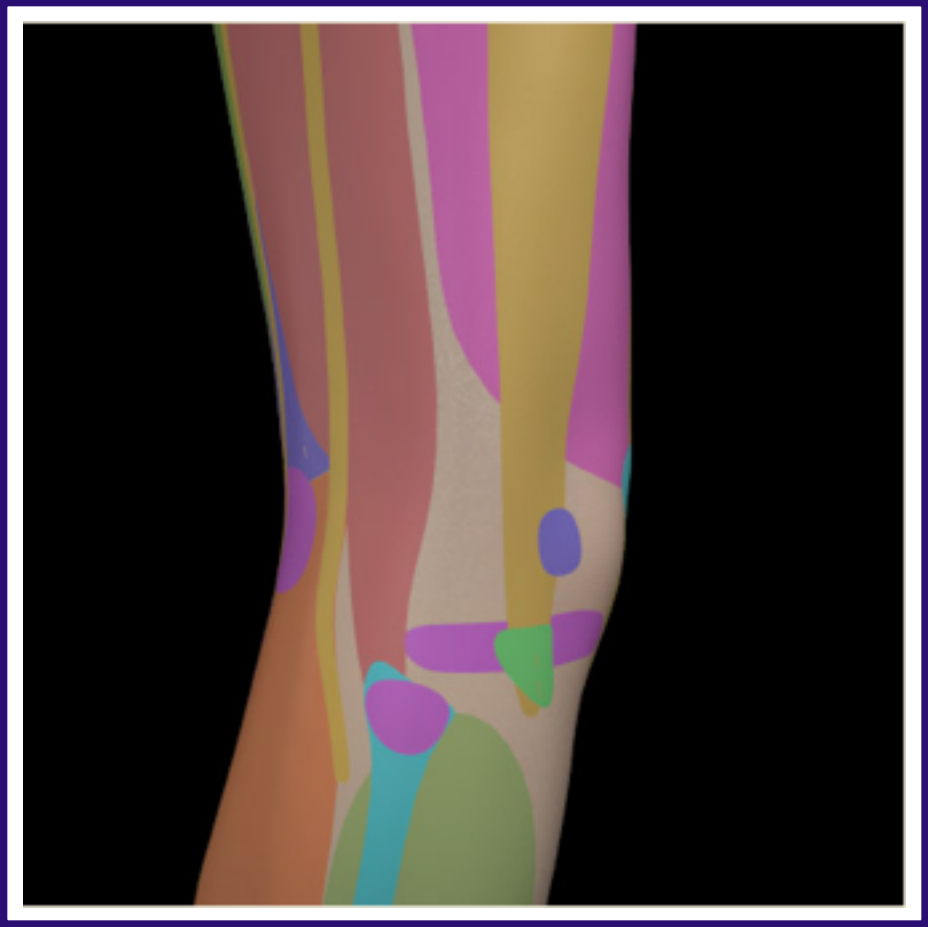
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Knee model: Lateral View



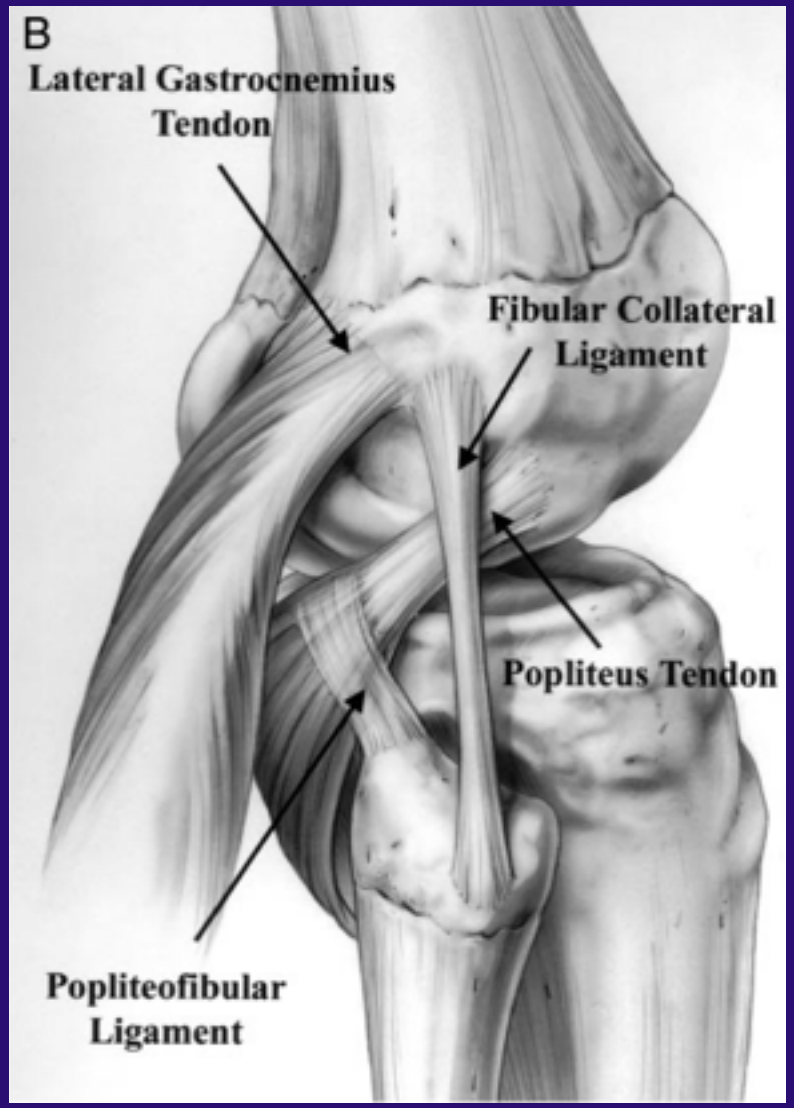
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Knee model: Lateral View



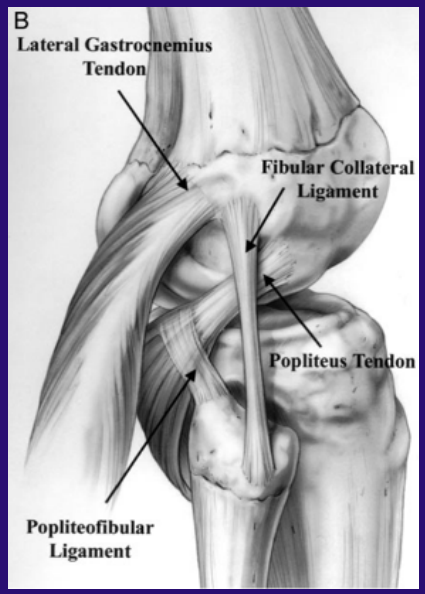
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OKU 10: “Soft Tissue Injuries About the Knee,” Kaar et. al., p. 455, Fig. 1B.



OKU 10: "Soft Tissue Injuries About the Knee," Kaar et. al., p. 455, Fig. 1B.

- Posterolateral corner: Static stabilizers
  - Fibular collateral ligament
  - Popliteofibular ligament
  - Posterolateral capsule
  - Popliteus serves as dynamic and static stabilizer
  - Popliteus femoral attachment in anterior popliteal sulcus, 2cm. anterior and distal to FCL attachment
  - Upside down muscle: origin distal, insertion proximal



Knee model: Posterior View



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Knee model: Posterior View



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Knee model: Posterior View



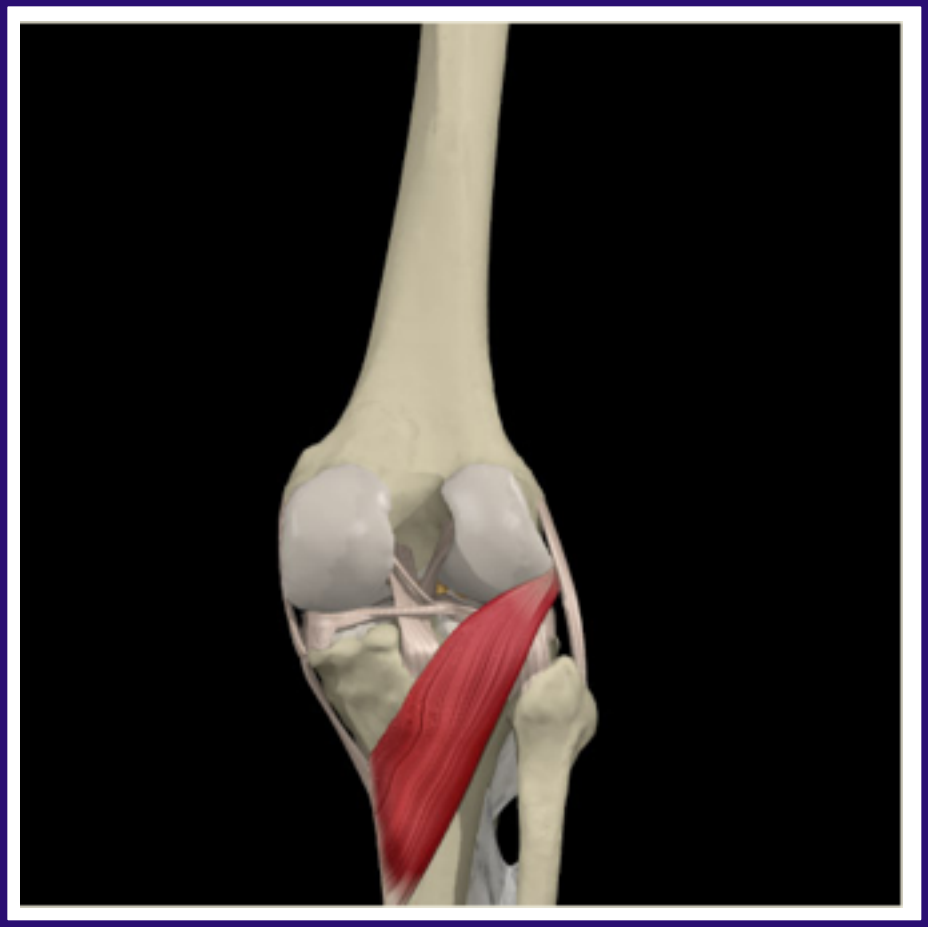
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Knee model: Posterior View



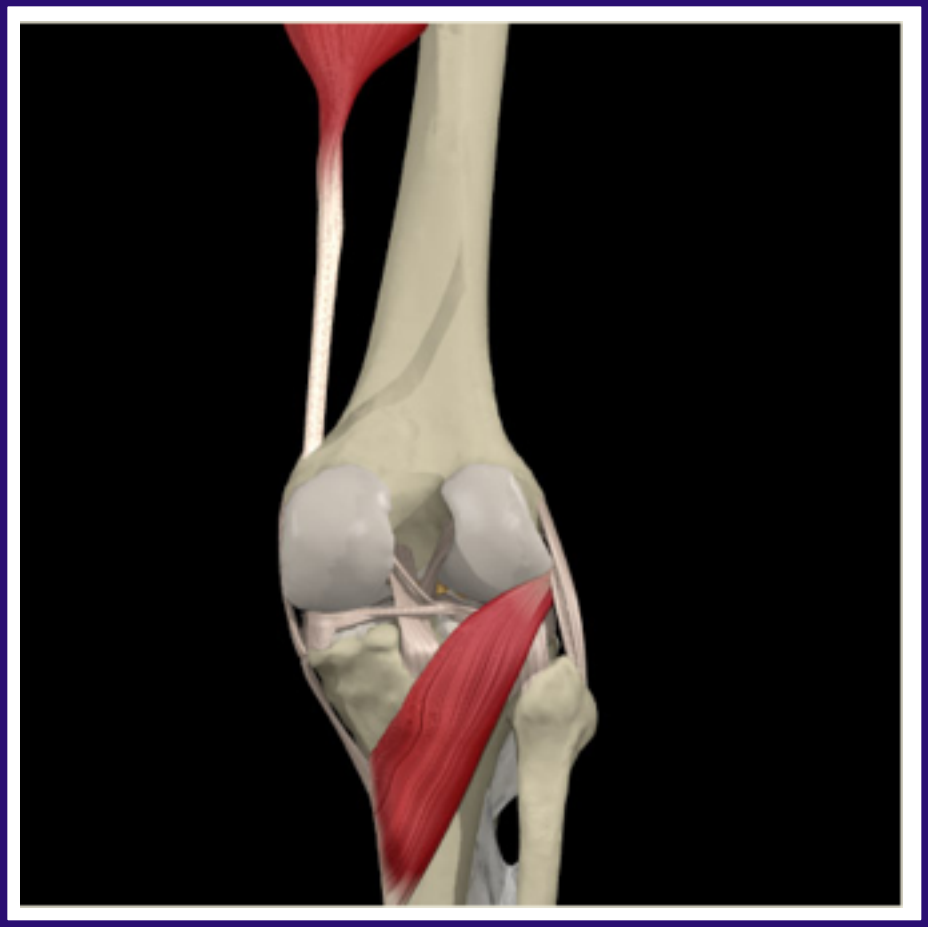
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Knee model: Posterior View



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Knee model: Posterior View



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Knee model: Posterior View



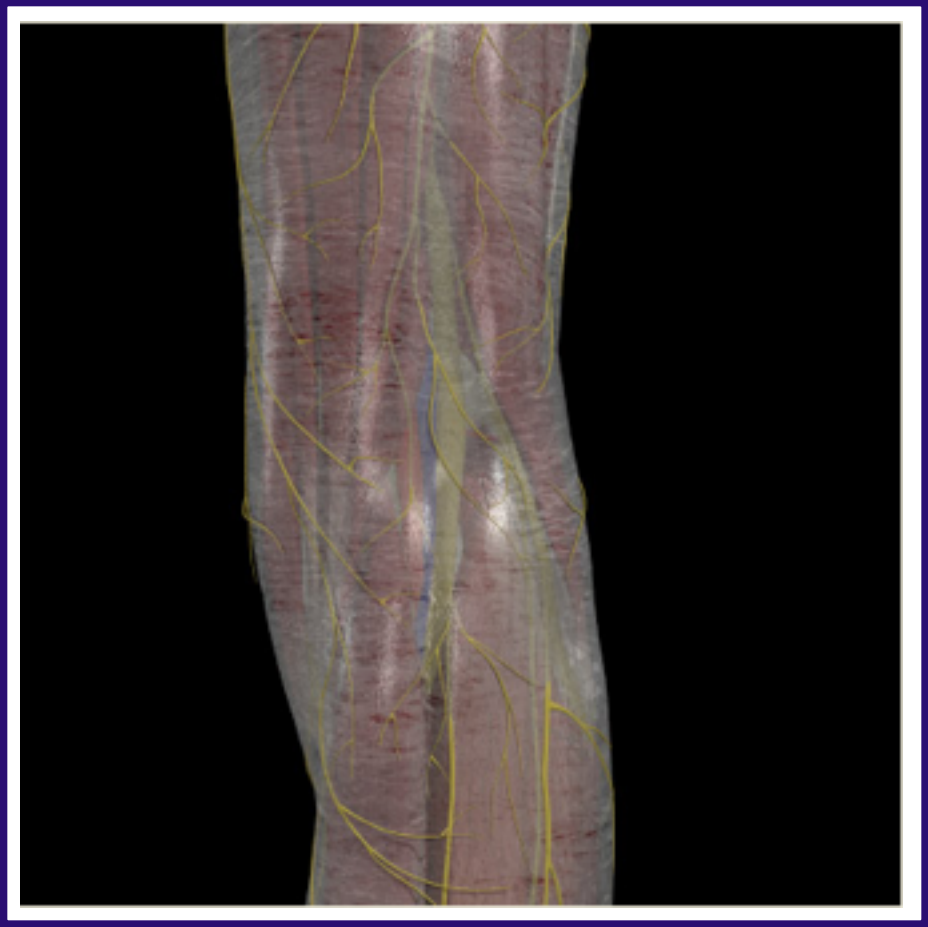
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Knee model: Posterior View



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Knee model: Posterior View



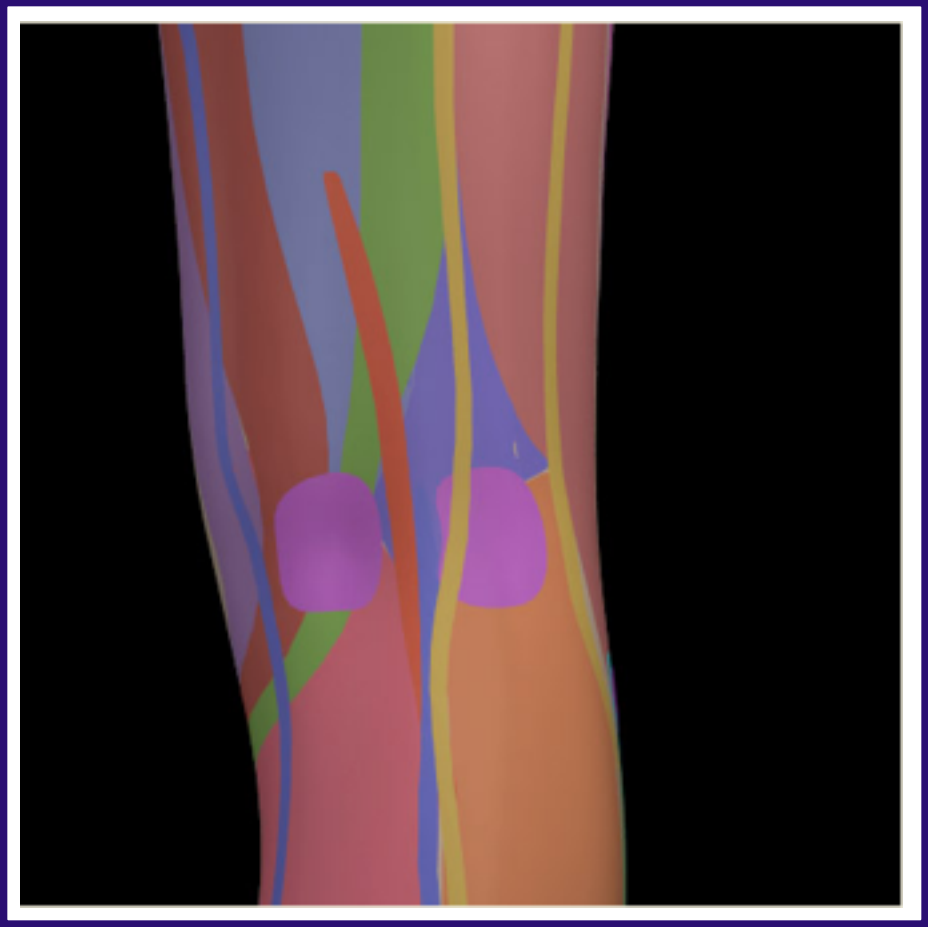
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Knee model: Posterior View



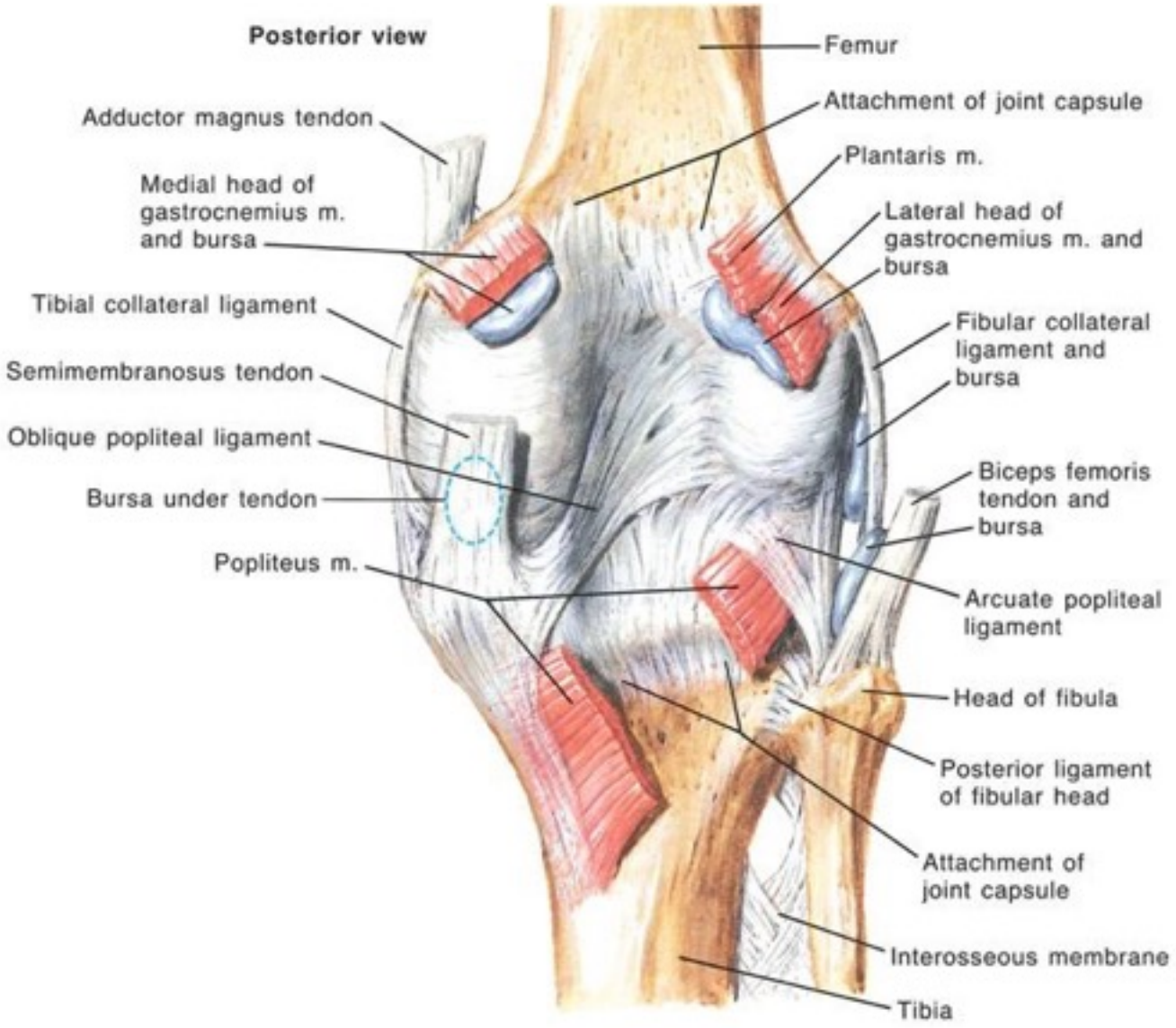
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Knee model: Posterior View



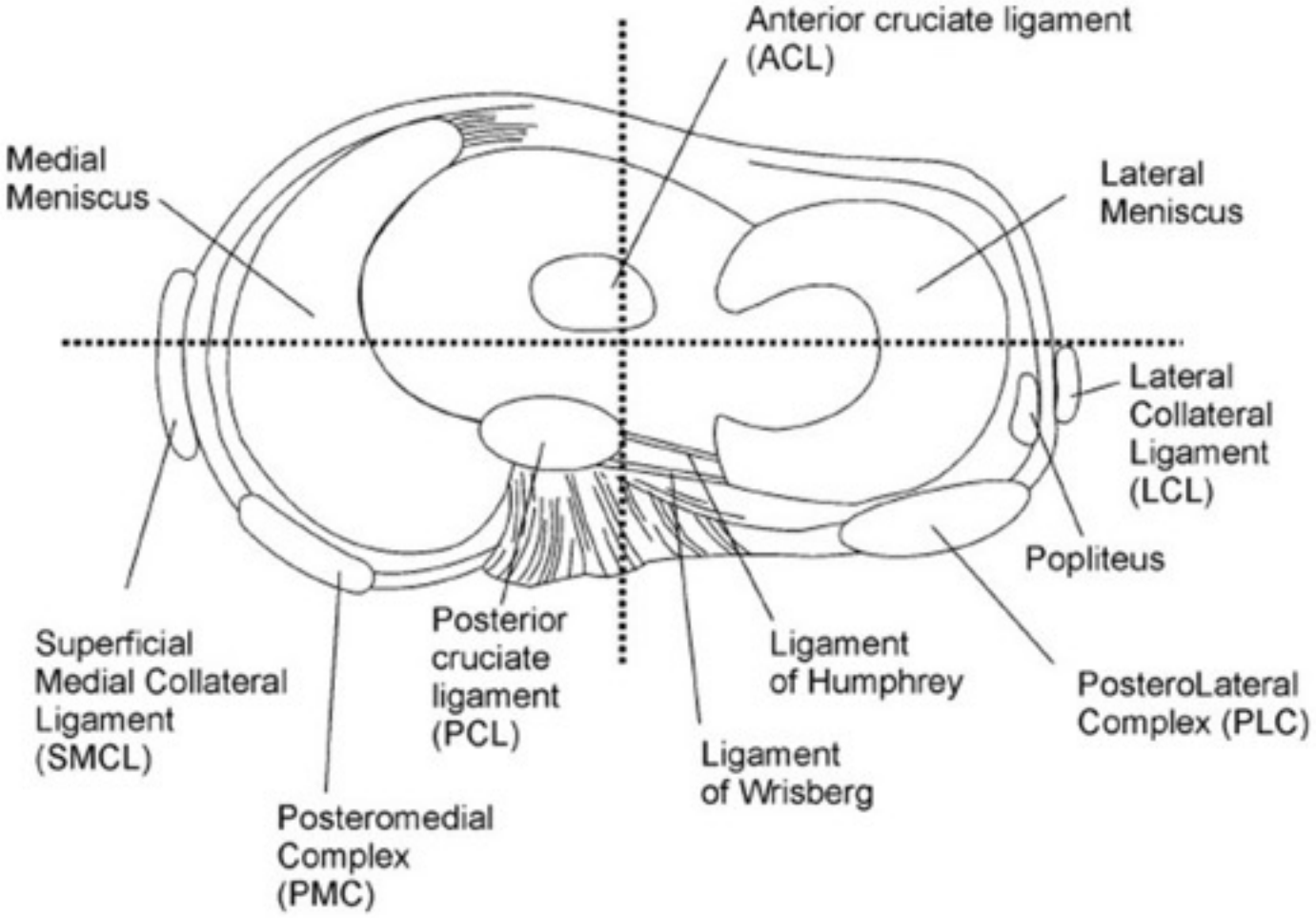
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Knee Joint (continued)



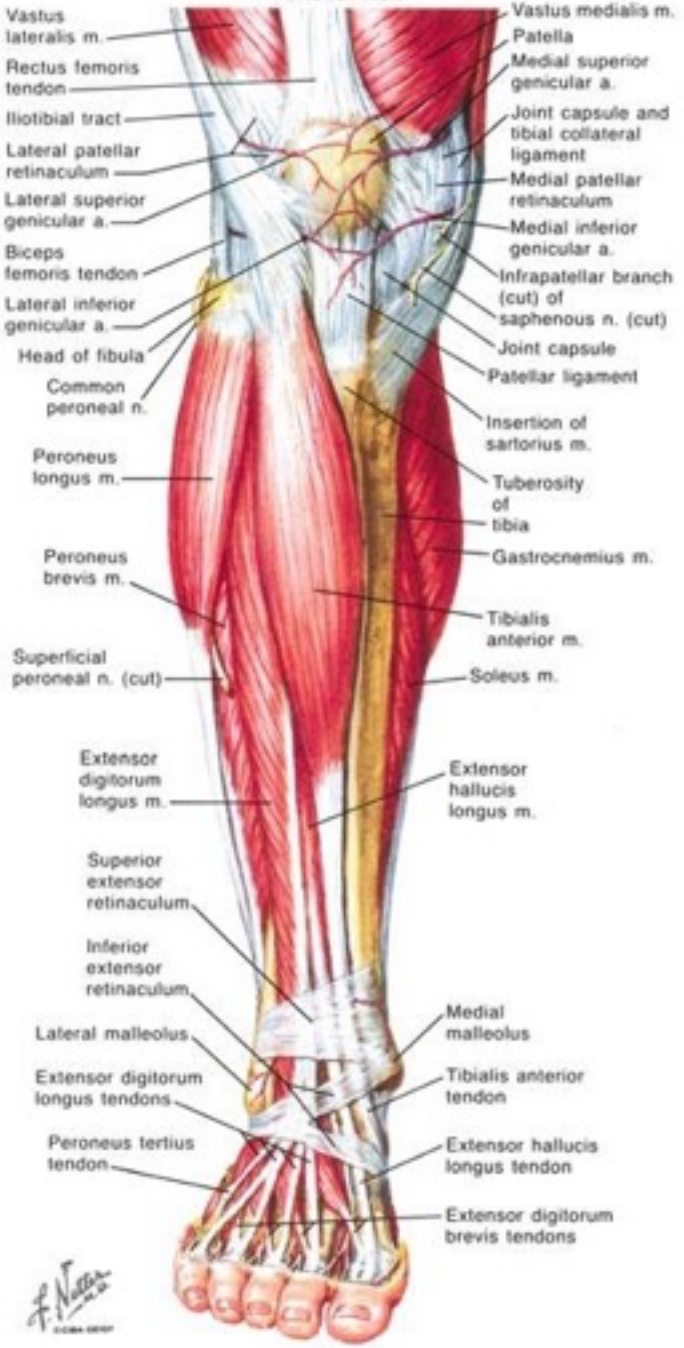
Knee Instabilities

Bird's-Eye view of Tibia



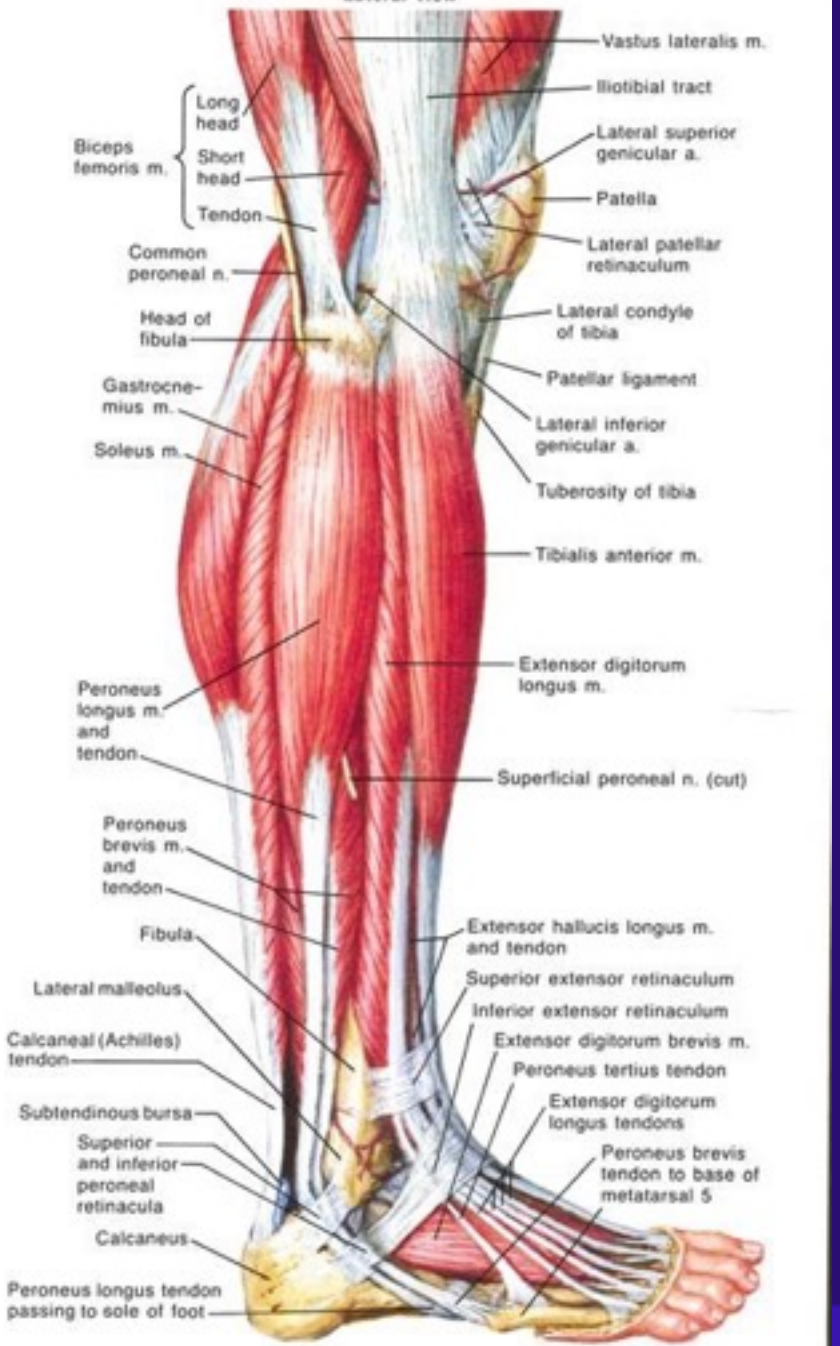
Muscles, Arteries, and Nerves of Leg: Superficial Dissection

Anterior view

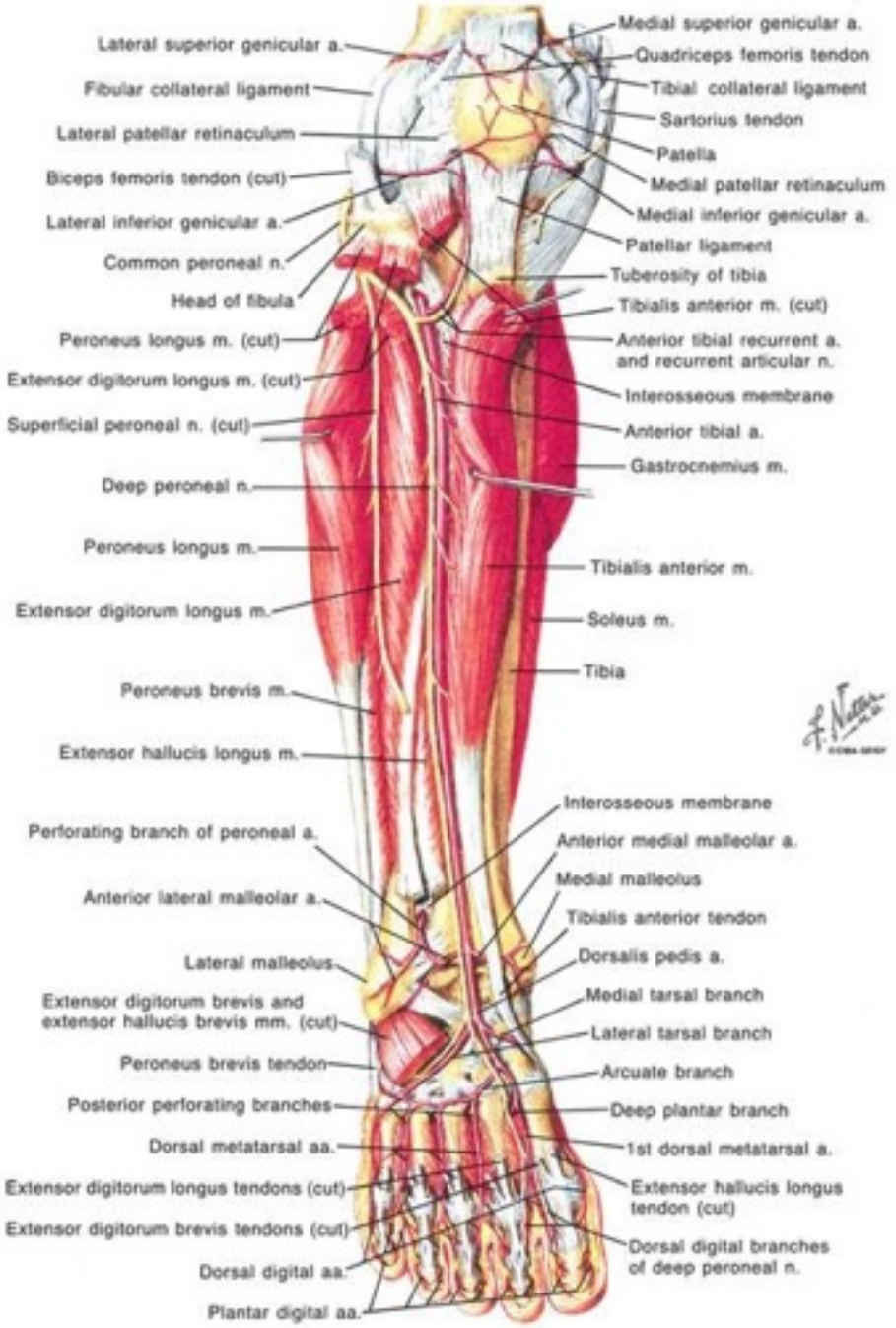


Muscles, Arteries, and Nerves of Leg: Superficial Dissection

Lateral view

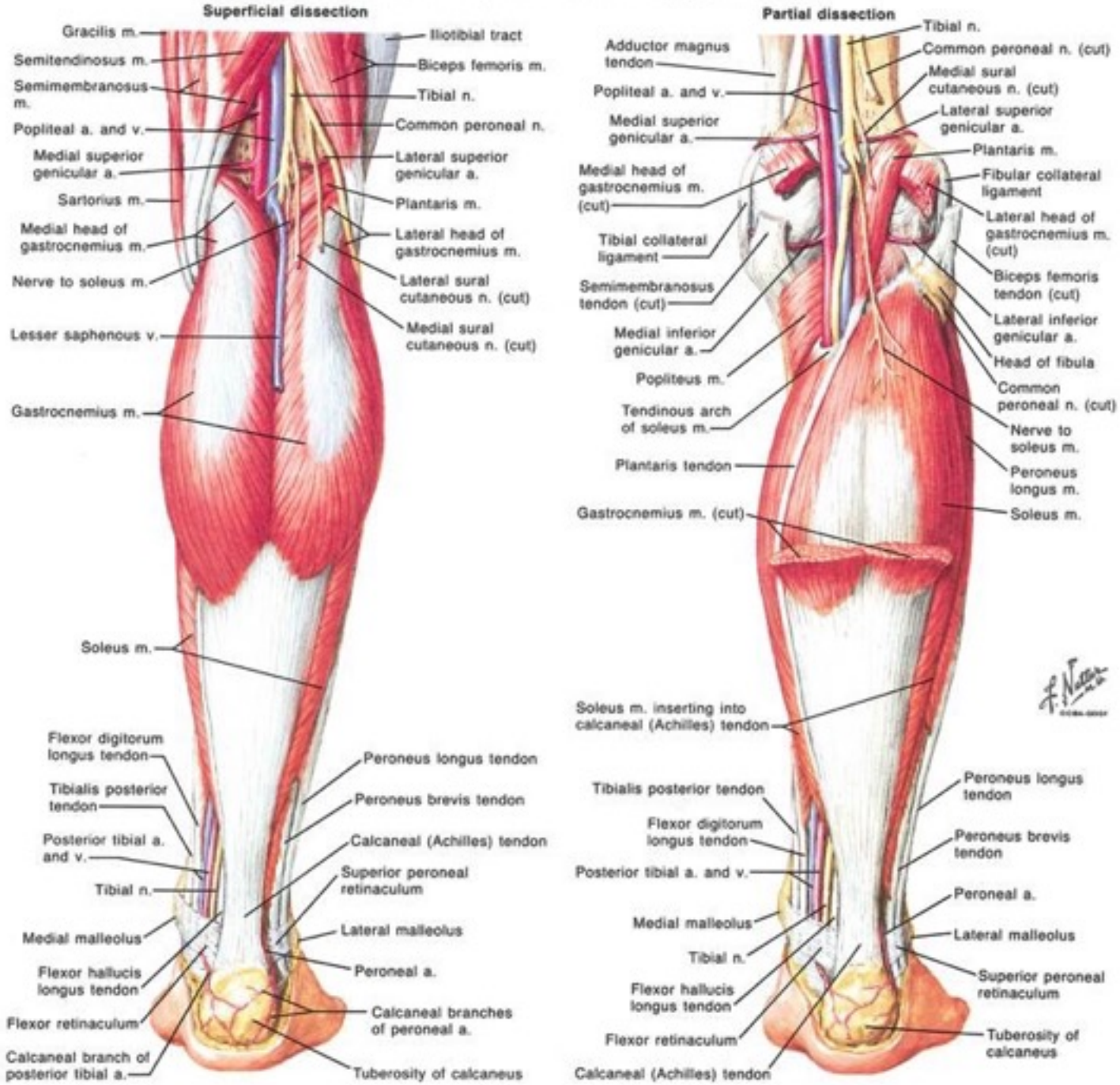


Muscles, Arteries, and Nerves of Leg: Deep Dissection (anterior view)



UKHealthCare Ort

Muscles, Arteries, and Nerves of Leg (posterior view)



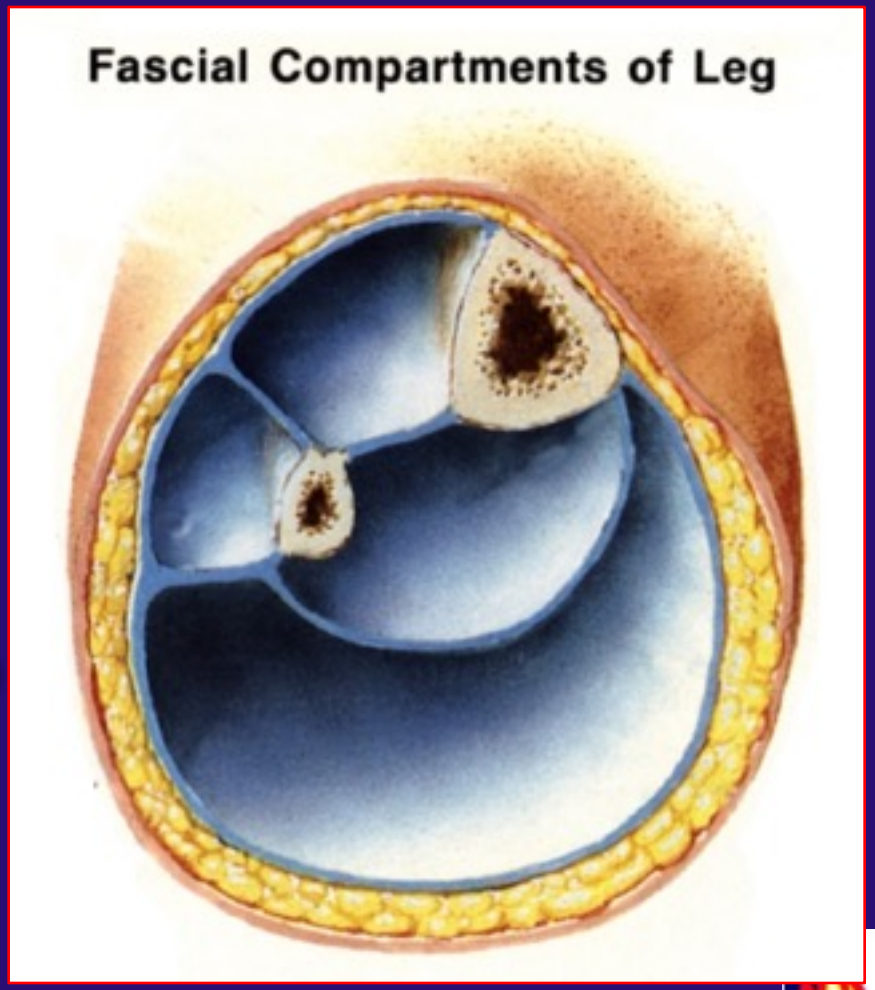
- Bone
  - A continuum of bone trauma exists from bone strain to stress reaction to stress fracture
- Periosteum
  - Inflammation occurs at muscular insertions particular of tibialis posterior and soleus.



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Anatomic Sources of Leg Pain

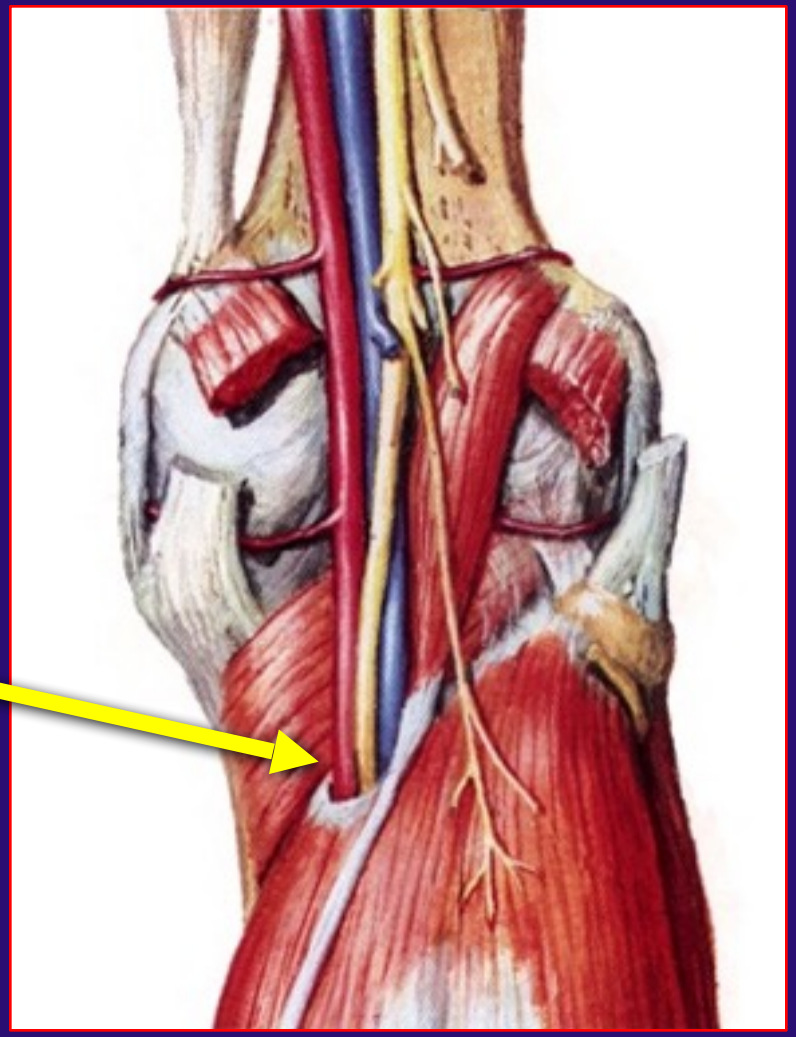
- Muscles and Compartments
  - 4-5 muscle compartments
  - Chronic strains and tendinopathy can occur
- Nerves
  - Proximal nerve entrapment can cause radicular pain
  - Systemic diseases can lead to neuropathy



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Anatomic Sources of Leg Pain

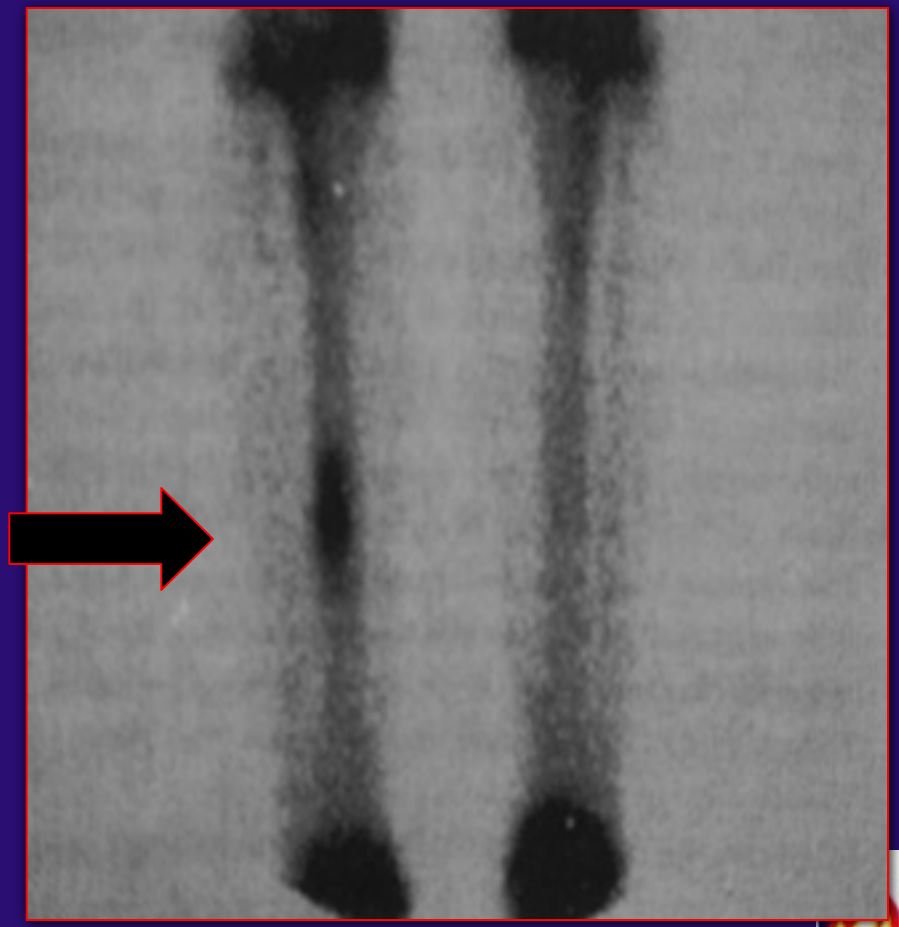
- Arteries and Veins
  - Atherosclerosis can lead to claudication
  - Venous phlebitis or thrombosis can occur
  - Popliteal artery entrapment and arterial endofibrosis has been described in younger population.



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Differential Dx of Chronic Leg Pain in Athletes

- CECS
- Muscle herniation
- Stress fractures
- Medial tibial periostitis (shin splints)
- Chronic muscle strain
- Popliteal artery entrapment
- Referred from spine



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Compartment Syndromes

- **Traumatic**
  - Secondary to fracture, crush, and reperfusion injuries
  - Surgical emergency
  - Skin and fascia may both contribute to compartmental restriction and increased pressure
  - Non-physiologic swelling secondary to trauma
- **Exertional**
  - Consistently exercise-induced
  - Generally endurance athletes
  - No pain at rest, pain consistently relieved with cessation of sport
  - Attributed to restriction of muscle swelling secondary to tight fascial compartments
  - Diagnosed with pre and post exercise pressure measurements

History and Physical: Clinical Pearls in Athletic Leg Pain



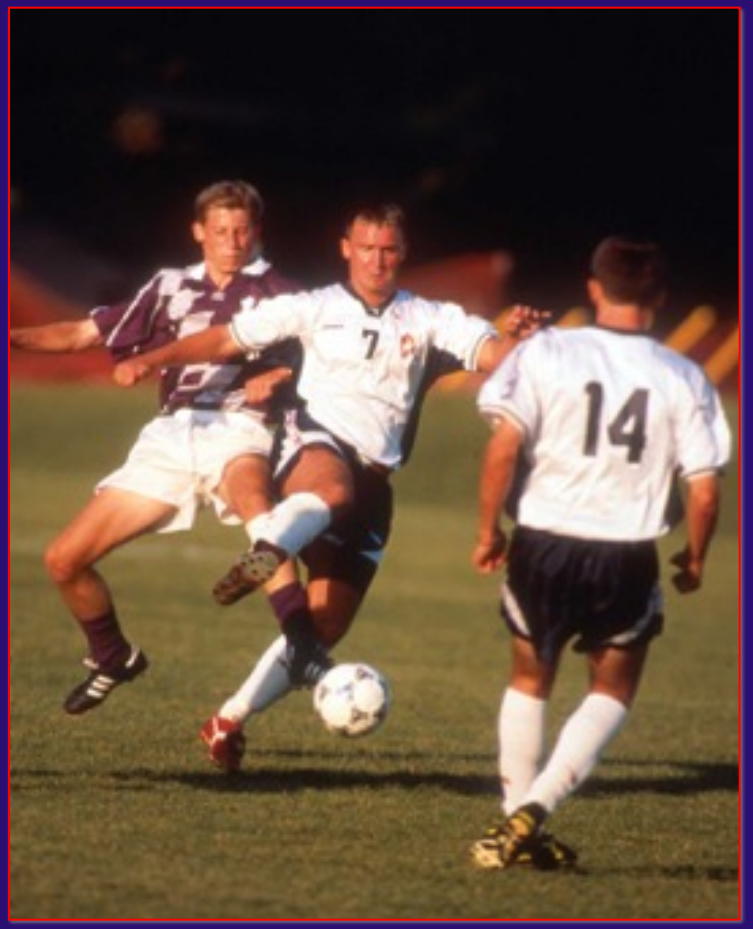
- Pain with initial impact
  - Stress fracture
  - Periostitis
  - Muscle strains and tendinitis
- Focal bone pain
  - Stress fracture
- Diffuse medial bone pain
  - Medial tibial periostitis
- Focal muscle pain
  - Strain or Hernia

History and Physical: Clinical Pearls in Athletic Leg Pain

- Pain with resisted motion
  - Muscle strains and periostitis
- Pain with vibration
  - Stress fractures
- Pain at night
  - Tumors
- Pain with exertion
  - CECS, Popliteal artery entrapment
- Paresthesias at rest
  - Nerve entrapment
- Paresthesias with exertion
  - CECS
- Electrical shooting pain
  - Radicular pain from back

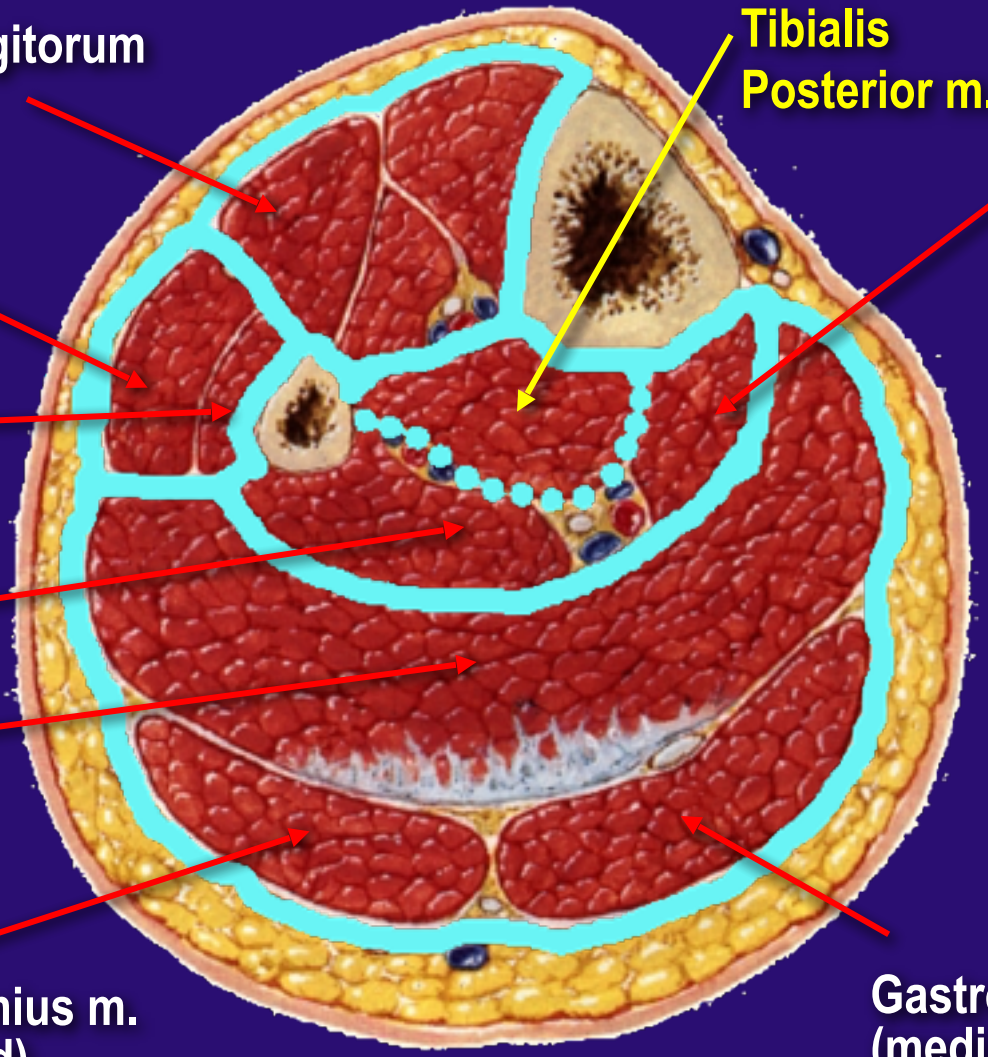
History and Physical: Clinical Pearls in Athletic Leg Pain

- Diffuse swelling
  - DVT
  - CECS
  - Muscle ruptures
- Focal swelling
  - Muscle herniation
  - Ganglion
  - Tumor



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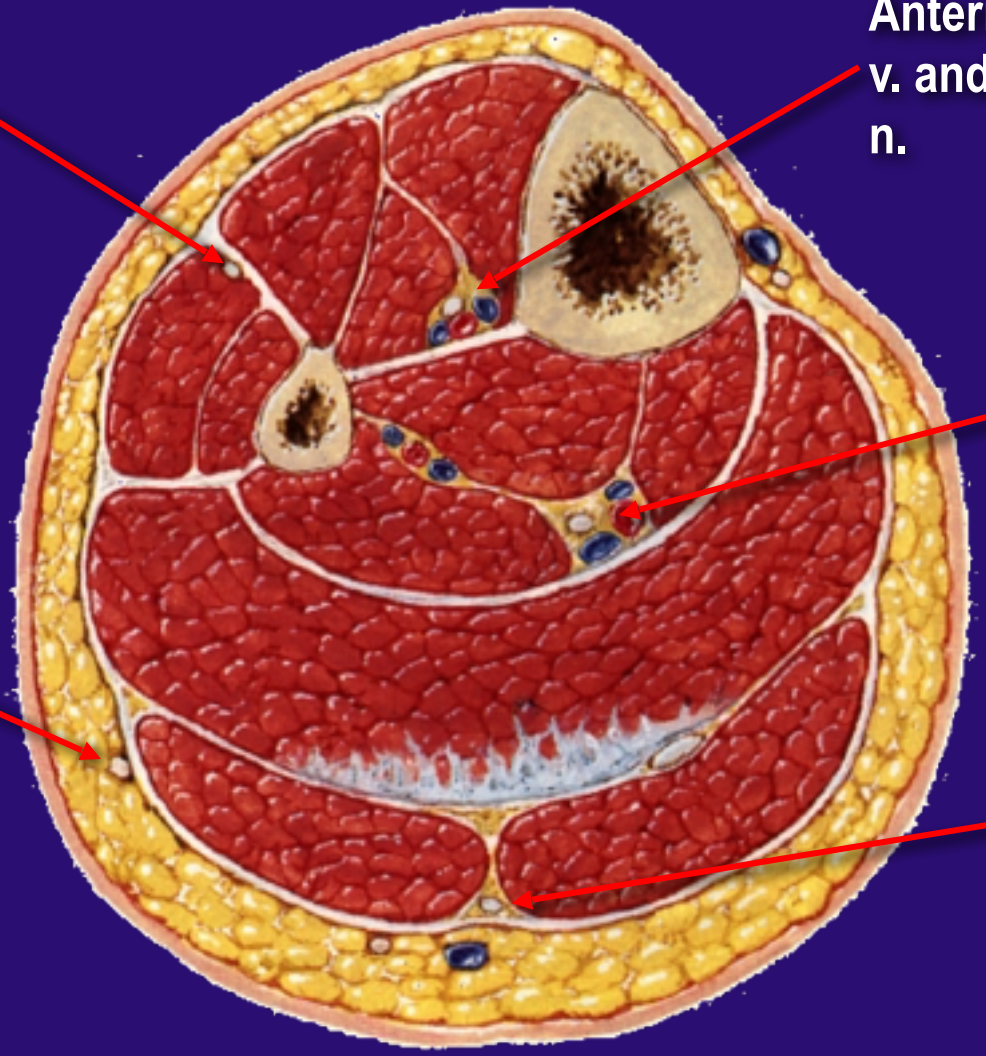
80% of CECS involve the anterior or lateral compartments (Cross-section just above middle of leg)



Davey J, Rorabeck C, and Fowler P. **The tibialis posterior muscle compartment.** *Am J Sports Med* 12(5): 391-397, 1984.

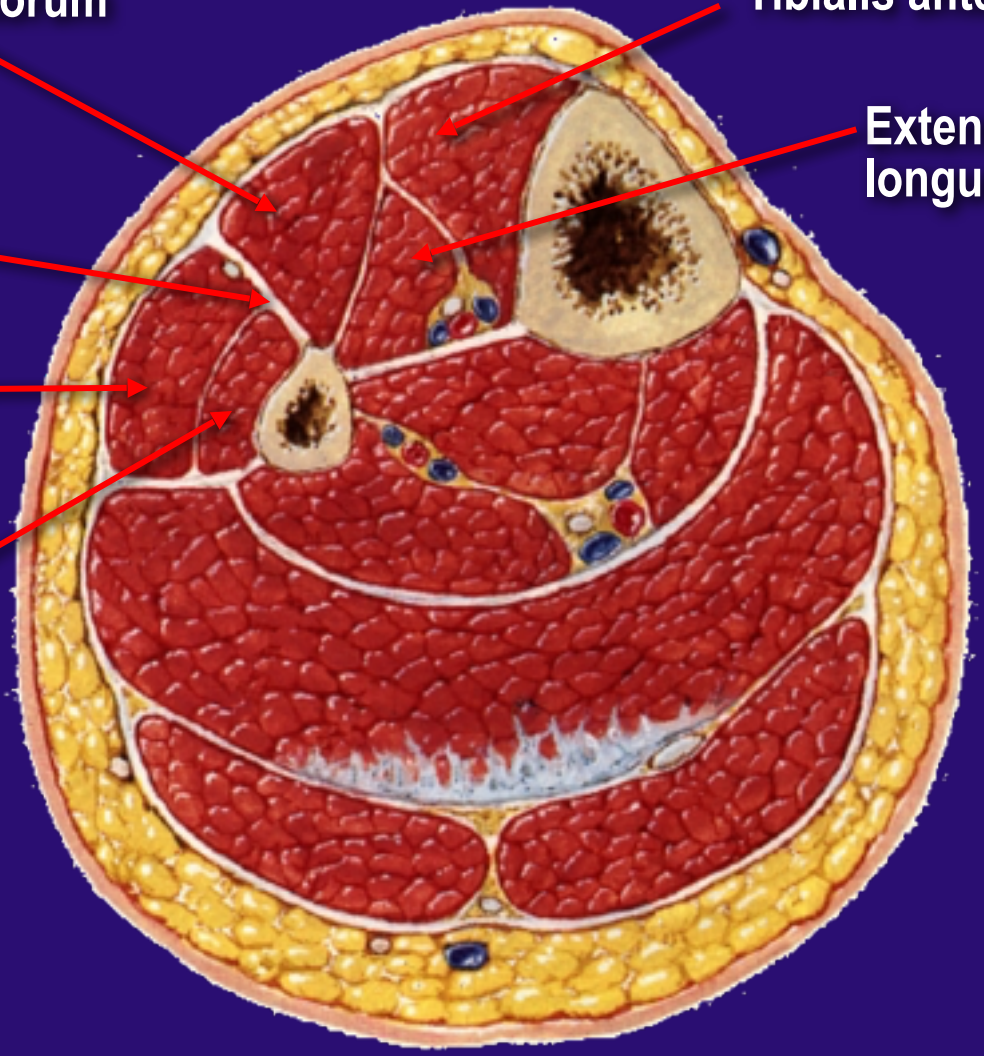
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Nerves (Cross-section just above middle of leg)



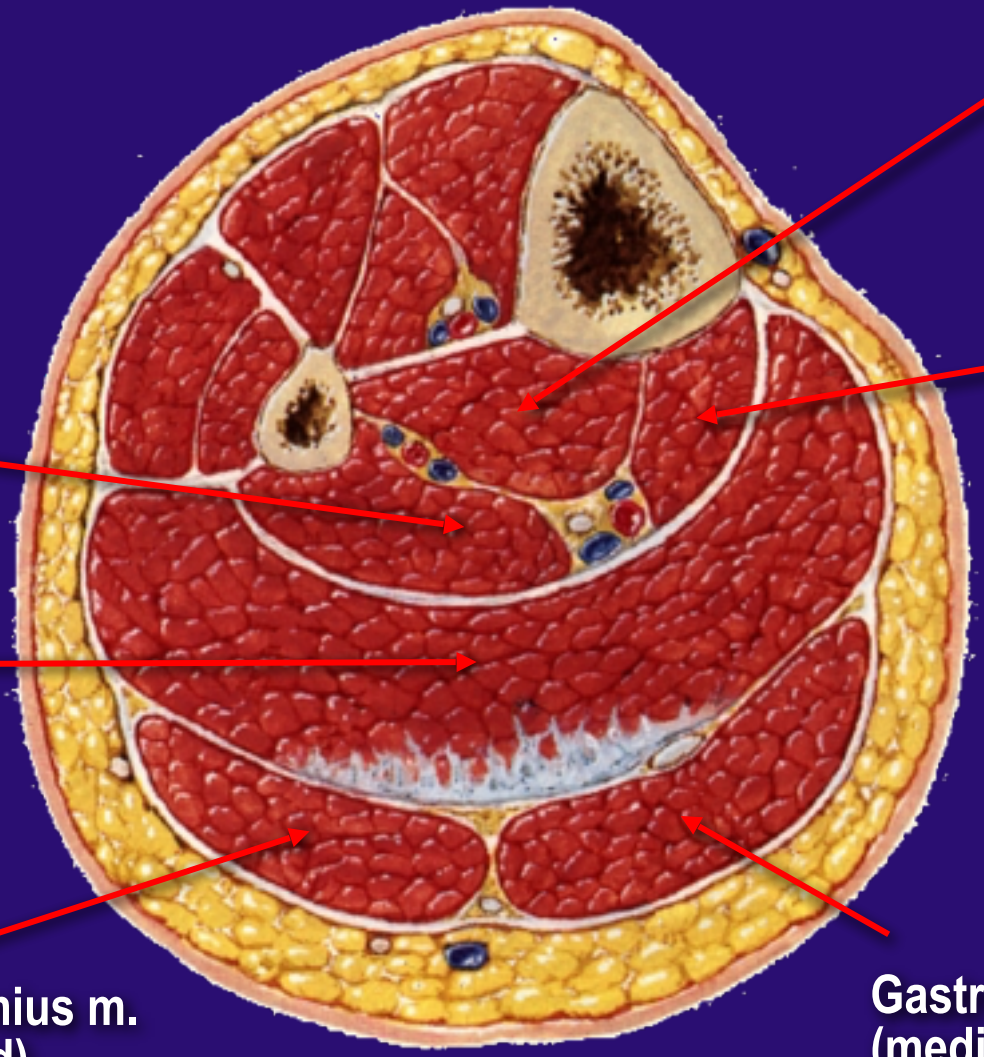
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Anterior and Lateral Compartments



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Posterior Compartments: Deep and Superficial



Tibialis Posterior m.

Flexor digitorum longus m.

Flexor hallucis longus m.

Soleus m.

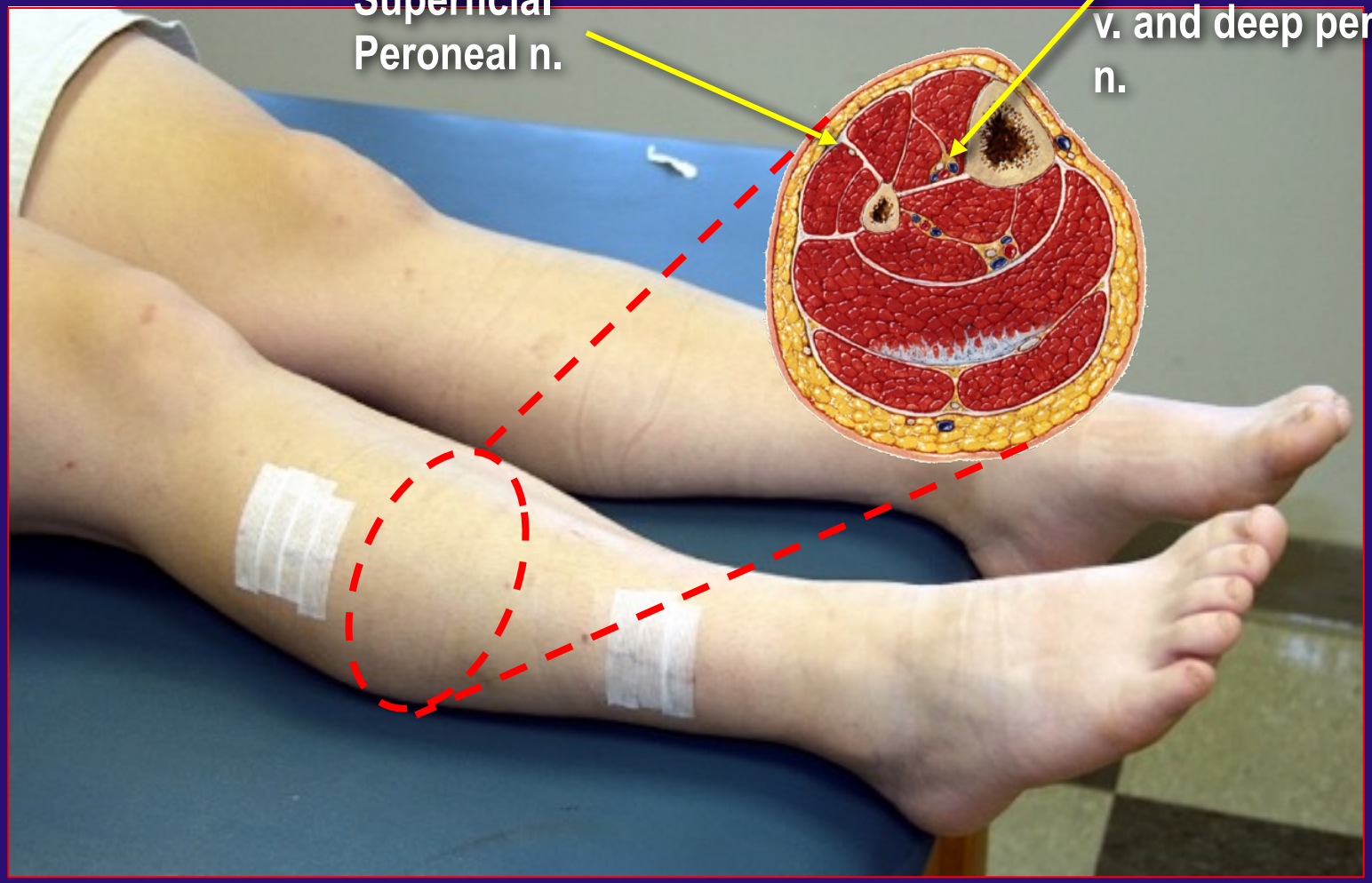
Gastrocnemius m. (lateral head)

Gastrocnemius m. (medial head)

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Know the anatomy before performing compartment testing or surgical releases.



Know the anatomy before performing compartment testing or surgical releases.

Functional Anatomy of the Knee and Leg



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ACSM TPC Part 2
Miami, Florida • February 9, 2013

The End . . .

Thank You!

Functional Anatomy of the Knee and Leg



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