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1 The Knee Joint
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Knee Joint

Knee Joint

- largest joint in body
- very complex
- primarily a hinge joint

Enlarged femoral condyles articulate on enlarged tibial condyles

Medial and lateral tibial condyles (medial & lateral tibial plateaus) - receptacles for femoral condyles

Tibia – medial

- bears most of weight

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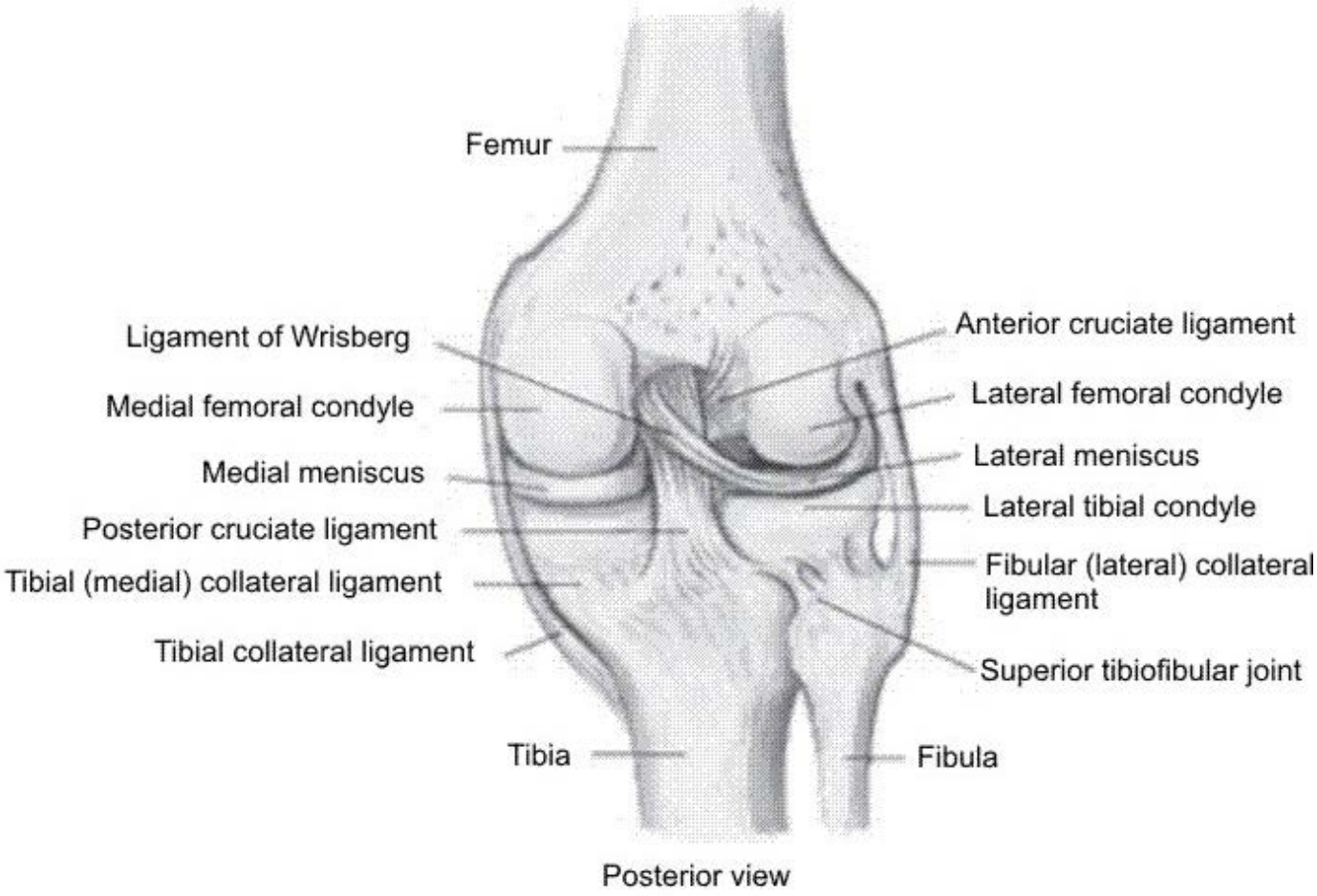
Bones

Fibula - lateral

serves as the attachment for knee joint structures

does not articulate with femur or patella

not part of knee joint



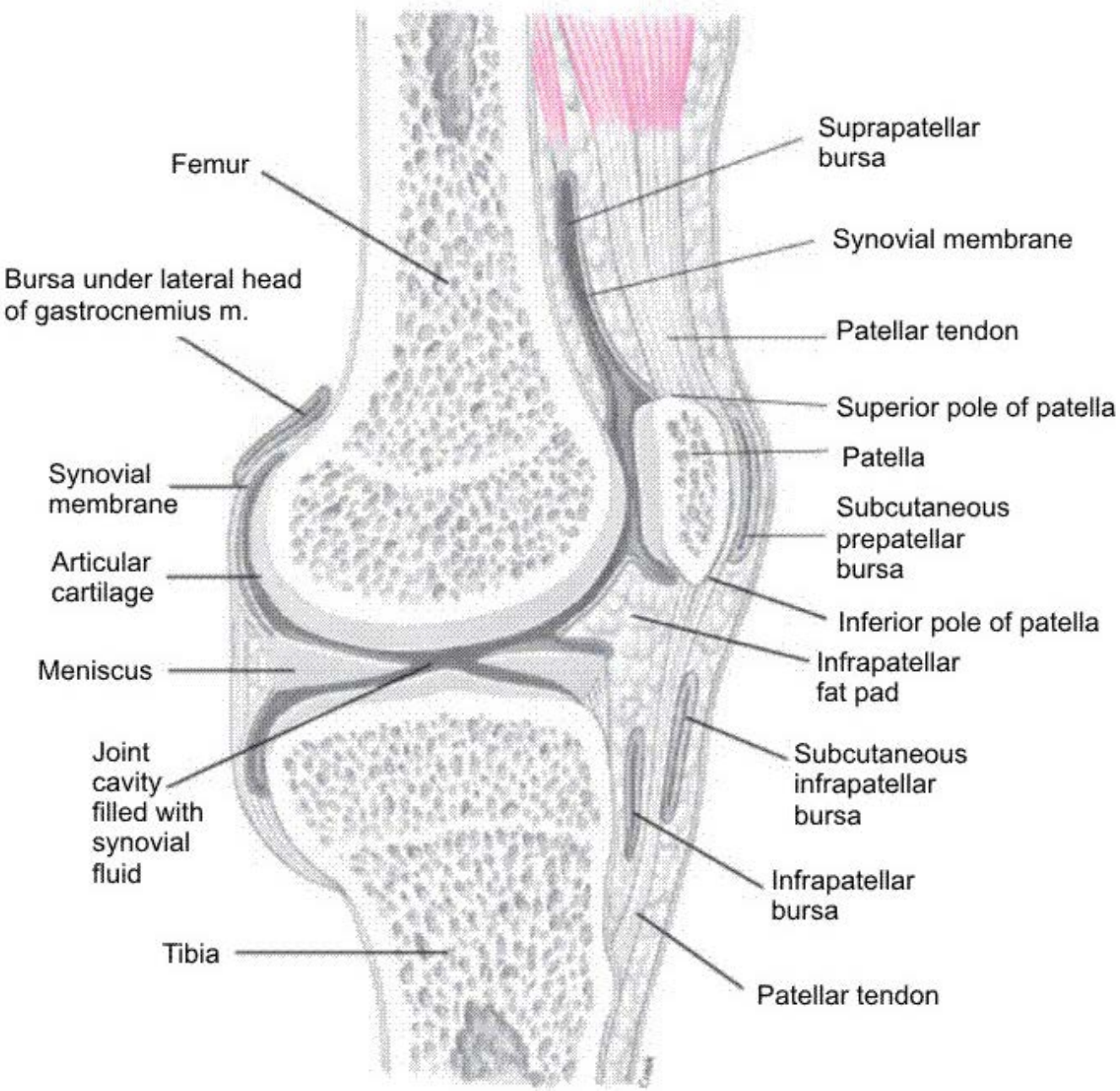
Bones

Patella

sesamoid (floating) bone

imbedded in quadriceps & patellar tendon

serves similar to a pulley in improving angle of pull, resulting in greater mechanical advantage in knee extension



Bones

Key bony landmarks

Superior and inferior patellar poles

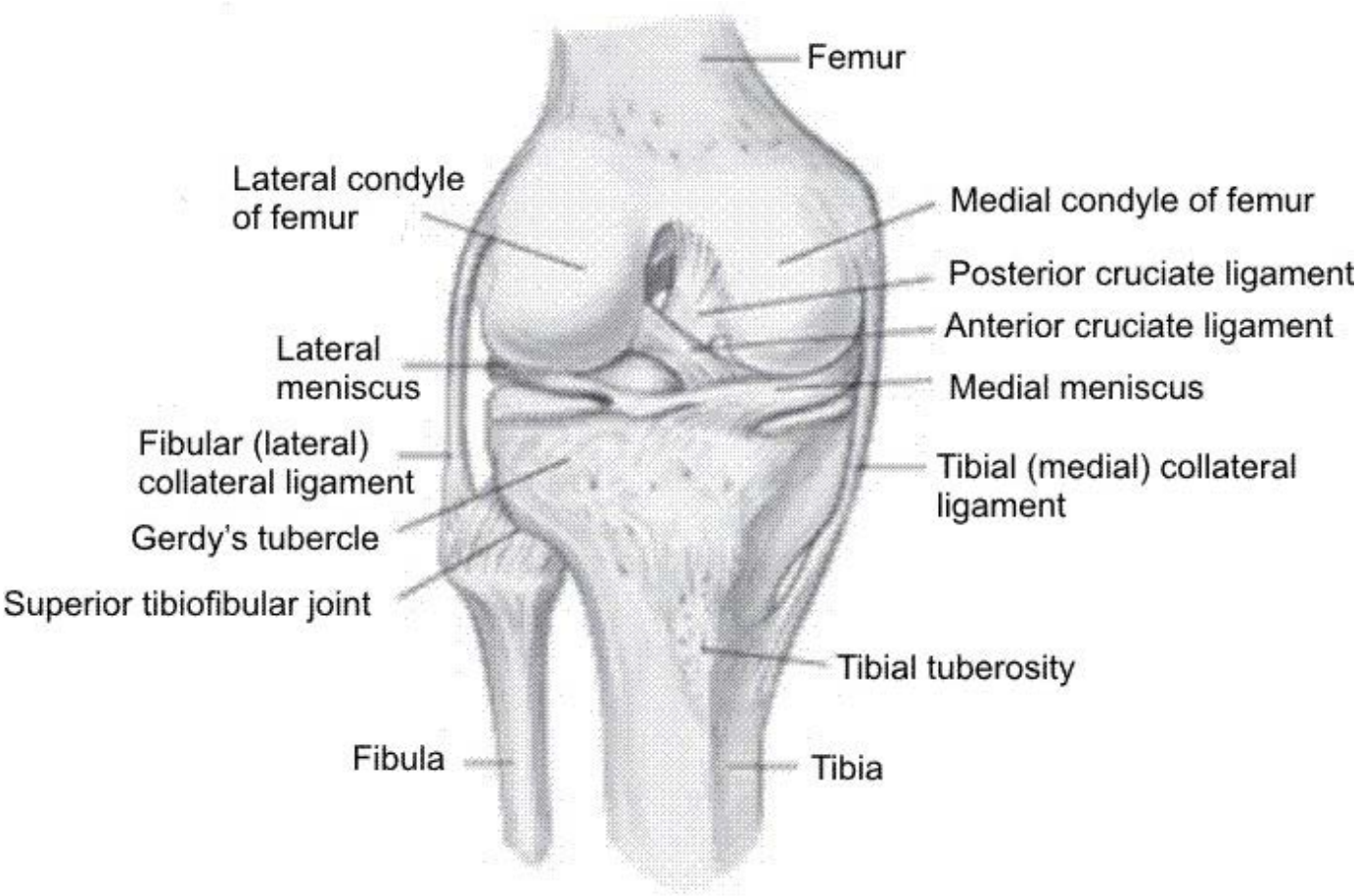
Tibial tuberosity

Gerdy's tubercle

Medial & lateral femoral condyles

Upper anterior medial tibial surface

Head of fibula



Anterior veiw with patella reomoved

Bones

Three vasti muscles of quadriceps originate on proximal femur and insert on patellar superior pole

insertion is ultimately on tibial tuberosity via patella tendon

Iliotibial tract of tensor fasciae latae inserts on Gerdy's tubercle

Sartorius, gracilis, and semitendinosus insert just below the medial condyle on upper anteromedial tibial surface

Semimembranosus inserts posteromedially on medial tibial condyle

Biceps femoris inserts primarily on fibula head

Popliteus originates on lateral aspect of lateral femoral condyle

Tibial collateral ligament originates on medial aspect of upper medial femoral condyle and inserts on medial tibial surface

Fibula collateral originates on lateral femoral condyle very close to popliteus origin and inserts on fibular head

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Joints

Knee joint proper (tibiofemoral joint)

- classified as a ginglymus joint ; Sometimes referred to as trochoginglymus joint internal and external rotation occur during flexion ; Some argue for condyloid classification

Patellofemoral joint

- arthrodial classification
- gliding nature of patella on femoral condyles

Ligaments provide static stability

Quadriceps and hamstrings contractions produce dynamic stability

Articular cartilage surfaces on femur and tibia

Menisci form cushions between bones

- attached to tibia
- deepen tibial fossa
- enhance stability

Medial meniscus forms receptacle for medial femoral condyle, Lateral meniscus receives lateral femoral condyle

- Thicker on outside border and taper down very thin to inside border
- Can slip about slightly, but held in place by various small ligaments
- Medial meniscus - larger and more open C appearance
- Lateral meniscus - closed C configuration

Either or both menisci may be torn in several different areas from a variety of mechanisms, resulting in varying degrees of problems

- Tears often occur due significant compression and shear forces during rotation while flexing or extending during quick directional changes in running

Anterior and posterior cruciate ligaments

cross within knee between tibia and femur

vital in respectively maintaining anterior and posterior stability, as well as rotatory stability

Anterior cruciate ligament (ACL) injuries

one of most common serious injuries to knee

mechanism often involves noncontact rotary forces associated with planting and cutting, hyperextension, or by violent quadriceps contraction which pulls tibia forward on femur

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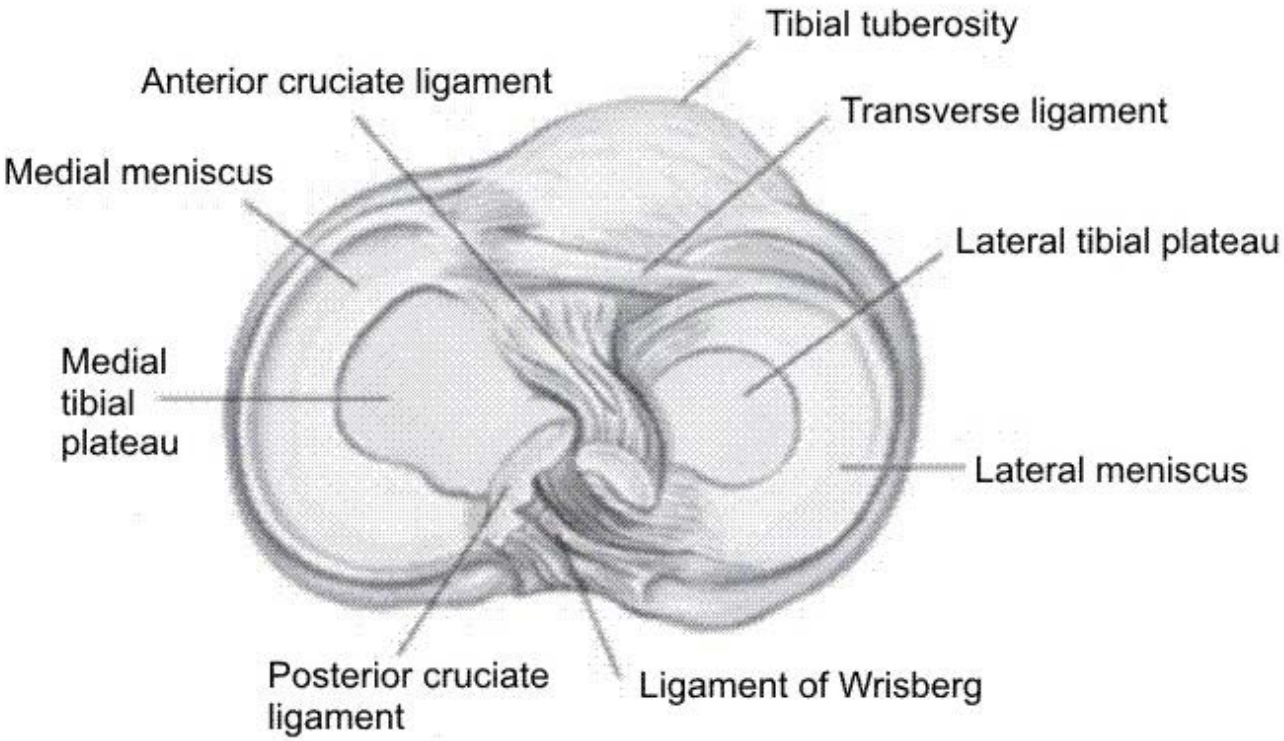
Joints



Superior view with femur removed

Joints

Posterior cruciate ligament (PCL) injuries

- not often injured
- mechanism of direct contact with an opponent or playing surface

Fibular (lateral) collateral ligament (LCL)

- infrequently injured

Tibial (medial) collateral ligament (MCL)

- maintains medial stability by resisting valgus forces or preventing knee from being abducted
- injuries occur commonly, particularly in contact or collision sports
- mechanism of teammate or opponent may fall against lateral aspect of knee or leg causing medial opening of knee joint and stress to medial ligamentous structures

Synovial cavity

- supplies knee with synovial fluid
- lies under patella and between surfaces of tibia and femur
- "capsule of the knee”

Infrapatellar fat pad

- just posterior to patellar tendon
- an insertion point for synovial folds of tissue known as “plica”
- an anatomical variant that may be irritated or inflamed with injuries or overuse of the knee

Bursae

- more than 10 bursae in and around knee
- some are connected to synovial cavity
- they absorb shock or prevent friction

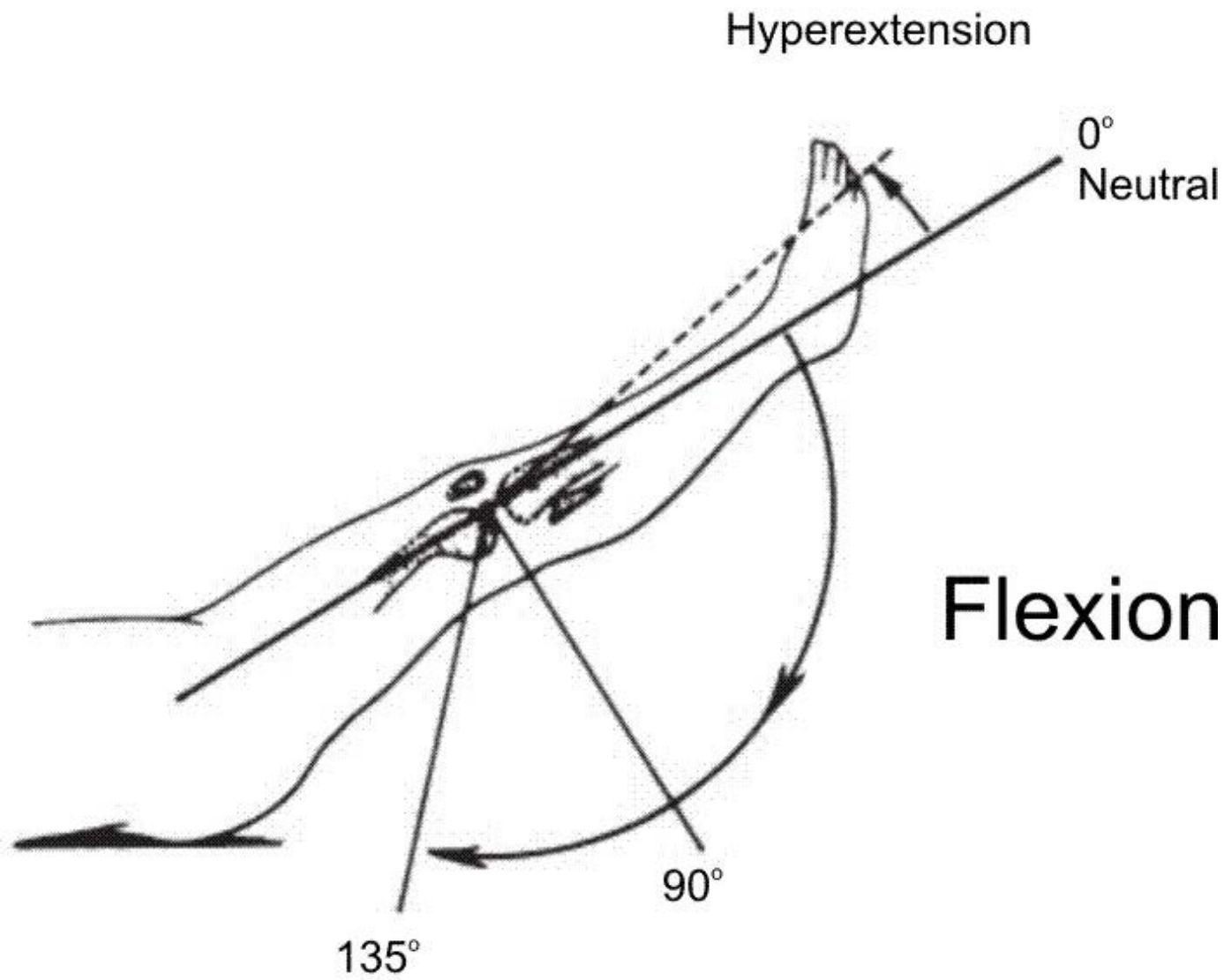
Joints

Extends to 180 degrees (0 degrees of flexion)

Hyperextension of 10 degrees or > not uncommon

Flexion occurs to about 140 degrees

With knee flexed 30 degrees or > ; internal rotation 30 degrees occurs ; external rotation 45 degrees occurs



Muscles

Knee “screws home” to fully extend due to the shape of medial femoral condyle

As knee approaches full extension tibia must externally rotate approximately 10 degrees to achieve proper alignment of tibial and femoral condyles

In full extension

- close congruency of articular surfaces
- no appreciable rotation of knee

During initial flexion from full extension

- knee “unlocks” by tibia rotating internally, to a degree, from its externally rotated position to achieve flexion

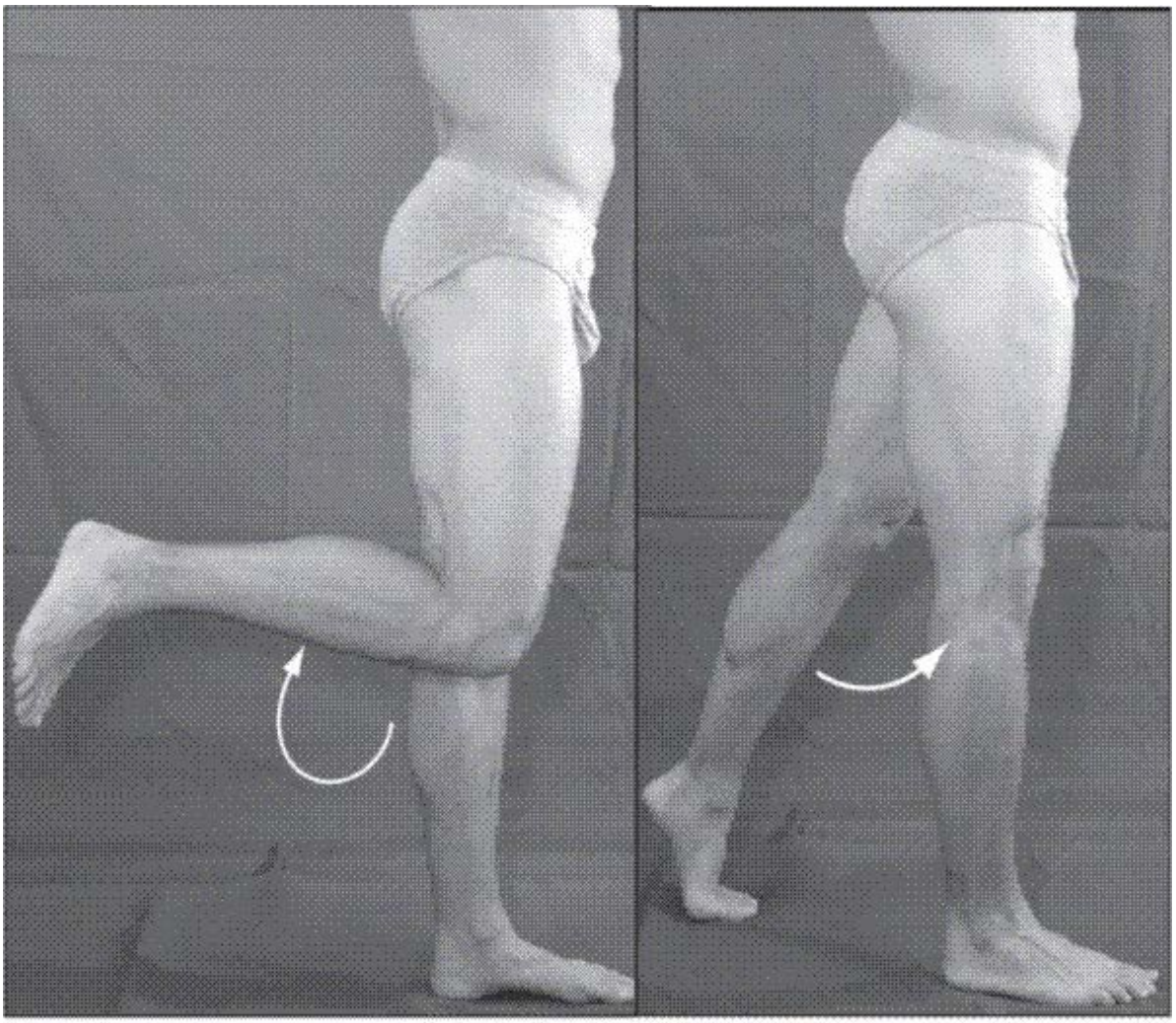
Movements

Flexion

bending or decreasing angle between femur and leg, characterized by heel moving toward buttocks

Extension

straightening or increasing angle between femur and lower leg



Flexion Extension

Movements

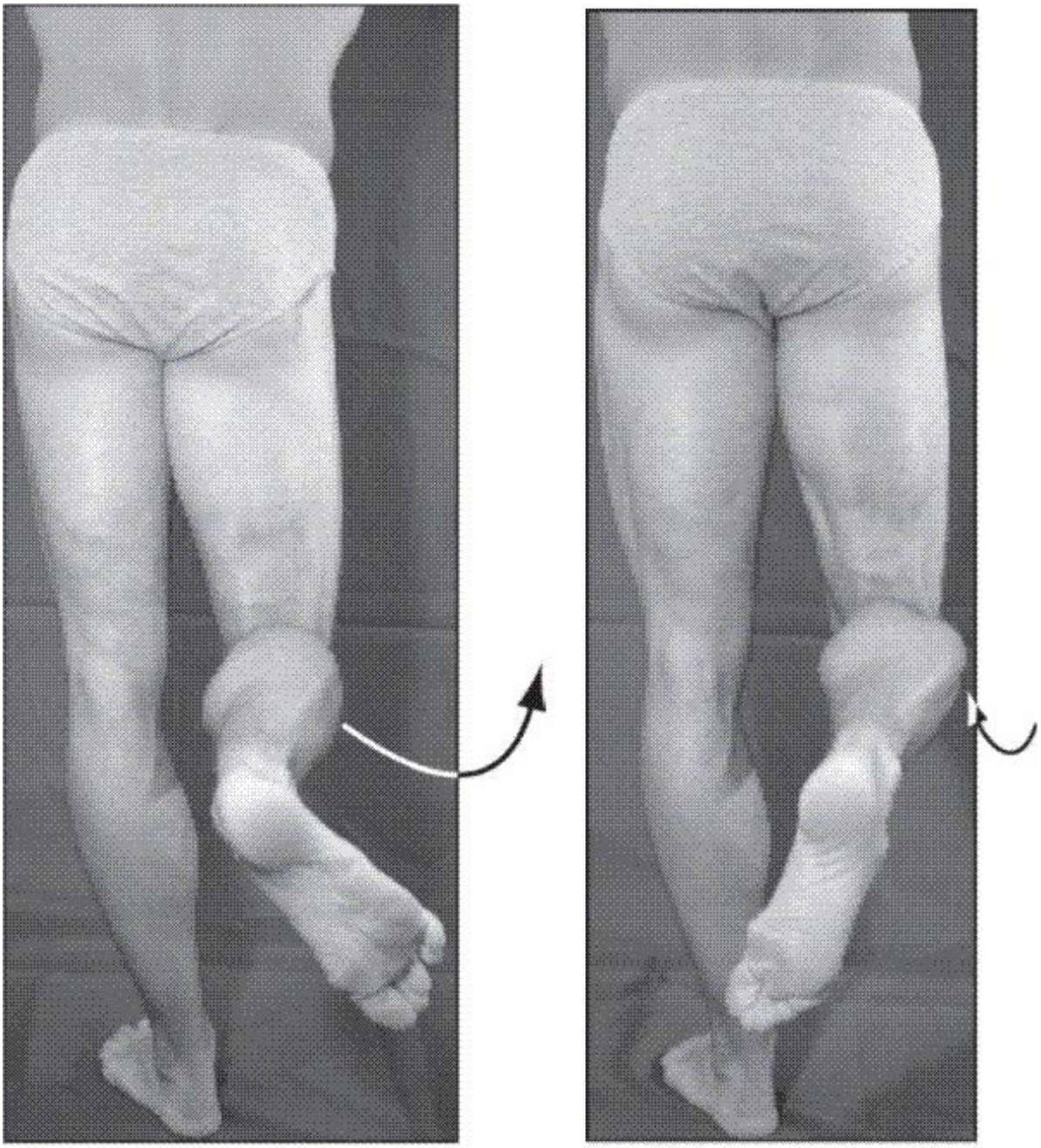
External rotation

rotary movement of leg laterally away from midline

Internal rotation

rotary movement of lower leg medially toward midline

Neither will occur unless flexed 20-30 degrees or >



Muscles

Q angle

Central line of pull for entire quadriceps runs from ASIS to the center of patella

Line of pull of patella tendon runs from center of patella to center of tibial tuberosity

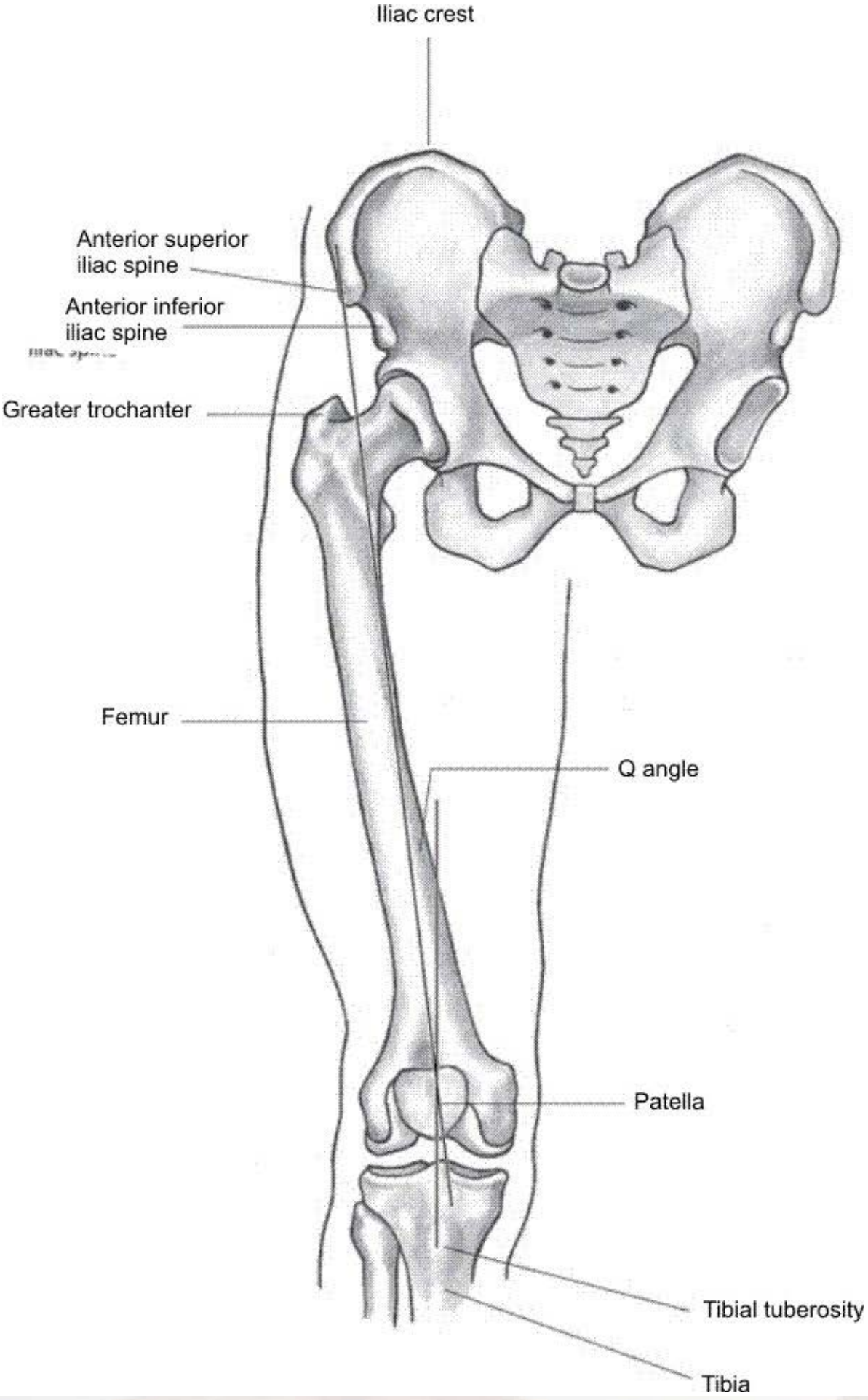
Angle formed by the intersection of these two lines at the patella is the Q angle

Normally, angle will be 15 degrees or less for males & 20 degrees or less in females

Generally, females have higher angles due to a wider pelvis

Higher Q angles generally predispose people in varying degrees to a variety of potential knee problems including lateral patellar subluxation or dislocation, patellar compression syndrome, chondromalacia, and ligamentous injuries

For people with above normal Q angles, it is particularly important to maintain high levels of strength & endurance in vastus medialis so as to counteract lateral pull of vastus lateralis


Iliac crest
Anterior superior iliac spine
Anterior inferior iliac spine
Greater trochanter
Femur
Q angle
Patella
Tibial tuberosity
Tibia

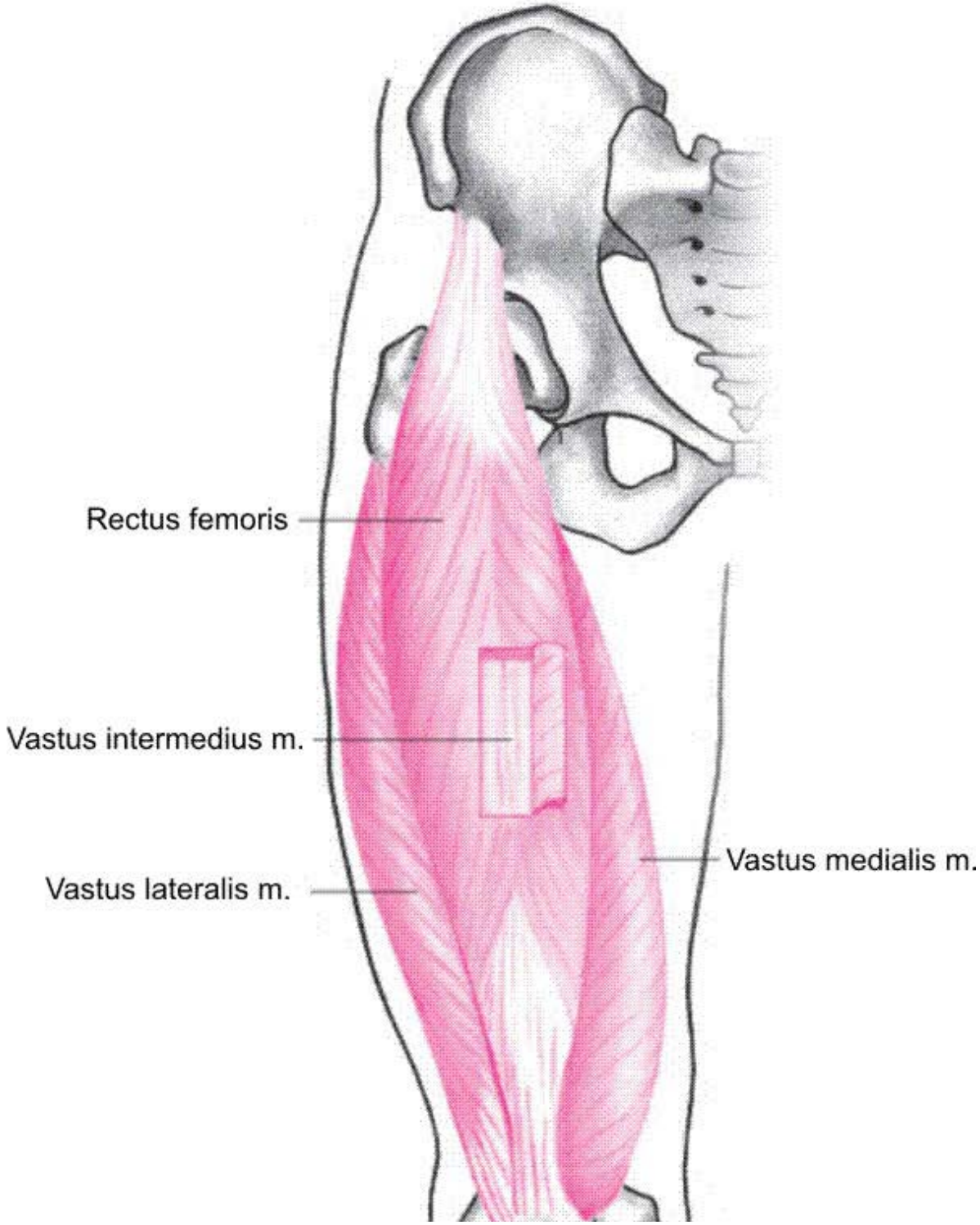
Muscles

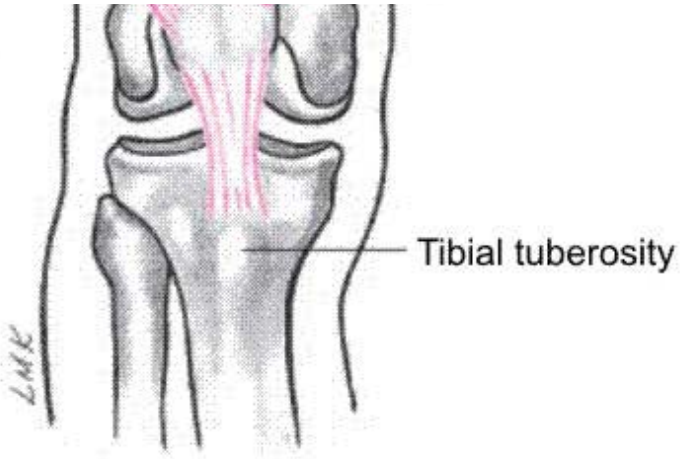
Quadriceps muscle group

extends knee

located in anterior compartment of thigh

consists of 4 muscles: rectus femoris ; vastus lateralis ; vastus intermedius ; vastus medialis





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Muscles

Hamstring muscle group

responsible for knee flexion

located in posterior compartment of thigh

consists of 3 muscles ; semitendinosus - medial, internal rotator ; semimembranosus - medial, internal rotator ; biceps femoris - lateral, external rotator

Popliteus assist medial hamstrings in knee internal rotation

Two-joint muscles

most effective when either origin or insertion is stabilized to prevent movement in direction of the contacting muscle

To a degree, muscles are able to exert greater force when lengthened than when shortened

Hamstring muscles and rectus femoris are biarticular (two-joint) muscles : Ex. sartorius muscle

increases its total length and becomes a better flexor at knee when pelvis is rotated posteriorly and stabilized by abdominal muscles

exemplified by trying to flex knee and cross the legs in the sitting position

one usually leans backward to flex legs at knees

Football kicker invariably leans well backward to raise and fix the rectus femoris origin to make it more effective as a knee extensor

Gracilis, sartorius, and semitendinosus join together distally to form pes anserinus

attaches to anteromedial aspect of proximal tibia below the level of tibial tuberosity

Their attachment and posteromedially line of pull enable them to assist with knee flexion particularly once the knee is flexed and hip is externally rotated

Medial and lateral gastrocnemius heads attach posteriorly on medial and lateral femoral condyles

assist with knee flexion

Knee Joint Muscle Location

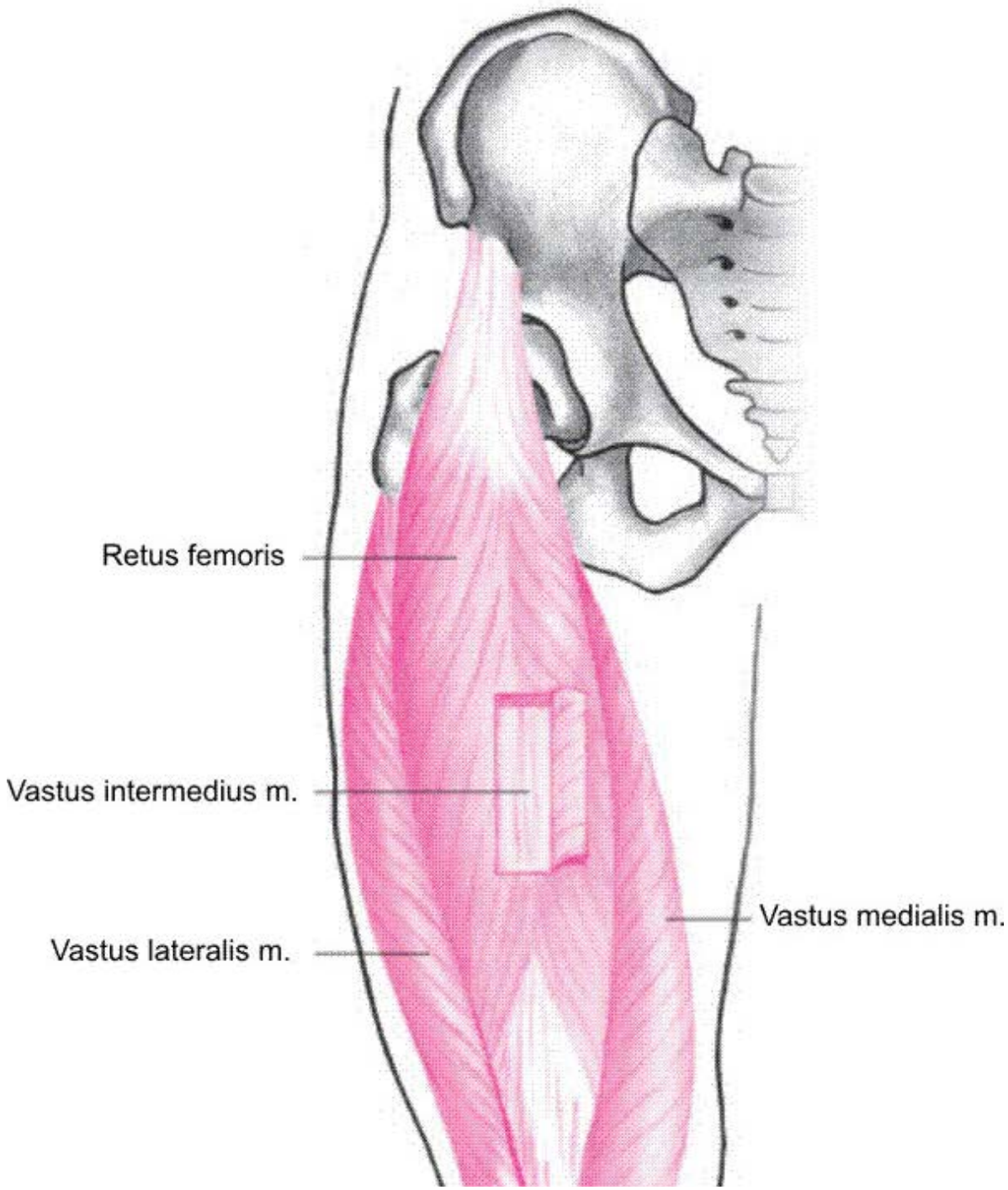
Anterior - primarily knee extension

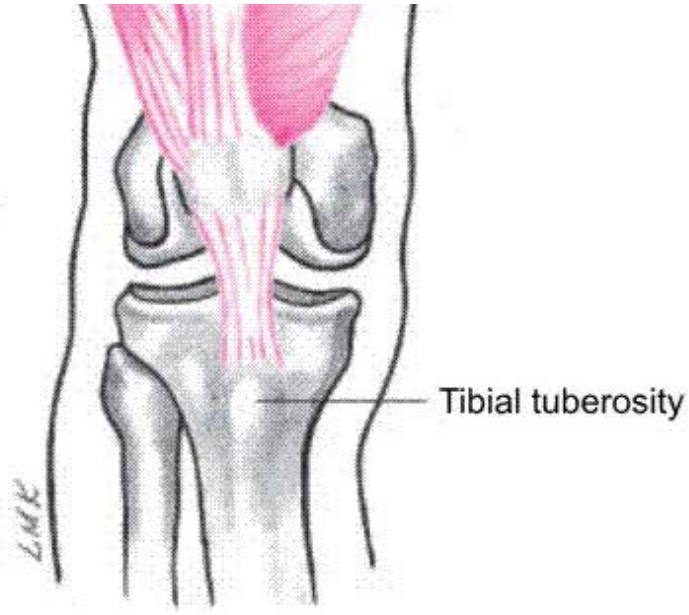
Rectus femoris

Vastus medialis

Vastus intermedius

Vastus lateralis





Knee Joint Muscle Location

Posterior - primarily knee flexion

Biceps femoris

Semimembranosus

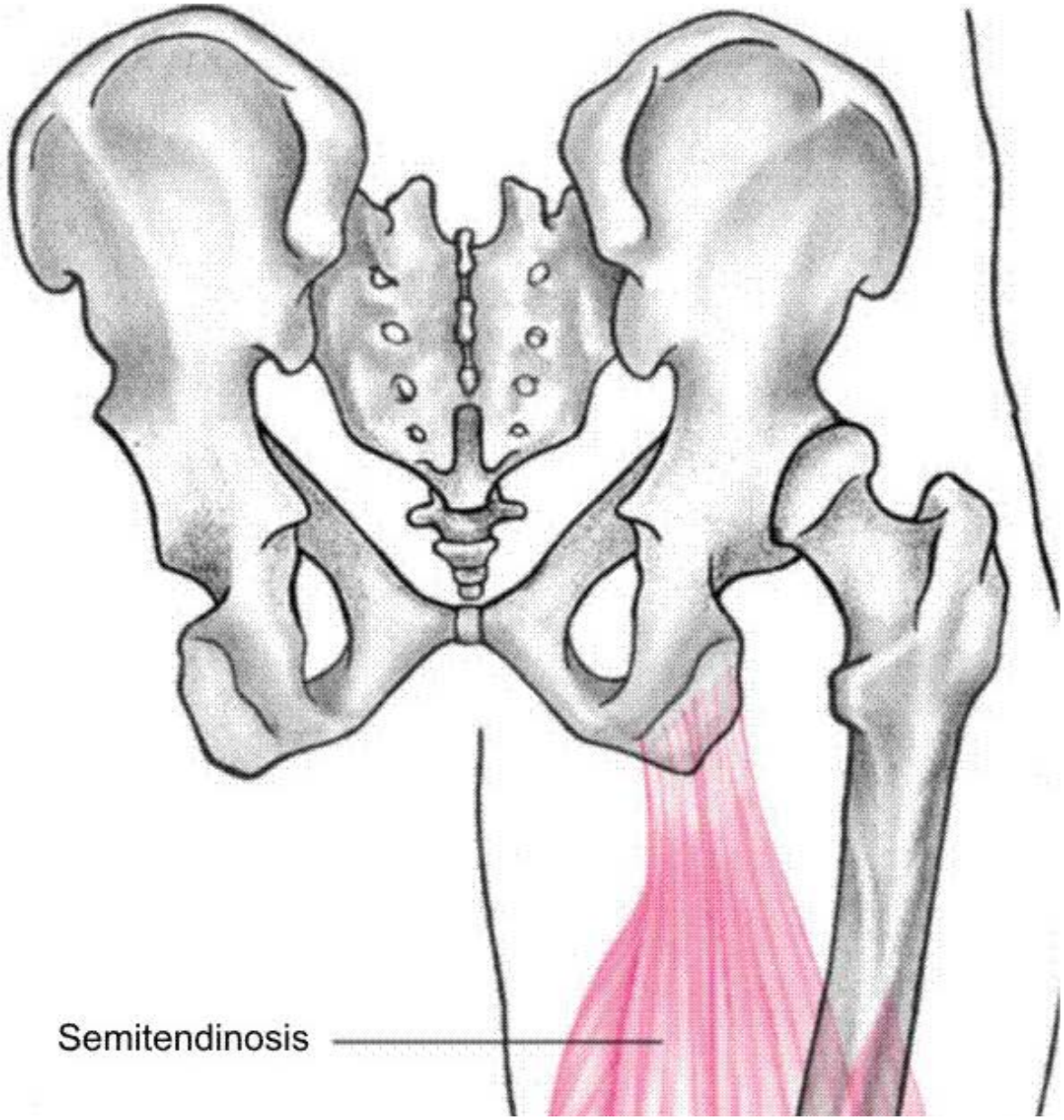
Semitendinosus

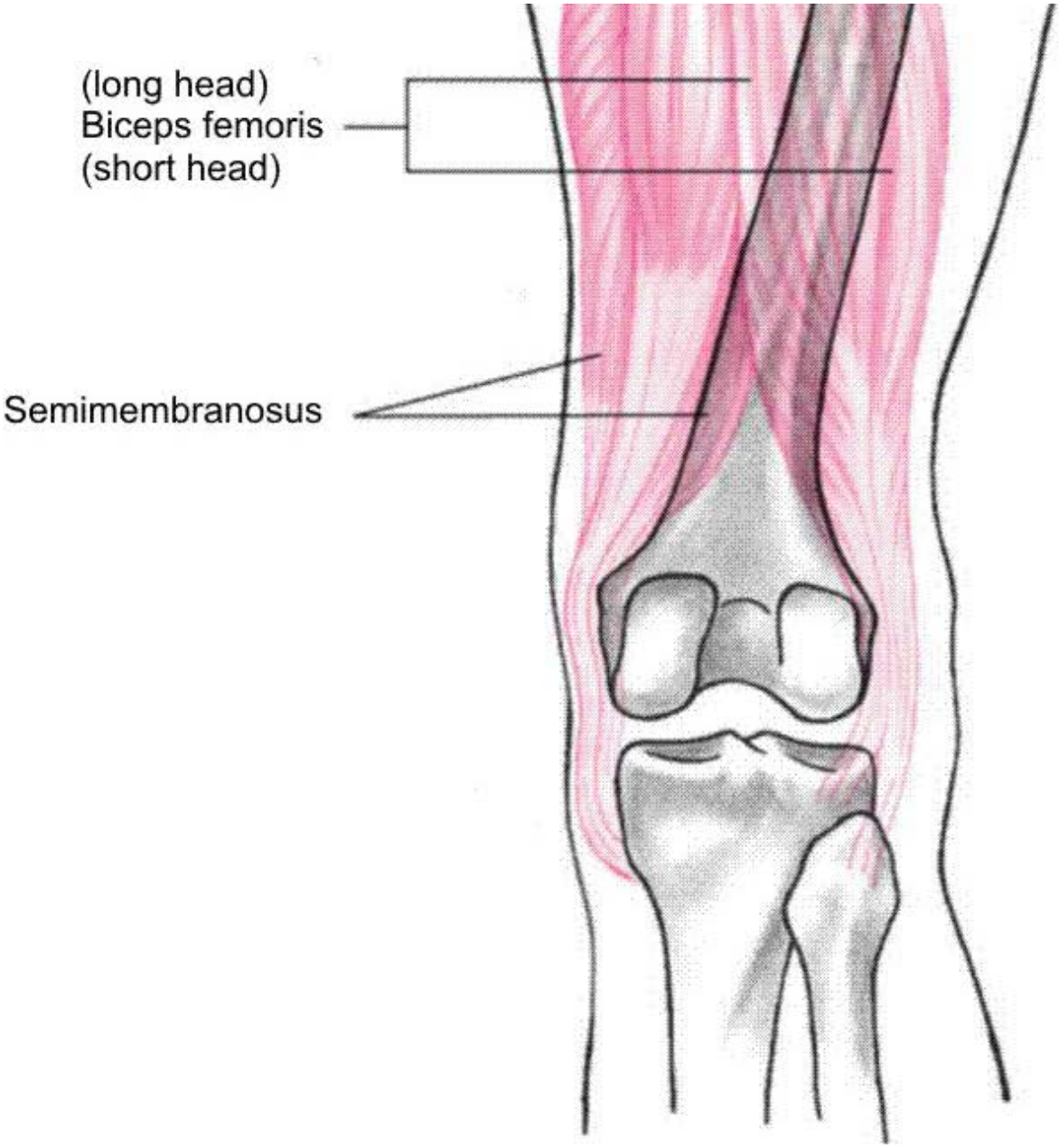
Sartorius

Gracilis

Popliteus

Gastrocnemius





Muscles

Quadriceps muscles - vital in jumping

functions as a decelerator : when decreasing speed to change direction ; when coming down from a jump

eccentric contraction during decelerating actions

controls slowing of movements initiated in previous phases of the sports skill

Rectus femoris (two-joint), vastus medialis, vastus intermedius, vastus lateralis (largest)

All attach to patella then to tibial tuberosity via patellar tendon

All superficial and palpable except vastus intermedius (under rectus femoris)

Strength or power may be indicated by vertical jump test

Generally desired to be 25% to 33% stronger than hamstring group

Strength and endurance is essential for maintenance of patellofemoral stability

often a problem

quads are particularly prone to atrophy when injuries occur

may be developed by resisted knee extension activities from a seated position

functional weight bearing activities such as step-ups or squats are particularly useful for strengthening and endurance

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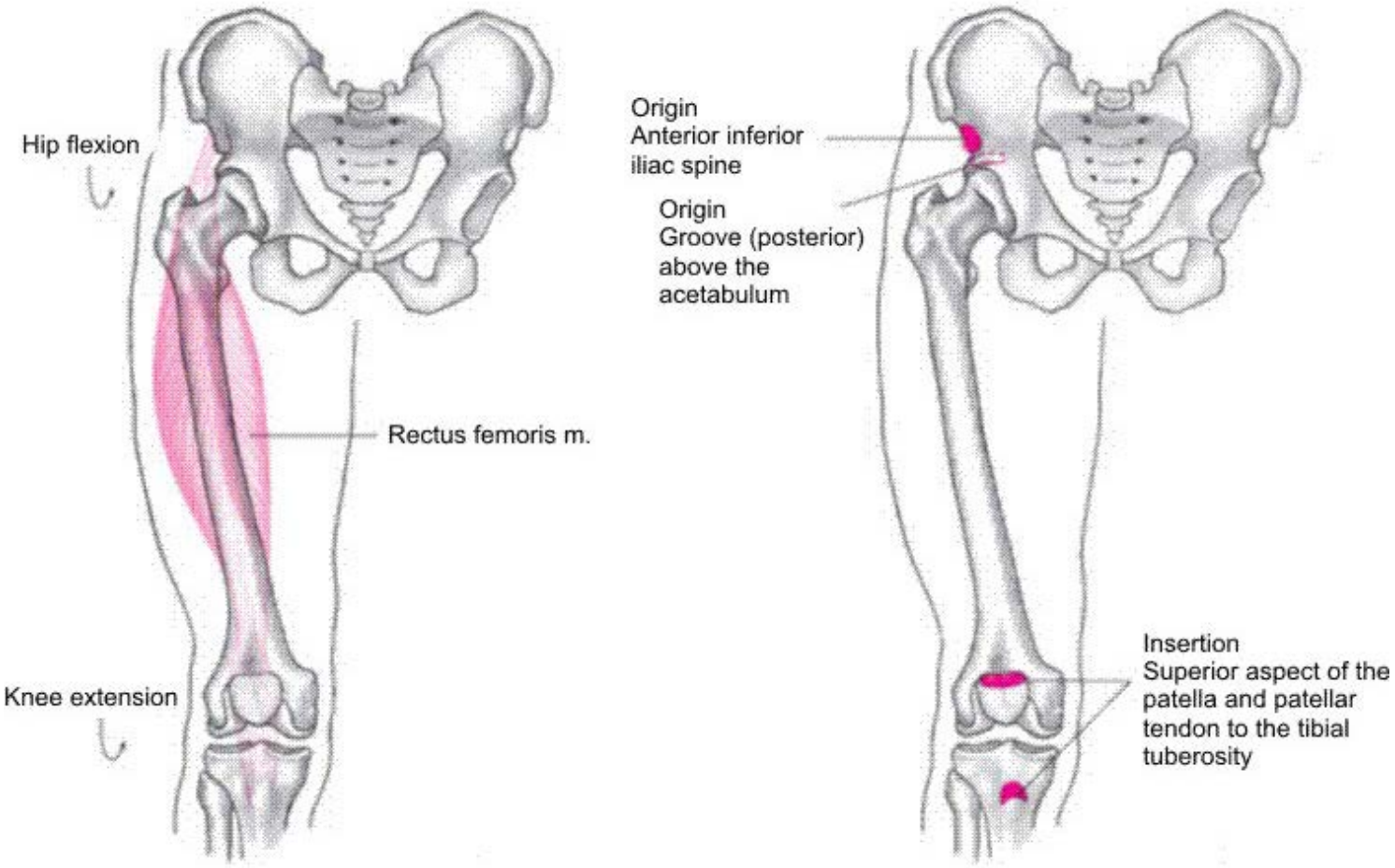
Rectis Femoris Muscle

Flexion of hip

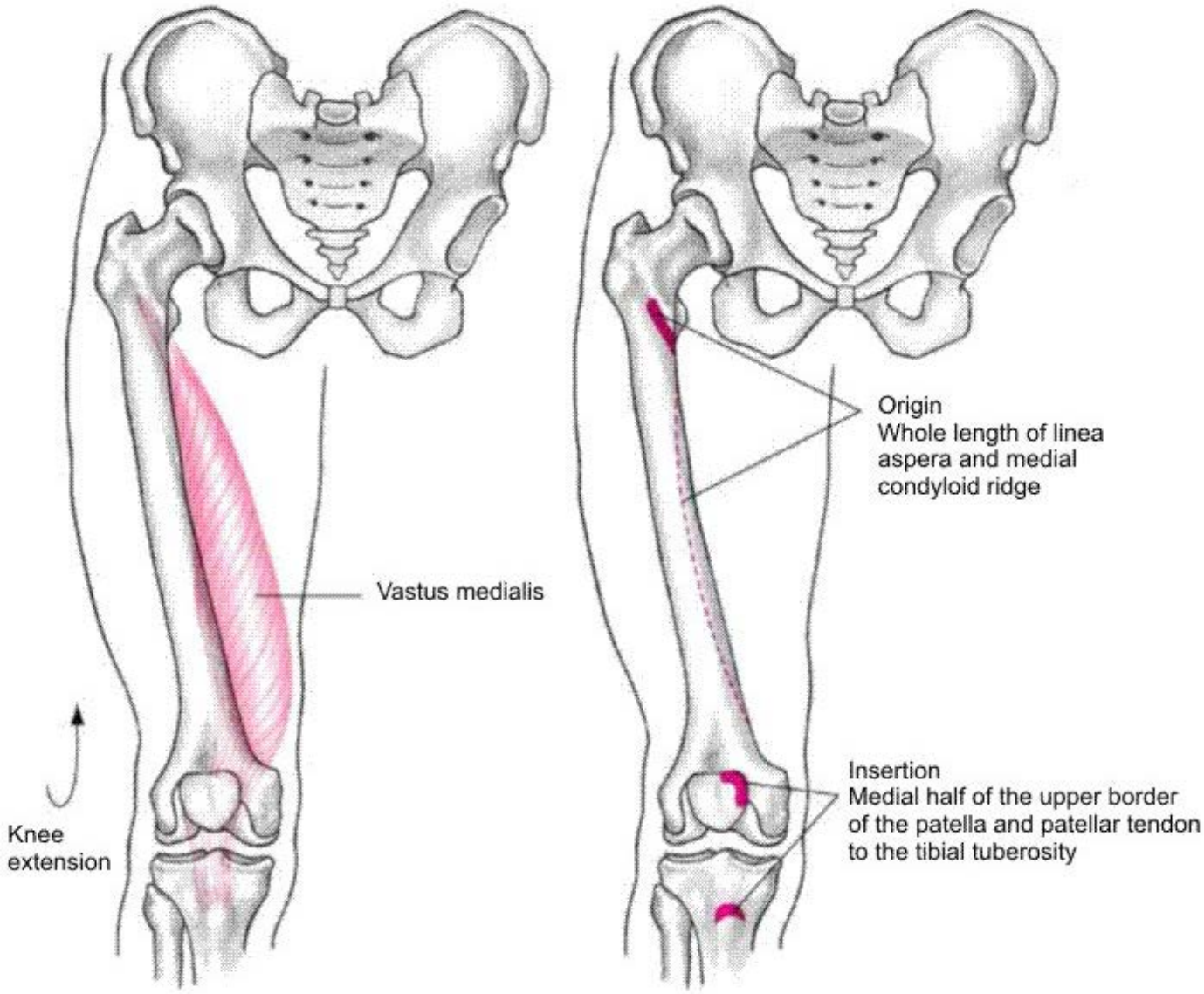
Extension of knee

Anterior pelvic rotation



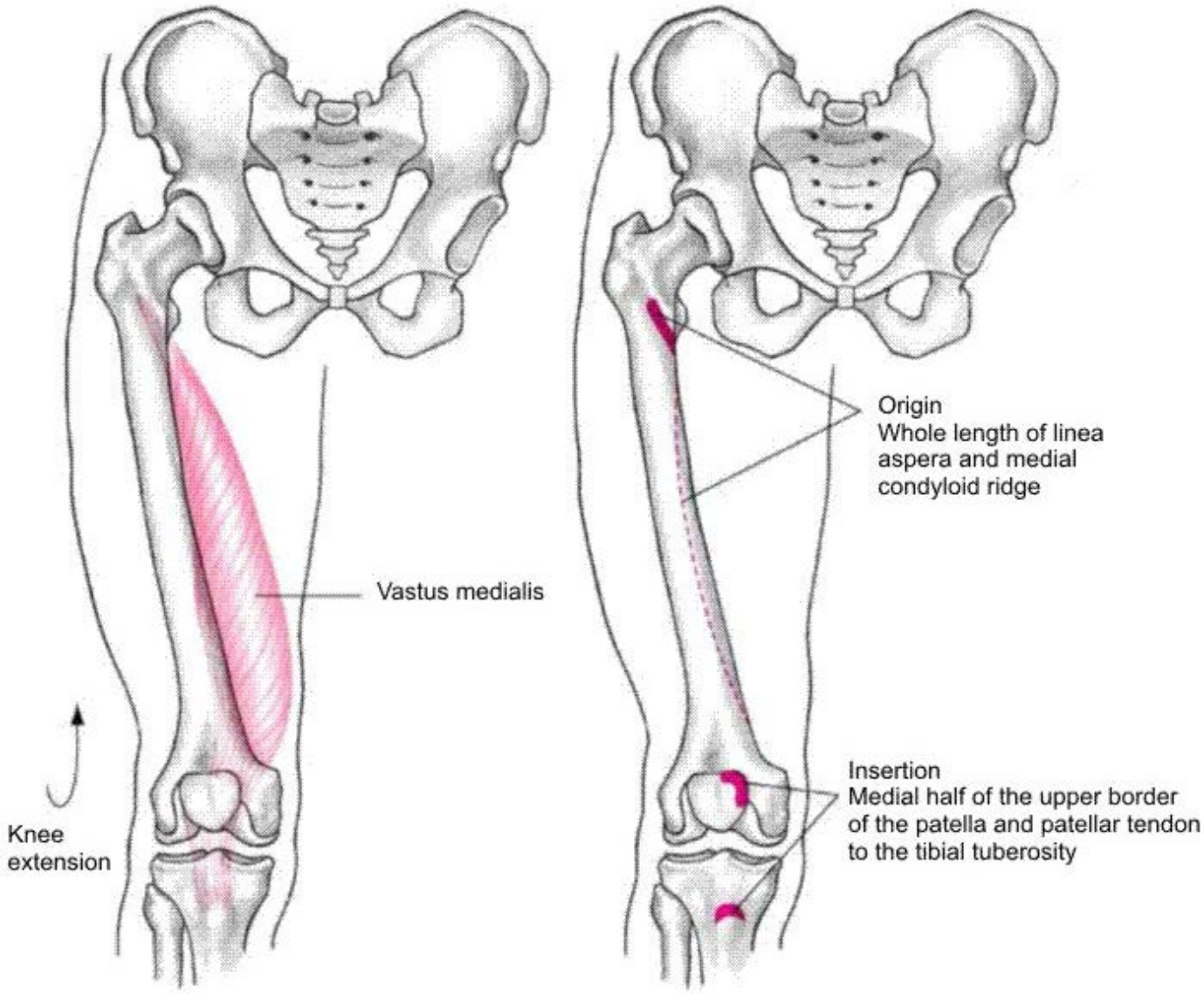
Vastus Intermedius Muscle

Extension of knee



Vastus Medialis Muscle

Extension of knee

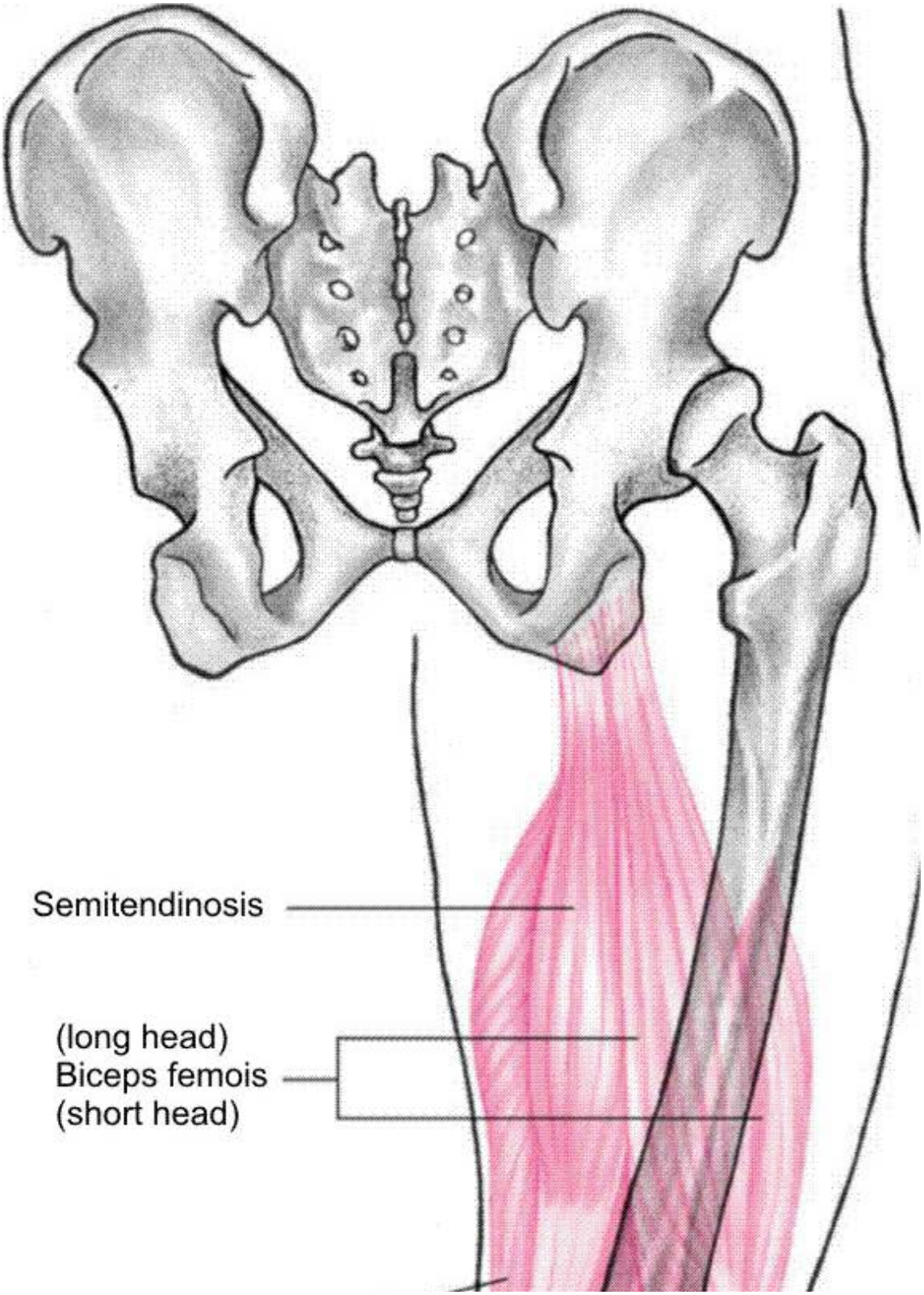


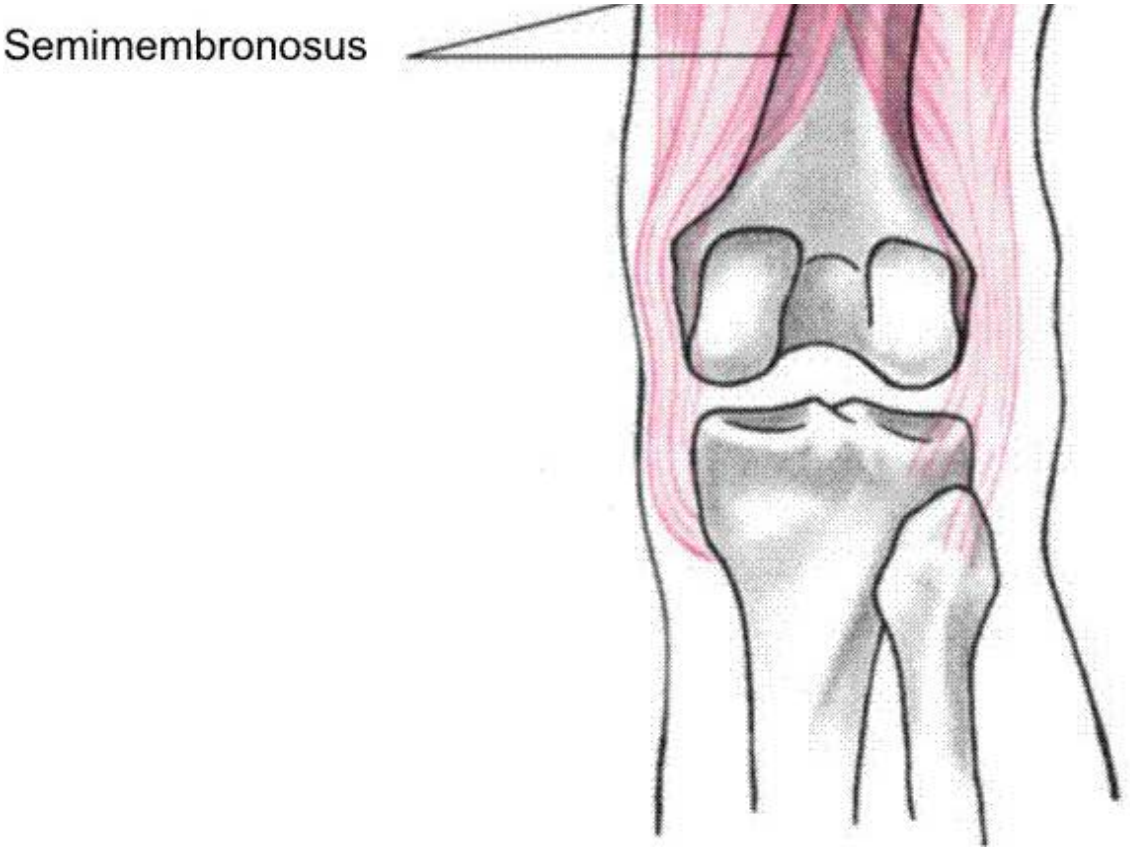
Hamstring Muscle Group

Semitendinosus

Biceps femoris

Semimembranosus





Hamstring Muscle Group

Semitendinosus

Biceps femoris

Semimembranosus

Hamstring muscle strains very common

“Running muscles” function in acceleration

Antagonists to quadriceps muscles at knee

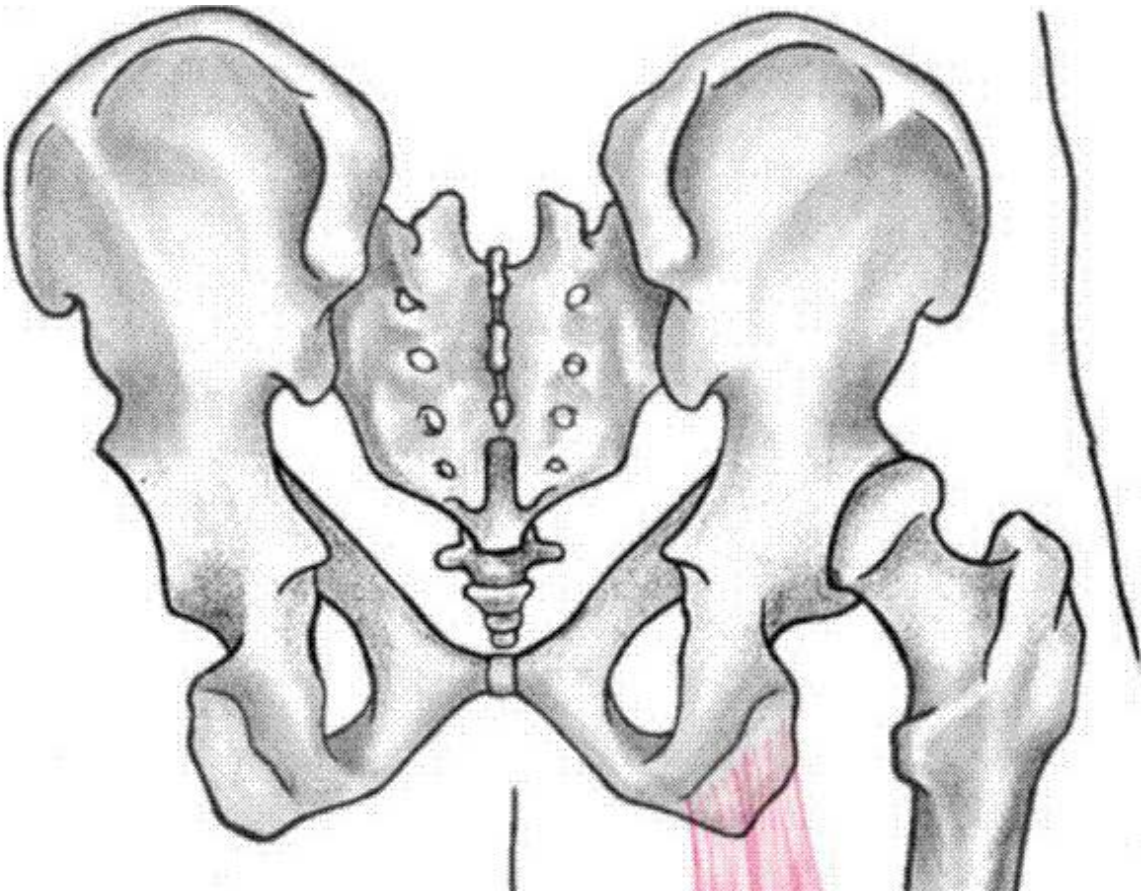
Named for cordlike attachments at knee

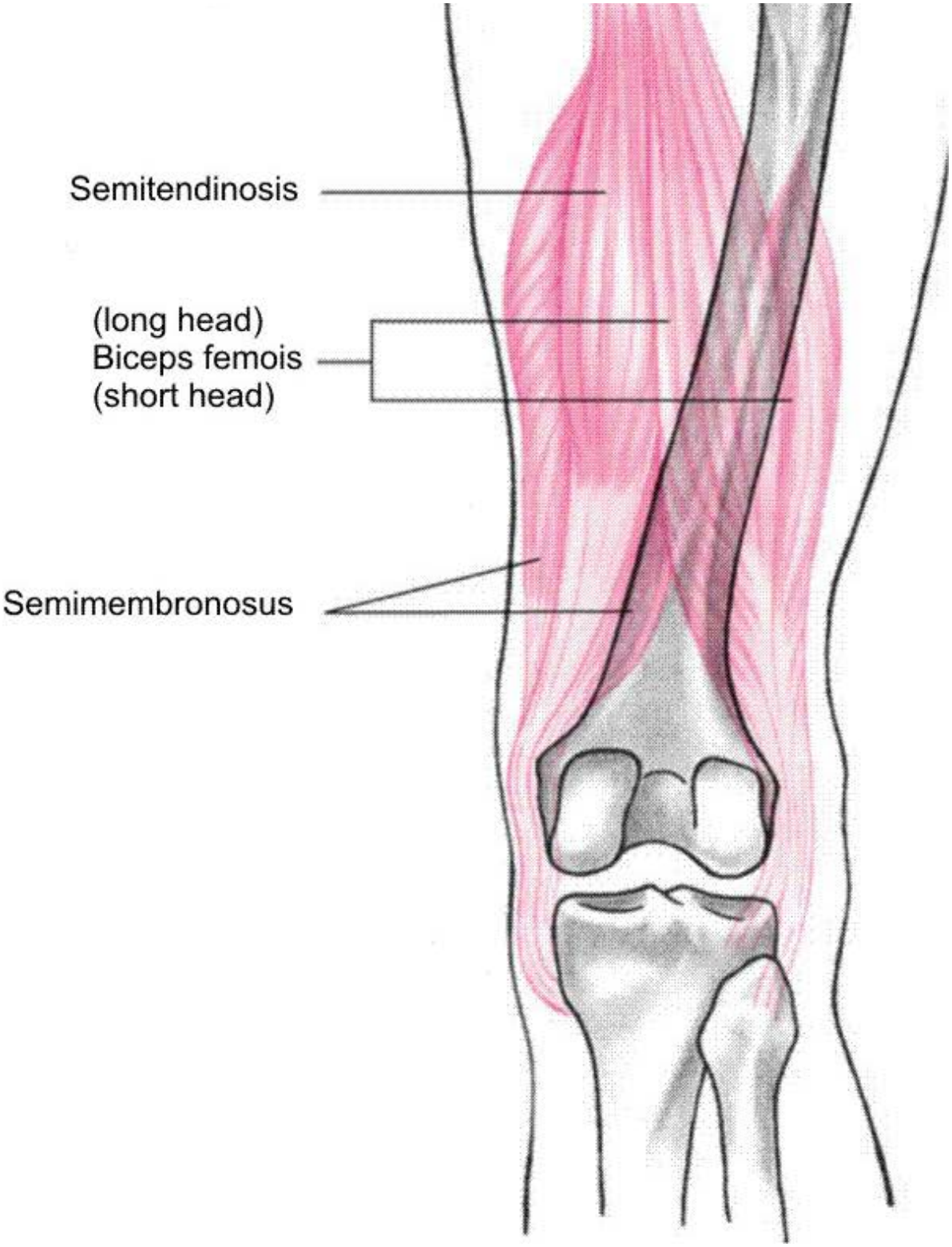
All originate on ischial tuberosity of pelvis

Semitendinosus inserts on anteromedial tibia

Semimembranosus inserts on posteromedial tibia

Biceps femoris inserts on lateral tibial condyle and head of fibula





Semitendinosus Muscle

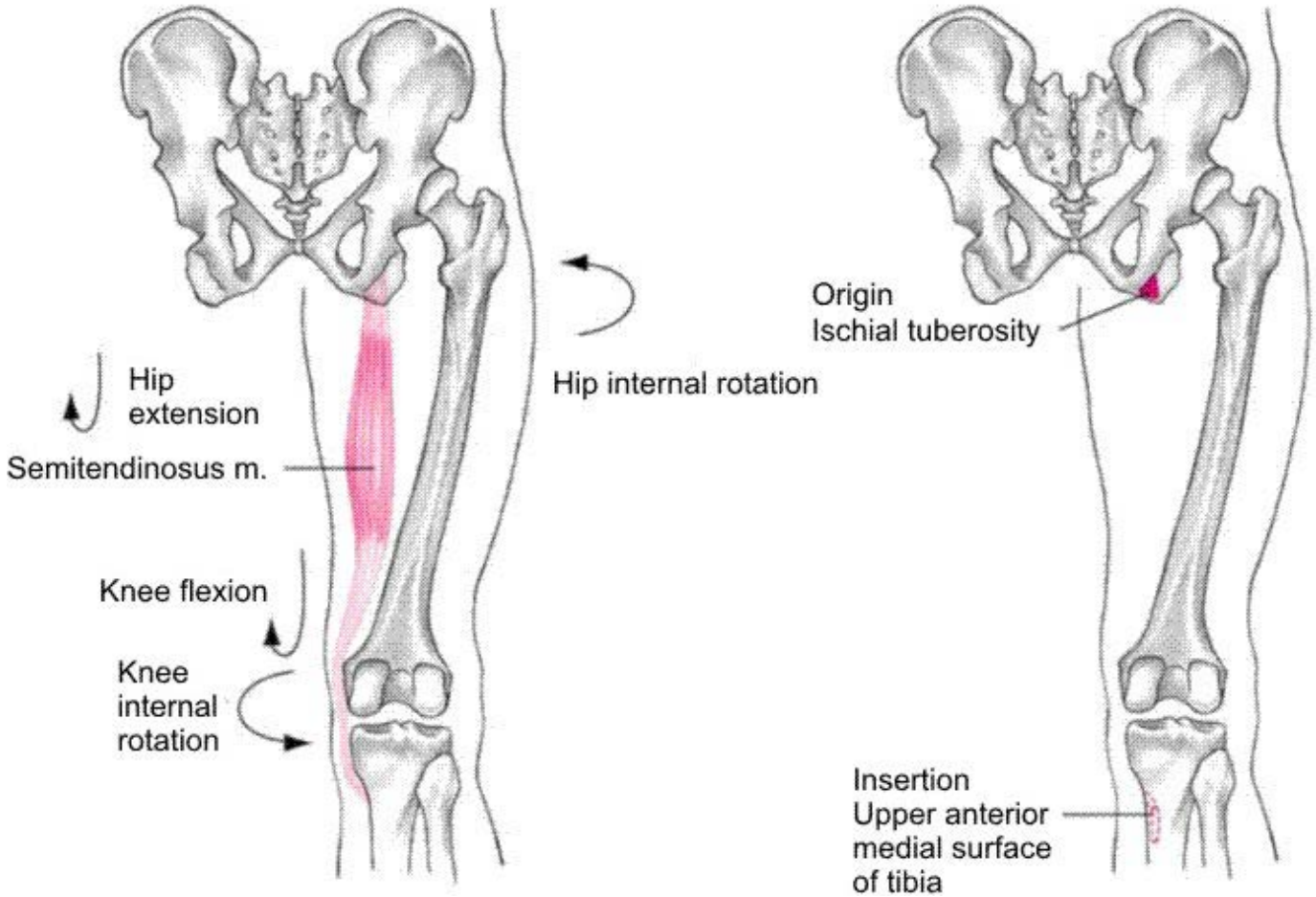
Flexion of knee

Extension of hip

Internal rotation of hip

Internal rotation of flexed knee

Internal rotation of flexed knee



Semimembranosus Muscle

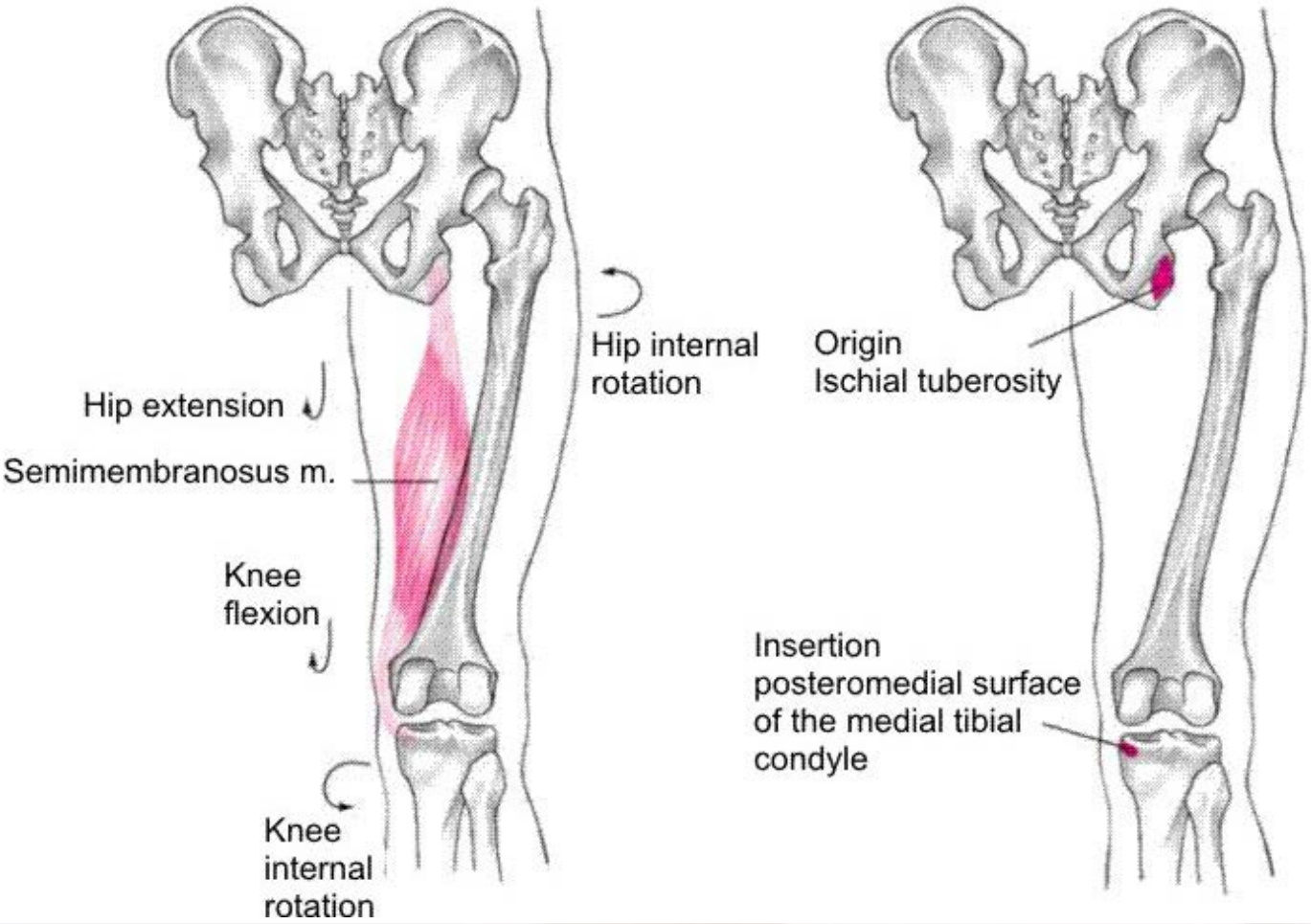
Flexion of knee

Extension of hip

Internal rotation of hip

Internal rotation of flexed knee

Posterior pelvis rotation



Biceps Femoris Muscle

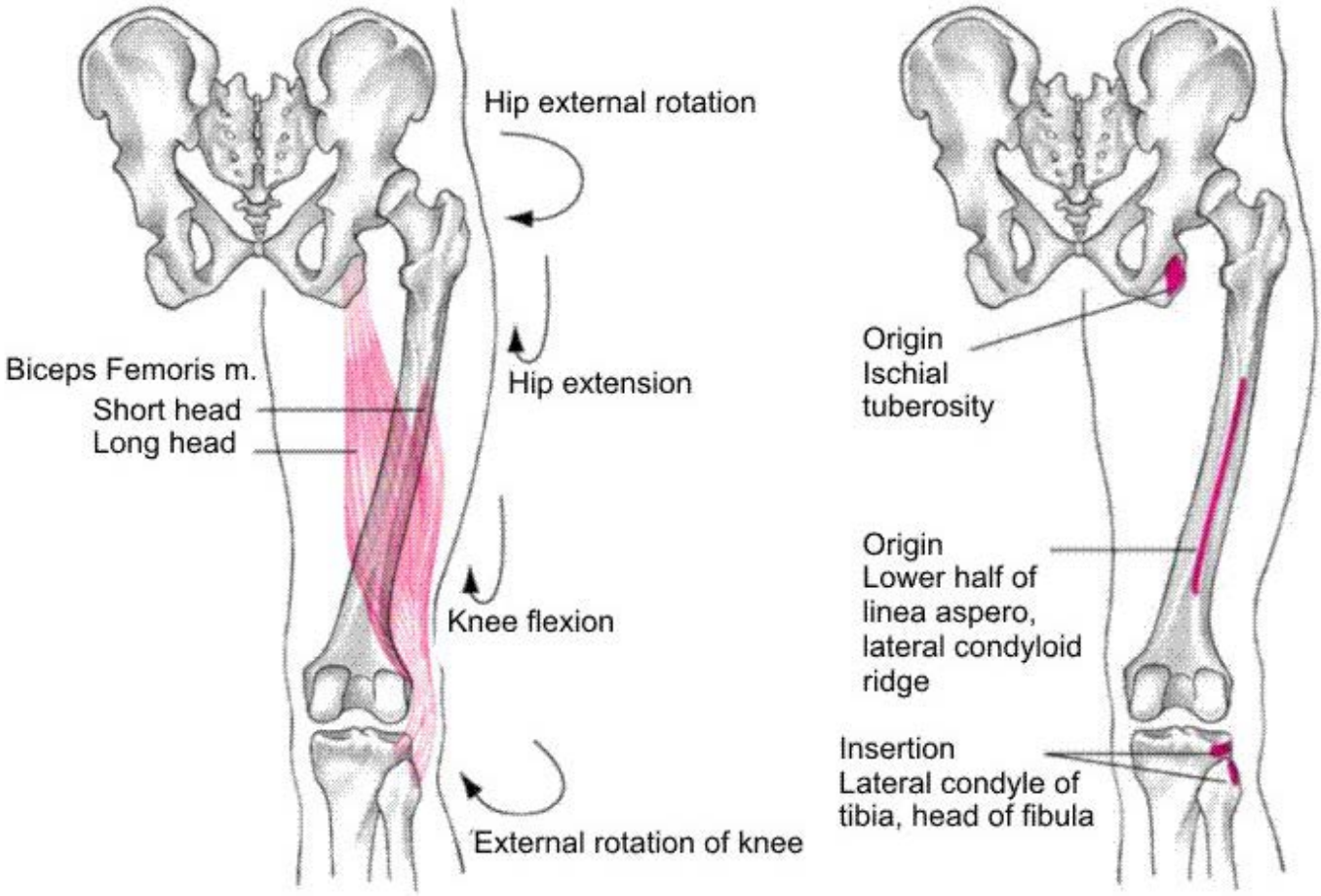
Flexion of knee

Extension of hip

External rotation of hip

External rotation of flexed knee

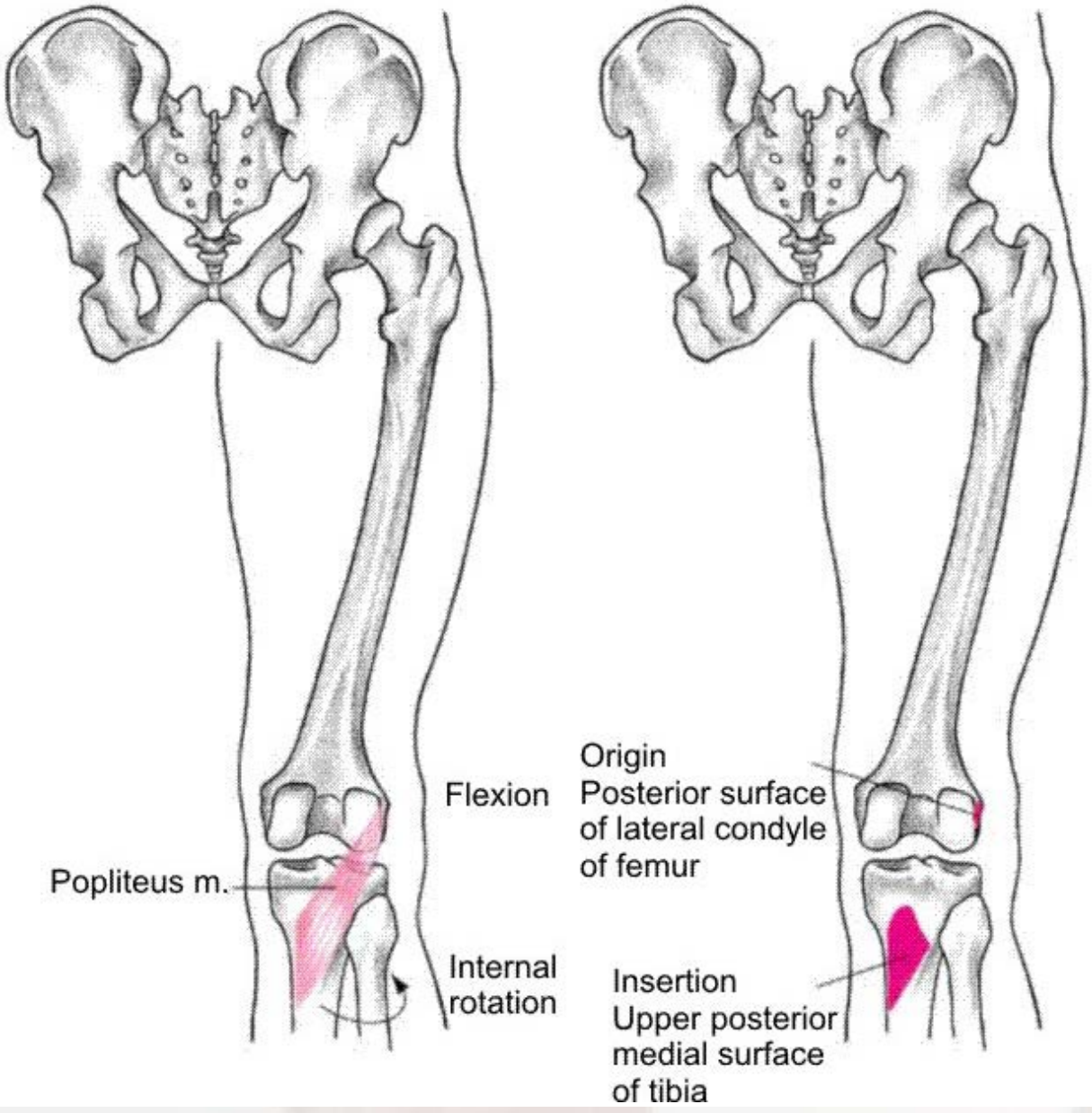
Posterior pelvis rotation



Popliteus Muscle

Flexion of knee

Internalrotation of flexed knee



Knee Extension

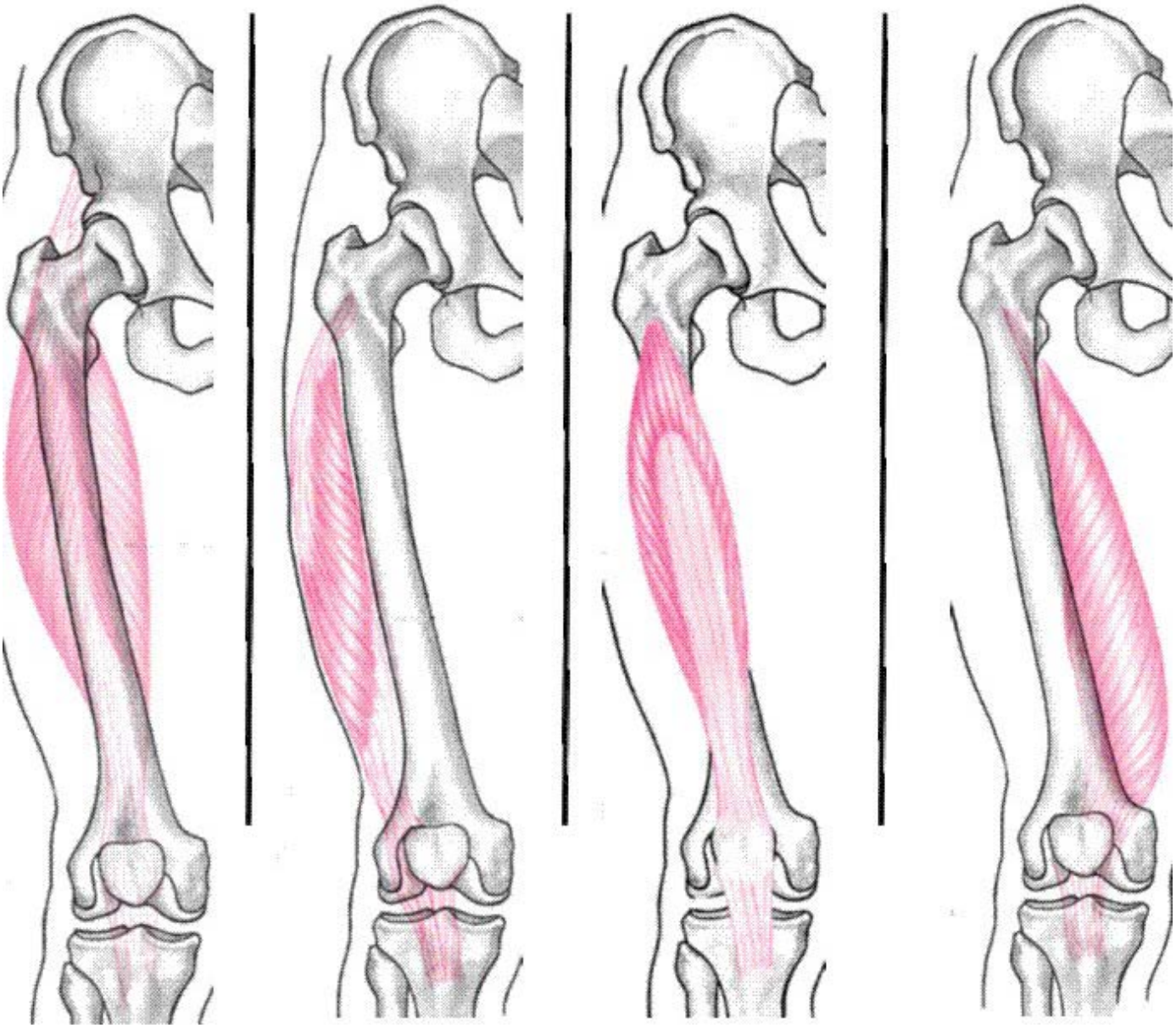
Agonist

Rectus Femoris

Vastus Lateralis

Vastus Intermedius

Vastus Medialis



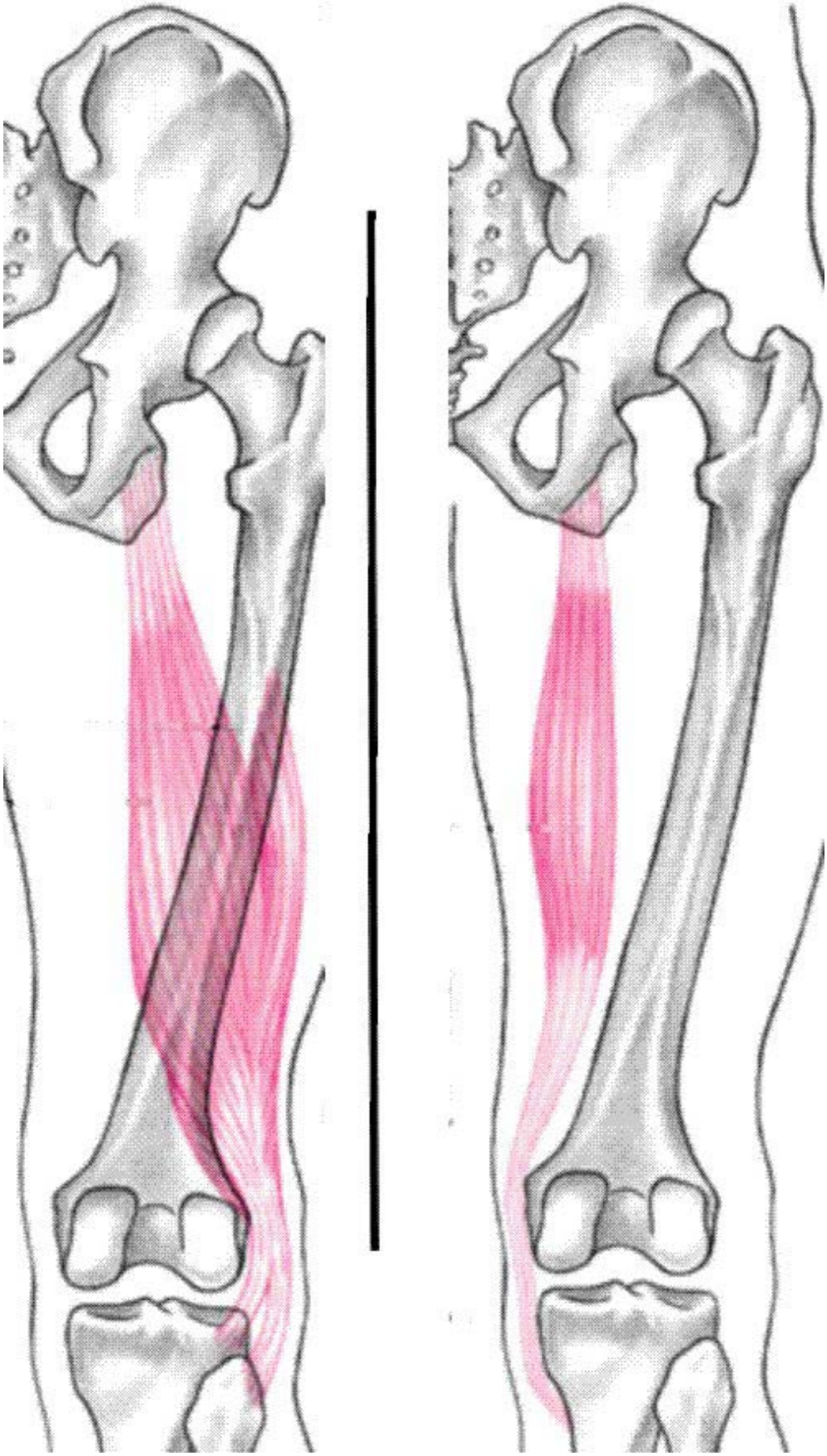
Knee Flexion

Agonist

Biceps Femoris (Long & Short Head)

Semitendinosus

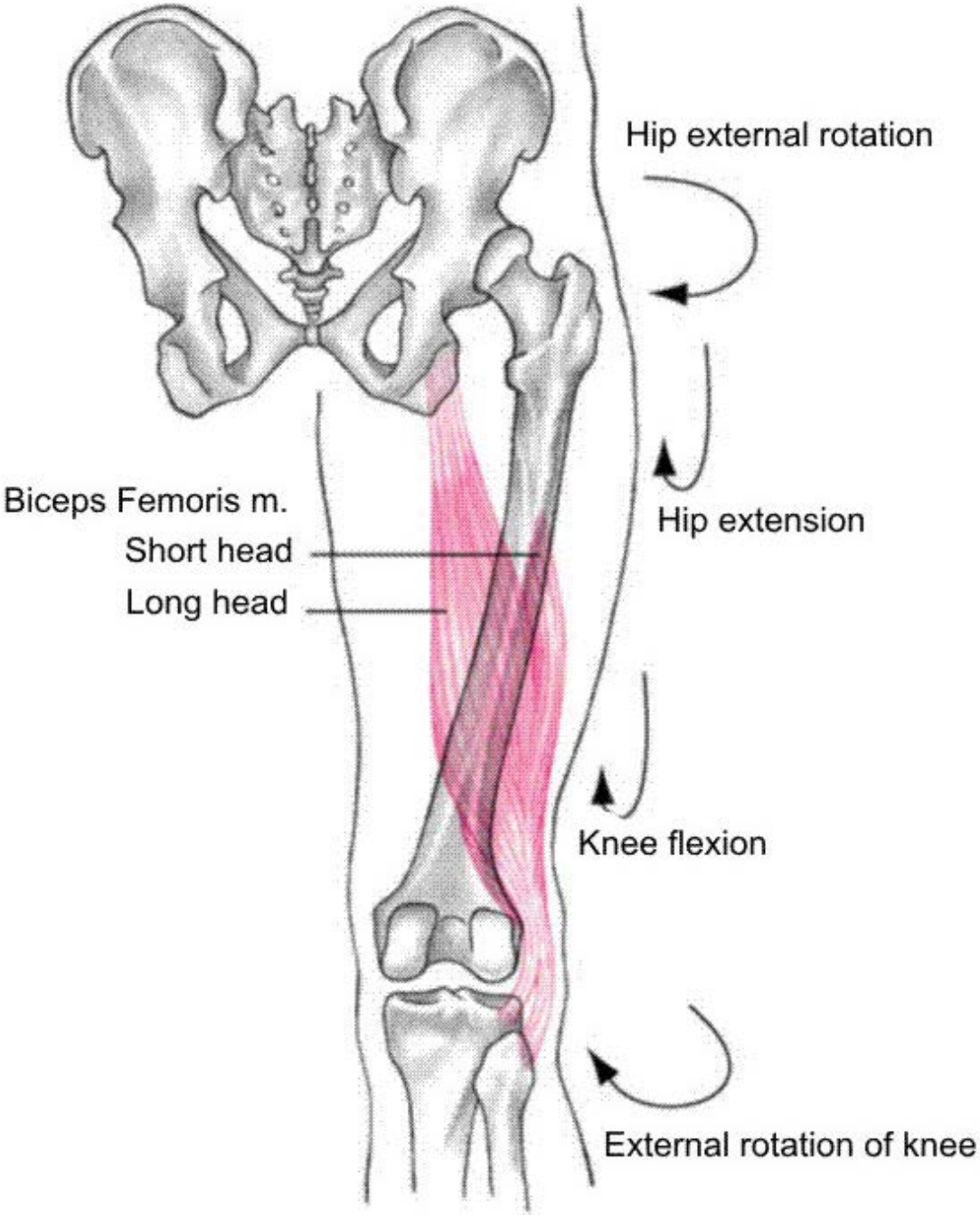
Semimembranosus



Knee External Rotation

Agonist

Biceps Femoris



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