


Lower Limb


- Dr. Robin Paudel



- What is a limb?
 - Skeleton
 - Joints
 - Pelvis or limb girdle
 - Hip/Hip Muscles
 - Lumbar and sacral plexus—getting spinal nerves out onto limb
- Muscles—anterior and posterior compartments
- Surface anatomy

No viscera—all innervation is somatic (motor or sensory) from ventral ramus of spinal nerve (except autonomic to blood vessels)

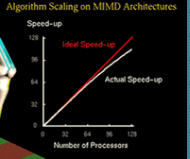
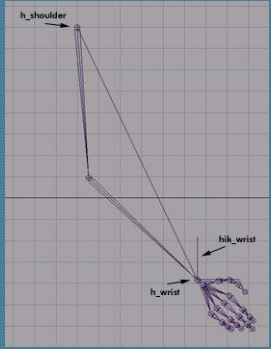
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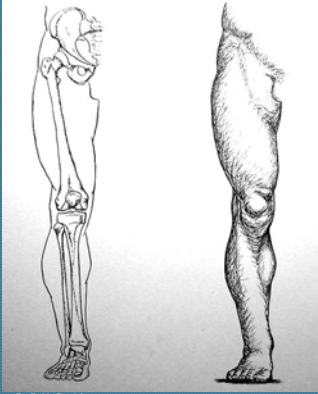
Upper-Lower Limb Comparison

23 degrees of freedom
54 muscles


Algorithm Scaling on MIMD Architectures

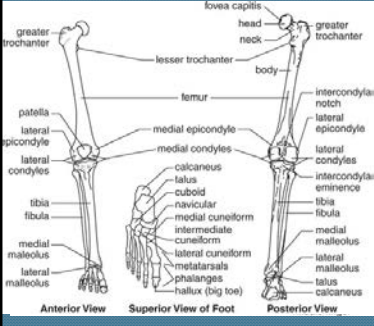
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Lower Limb




- Pelvis
- Femur
- Tibia, fibula
- Tarsals
- Digits
 - Metatarsals
 - Phalanges



Bony structure of the pelvis

<p>MAIN STRUCTURES</p> <ul style="list-style-type: none"> Hip bone (innominate, os coxae)—fusion of <ul style="list-style-type: none"> Ilium (“hips”) Ischium (“rear”) Pubis (anterior midline) Sacrum and coccyx Acetabulum Femur—head, neck, greater trochanter 	<p>HOLES</p> <ul style="list-style-type: none"> False and true pelvis (major, minor pelvis) Pelvic inlet, pelvic outlet Sacrospinous ligament Sacrospinous ligament Greater, lesser sciatic foramen Obturator foramen
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Tibia/fibula




- Tibia--big toe side/ Medial
- Fibula--little toe side/ Lateral

(no pronation/supination)

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Ankle



- Tarsus--forms ankle joint
- Calcaneus--forms heel

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Foot



- **Function:**
 - Support weight
 - Act as lever when walking
- **Tarsals**
 - Talus = ankle
 - Between tibia + fibula
 - Articulates w/both
 - Calcaneus = heel
 - Attachment for Calcaneal tendon
 - Carries talus
- **Metatarsals**
 - Homologous to metacarpals
- **Phalanges**
 - Smaller, less nimble

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Joints of Lower Limb



- Hip (femur + acetabulum)
 - Ball + socket
 - Multiaxial
 - Synovial
- Knee (femur + patella)
 - Plane
 - Gliding of patella
 - Synovial
- Knee (femur + tibia)
 - Hinge
 - Biaxial
 - Synovial

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Joints of Lower Limb



- **Proximal Tibia + Fibula**
 - Plane
 - Gliding
 - Synovial
- **Distal Tibia + Fibula**
 - Slight "give"
 - Fibrous
- **Ankle (Tibia/Fibula + Talus)**
 - Hinge
 - Uniaxial
 - Synovial

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Nerve Supply

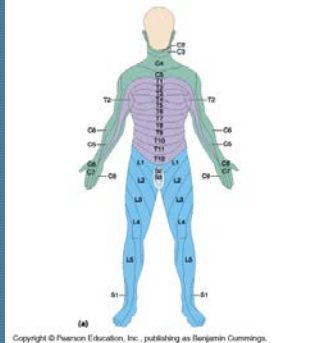
- Segmental Innervation to Muscles of Lower Limb

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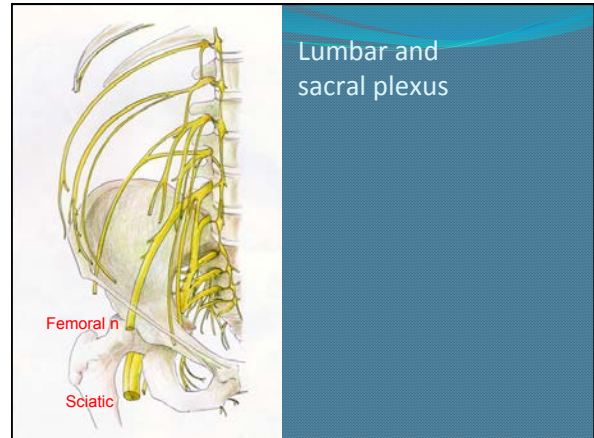
Dermatomes show twisting of leg during development

Dorsal becomes anterior: thus "dorsiflexion" and extension in anterior compartment (unlike upper limb)

Ventral becomes posterior: thus flexion is in posterior compartment (unlike upper limb)



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Lumbar and sacral plexus

Sacral plexus (sciatic nerve)

With leg out to side like quadruped, lumbar-anterior, sacral-posterior makes sense

- Lumbar plexus (femoral nerve)

LUMBOSACRAL PLEXUS

- The lumbosacral plexus is formed by the anterior rami of spinal nerves **T12** through **S4**.
- The innervation of the lower limb arises from segments **L2** through **S3**.
- The major nerves of the lower limb are the:
 - Femoral nerve** - posterior divisions of **L2** through **L4**.
 - Obturator nerve** - anterior divisions of **L2** through **L4**.
 - Tibial nerve** - anterior divisions of **L4** through **S3**.
 - Common peroneal nerve** - posterior divisions of **L4** through **S2**.
- The tibial nerve and common peroneal nerve travel together through the gluteal region and thigh in a common connective tissue sheath and together are called the sciatic nerve.
- The common peroneal nerve divides in the proximal leg into the superficial and deep peroneal nerves.

LUMBO SACRAL PLEXUS

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Terminal Nerve	Origin	Muscles Innervated
Femoral nerve	L2 through L4 posterior divisions	Anterior compartment of thigh (quadriceps femoris, sartorius, pectineus)
Obturator nerve	L2 through L4 anterior divisions	Medial compartment of thigh (gracilis, adductor longus, adductor brevis, anterior portion of adductor magnus)
Tibial nerve	L4 through S3 anterior divisions	Posterior compartment of thigh (semimembranosus, semitendinosus, long head of biceps femoris, posterior portion of adductor magnus) Posterior compartment of leg (gastrocnemius, soleus, flexor digitorum longus, flexor hallucis longus, tibialis posterior) Plantar muscles of foot
Common peroneal nerve	L4 through S2 posterior divisions	Short head of biceps femoris
Superficial peroneal nerve		Lateral compartment of leg (peroneus longus, peroneus brevis)
Deep peroneal nerve		Anterior compartment of leg (tibialis anterior, extensor hallucis, extensor digitorum, peroneus tertius)

Lower Limb Movements

- Hip
 - Flexion/extension
 - Abduction/adduction
 - Lateral/medial rotation
- Knee
 - Flexion/extension
- Ankle
 - Dorsiflexion/plantarflexion
 - Inversion/eversion
- Toes
 - Flexion/extension

Anterior/Posterior compartments at Hip

	ANTERIOR COMPARTMENT	POSTERIOR COMPARTMENT
MOVEMENT	Extension	Flexion
MUSCLES		
NERVES		

Posterior and lateral hip

- Gluts (gluteal nerves)
 - Maximus—extensor of thigh
 - Medius--pelvic tilt
- Lateral rotators (spinal nn.)
 - Piriformis syndrome

Anterior Hip

- iliopsoas
 - iliacus
 - psoas
- Quadratus lumborum

Flexors of Hip

Collectively known as the **iliopsoas** or inner hip muscles:

- Psoas major
- Psoas minor
- Iliacus muscle

Anterior compartment of thigh

- Rectus femoris (part of the quadriceps muscle group)
- Sartorius

One of the **gluteal muscles**:

- Tensor fasciae latae

Medial compartment of thigh

- Pectineus
- Adductor longus
- Adductor brevis
- Gracilis



Extensors of the Hip

Gluteus Maximus
Hamstring
Semi-membranosus
Semi-tendinosus

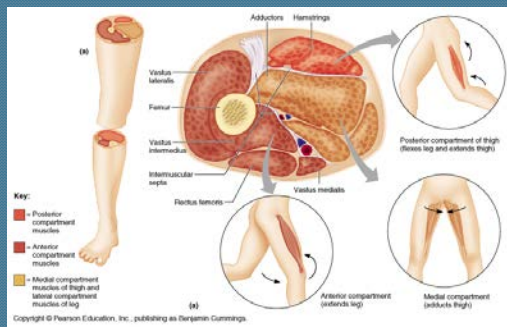


Anterior/Posterior compartments at Knee

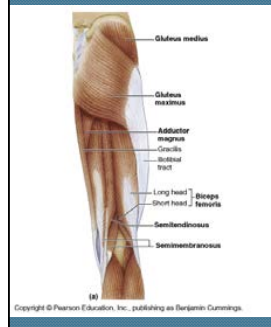
	ANTERIOR COMPARTMENT	POSTERIOR COMPARTMENT
MOVEMENT	Extension	Flexion
MUSCLES	Quadriceps	Hamstrings Gastrocnemius Soleus
NERVES	Femoral n. (lumbar plexus)	Sciatic n. (sacral plexus)



Thigh movements by compartment



Posterior Thigh

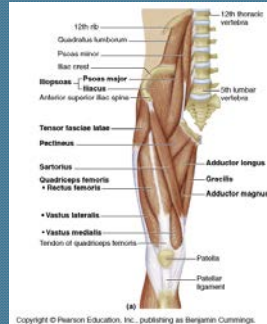


- Gluts (gluteal nn.)
 - Maximus—extensor of thigh
 - Medius—pelvic tilt
- Lateral rotators (spinal nn.)
 - Piriformis syndrome
- Hamstrings (sciatic n.)
 - Biceps femoris
 - Semimembranosus
 - Semitendinosus

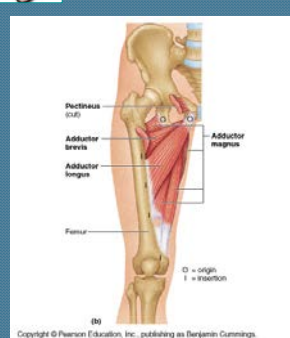


Anterior thigh (femoral n.)

- Sartorius (Tailor's muscle)
- Quads (four)
 - Rectus femoris (crosses hip)
 - 3 vastus mm. (vast--big)



Medial compartment (obturator n.)



- Adductor muscles
 - Gracilis
 - Adductor
 - Magnus
 - Longus
 - brevis

Leg movements by compartment

(leg all inn are branches of sciatic)

Key:

- Posterior compartment muscles
- Anterior compartment muscles
- Medial compartment muscles of thigh and lateral compartment muscles of leg

(a) Posterior compartment of leg (plantar flexes foot, flexes toes)

(b) Lateral compartment of leg (plantar flexes and everts foot)

(c) Medial compartment of leg (plantar flexes foot, flexes toes)

(d) Anterior compartment of leg (dorsiflexes foot, extends toes)

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Anterior Leg (deep fibular n.)

- Fibularis (peroneus) tertius
- Extensor digitorum longus
- Extensor hallucis longus
- Tibialis anterior

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Lateral Leg (superficial fibular n.)

- Fibularis brevis/longus

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Posterior Leg (tibial n.)

- Gastroc and soleus
- Flexor digitorum longus
- Flexor hallucis longus

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Intrinsics of foot

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Sacral plexus (sc nerve)

With leg out to side like quadruped, lumbar-anterior, sacral-posterior makes sense

- Lumbar plexus (femoral nerve)

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Blood supply to lower limb

- Internal iliac**
 - Cranial + Caudal Gluteals = gluteals
 - Internal Pudendal = perineum, external genitalia
 - Obturator = adductor muscles
- External iliac**
 - Femoral = lower limb**
 - Deep femoral = adductors, hamstrings, quadriceps
 - Popliteal (continuation of femoral)**
 - Geniculars = knee
 - Anterior Tibial = ant. leg muscles, further branches to feet
 - Posterior Tibial = flexor muscles, plantar arch, branches to toes

(a)
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NERVE INJURIES AND ABNORMALITIES OF GAIT

Superior Gluteal Nerve
Causes loss of abduction of the limb; impairment of gait; patient cannot keep pelvis level when standing on one leg. Sign is "Trendelenburg gait"

Inferior Gluteal Nerve
Produces a weakened hip extension; patient has difficulty rising from a sitting position or climbing stairs.

Femoral Nerve
Induces weakened hip flexion; loss of extension of the knee. Sensory loss occurs on the anterior thigh, medial leg, and foot.

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Obturator Nerve
Causes a loss of adduction of the thigh as well as sensory loss on medial thigh.

Sciatic Nerve
Brings about a weakened extension of the thigh; loss of flexion of the knee; and loss of function below the knee. Sensory loss on the posterior thigh, leg (except medial side), and foot is also observed.

Tibial nerve only
Causes a loss of flexion of the knee and digits; Loss of plantar flexion
Weakened inversion and sensory loss on the leg (except medial) and plantar foot.

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Common peroneal nerve
Produces a combination of deficits of lesion of the deep and superficial peroneal nerves. Sign is "foot drop."

Deep peroneal nerve--weakened inversion; loss of extension of the digits; loss of dorsiflexion "foot drop."

Sensory loss on anterolateral leg and dorsum of the foot.

Superficial peroneal nerve--loss of eversion of the foot. Sensory loss on dorsum of foot except the first web space.

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Sensory Innervation of the lower Leg and Foot

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Surface Anatomy: Posterior Pelvis

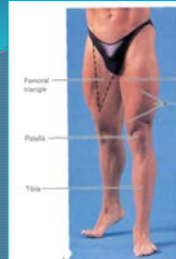
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- Iliac crest
- Gluteus maximus = cheeks
- Natal/gluteal cleft = crack
- Gluteal folds = bottom of cheek





Gluteus medius — Most superior point of iliac crest
 Gluteus maximus — Dimple for posterior superior iliac spine
 Greater trochanter of femur — Natal cleft
 Gluteal fold — Ischial tuberosity




Surface Anatomy: Anterior Thigh + Leg

- Palpate
 - Patella
 - Condyles of femur
- Femoral Triangle
 - Sartorius (lateral)
 - Adductor longus (medial)
 - Inguinal ligament (superior)
 - Femoral a + v, lymph nodes

Surface Anatomy: Posterior Leg



- Popliteal fossa
 - Diamond-shape fossa behind knee
- Boundaries
 - Biceps femoris (sup-lat)
 - Semitendinosus + semimembranosus (sup-med)
 - Gastrocnemius heads (inf)
- Contents
 - Popliteal a + v
- Calcaneal (Achilles) tendon

Plantaris muscle
 Biceps femoris
 Semitendinosus
 Semimembranosus
 Popliteal fossa
 Gastrocnemius
 Lateral head
 Medial head
 Soleus
 Calcaneal tendon
 Lateral malleolus
 Calcaneus