

LOWER LIMB ANATOMY NOTES

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LOWER LIMB MUSCLES OVERVIEW

MUSCLES OF GLUTEAL REGION

Deep group of small muscles which are mainly lateral rotators of the femur at the hip joint:

1. Piriformis
2. Obturator internus
3. Gemelli superior
4. Gemelli inferior
5. Quadratus Femoris

Superficial group of larger muscles, which mainly abduct and extend the hip

1. Gluteus minimus
2. Gluteus medius
3. Gluteus maximus
4. Tensor Fascia Latae

MUSCLES OF THIGH

ANTERIOR COMPARTMENT

- contains muscles that mainly extend the leg at the knee joint
- Innervated by femoral nerve

1. Quadriceps Femoris
 - a) Sartorius
 - b) Rectus Femoris
 - c) Vastus lateralis
 - d) Vastus intermedius
2. Psoas major
3. Iliacus

POSTERIOR COMPARTMENT

- Contains muscles that mainly extend the thigh at the hip joint and flex the leg at the knee joint
 - Innervated by sciatic nerve
 - Include the three hamstring muscles
1. Biceps Femoris
 2. Semitendinosus
 3. Semimembranosus

MEDIAL COMPARTMENT

- Consist of muscles that mainly adduct the thigh at the hip joint
 - Innervated by obturator nerve
 - Mnemonic: Observe Three Ducks Pecking Grass
Obturator, Three Adductors, Pectineus, Gracilis
1. Gracilis
 2. Pectineus
 3. Adductor longus
 4. Adductor brevis
 5. Adductor magnus
 6. Obturator externus

MUSCLES OF THE LEG

POSTERIOR COMPARTMENT

- Mainly plantarflex and invert the foot and flex the toes
 - All muscles are innervated by tibial nerve
- a) **SUPERFICIAL GROUP**
 1. Gastrocnemius
 2. Plantaris
 3. Soleus

 - b) **DEEP GROUP**
 1. Popliteus
 2. Flexor hallucis longus
 3. Flexor digitorum longus
 4. Tibialis posterior

LATERAL COMPARTMENT

Evert the foot (turn the sole outward) and are innervated by superficial fibular nerve

1. Fibularis longus

2. Fibularis brevis

ANTERIOR COMPARTMENT

Their function is dorsiflexion of foot and extension of toes. Innervated by deep fibular (peroneal) nerve.

1. Tibialis anterior
2. Extensor hallucis longus
3. Extensor digitorum longus
4. Fibularis tertius

MUSCLES OF THE FOOT

Contain extrinsic muscles and intrinsic muscles

Intrinsic muscles

- Dorsal aspect
- Plantar aspect

DORSAL ASPECT

1. Extensor digitorum brevis
2. Extensor hallucis brevis

PLANTAR ASPECT

- **FIRST LAYER (SUPERFICIAL)**
 1. Abductor Hallucis
 2. Flexor digitorum brevis
 3. Abductor digiti minimi

- **SECOND LAYER**
 1. Quadratus plantae
 2. Lumbricals (four muscles)

- **THIRD LAYER**
 1. Flexor hallucis brevis
 2. Adductor hallucis
 3. Flexor digiti minimi brevis

- **FOURTH LAYER**

1. Plantar interossei
2. Dorsal interossei

LOWER LIMB OVERVIEW

- **PALPATIONS OF LOWER LIMB:**

- The part of the head of the femur that is not intra-acetabular can be palpated on the anterior aspect of the thigh just inferior to the inguinal ligament and just lateral to pulsating femoral artery
- Patella is situated in an exposed position in front of the knee joint and is easily palpable through the skin
- Calcaneum is the largest bone of the foot and form the prominence of the heel
- The constant position of the great saphenous vein in front of the medial malleolus should be remembered for patients requiring emergency blood transfusion
- The femoral pulse is palpated midway between the anterosuperior iliac spine and the symphysis pubis.
The femoral vein lies immediately medial to femoral artery
- The peripheral pulse is checked on the dorsum of the foot between the tendons of extensor hallucis longus and extensor digitorum longus

- The neck of the femur, which connects the head to the shaft, passes downward, backward, and laterally and makes an angle of about 125° in adults and 160° in young child, with the long axis of the shaft. Diseases such as coxa valga and vara can alter the size of this angle

- The cavity of acetabulum is deepened by the presence of a fibrocartilagenous ring called **acetabular labrum**.

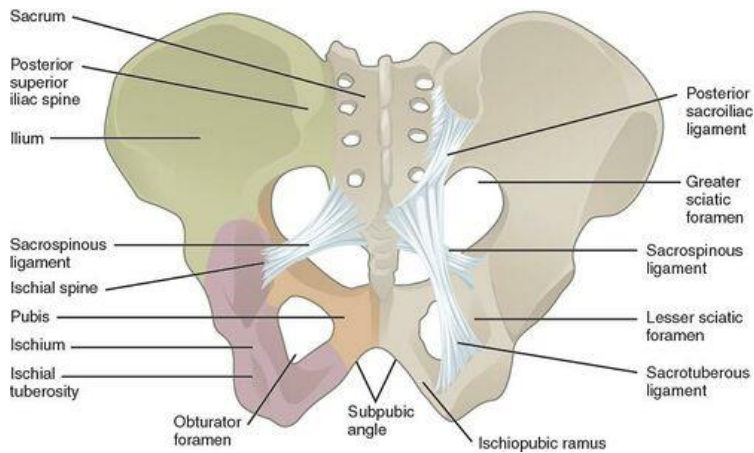
- Patella, the largest sesamoid bone, develops within the tendon of quadriceps femoris muscle in front of the knee joint

- Tarsal bones:

- Calcaneum
- Talus
- Navicular
- Cuboid
- Three cuneiform bones

Only talus articulates with tibia and fibula at ankle joint

- The **sacrospinous ligament** connects the back of the sacrum to the ischial tuberosity
The **sacrospinous ligament** connects the back of the sacrum to the spine of ischium



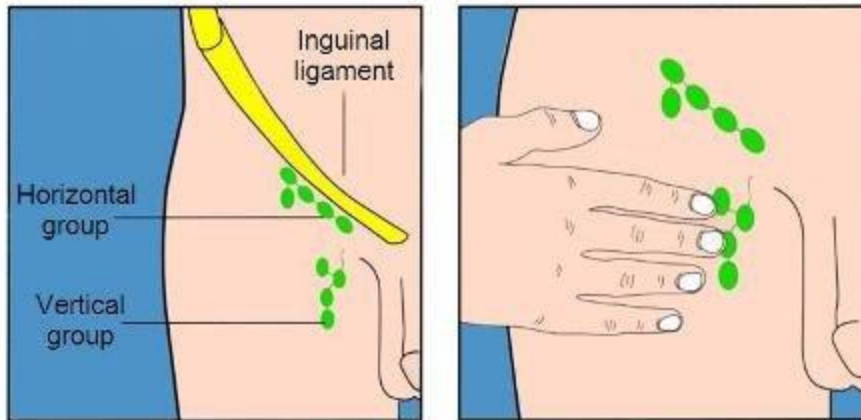
- Structures passing through greater sciatic foramen:
 - Piriformis muscle
 - Sciatic nerve
 - Posterior cutaneous nerve of thigh
 - Superior and inferior gluteal nerves
 - Nerves to obturator internus and quadratus femoris
 - Pudendal nerve
 - Internal pudendal artery and vein

- Structures passing through lesser sciatic foramen:
 - Tendon of obturator internus muscle
 - Nerve to obturator internus
 - Pudendal nerve
 - Internal pudendal artery and vein

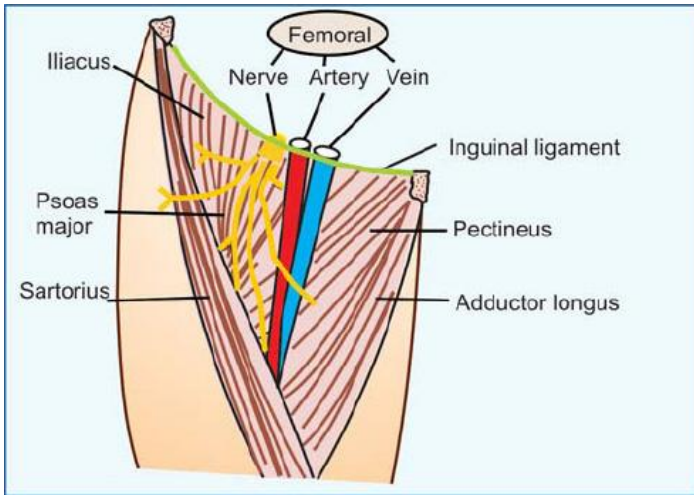
- Remember:
 - The gluteus maximus is the largest muscle in the body
 - Sciatic nerve is the largest nerve in the body
 - Iliofemoral ligament is the strongest ligament of hip joint
 - Sartorius is unique in that it can serve as both hip and knee flexor
 - No muscles attach to talus bone
 - Iliopsoas muscle is the prime hip flexor
 - Popliteus is often referred to as “key” to unlocking the knee since it begins knee flexion by laterally rotating the femur on tibia
 - Rectus femoris muscle cross both the hip and knee joint
 - Sartorius is named as tailor’s muscle
 - The primary invertors of foot include tibialis anterior and tibialis posterior
 - The primary evertors of foot include fibularis longus, fibularis brevis, and fibularis tertius

- **Structures passing through saphenous opening:**

- Great saphenous vein
 - Some small branches of femoral artery
 - Lymph vessels
- The **superficial lymph nodes** lie in the superficial fascia between the inguinal ligament and can be divided into horizontal and vertical group.
The efferent lymph vessels from the superficial inguinal nodes pass through the saphenous opening in the deep fascia and join the deep inguinal nodes.
The **deep nodes** are located beneath the deep fascia and along the medial side of femoral vein.



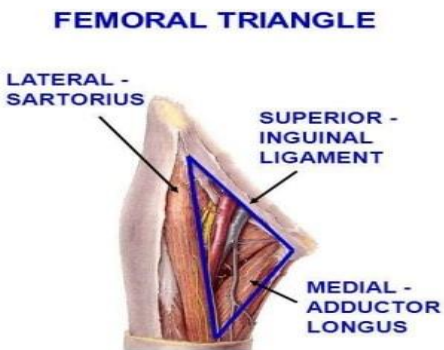
- The vastus medialis is the first part of the quadriceps muscle to atrophy in knee joint disease and the last to recover
- **BOUNDARIES OF FEMORAL TRIANGLE**
Superiorly: Inguinal ligament
Laterally: Sartorius
Medially: Adductor longus muscle
Floor: Gutter shaped and formed from lateral to medial by iliopsoas, pectineus, adductor longus
Roof: Skin and fascia of thigh
- **CONTENTS OF FEMORAL TRIANGLE**
Learn mnemonic: NAVEL (from lateral to medial)
 - Femoral nerve and its terminal branches
 - Femoral sheath
 - Femoral artery and its branches
 - Femoral vein and its tributaries
 - Deep inguinal lymph nodes



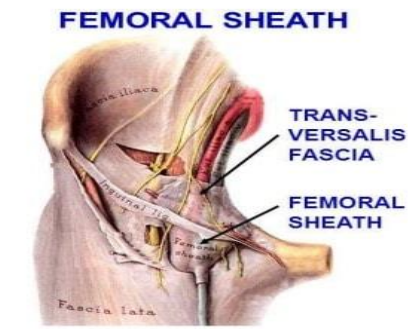
- **WALLS OF ADDUCTOR CANAL**
 - Anteromedial – Sartorius muscle and fascia
 - Posterior – Adductor longus and magnus
 - Lateral – Vastus medialis

- **CONTENTS OF ADDUCTOR CANAL**
 - Terminal parts of femoral artery
 - Femoral vein
 - Deep lymph vessels
 - Saphenous nerve, nerve to vastus medialis and the terminal part of obturator nerve

- **CONTENTS OF FEMORAL SHEATH**
 - From lateral to medial
 - Femoral artery
 - Femoral vein
 - Lymph vessels (in femoral canal)



CONTAINS - LATERAL TO MEDIAL
FEMORAL NERVE, ARTERY
VEIN, LYMPHATICS -
REMEMBER NAVL



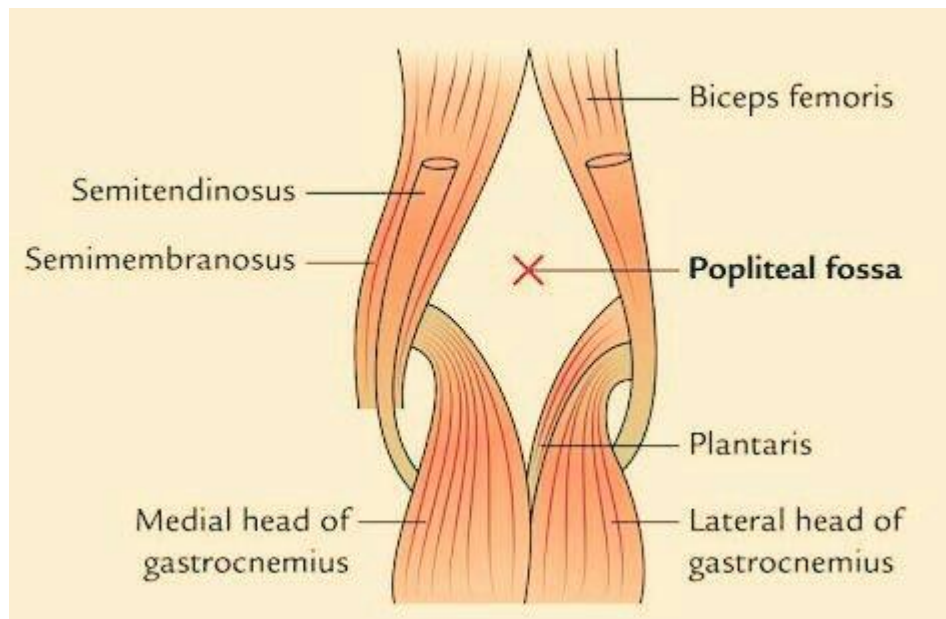
- SHEATH IS CONTINUATION OF
TRANSVERSALIS FASCIA OF
ABDOMEN
 - SURROUNDS ARTERY, VEIN,
 LYMPHATICS NOT NERVE

- **FEMORAL CANAL BOUNDARIES**

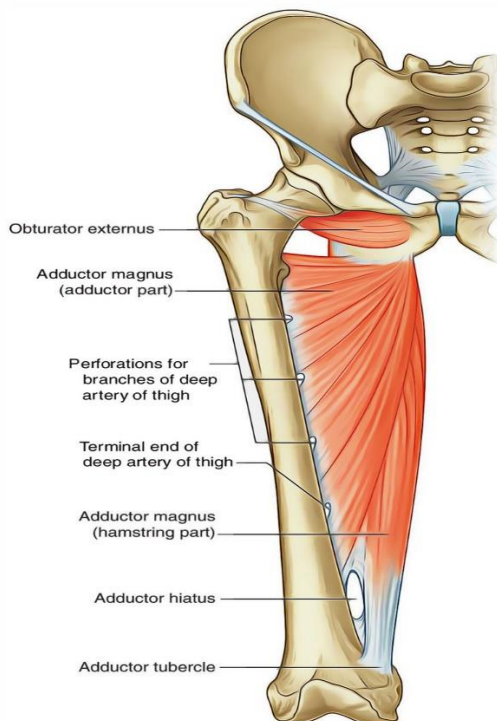
- Anteriorly – Inguinal ligament
- Posteriorly – Superior ramus of pubis
- Medially – Lacunar ligament
- Laterally – Femoral vein

- **BOUNDARIES OF POPLITEAL FOSSA**

- Laterally – Biceps femoris above , lateral head of gastrocnemius and plantaris below
- Medially – Semimembranosus and semitendinosus above , medial head of gastrocnemius below
- Anterior wall (Floor) – Popliteal surface of femur, capsule of knee joint, popliteus muscle
- Roof – Skin, superficial fascia and deep fascia of thigh



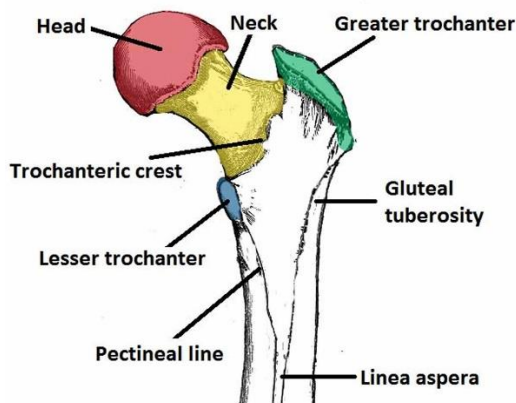
- The adductor hiatus transmits femoral artery and vein from the adductor canal in the thigh to the popliteal fossa



- The rectus femoris can rupture in sudden violent extension movements of knee joint
- About six lymph nodes are embedded in the fatty connective tissue of popliteal fossa. They receive:
 - Superficial lymph vessels from lateral side of foot and leg
 - Lymph from knee joint
 - Lymph from deep lymph vessels accompanying anterior and posterior tibial arteries
- Structures that pass immediately anterior to medial malleolus:
 - Great saphenous vein
 - Saphenous nerve
- Two muscles produce inversion of foot:
 1. Tibialis anterior
 2. Tibialis posterior
- Gastrocnemius is essential to lift the heel off the ground during walking
- In upright posture, **the soleus** is responsible for pumping venous blood back into the heart from the periphery, and is often called the peripheral heart.
- Foot Dorsiflexion and eversion – Common peroneal nerve
 Foot plantar flexion and inversion – Tibial nerve
 Foot eversion – Superficial peroneal nerve

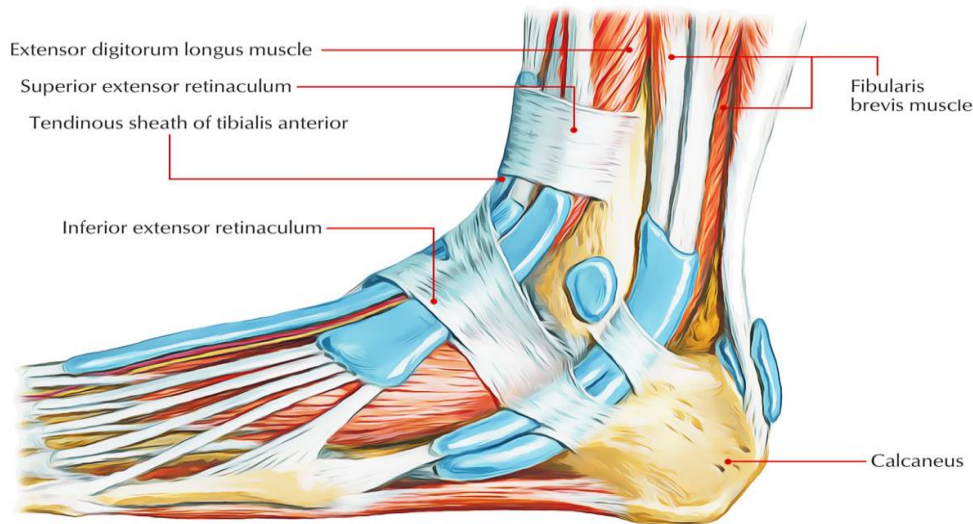
Foot dorsiflexion, toe extension – Deep peroneal nerve

- The femoral sheath is a continuation of transversalis and iliopsoas fascia
- Greater trochanter is the attachment site for five muscles:
 - Gluteus medius
 - Gluteus minimus
 - Piriformis
 - Obturator externus
 - Obturator internus
- Lesser trochanter receives insertion of psoas major and iliacus muscle



- Muscles attached to first metatarsal bone:
 - Tibialis anterior
 - Fibularis (peroneal) longus
 - First dorsal interosseus
- Heterotopic ossification in the tendon of adductor longus muscle occur chiefly in those who frequently ride horses
- Structures passing superficial to extensor retinaculum (From medial to lateral)
 - Saphenous nerve and great saphenous vein
 - Superficial fibular (peroneal) nerve
- Structures passing deep to extensor retinaculum (From medial to lateral)
 - Tibialis anterior tendon
 - Extensor hallucis longus tendon
 - Anterior tibial artery with venae comitantes
 - Deep fibular nerve
 - Extensor digitorum longus tendon

- Fibularis tertius



- Muscles with dual nerve supply:
 - Pectineus
 - Adductor magnus
 - Biceps femoris
- Cribriform fascia covers saphenous opening
- Position commonly seen in posterior dislocation of hip is internal rotation, flexion and adduction
- Rupture of ligamentum teres may lead to damage of obturator artery

- **NERVES OF LOWER LIMB**

- LUMBAR PLEXUS (L1 – L4)**

- Mnemonic : I, I Get Leftovers On Friday

- Iliohypogastric nerve (L₁)
 - Ilioinguinal nerve (L₁)
 - Genitofemoral nerve (L₁, L₂)
 - Lateral cutaneous nerve of thigh (L₂, L₃)
 - Obturator nerve (L₂, L₃, L₄)
 - Femoral nerve (L₂, L₃, L₄)

- LUMBO-SACRAL PLEXUS (S₁, S₂, S₃, S₄, L₄, L₅)**

- Superior Gluteal nerve (L₄, L₅, S₁)
 - Inferior Gluteal nerve (L₄, L₅, S₁)
 - Sciatic nerve (L₄, L₅, S₁, S₂, S₃)

- Posterior cutaneous nerve of thigh (S₁, S₂, S₃)
- Pudendal nerve (S₂, S₃, S₄)
- Nerve to piriformis
- Nerve to obturator internus
- Nerve to quadratus femoris

BRANCHES OF SCIATIC NERVE

- Tibial nerve
- Common fibular nerve

BRANCHES OF TIBIAL NERVE IN SOLE OF FOOT

- Medial calcaneal branches
- Medial plantar nerve
- Lateral plantar nerve

Around the neck of fibula, common fibular nerve terminates into

- Superficial fibular nerve
- Deep fibular nerve

- Posterior cutaneous nerve of thigh supplies skin in the popliteal fossa
- Branches of posterior cutaneous nerve of thigh
 - Gluteal branches to the skin over the lower medial quadrant of the buttock
 - Perineal branch to the skin of the back of the scrotum or labium majus
 - Cutaneous branch to back of thigh and upper part of leg
- Lateral cutaneous nerve of thigh supplies
 - Skin of lateral aspect of leg
 - Skin of lower lateral quadrant of buttock
- Superior gluteal nerve supplies gluteus medius, gluteus minimus and tensor fascia lata
- Inferior gluteal nerve supplies gluteus maximus
- Femoral nerve is the largest branch of lumbar plexus
- Sciatic nerve is the largest nerve in the body
- The sciatic nerve ends in lower third of the thigh by dividing into tibial and common fibular (peroneal) nerves
- Sciatic nerve can be injured due to injections in upper medial quadrant of buttocks
- Injury to common fibular nerve causes foot drop. Or

Lesion of deep peroneal nerve causes foot drop

- **NERVE SUPPLY:**
 - Anterior compartment of thigh – Femoral nerve
 - Medial compartment of thigh – Obturator nerve
 - Posterior compartment of thigh – Sciatic nerve
 - Anterior compartment of leg – Deep fibular nerve
 - Lateral compartment of leg – Superficial fibular nerve
 - Posterior compartment of leg – Tibial nerve

- The **great saphenous vein** usually receives three tributaries at the saphenous opening in the deep fascia:
 1. Superficial circumflex iliac vein
 2. Superficial epigastric vein
 3. Superficial external pudendal vein

- The veins of lower limb are organized into three groups i.e. superficial, deep and perforating veins.

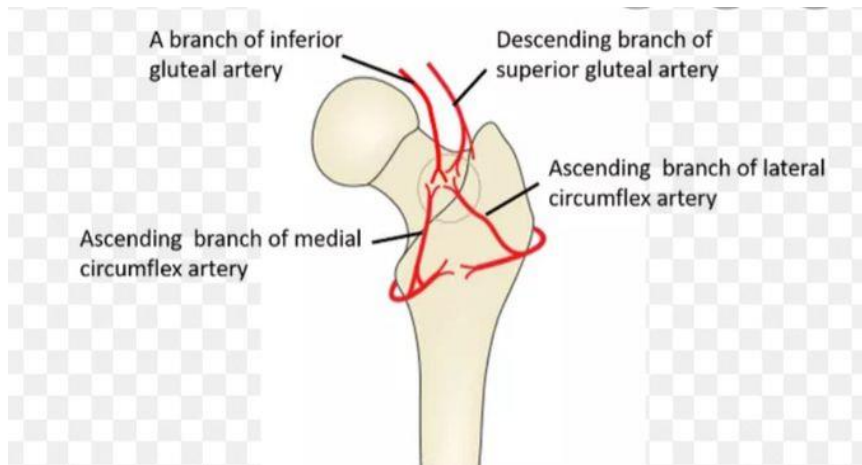
The superficial veins consist of great and small saphenous veins and their tributaries, which are situated beneath the skin in superficial fascia

The deep veins are the venae comitantes to the anterior and posterior tibial arteries, the popliteal vein and the femoral veins and their tributaries.

The perforating veins are commonly vessels that run between the superficial and deep veins.

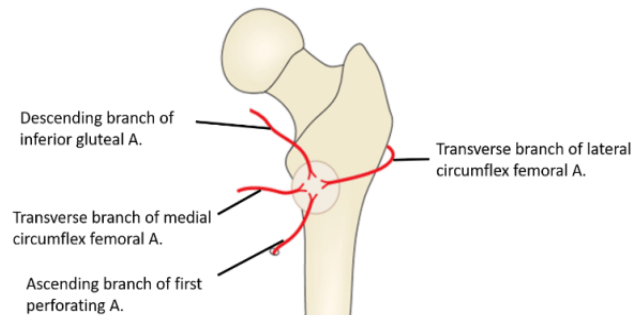
- **BLOOD SUPPLY TO LOWER LIMB**
 - Anterior compartment of thigh – Femoral artery
 - Medial compartment of thigh – Profunda femoris artery and obturator artery
 - Posterior compartment of thigh – branches of profunda femoris artery
 - Anterior compartment of leg – Anterior tibial artery
 - Lateral compartment of leg – Branches from fibular artery
 - Posterior compartment of leg – Posterior tibial artery

- Arteries involved in trochanteric anastomoses:
 - Superior gluteal artery
 - Inferior gluteal artery
 - Medial femoral circumflex artery
 - Lateral femoral circumflex artery

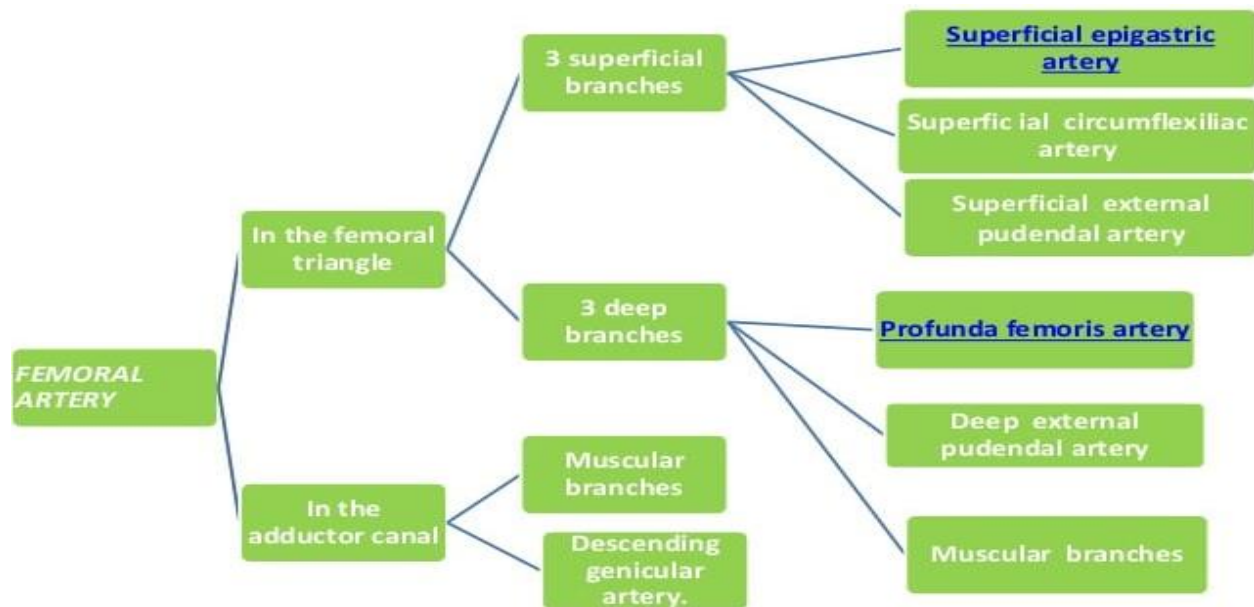


- Arteries involved in cruciate anastomoses
 - Inferior Gluteal artery
 - Medial femoral circumflex artery
 - Lateral femoral circumflex artery
 - First perforating artery, a branch of profunda artery

Cruciate Anastomosis



- The femoral artery is the continuation of external iliac artery.
The femoral vein drains into external iliac vein
- Branches of Femoral artery:
 - Superficial circumflex iliac artery
 - Superficial epigastric artery
 - Superficial external pudendal artery
 - Deep external pudendal artery
 - Profunda femoris artery
 - Descending genicular artery

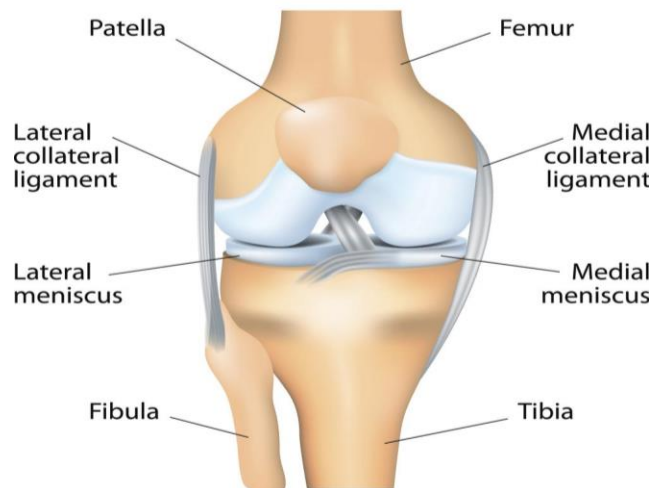


- Obturator artery is a branch of internal iliac artery
- The popliteal artery ends at the level of lower border of popliteus muscle by dividing into anterior and posterior tibial arteries
- L4 – L5 lesion will lead to weakness of dorsiflexion and difficulty in heel walking
L5 – S1 lesion will lead to weakness of plantar flexion, difficulty in toe walking and decreased Achilles reflex
L3 – L4 lesion will result in weakness of knee extension and decreased patellar reflex
- Gluteus medius is a stabilizer of the pelvis. When the left leg is lifted off the ground, the right side of the pelvis will drop due to loss of support and increased weight-bearing. The Gluteus medius muscle prevents this muscle drop of the opposite side of pelvis.

- **Joint Types**

Hip Joint	Synovial ball-and-socket joint
Knee Joint	Synovial Hinge Joint
Proximal Tibiofibular Joint	Synovial plane, gliding joint
Distal Tibiofibular Joint	Fibrous joint
Ankle Joint	Synovial Hinge Joint
Subtalar Joint (between talus and calcaneum)	Synovial Plane Joint
Calcaneocuboid Joint	Synovial Plane Joint
Cuneonavicular Joint	Gliding Joint
Cuboidonavicular Joint	Fibrous Joint
Tarsometatarsal Joint	Synovial Plane Joint
Intermetatarsal Joints	Synovial Plane Joint

- **Ligaments of Hip Joint:**
 1. Iliofemoral ligaments – prevents overextension during standing
 2. Pubofemoral ligament – limits extension and abduction
 3. Ischiofemoral ligament – limits extension
 4. Transverse acetabular ligament
 5. Ligament of head of femur – lies within the joint
- The **knee joint** is the largest and most complicated joint in the body. It consists of two main parts:
 1. Paired condylar joints between the rounded medial and lateral condyles of the femur above and the corresponding condyles of the tibia and their cartilaginous menisci below
 2. Gliding joint between patella and the patellar surface of femur



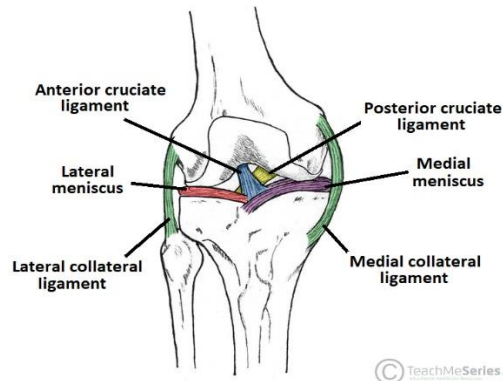
- **LIGAMENTS OF KNEE JOINT**

- **Extracapsular ligaments**

- Ligamentum patellae
 - Lateral collateral ligament
 - Medial collateral ligament
 - Oblique popliteal ligament – strengthens the posterior aspect of the capsule

- **Intracapsular ligaments**

- Anterior cruciate ligament (ACL)
 - Prevents posterior displacement of the femur on tibia
 - With the knee joint flexed, the ACL prevents tibia from being pulled anteriorly relative to the femur
 - Posterior cruciate ligament (PCL)
 - Prevents anterior displacement of femur on tibia
 - With the knee joint flexed, the PCL prevents tibia from being pulled posteriorly relative to the femur



LOWER LIMB MUSCLE FUNCTIONS

1. **PIRIFORMIS**
 - Lateral rotator of thigh at hip joint
2. **OBTURATOR INTERNUS**
 - Lateral rotator of thigh at hip joint
3. **GAMELLUS SUPERIOR**
 - Lateral rotator of thigh at hip joint
4. **GAMELLUS INFERIOR**
 - Lateral rotator of thigh at hip joint
5. **QUADRATUS FEMORIS**
 - Lateral rotator of thigh at hip joint
6. **GLUTEUS MINIMUS**
 - Abducts thigh at hip joint
 - Tilts pelvis when walking to permit opposite leg to clear ground
7. **GLUTEUS MEDIUS**
 - Abducts thigh at hip joint
 - Tilts pelvis when walking to permit opposite leg to clear ground
8. **GLUTEUS MAXIMUS**
 - Extends and laterally rotates hip joint
 - Through iliotibial tract, it extends knee joint
9. **TENSOR FASCIAE LATAE**
 - Assists gluteus maximus in extending the knee joint
10. **SARTORIUS**
 - Flexes, abducts, laterally rotates thigh at hip joint
 - Flexes and medially rotate leg at knee joint

11. RECTUS FEMORIS

- Extension of leg at knee joint
- Flexes thigh at hip joint

12. VASTUS LATERALIS

- Extension of leg at knee joint

13. VASTUS MEDIALIS

- Extension of leg at knee joint
- Stabilizes patella

14. VASTUS INTERMEDIUS

- Extension of leg at knee joint
- Articularis genus retracts synovial membrane

15. PSOAS MAJOR

- Flexes thigh on trunk
- If trunk is fixed, it flexes the trunk on the thigh as in sitting up from lying down

16. ILIACUS

- Flexes thigh on trunk
- If trunk is fixed, it flexes the trunk on the thigh as in sitting up from lying down

17. BICEPS FEMORIS

- Flexes and laterally rotates leg at knee joint
- Extends thigh at hip joint

18. SEMITENDINOSUS

- Flexes and medially rotates leg at knee joint
- Extends thigh at hip joint

19. SEMIMEMBRANOSUS

- Flexes thigh on trunk
- If trunk is fixed, it flexes the trunk on the thigh as in sitting up from lying down

20. GRACILIS

- Adducts thigh at hip joint
- Flexes leg at knee joint

21. PECTINEUS

- Flexes and abducts thigh at hip joint

22. ADDUCTOR LONGUS

- Adducts thigh at hip joint and assists in medial rotation

23. ADDUCTOR BREVIS

- Adducts thigh at hip joint

24. ADDUCTOR MAGNUS

- Adducts thigh at hip joint and assists in medial rotation
- Hamstring portion extends thigh at hip joint

25. OBTURATOR EXTERNUS

- Laterally rotates thigh at hip joint

26. GASTROCNEMIUS

- Plantar flexes foot at ankle joint
- Flexes knee joint

27. PLANTARIS

- Plantar flexes foot at ankle joint
- Flexes knee joint

28. SOLEUS

- Together with gastrocnemius and plantaris is powerful plantar flexor of ankle joint
- Provides main propulsive forces in walking and running

29. POPLITEUS

- Flexes leg at knee joint
- Unlocks knee joint by lateral rotation of femur on tibia and slackens ligaments of joints

30. FLEXOR HALLUCIS LONGUS

- Flexes distal phalanx of big toe
- Plantar flexes foot at ankle joint
- Supports medial longitudinal arch of foot

31. FLEXOR DIGITORUM LONGUS

- Flexes distal phalanges of lateral four toes
- Plantar flexes foot at ankle joint
- Supports medial and lateral longitudinal arches of foot

32. TIBIALIS POSTERIOR

- Plantar flexes foot at ankle joint
- Inverts foot at subtalar and transverse tarsal joints
- Supports medial longitudinal arch of foot

33. FIBULARIS LONGUS

- Plantarflexes foot at ankle joint
- Everts foot at subtalar and transverse tarsal joints
- Supports lateral longitudinal and transverse arches of foot

34. FIBULARIS BREVIS

- Plantarflexes foot at ankle joint
- Everts foot at subtalar and transverse tarsal joints
- Supports lateral longitudinal arch of foot

35. TIBIALIS ANTERIOR

- Extends foot at ankle joint
- Inverts foot at subtalar and transverse tarsal joints
- Holds up medial longitudinal arch of foot

36. EXTENSOR HALLUCIS LONGUS

- Extends big toe
- Extends foot at ankle joint
- Inverts foot at subtalar and transverse tarsal joints

37. EXTENSOR DIGITORUM LONGUS

- Extends toes
- Extends foot at ankle joint

38. FIBULARIS TERTIUS

- Extends foot at ankle joint
- Everts foot at subtalar and transverse tarsal joints

39. EXTENSOR DIGITORUM BREVIS

- Extends toes

40. EXTENSOR HALLUCIS BREVIS

- Extends the big toe

41. ABDUCTOR HALLUCIS

- Flexes and abducts big toe
- Braces medial longitudinal arch

42. FLEXOR DIGITORUM BREVIS

- Flexes lateral four toes
- Braces medial and lateral longitudinal arches

43. ABDUCTOR DIGITI MINIMI

- Flexes and abducts fifth toe
- Braces lateral longitudinal arch

44. QUADRATUS PLANTAE

- Assists flexor digitorum longus in flexing lateral four toes

45. LUMBRICALS

- Extends toes at interphalangeal joints

46. FLEXOR HALLUCIS BREVIS

- Flexes metacarpophalangeal joint of big toe
- Supports medial longitudinal arch

47. ADDUCTOR HALLUCIS

- Flexes metatarsophalangeal joint of big toe
- Holds together metatarsal bones

48. FLEXOR DIGITI MINIMI BREVIS

- Flexes metatarsophalangeal joint of little toe

49. PLANTAR INTEROSSEI

- Adduction of toes
- Flexes metatarsophalangeal joints
- Extends interphalangeal joints

50. DORSAL INTEROSSEI

- Abduction of toes
- Flexes metatarsophalangeal joints
- Extends interphalangeal joints