Lower Extremity

Introduction
Hip Joint

- Head of the femur with acetabulum of innominate
- Ball in socket
- Better union than shoulder
- Acetabular labrum similar to glenoid labrum
- Acetabulum is not a complete circle, open inferiorly. This opening is closed by the transverse ligament
- Head of femur attached to inside of acetabulum by ligamentum teres AKA Head ligament
Acetabulum
Acetabulum

- Acetabulum
- Body of pubic bone
- Ischiopubic ramus
- Obturator foramen
- For attachment of semimembranosus muscle
- For attachment of semitendinosus and long head of biceps femoris muscles
- For attachment of adductor magnus muscle
- For attachment of sacrotuberous ligament
- Covered by connective tissue and bursa
Acetabulum
Femur - Posterior

- Neck
- Greater trochanter
- Attachment site for gluteus medius
- Quadratus tubercle
- Lesser trochanter
- Intertrochanteric crest
- Gluteal tuberosity
- Pectineal line (Spiral line)
- Medial margin of linea aspera
- Lateral margin of linea aspera
- Gluteus medius
- Gluteus minimus
- Lesser trochanter
Hip Joint

- Acetabulum of pelvic bone
- Acetabular labrum
- Head of femur
Hip Joint
Hip

- Strong but loose joint capsule running from above the acetabulum and labrum down to the intertrochanteric line
- Suction exists in joint owing to atmospheric differences – this increases joint stability
- Approximately 70% of head of femur in contact with acetabulum at max contact
Anterior Capsule
Anterior Capsule

- Synovial membrane
- Line of attachment around head of femur
- Membrane reflects back to attach to margin of acetabulum
Posterior Capsule
Iliofemoral ligament – AKA the “Y” ligament or the “Y ligament of Bigelo”
AIIS inferiorly to the intertrochanteric line
Triangular in shape
Supports hip anteriorly, resists extension, internal rotation and some external rotation
“Y” Ligament

Anterior inferior iliac spine

Iliopubic innence

Iliofermal ligament

Pubofemoral ligament
Hip Joint Ligaments - Y
Hip

- Pubofemoral
- Runs from the superior pubic ramus and the acetabular rim, to just above lesser trochanter
- Resists ABD with some resistance to external rotation
Pubofemoral
Pubofemoral
Hip

- Ischiofemoral
- From the ischium to the posterior neck of the femur – is directed upwards and laterally
- Resists ADD and internal rotation
- ALL three loose during flexion, the freest motion
Ischiofemoral ligament
Hip

- **Nerve Supply**
  - Superior gluteal
  - Inferior gluteal and
  - Femoral

- **Blood Supply**
  - Medial circumflex artery
  - Lateral circumflex artery

- **Bursae**
  - Iliopectineal
Blood Supply to Hip

- Common iliac artery
- External iliac artery
- Internal iliac artery
- Superior gluteal artery
- Inferior gluteal artery
- Lateral circumflex femoral artery
- Medial circumflex femoral artery
- Deep artery of thigh
- 1st perforating artery
- Femoral artery
- Obturator artery
Blood Supply

Arteries of Femoral Head and Neck

Anterior and Posterior Views

- Inferior retinacular artery (subsynovial)
- Anterior retinacular artery (subsynovial)
- Superior retinacular artery (subsynovial)
- Foveolar artery (often minute)
- Posterior retinacular artery (subsynovial)
- Superior retinacular artery (subsynovial)
- Ischiofemoral ligament and joint capsule
- Anastomosis between medial and lateral circumflex femoral arteries
- Iliopectineal (Y) ligament and joint capsule
- Transverse branch of lateral circumflex femoral artery
- Iliopsoas tendon
- Medial circumflex femoral artery
- Deep femoral artery
- Lateral circumflex femoral artery
- Nutrient artery of femur
- Ascending branch of lateral circumflex femoral artery
- Descending branch of lateral circumflex femoral artery
Hip Angles

- Femur is held away from the hip joint and the pelvis via the femoral neck
- Forms an angle called the angle of inclination
  - In the frontal plane, angle = approximately 125 degrees; the range = from about 90 degrees to 135 degrees
- Determines
  - The effectiveness of hip ABD muscles
  - The length of the limb
  - The forces acting on the hip joint and femoral neck
Hip Angles

- If greater than 125 degrees called coxa valgus
  - Increase = lengthened limb length, increase load on femoral head, decrease stress on femoral neck, decrease effectiveness of hip ABD

- If less than 125 degrees, called coxa cara
  - Decrease = shortened limb, decrease load on femoral head, increase stress on femoral neck, increase effectiveness of hip ABD
Angle of Inclination

Femur
Anterior View

- Greater trochanter
- Fovea of head
- Neck
- Lesser trochanter
- Intertrochanteric line
- Head
- Shaft (body)
- Adductor tubercle
- Lateral epicondyle
- Medial epicondyle
- Lateral condyle
- Medial condyle
- Patellar surface

Line of attachment of border of synovial membrane
Line of reflection of synovial membrane
Line of attachment of fibrous capsule
Line of reflection of fibrous capsule (unattached)
Angle of Inclination
Coxa Valga (L) v. Coxa Vara
Hip Angles

- Angle of femoral neck in the transverse plane is termed anteverversion.
- Neck is rotated 12-14 degrees with respect to femur.
- Increases the MA of the gluteus maximus – making it a more effective hip external rotator.
  - Excessive (beyond 14 degrees) to the anterior side means that the head of femur is uncovered – tends to dislocate, unstable hip.
  - Decrease (less than 12 degrees) is called Retroversion, angle reversed and moved posteriorly.
Anterverision

- Gluteus medius
- Gluteus minimus
- Lesser trochanter
Anterversion - Normal
Anterversion - Excessive
Retroversion
Hip ROM

- 70-140 degrees of flexion – 90 with knees extended, 125-140 with knees flexed
- 4-15 degrees of hyperextension (beyond anatomical position)
- Hyperextension is limited by anterior capsule, strong hip flexors, iliofemoral ligament
- ABD = about 30-50
- ADD = about 25 from anatomical position
Lumbo-Sacral Plexus

- Two distinctly different plexi that are connected and serve the entire Hip and LE
- Lumbar from T12, L1, L2, L3, L4
- Sacral from L4, L5, S1, S2, S3, and S4
- Ventral rami, anterior and posterior divisions and terminal nerves
Lumbar Plexus Schematic

- Iliohypogastric nerve
- Ilio-inguinal nerve
- Genitofemoral nerve
- Lateral femoral cutaneous nerve
- To iliacus muscle
- Femoral nerve
- Obturator nerve
- To lumbosacral trunk
Lumbar Division
Ventral Rami from T12 to L5

- Subcostal (T12)
- Iliohypogastric (T12,L1)
- Ilioinguinal (L1)
- Genitofemoral (L1, L2)
- Lateral Femoral Cutaneous (Post. Divisions L2,L3)
- Femoral (Posterior Division L2,L3,L4)
- Obturator (Anterior Division L2,L3,L4)
- Sacral Trunk (L4,L5)
Lumbar Division

- L1 anterior ramus
- L2 anterior ramus
- L3 anterior ramus
- Ilio-inguinal nerve
- Lateral cutaneous nerve of thigh
- Sacrotuberous ligament
- Femoral branch of genitofemoral nerve
- Sacrospinous ligament
- Femoral nerve
- Obturator nerve
- Perforating cutaneous nerve
- Posterior cutaneous nerve of thigh
- Lumbosacral trunk
- Superior gluteal nerve
- Inferior gluteal nerve
- Inguinal ligament
- Nerves to quadratus femoris and obturator internus
- Sciatic nerve
Sacral Division
Ventral Rami from L4 to S4

- **Posterior Division Nerves**
  - Superior Gluteal (L4,L5,S1)
  - Inferior Gluteal (L5,S1,S2)
  - Common Peroneal (L4,L5,S1,S2)

- **Anterior Division**
  - Tibial (L5,S1,S2,S3)

- **Both Divisions**
  - Posterior Femoral Cutaneous (S1,S2,S3)
Both

Lumbosacral and Coccygeal Plexuses

- Intercostal nerve (T11)
- Iliohypogastric nerve (T12, L1)
- Iliinguinal nerve (L1)
- Genitofemoral nerve (L1, 2)
- To psoas major and iliacus muscles
- Lateral cutaneous nerve of thigh (L2, 3)
- Genital branch of genitofemoral nerve
- Femoral branch of genitofemoral nerve
- Lumbosacral trunk
- To quadratus femoris and inferior gemellus muscles (L4, 5, S1)
- To psoas major and iliacus muscles
- Anterior branches of subcostal and iliohypogastric nerves
- Lateral branches of subcostal and iliohypogastric nerves
- To obturator internus and superior gemellus muscles (L5, S1, 2)
- Superior gluteal nerve (L4, 5, S1)
- To piriformis muscle (S1, 2)
- Obturator nerve (L2, 3, 4)
- Inferior gluteal nerve (L5, S1, 2)
- Sciatic nerve
- Femoral nerve (L2, 3, 4)
- Accessory obturator nerve (L3, 4)
- (inconstant)
- Posterior femoral cutaneous nerve (S1, 2, 3)
- Pudendal nerve (S2, 3, 4)
- Common fibular (peroneal) nerve
  (L4, 5, S1, 2) (part of sciatic nerve)
- Tibial nerve (L4, 5, S1, 2, 3) (part of sciatic nerve)
- Posterior cutaneous nerve of thigh
- Perineal nerve
- Posterior scrotal (labial) branches of perineal nerve
- Inferior anal (rectal) nerve
- Dorsal nerve of penis (clitoris)
- Anococcygeal nerves
- Perineal branch of 4th sacral nerve
- Obturator nerve
- Perforating cutaneous nerve (S2, 3)
- To levator ani and coccygeus muscles (S3, 4)
- Pelvic splanchnic nerves (nervi erigentes)
- Anterior division
- Posterior division
Sacral Plexus in Situ

Sacral and Coccygeal Plexuses in Situ
Small Nerves from Sacral Plexus

- Branch to Quadratus Femoris and Inferior Gemellus (L4, L5, S1) [ant. div.]
- Branch to Obturator Internus and Superior Gemellus (L5, S1, S2)
- Nerve to Piriformis (S1, S2) [post. div.]
- Pudendal Nerve (S3, S4)
Small Nerves

- Lumbosacral trunk
- Superior gluteal
- Inferior gluteal
- To piriformis muscle
- Sciatic nerve
  - Common fibular part
  - Tibial part
    - To quadratus femoris and inferior gemellus muscles
    - To obturator internus muscle
- Posterior femoral cutaneous nerve
- Pudendal nerve
- Anococcygeal nerves
- To levator ani, coccygeus and external anal sphincter muscles
- Coccygeal plexus
- Sacral plexus
- Dorsal divisions
- Ventral divisions
Coccygeal Plexus

emosis and us muscles
intermus muscle
oral cutaneous nerve

Pelvic splanchnic nerve

S2

S3

S4

S5

Pelvic splanchnic nerves

Perforating cutaneous nerve

To levator ani, coccygeus and external anal sphincter muscles

Anococcygeal nerves

Co

Coccygeal plexus
Femoral Nerve

Femoral and Lateral Femoral Cutaneous Nerves

Lateral cutaneous nerve of thigh (L2, 3)
Femoral nerve (L2, 3, 4)
Obturator nerve
Iliacus muscle
Psoas major muscle (lower part)
Articular branch of femoral nerve
Sartorius muscle (cut and reflected)
Rectus femoris muscle (cut and reflected)
Vastus intermedius muscle
Vastus medialis muscle
Vastus lateralis muscle
Articularis genus muscle
Infrapatellar branch of saphenous nerve
Medial crural cutaneous branches of saphenous nerve

Note: only muscles innervated by femoral nerve shown
Femoral Nerve
Femoral and Lateral Femoral Cutaneous Nerves
Cutaneous Innervation

- Lateral cutaneous nerve of thigh
- Anterior cutaneous branches of femoral nerve
- Infrapatellar branch of saphenous nerve
- Medial crural cutaneous branches of saphenous nerve
Obturator Nerve

L1 (part of lumbar plexus)
L2 (part of lumbar plexus)
L3 (part of lumbar plexus)
L4 (part of lumbar plexus)

Iliohypogastric nerve
Ilioinguinal nerve
Genitofemoral nerve
Lateral cutaneous nerve of thigh
Femoral nerve
Obturator nerve (L2, 3, 4)

Articular branch of obturator nerve
Obturator externus muscle
Adductor brevis muscle
Adductor longus muscle (cut)
Articular branch (to knee joint)
Adductor hiatus

Lumbosacral trunk
Posterior branch of obturator nerve
Anterior branch of obturator nerve
Adductor magnus muscle (ischioadductor part supplied by sciatic nerve)
Gracilis muscle
Cutaneous branch of obturator nerve

Note: only muscles innervated by obturator nerve shown
Obturator Nerve

Obturator Nerve

Cutaneous Innervation
“Sciatic” Nerve
Sciatic and Posterior Femoral Cutaneous Nerves

- Posterior femoral cutaneous nerve (S1, 2, 3)
- Greater sciatic foramen
- Sciatic nerve (L4, 5, S1, 2, 3)
- Common fibular (peroneal) segment of sciatic nerve
- Adductor magnus muscle (also partially supplied by obturator nerve)
- Short head of biceps femoris muscle
- Long head (cut) of biceps femoris muscle
- Common fibular (peroneal) nerve
- Articular branch of common fibular (peroneal) nerve
- Plantaris muscle
- Lateral sural cutaneous nerve
- Fibular (peroneal) communicating branch
- Sural nerve
- Gastrocnemius muscle
- Soleus muscle
- Tibial nerve
- Medial calcaneal branches of tibial nerve
- Lateral calcaneal branches of tibial nerve
- Medial and lateral plantar nerves
- Lateral dorsal cutaneous nerve
“Sciatic Nerve”

Sciatic and Posterior Femoral Cutaneous Nerves

Cutaneous Innervation

- Posterior cutaneous nerve of thigh

- Common fibular (peroneal) nerve via lateral sural cutaneous nerve (from sciatic nerve)

- Medial sural cutaneous nerve (from sciatic nerve)

- Superficial fibular (peroneal) nerve (from sciatic nerve)

- Sural nerve (from sciatic nerve)

- Tibial nerve via medial calcaneal branches (from sciatic nerve)
Tibial Nerve

- Tibial nerve (L4, 5, S1, 2, 3)
- Medial sural cutaneous nerve (cut)
- Articular branches of tibial nerve
- Plantaris muscle
- Popliteus muscle
- Intersosseous crural nerve
- Soleus muscle (cut)
- Flexor digitorum longus muscle
- Flexor hallucis longus muscle
- Medial calcaneal branch of tibial nerve
- Sural nerve (cut)
- Flexor retinaculum (cut)
- Lateral calcaneal branch of sural nerve
- Lateral dorsal cutaneous nerve
- Articular branch of common fibular (peroneal) nerve
- Common fibular (peroneal) nerve
- Lateral sural cutaneous nerve (cut)
Common Peroneal Nerve

Common Fibular [Peroneal] Nerve

- Common fibular (peroneal) nerve (phantom)
- Recurrent articular nerve
- Lateral branch of deep fibular (peroneal) nerve
- Tibialis anterior muscle
- Articular branches of common fibular (peroneal) nerve
- Extensor digitorum longus muscle
- Deep fibular (peroneal) nerve
- Fibularis (peroneus) longus muscle
- Extensor digitorum brevis muscle
- Fibularis (peroneus) brevis muscle
- Extensor hallucis longus muscle
- Medial dorsal cutaneous nerve
- Intermediate dorsal cutaneous nerve
- Lateral dorsal cutaneous nerve (branch of sural nerve)
- Dorsal digital nerves
- Biceps femoris tendon
- Head of fibula
- Branches of lateral sural cutaneous nerve
- Common fibular (peroneal) nerve (L4, 5, S1, 2)
Common Peroneal Nerve

Common Fibular [Peroneal] Nerve
Cutaneous Innervation

- Lateral sural cutaneous nerve
- Superficial fibular (peroneal) nerve
- Sural nerve via lateral dorsal cutaneous branch
- Deep fibular (peroneal) nerve
Tibial Nerve
Cutaneous Innervation of Sole of Foot

- Medial calcaneal branches (S1, 2) from tibial nerve
- Medial plantar nerve (L4, 5) from tibial nerve
- Saphenous nerve (L3, 4)
- Sural nerve (S1, 2) via lateral calcaneal and lateral dorsal cutaneous branches
- Lateral plantar nerve (S1, 2) from tibial nerve