Final Exam

December-03-13
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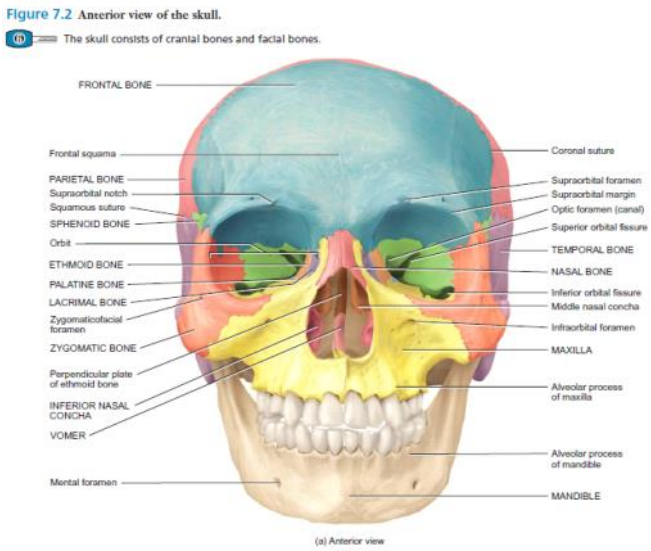
Axial skeleton is one of the two division of the skeleton, the other being the appendicular skeleton. Bone will lie around the longitudinal axis of the human body. It includes the skull, vertebral column and thorax (rib and sternum)

Flat bones of the skulls and some of the face are developed through intramembranous ossification

There are 22 bones, cranial and facial bones excluding bones of the middle ear forming the skull (calvarium).

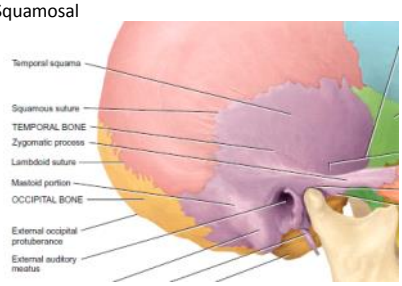
The 8 cranial bones are the frontal, occipital, the two temporal, the two parietal, ethmoid and shenoid bones.

There's 14 facial bones, the mandible, 2 maxilla ,2 zygomatic, 2 nasal, 2 lacrimal, 2 palatine, vomer and 2 inferior nasal conchae bones.

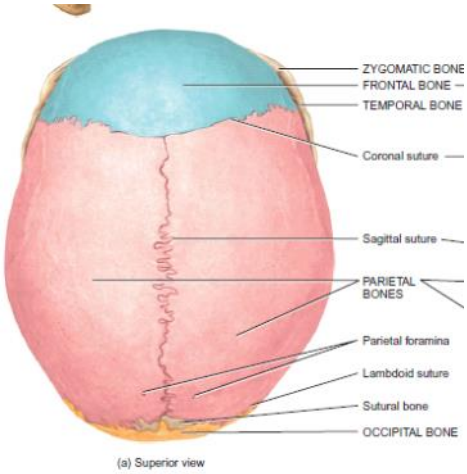


Sutures are what joins the different bones of the skull together, they form nearly immovable joint. The four sutures are coronal, sagittal, lambdoidal and squamosal.
The coronal and sagittal sutures form the anterior fontanel (bregma) which is a spot that was not closed in early childhood. It does not close until about 2 years of age and is brain tissues.
The lambdoidal+ sagittal sutures form them posterior fontanel which closes 3 months after birth.

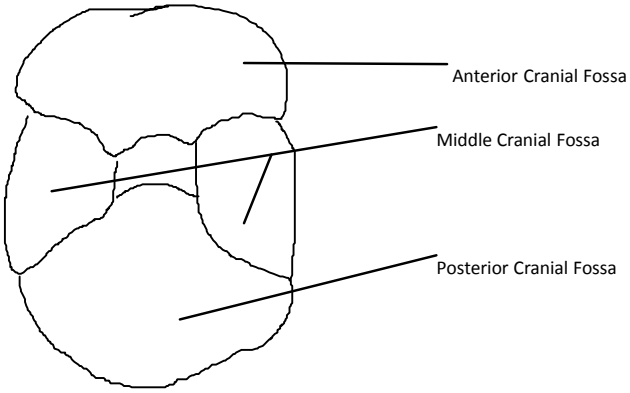
Squamosal

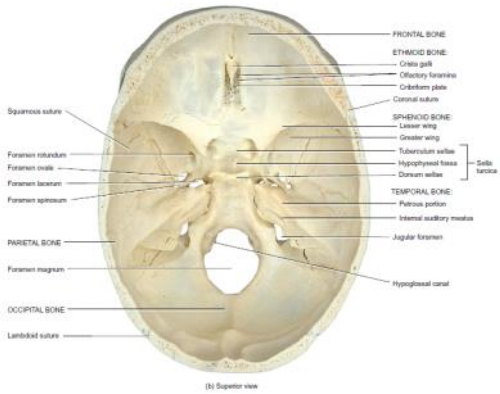


Sagittal, coronal and lambdoidal sutures



There are fossae in the skull too
The orbital fossae are the opening for the eyes, the nasal fossa is the opening for the nose, foramen magnum is the opening for the spinal cord and meninges to pass through and the cranial fossa when cut across transversely and viewed from an inferior angle, three compartments can be seen; the anterior, middle and posterior fossae which houses the frontal lobe, temporal lobe and occipital/cerebellum lobe respectively.





Vertebrae
There is 7 cervical, 12 thoracic, 5 lumbar, 5 sacral (sacrum when fused) and 4 coccygeal (coccyx when fused), for a total of 33 vertebrae but 26 bones (sacrum and coccyx). Between each vertebrae, there is the intervertebral discs (24), but there isn't any between occipital bone and C1, the first is between C2 and C3. Flexion of trunk is mostly (80-90%) accounted for by L4/L5 and L5/S1.

Vertebral Curvature

When born, newborn are in the fetal position meaning everything in their body is in flexion. The newborns are in kyphosis. When they begin extending their head, there is an eventual cervical lordosis in the cervical vertebrae while the thoracic remains kyphotic. Once the newborn learns to stand up, the new pressure eventually curves the lumbar spine into lumbar lordosis. There is a also the fused saral and coccygeal curve.

It is possible to over develop certain curves in the spine through habits and posture. For instance, when the head approaches the monitor and stays fixed in said position for elongated period of time, may find their spine to be lordotic. There is an exaggerated lordosis in the spine. Another possibility is scoliosis which is lateral curves of the spine.

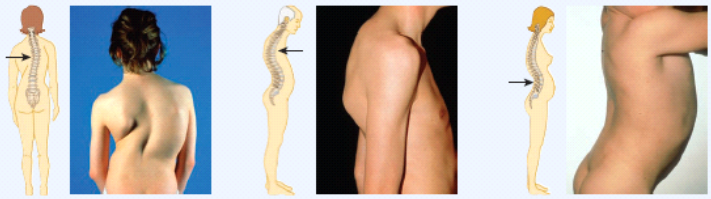
CLINICAL CONNECTION | *Abnormal Curves of the Vertebral Column*

Various conditions may exaggerate the normal curves of the vertebral column, or the column may acquire a lateral bend; both of these result in **abnormal curves** of the vertebral column.

Scoliosis (skō-lē-Ō-sis; *scolio-*=crooked) is a lateral bending of the vertebral column, usually in the thoracic region (Figure A). The most common of the abnormal curves, scoliosis may result from congenitally (present at birth) malformed vertebrae, chronic sciatica (pain in the lower back and lower limb), paralysis of muscles on one side of the vertebral column, poor posture, or one leg being shorter than the other.

Kyphosis (kī-FŌ-sis; *kyphos-*=hump) is an increase in the thoracic curve of the vertebral column (Figure B). In tuberculosis of the spine, vertebral bodies may partially collapse, causing an acute angular bending of the vertebral column. In the elderly, degeneration of the intervertebral discs leads to kyphosis. Kyphosis may also be caused by rickets and poor posture. It is also common in females with advanced osteoporosis.

Lordosis (lor-DŌ-sis; *lord-*=bent backward), sometimes called *hollow* or *sway back*, is an increase in the lumbar curve of the vertebral column (Figure C). It may result from increased weight of the abdomen, as in pregnancy, or extreme obesity, poor posture, rickets, osteoporosis, or tuberculosis of the spine. •



(A) Scoliosis (B) Kyphosis (C) Lordosis

General Feature of Vertebrae

Typically, the vertebrae will consist of a body (centrum), vertebrae arch and its processes.

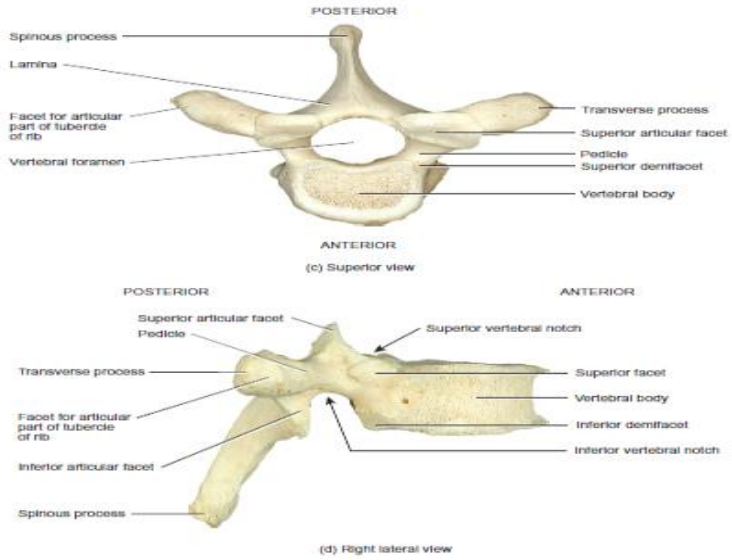
The *body (centrum)* will be in general the largest part of the vertebra, and is orientated anteriorly. The other vertebrae will line up with each other on the body creating the iconic column shape. It acts as the weight bearer of the body. The intervertebral disk will keep water within the disk by the attachment to the body. It roughens the edges, and this impedes water loss.

The vertebral arch extends posteriorly and is formed collectively by the *pedicles* which are two short thick processes forming the base of the arch. The pedicles will continue projecting posteriorly, uniting with the *laminae*. They are flat and join to make the posterior vertebral arch.

Vertebral foramen is the hole housing the spinal cord and its meninges covering, adipose tissues, blood vessels and areolar connective tissues and lies between the body(centrum) and vertebral arch.

Collectively, the *vertebral foramen* form the *vertebral (spinal) canal.* There are vertebral notches on the pedicles (superior and inferior) and when superimposed creates the *intervertebral foramen* which single spinal nerve will pass through carrying information from the spinal cord to the rest of the body.

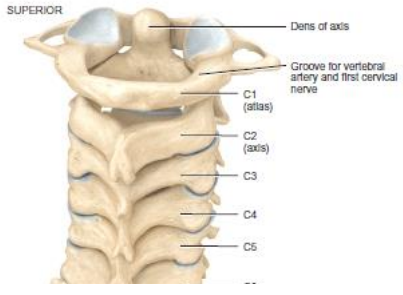
From the vertebral arch, there's 7 processes. There are 2 transverse process which projects posterolaterally at the junction of the pedicle and lamina, and a spinous process which arises from the junction of the lamina.
The spinous and transverse process usually allow for the attachments of muscles. There are 2 superior and 2 inferior articular process which articulate with the immediate superior vertebrae at its inferior articular process and the immediate inferior vertebrae at its superior articular process, respectively. The are articulating surfaces are covered in hyaline cartilage, and the articulation formed between the successive vertebrae are called *intervertebral joints.*
These articular process also arises from the junction of the pedicle and lamina (where those two part meets).



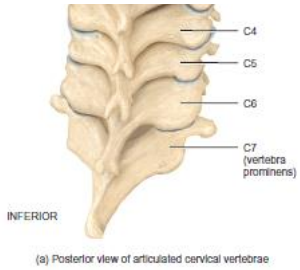
Cervical

C1-C7

They tend to have larger foramen to house the cervical enlargement of the spinal cord. C2-C6 will have often be bifid, meaning that their tips branches off into two small projections. C1 and C2 are vastly different than the other five cervical vertebrae. C1, the *atlas* supports the head. It is largely flat and ring like. It has an anterior and posterior arch and large lateral masses, while lacking any vertebral body and spinous process but have large transverse process and larger transverse foramen.



The superior portion of these lateral masses are Called the superior articular facets which are concave and articulate with the occipital condyles to form the *atlanto-occipital joints.* It allows for the "yes" motion of the neck.
The inferior surfaces of the lateral masses will articulate with C2. C2 is called the axis, and has a vertebral body. There's a projection from C2 known as the Dens or odontoid process, projecting through the anterior arch of the vertebral foramen of C1. It forms a pivot joint which allows for the side to side motion such as no. This is known as the *atlanto-axial joint.*



(a) Posterior view of articulated cervical vertebrae

There's a projection from C2 known as the Dens or odontoid process, projecting through the anterior arch of the vertebral foramen of C1. It forms a pivot joint which allows for the side to side motion such as no. This is known as the *atlanto-axial joint.*

C3-C6 are more general and less unique, they have transverse foramen. C5-C6 only have partial transverse foramen. They in general will appear more typical.
C7 is not bifid, and is known as the *vertebra prominens*. It is much larger and can be felt and seen at the base of the neck.

Thoracic

They are much larger and stronger than cervical. Their spinous process are longer and obliquely flatten, overlapping more with each other. They grow larger as you move caudally (superior to inferior) T11 and T12 how shoulder spinous process compared to T1-T10. Their transverse processes are also much larger. They articulate with the ribs, except T11 and T12, the thoracic vertebrae have *costal facets* that forms synovial articulation with the *tubercles of the ribs.* The body will also have articulations for the head of the ribs. This forms the *demifacets* which the head of the ribs will articulate with the two adjacent vertebral bodies. This articulation is known as the *vertebrocostal joints,* unique to the thoracic vertebrae. The superior and inferior articular processes, faces in the posterior and anterior direction respectively. This limits the back and forth bending but allows for lateral bending and some rotation.

Lumbar

They are very typical of vertebrae, normally just larger due to the weight it supports. They have facet joints on the sagittal plane and allow for flexion and extension.

Sacrum

Formed by the fusion of the 5 sacral vertebrae. The anterior surface is concave and contains *transverse ridges (lines)* form from the joining of the sacral vertebrae. Right next to them, there's the *anterior sacral foramina*, there is four surrounding each transverse ridges. Near the top of the sacrum, there is the Alae, which are larger expansions which appear to look like wings.
The convex surface of the sacrum contains the *medial sacral crest* which are formed by the fused spinous process from the once sacral vertebrae. The lateral sacral crest is the fused transverse processes. There will also be the *posterior sacral foramina,* which are the same as the anterior ones. These foramina allow for spinal nerves to exit from *the sacral canal* which really is just the fused vertebrae canal of the sacrum. There could also be a *sacral hiatus* which is where the canal stops and is usually caused by the 5th and sometime the 4th pedicle failing to meet, which leaves an opening.

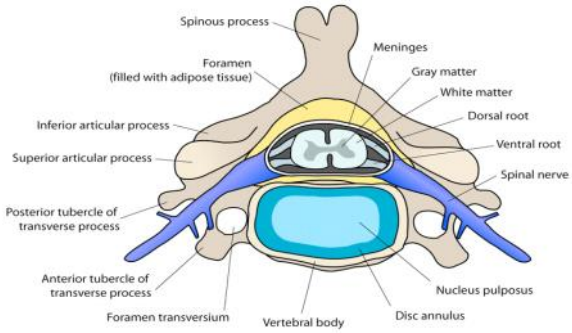
The broad superior portion is known as the *base* and the narrow end is the *apex.* The base will tend to project anteriorly which is known as the *sacral promontory.*

Lateral of the sacrum, there is the *auricular surfaces* which articulates with the ilium of the hip bone to form the *sacroiliac joint*. The sacroiliac joint will have a fibrous upper portion (sacrum) and a synovial lower portion (ilium) of the joint. The joint has two types of fibers.

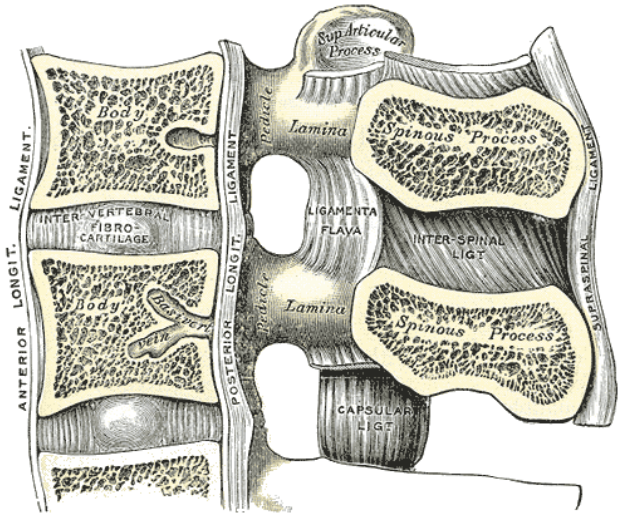
Intervertebral Disc
The intervertebral disc have high water content at birth, and loses this water as aging progresses. Height is lost during the day but is resumed through osmosis at night.

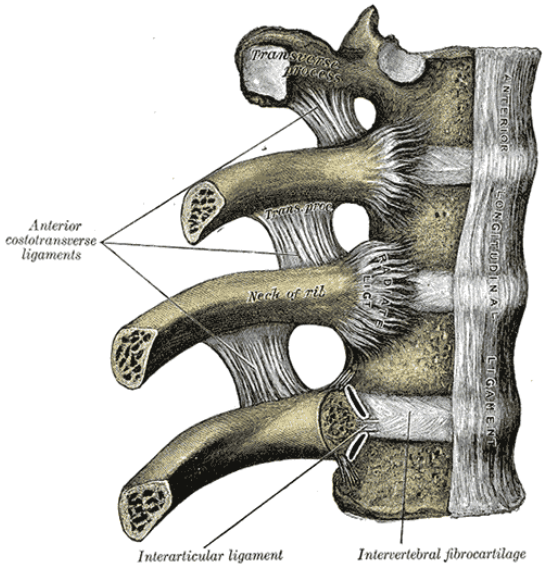
Disc compression can cause herniation (squishing the disk out, like two bricks push down on the mortar). Permanent thinning of the disc is known as spondylosis.

Inside the disc there are *annulus fibrosis* and the *nucleus pulposu* .The annulus fibrosis binds the vertebral bodies together and provides stability, it permits motion between the vertebral bodies due to it spiral and oblique fibers. It acts like a ligaments and checks motion, and absorbs shock. The nucleus pulposis is a gel like substance that also absorbs shock. It equalizes the stress and is important in the exchange of fluid between the disc and capillaries in the vertebrae. The axis of movement between two adjacent vertebrae runs vertical through it.



Ligaments of the Vertebral Column
Anterior Longitudinal Ligament: Limits the cervical to sacrum extension. Run down all the anterior vertebral bodies and intervertebral discs.
Posterior Longitudinal Ligament: Run down the posterior spine and degree by 1/2 it width as it goes inferiorly. Due to this nature, there is an inherent weakness and spinal cord nerves can push out.
Ligamentum Flavum: Posterior spinal canal, connecting all the laminae of adjacent vertebrae together from the axis (C2) to the first segment of the sacrum
Interspinous Ligament: Limits movement on the vertebrae body by connecting the adjacent spinous process
Supraspinous Ligament: Touches the spinous process, along the spinal cord
Ligamentum Nuchae: formed by the interspinous, supraspinous ligaments and the ligamentum flavum. Continuous with the supraspinal ligament.
Intertransverse ligaments limits lateral flexion of the spine between the transverse process of the spine.





Landmarks

C7- Vertebra Prominens
T2- Superior angle of scapula
T3- Medial border of scapula
T7- Inferior angle of scapula
L4/L5- imaginary line between and across both liac crests
S2- Line across posterior superior iliac spine (PSIS)

The Lower Extremity

Terminology
Pes is Foot, Calx is heel, planta is foot and coxa is hip.

Bones

The innominate bone is the hip bone as a whole, which is made up of three bones known as the ileum, ischium and pubis.

Know landmarks and different bones, look in lab manual.

Joints and Ligaments

The hip joint is ball and socket joint (Diarthrosis synovial enarthrodial). The head of the femur will join into the acetabulum of the innominate bone.
The acetabular labrum will hold in the head.
The fovea of the femur will have a pit which attaches the ligamentum teres. It has no real function.
The lunar shape of the acetabulum is completed by the transverse acetabulum ligaments.

The joint capsule is reinforced by the *iliofemoral ligament* which goes from the ASIS to the Greater Trochanter of the femur, taking up most of the anterior portion of the joint. The *Ishiofemoral Ligament* is posterior between the ischium and the femur. Lastly, the *pubofemoral ligament* goes from the ramus of the pubis to the intertrochanteric line. It limits external rotation.

Knee Joint

The knee joint is formed by the tibia, femur and the patella. The medial collateral ligament is attached to the joint capsule and the medial meniscus. This is consiered an extracapsular/extraarticular ligament. The medial collateral ligament is a long flat ligament, which stabilizes the medial knee (semimembranosus helps stabilize as well). With the lateral collateral and semimembranosus, it helps stop hyperextension of the leg. They slack on flexion.

The lateral collateral ligament is round and short with a bursa in between it and the popliteal. It stabilizes the lateral knee with the semimembranosus, tendons of the biceps

femoris, tendons of the popliteal muscle and the IT tract, they prevent lateral injury.

Intracapsular/Intraarticular ligaments are the Anterior Cruciate Ligament (ACL) goes posteriorly/superiorly to the lateral femoral condyles. Prevent excess anterior tibial gliding and tibial external rotation.
Posterior Cruciate Ligament (PCL) goes anteriorly/inferiorly to the medial femoral condyles.
Prevents excess tibial internal rotation and posterior gliding of the tibia.

Menisci (Semilunar Cartilage)

- Deepens the condylar surfaces of the tibia with a fibrocartilage cushion that absorbs shock. It facilitates lubrication. The horns of the menisci will attach to the intercondylar eminence. The medial meniscus will be shaped like a C and the lateral meniscus will be shaped like an O/ round.

The knee joint capsule is strengthen by the oblique popliteal and arcuate popliteal ligaments (posterior strength) and the medial and lateral patellar retinaculum (right along the patellar tendon/ligament).

Knee Bursae

- The prepatellar bursae sits between the skin and patella allowing for flexion.
- The suprapatellar sits above the patella, and is continuous with the joint capsule. In the instance of an ACL, the bursae will swell, so a noticeable swelling of the top of the knee
- Infrapatellar bursae sits below the patella and behind the patellar ligament.

Ankle Joints

- Talocrural joint is the ankle
- Diarthrosis Synovial Arthrodial (gliding)
- Formed by the tibia, fibula and talus
- The ankle can dorsiflex 20 degree and plantarflex for 50 degrees.
- Abduction of 16 degree

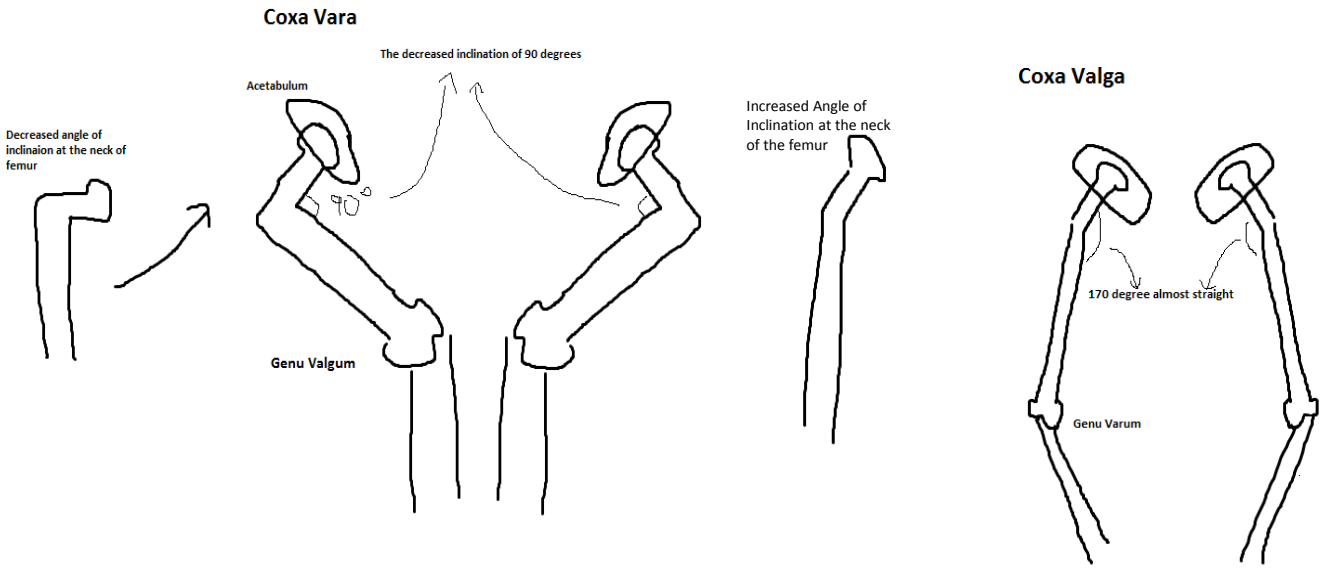
The second joint that makes up the ankle is the Talocalcaneal joint (subtalar joint), between the calcaneus and the talus for inversion and eversion. The third joint of the ankle is the inferior tibiofibular joint, with these three joints the ankle will be capable of its movement.

The ligaments of the ankle includes the medial deltoid ligaments; the anterior tibiotalar, tibiocalcaneal, posterior tibiotalar and the tibionavicular. This supports the medial side at the medial malleolus. The lateral side is supported by the anterior talofibular, posterior talofibular and the calcaneofibular ligament. The interosseous talocalcaneal ligament is what bonds the talus and calcaneus. It is formed from the fiber portion of the talocalcaneonavicular and talocalcaneal joint. It's inside the talus.

The transverse (mid)tarsal joints is formed by the calcaneocuboid joint and the talonavicular joint.

<u>Hip Joint, Angle of Inclination and Angle of Anteversion</u>

There is a normal angle of inclination of the neck of the femur for the hip joint. It should be around 135 degrees. However, through circumstances, the inclination of the neck can either decrease or increase, causing *coxa vara* or *coxa valga.* Coxa vara, for instance would have a femur neck inclination angle of 90 degree. The acetabulum will remain in its normal position, forcing the orientation of the femur to compromise in order to fit the head into the acetabulum. This will cause the femur to head too medial, making the appearance of knock-knees; *genu valgum*. In Coxa Valga, a similar scenario happens, but when the femur is forced to compromise in orientation due to the head, the body will stick out more laterally, causing the knee to be too lateral. This makes the appearance of bow legged ; *genu varum*



Angle of anteversion and Angle of Retroversion will also determine how the lower extremities behave. This has to do with the twisting angle of the neck of the femur, if it was bent too much anteriorly or posteriorly. This forces the shaft of the femur to either be too anterior or posterior. If there is an angle of anteversion, the individuals will be

pidgeon-toed. In an angle of retroversion, the femur is too far posterior and therefore the individuals will have foot facing much more outwards than normal; duck-footed.

Arches of the Foot

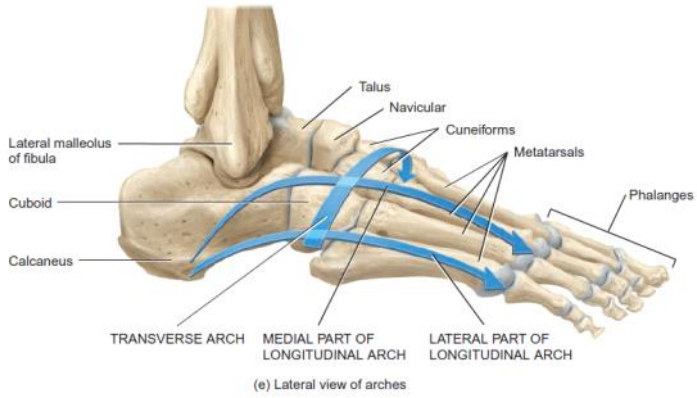
The two arches of the foot is meant to evenly distribute the weight of the body over soft and hard tissues of the foot and it supports the weight. They also will give in to the weight applied, but spring back to their original form once the foot is lifted, acting as a shock absorber. They are not rigid.
The *longitudinal arch* consists of the medial and lateral longitudinal arches.

The *medial longitudinal arch* starts at the calcaneus, rises at the talus and descends at the navicular, 3 cuneiforms and the head of the 3 medial metatarsals.

The *lateral longitudinal arch* begins at the calcaneus, rises at the cuboid and descends to the heads of the two lateral metatarsals.

The *transverse arch of the foot* is found between the medial and lateral aspect of the foot and formed by the navicular, three cuneiforms and base of the five metatarsals.

A lot of pathologies can arise from a collapse foot such as plantar fascitis, which is the inflammation of the plantar fascia. The eventual pressure from the collapse foot will stretch the fascia and cause it to be inflamed. There could be also inflammation in tibialis anterior, flexor digitorum longus and flexor hallucis longus from a collapse medial arch. A collapse arch can also cause Achilles tendonitis, since the collapse foot will pull down on the calcaneus stretching the Achilles tendon. The collapse of the medial arch will stress the lateral end of the Anchilles tendons. A tight calf will also have the same effect by rotating forward the calcaneus.



(e) Lateral view of arches

Pelvis

The pelvis is divided into what is known as the *lesser (true) pelvis* and the *greater (false) pelvis*.

The lesser (true) pelvis below the arcuate line and the greater (false) pelvis is above the arcuate line.

The upper pelvic aperature (pelvic inlet) goes from the sacral promontory to symphysis pubis. It is on this plane.

The lower pelvic aperature (pelvic outlet) is diamond shapre and goes from the arcuate pubic ligament to the apex of coccyx posteriorly. It is laterly bounded by the ischial tuberosity.

They serve as division for the pelvic cavity and abdominal cavity, dividing the true and false pelvic (one hosts the pelvic organ and the other doesn't).

Regional Structures

Femoral Sheath is laterally bounded by the Iliopsoas and femoral nerve, medial bounded by pectineus, and superiorly bounded by the inguinal canal. It is a CT that houses the femoral artery and vein.

Femoral Triangle is laterally bounded by the medial border of the sartorius, medially bounded by the medial border of the adductor longus and superiorly bounded by the inguinal ligament (making the base of the boundary). The roof of the femoral triangle is covered by the fascia lata and the cribriform fascia (covers the saphenous opening). The floor is bounded by the iliopsoas, pectineus and adductor longus. Contained within the femoral triangle is the femoral artery, vein and nerve and the profundas (deep) femoral artery.

Adductor (subsartorial) canal is laterally bounded by the vastus medialis, medially bordered by the adductor magnus and longus and superficially bordered by sartorius and the subsartorial fascia. The adductor canal houses the femoral artery and vein along with the saphenous nerve.

Popliteal Fossa is a diamond regional structure. The upper lateral border is made up by biceps femoris, and the upper medial border by semitendinosus and semimembranosus.
The lower lateral border is made up of the lateral head of the gastrocnemius and the plantaris, and the lower medial border is formed by the medial head of the gastrocnemius.
The roof is formed by the popliteal fascia. The floor is formed by the popliteal surface of the femur and the oblique popliteal ligament of the knee.
The popliteal fossa houses the common peroneal nerve, tibial nerve, popliteal artery and vein, genicular arteries, and the small saphenous vein.

Abdominal Musculature

The abdominal wall is divided into different layers.

Quadratus Lumborum (T12,L1-L4)
- It help to perform lateral flexion and is synergistic in forced exhalation. It stabilizes the last rib in deep inhalation since it is "floating"

External (Abdominal) Obliques
- It originates from the lower 8 ribs, and inserts on the iliac crest and linea alba. Its aponeurosis will form the ininguinal ligament. The external obliques will interdigitate with serratus anterior, meaning they "hold hands" in appearance. They create the saw-like edges. It is innervated by the intercostal (thoracic) nerves and helps in forced exhalation.
- The fiber course of the external oblique would follow the direction of your hands if you were to put them in your jacket pockets.

Internal (Abdominal) Obliques
- Originates on the iliac crest and inserts on the last 4 last ribs.
- Innervated by the intercostal nerves.
- Helps in forced exhalation
- Reaching the hand over to the opposing jacket pocket will follow the fiber course of the internal obliques which runs perpendicular to the external obliques.

Transversus Abdominis

- Its fiber courses is horizontal.
- Originates from the iliac crest, inguinal ligaments and inserts onto the linea alba (white line running vertical down the center of the body), xiphoid process and to the pubic symphysis.
- It is innervated by the intercostal nerves and helps in forced exhalation.

Rectus Abdominis
- Originates on the xiphoid process and to the true upper ribs 6-7 directly to the sternum and inserts onto the pubic crest. A transverse covering called the tendinosus sheath will help form inscription/ intersections of the rectus abdominis which forms the "six-pack". It divides the rectus abdominis into individuals muscle bellies to strengthen it.

The abdominal wall is made up of the anterior rectus sheath and posterior rectus sheath, which helps it hold the rectus abdominis in place. Also, the transversalis fascia and parietal peritoneum.
There is a line known as the arcuate line, which is the sudden difference between the thinning of the posterior rectus sheath. This happens about 2/3 of the way down, the sheath will suddenly come out more anteriorly. This happens below the arcuate line, 2/3 down from the xiphoid process to the symphysis pubis.

The content below the arcuate line is the deep parietal peritoneal and the visceral.

In general, the abdominal wall acts as protection, forced exhalation, and aides in defecation, micturition, parturition and vomiting.

Muscles of the Lower Extremities

The Lateral Rotators of the Hip

All behind and below the Gluteus Minimus

- Piriformis: Originates on the anterior surface of the sacrum, inserts onto the greater trochanter of the femur, it performs lateral rotation and abduction of the thigh at the hip joint. It is innervated by the sacral plexus.
- Superior Gemellus: Originates on the ischial spine, inserts onto the greater trochanter of the femur, performs lateral rotation and abduction of the thigh at the hip and it is innervated by the lumbosacral plexus.
- Obturator Internus: Originates on the inner surface of the obturator foramen, inserts onto the greater trochanter of the femur, performs lateral rotation and abduction of the thigh at the hip joint. It is innervated by the lumbosacral plexus.
- Inferior Gemellus: Originates from the ischial tuberosity, inserts onto the greater trochanter, performs lateral rotation and abduction of the thigh at the hip joint. It is innervated by the lumbosacral plexus.
- Quadratus Femoris: Originate on the ischial tuberosity, inserts onto the quadrate tubercle of the femur, performs lateral rotation and stabilization of the thigh at the hip joint and innervated by the lumbosacral plexus.
- Obturator Externus: Originates on the outer surface of the obturator foramen , inserts onto the trochanteric fossa of the femur, performs lateral rotation and abduction of the thigh at the hip joint and is innervated by the obturator nerve.

The Medial Rotators of the Hip (Posterior Lateral Hip)

- Tensor Fascia Latae: Originates on the anterior superior iliac spine (ASIS) and the iliac crest, inserts onto the iliotibial tract which attaches to the lateral tibia, performs flexion and abduction of the thigh at the hip joint and is innervated by the superior gluteus nerve. TFL takes fascia from gluteal and iliacus fascia and turns into the thick tendon of the IT band and attaches specifically on gerdy's tubercle. Synergistic in hip flexion.
- Gluteus Medius: Originates on the ilium, between the posterior and anterior gluteal lines, inserts onto the greater trochanter, and performs medial rotation and abduction of the thigh at the hip joint. Innervated by the superior gluteal nerve.
- Gluteus Minimus: Originates on the ilium, between the anterior and inferior gluteal lines, inserts onto the greater trochanter and performs medial rotation and abduction of the thigh at the hip joint. Innervated by the superior gluteal nerve.

The tendons of gluteus medius and minimus wraps around anteriorly to the greater trochanter. When it contracts, they end up medially rotating the femur.

Hip Flexors (Anterior Hip)

The Iliopsoas Group:
- Psoas Major: Originates on the vertebral body and transverse process of the lumbar vertebrae (can include T12), inserts on the lesser trochanter of the femur, performs flexion and lateral rotation of the thigh at the hip joint, and trunk flexion. Innervated by the lumbar spinal nerves L2 and L3.
- Psoas Minor: Originates T12 and L1, inserts onto the iliopectineal line of the innominate bone, performs pelvis flexion. Innervated by the lumbar plexus.
- Iliacus: Originates on iliac fossa and the sacrum, inserts onto the tendon of psoas major and to the lesser trochanter, and performance lateral rotation and flexion of the thigh at the hip joint. Innervated by the femoral nerve.

Synergistic hip flexors would be *tensor fascia latae*, *rectus femoris* and *sartorius*.
Keep in mind, joints are only influenced when the muscles goes over it. In a leg lift type exercise (suspended leg lifts) the abdominal muscles are only effectively getting 20% of the work out while 80% is going to the hip flexor. None of the abdominal muscles goes onto the thigh. Secondly, this workout would be a waste as there is no real reason to work out the already strong hip flexor muscle. Will only cause excess lordosis.

Hip Extensors (Posterior Thigh/ Hamstrings)

- Biceps Femoris: The long head of the biceps femoris originates on the ischial tuberosity, and the short head originates on the linea aspera. They insert onto the lateral condyle of the tibia and head of fibula and perform extension of the thigh at the hip and flexion of the leg at the knee. It is innervated by the sciatic (tibial and common peroneal) nerve.
- Semitendinosus: Originates on the ischial tuberosity, inserts on the proximal medial surface of the tibia- part of the pes anserine group. Performs extension of the thigh at the hip joint and flexion of the leg at the knee joint. Innervated by the sciatic (tibial n.) nerve.
- Semimembranosus: Originates on the ischial tuberosity, inserts onto the medial condyle of the tibia, performs extension of the hip and flexion of the knee. Innervated by the sciatic (tibial n.) nerve.

Fascial Compartment of the Thigh

The Quadriceps make up the anterior compartment of the thighs. The posterior compartment is made up by the hip extensor muscles (hamstrings) and the medial compartment is made up of the adductors.

Anterior Compartment
The Quadriceps Femoris Group

- Rectus Femoris: Originates at the ASIS, performs hip flexion and knee extension. Innervated by the femoral nerve.
- Vastus Medialis: Originates on the medial border of the linea aspera of the femur, performs knee extension and it is innervated by the femoral nerve.
- Vastus Lateralis : Originates on the lateral border of the linear aspera and the greater trochanter, performs knee extension and is innervated by the femoral nerve.

- Vastus Intermedius: Anterior and lateral surface of the femur, performs knee extension and innervated by the femoral nerve.
- They all insert onto the patella via the quadriceps tendon and the tibial tuberosity via the patellar ligament.

Sartorius is also part of the anterior compartment of the thigh, it does flexion of the hip and knee along with lateral rotation of the thigh. It is part of the pes anserine group.

Posterior Compartment

Hamstrings

Medial Compartment
Adductors

- Adductor Magnus: Originates on the inferior ramus of the pubis and ischium to ischial tuberosity, it inserts on the linea aspera of femur and adductor tubercle, it adducts the thigh. The anterior fiber of the adductor magnus will do flexion of the hip and the posterior fiber will extend the hip. It is innervated by the obturator nerve and sciatic nerve.
- Adductor Longus: Originate on the symphysis pubis and pubic crest, inserts onto the linea aspera, adduction and flexion of the thigh and thigh rotation. It is innervated by the obturator nerve.
- Adductor Brevis: Originate on the inferior ramus of the pubis, inserts onto the superior portion of the linea aspera and adducts and flexes the thigh at the hip joint. It also rotated the thigh. It is innervated by the obturator nerve.
- Pectineus: Superior ramus of the pubis, inserts onto the pectineal line, adducts and flexion of the thigh and is innervated by the femoral n.
- Gracilis: Body and inferior ramus of the pubis, inserts onto the proximal medial surface of the tibia, adduction of the thigh, flexion and medial rotation of the leg.

<u>Fascial Compartment of the Leg</u>

Anterior:
- Tibialis Anterior: Originates on the lateral condyle, shaft of the tibia and the interosseous membrane. Inserts onto the 1st metatarsal and the 1st cuneiform. Dorsiflexion and inversion of the foot, innervated by the deep peroneal nerve.
- Extensor Digitorum Longus: Originates on the lateral condyle of the tibia, anterior surface of the fibula and interosseous membrane, inserts onto the middle and distal phalanges of digits 2-5. Extends digits 2-5 and dorsiflexion of the foot.
- Extensor Hallucis Longus inserts on the distal phalanges of the first digit, extension of hallucis, and dorsiflexion of the ankle. Innervated by the deep peroneal n.
- Extensor Retinaculum, there is the inferior and superior portion of it. They sit on the anterior portion around the ankle. The inferior extensor retinaculum will split into the superior and inferior peroneal retinaculum.

Lateral:
- Peroneus Longus: Originates on the head of the fibula and proximal 2/3 of fibula, inserts onto the 1st metatarsal and 1st cuneiform, plantar flexion and eversion of the foot and is innervated by the superficial peroneal nerve.
- Peroneus Brevis: Originates on the distal 2/3 of the fibula, inserts onto the base of the 5th metatarsal, plantar flexion and eversion of the foot. Innervated by the superficial peroneal nerve.

Peroneal Retinaculum
- Inferior Peroneal Retinaculum
- Superior Peroneal Retinaculum } **Shaped like a Y, goes laterally to cover the tendons of the Peroneal Longus and Brevis**

Posterior
Deep
- Tibialis Posterior: Originates on the posterior surface of the tibia, posterior fibula and interosseous membrane inserts onto the three cuneiform, the cuboid, navicular and the base of metatarsals 2-4. It performs plantar flexion, and inversion of the foot. It is innervated by the Tibial Nerve.
- Flexor Digitorum Longus: Originates on the posterior surface of tibia, inserts onto the distal phalanges 2-5, plantar flexion of foot and flexion of digits 2-5, innervated by the tibial nerve.
- Flexor Hallucis Longus: Originate on the distal 2/3 of fibula, inserts onto the distal phalange of digit 1, flexion of the big toe and plantar flexion of the foot. Innervated by the tibial nerve.
- Those three are covered by the Flexor Retinaculum to hold the tendons in place.

Superficial
- Triceps Surae Group:
- Lateral and Medial head of the Gastrocnemius: Originates on the Lateral and Medial Condyles of the Femur, flexion of the leg at the knee joint, and plantar flexion of the foot, innervated by the tibial nerve.
- Soleus: Fibula Head and soleal line of tibia, plantar flexion of the foot and innervated by the tibial nerve.
- Plantaris: Lateral Supracondylar ridge of the femur, plantarflexion of the foot and flexion of the knee, and innervated by the tibial nerve.
- This superficial muscle group of the lower leg all insert into the calcaneus via the anchilles tendon.

Muscle of the Foot
Dorsum
- Extensor Digitorum Brevis- Deep Peroneal n.
- Extensor Hallucis Brevis - Deep Peroneal n.

First Layer
- Abductor Hallucis- Medial Plantar n.
- Flexor Digitorum Brevis- Medial Plantar n.
- Abductor Digiti Minimi - Lateral Plantar n.

Second Layer
- Quadratus Plantae: Flexion of the lesser four toes and innervated by the Lateral Plantar n.
- Flexor Hallucis Longus: Tibial n.
- Flexor Digitorum Longus Tibial n.
- Lumbricales: Its action is to do flexion of the proximal phalanges, extension of the middle and distal phalanges of the four lesser toes, Medial and Lateral Plantar n.

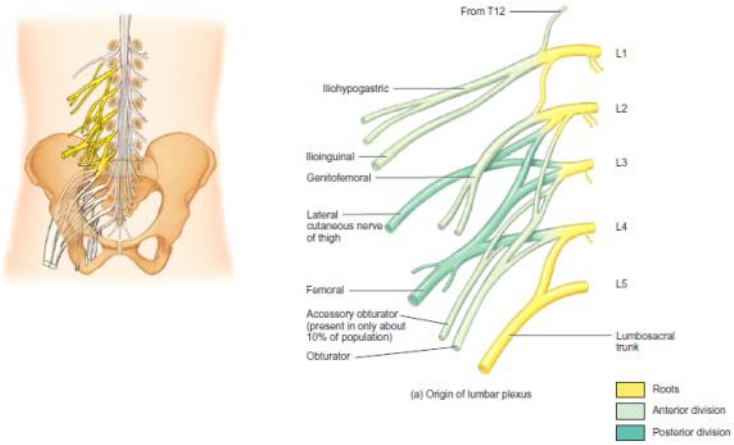
Third Layer
- Flexor Hallucis Brevis Medial Plantar n.
- Adductor Hallucis (oblique and transverse heads) Lateral Plantar n.
- Flexor Digiti Minimi Lateral Plantar n.

Fourth Layer
- Plantar Interossei(3) A fourth isn't necessary due to the adductor hallucis - Lateral Plantar n.
- Dorsal Interossei (4)- Lateral Plantar n.

<u>Nerves of the Lower Extremities</u>

The Lumbosacral Plexus L1-S4 can include T12.
- Lumbar Plexus (T12) L1-L4

- Sacral Plexus L4/L5-S4

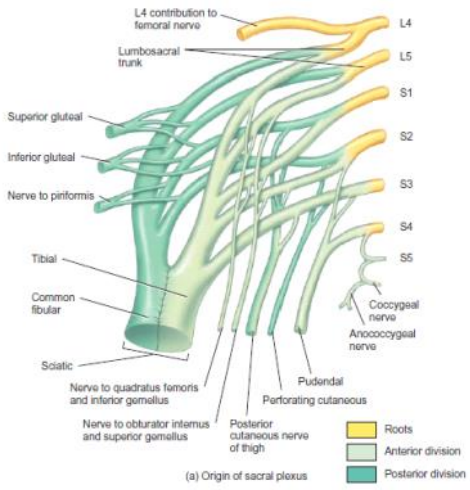


Iliohypogastric (L1) - Under the stomach. Muscle of the anterolateral abdominal wall, skin of the inferior abdomen and buttock
Ilioinguinal (L1)- skin of superior and mesial aspect of the thigh
Genitofemoral (L1,L2)- cremaster muscle, skin over the middle anterior surface of thigh
Lateral Cutaneous Nerve of Thigh (L2-L3)- skin over lateral, anterior and posterior aspect of thigh
Femoral (L2,L3,L4) Distribute to the flexor muscle of hip joint and extensor muscles , skin over anterior and medial aspect of the thigh, and medial side of the leg and foot
Obturator (L2, L3,L4) Adductor Muscles of the Hip and skin on the medial thigh.

NERVE	ORIGIN	DISTRIBUTION
Iliohypogastric (il'-ē-ō-hī-pō-GAS-trik)	L1	Muscles of anterolateral abdominal wall; skin of inferior abdomen and buttock
Ilioinguinal (il'-ē-ō-ĭN-gwi-nal)	L1	Muscles of anterolateral abdominal wall; skin of superior and medial aspect of thigh, root of penis and scrotum in male, and labia majora and mons pubis in female
Genitofemoral (jen'-i-tō-FEM-or-al)	L1–L2	Cremaster muscle; skin over middle anterior surface of thigh, scrotum in male, and labia majora in female
Lateral cutaneous nerve of thigh	L2–L3	Skin over lateral, anterior, and posterior aspects of thigh
Femoral	L2–L4	Largest nerve arising from the lumbar plexus, distributed to the flexor muscles of hip joint and extensor muscles of knee joint and skin over anterior and medial aspect of thigh and medial side of leg and foot
Obturator (OB-too-rā-tor)	L2–L4	Adductor muscles of hip joint; skin over medial aspect of thigh

The saphenous nerve which comes from the femoral nerve is a purely sensory nerve.

Lumbosacral Trunk includes 1/2 of L4 and all of L5.



<u>The Sacral Plexus (|L4/L5- S4)</u>

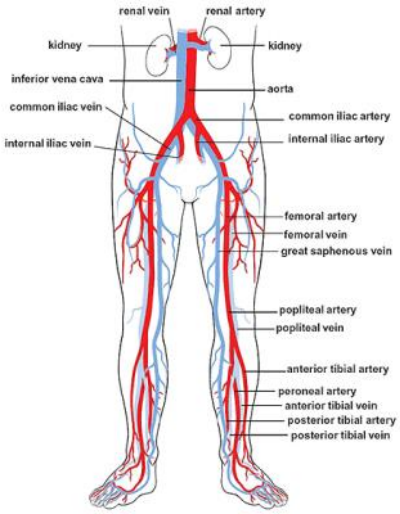
Superior Gluteal Nerve - L4, L5, S1
Inferior Gluteal Nerve- L5, S1, S2
Sciatic Nerve- L4-S3
Tibial Nerve- L4-S3
Common Peroneal Nerve- L4-S2

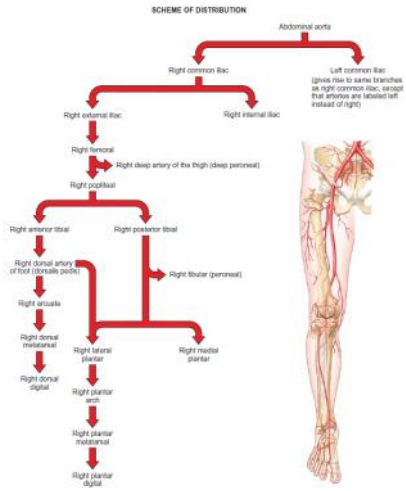
NERVE	ORIGIN	DISTRIBUTION
Superior gluteal (GLOO-tē-al)	L4–L5 and S1	Gluteus minimus, gluteus medius, and tensor fasciae latae muscles
Inferior gluteal	L5–S2	Gluteus maximus muscle

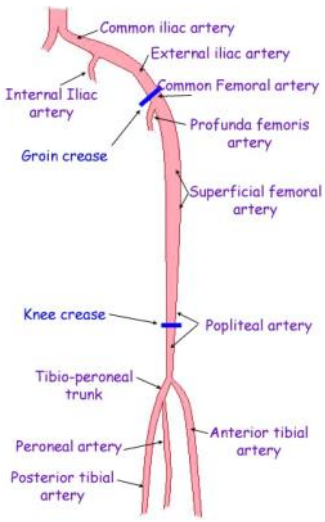
Sciatic (sī-AT-ik)	L4–S3	Actually two nerves—tibial and common fibular—bound together by common sheath of connective tissue; it splits into its two divisions, usually at the knee (see below for distributions); as it descends through the thigh, sends branches to hamstring muscles and the adductor magnus
Tibial (TIB-ē-al)	L4–S3	Gastrocnemius, plantaris, soleus, popliteus, tibialis posterior, flexor digitorum longus, and flexor hallucis longus muscles; branches in foot are medial plantar nerve and lateral plantar nerve
Medial plantar (PLAN-tar) (see Figure 13.10b)		Abductor hallucis, flexor digitorum brevis, and flexor hallucis brevis muscles; skin over medial two-thirds of plantar surface of foot
Lateral plantar (see Figure 13.10b)		Remaining muscles of foot not supplied by medial plantar nerve; skin over lateral third of plantar surface of foot
Common fibular (FIB-ū-lar)	L4–S2	Divides into a superficial fibular and a deep fibular branch
Superficial fibular		Fibularis longus and fibularis brevis muscles; skin over distal third of anterior aspect of leg and dorsum of foot
Deep fibular		Tibialis anterior, extensor hallucis longus, fibularis tertius, and extensor digitorum longus and extensor digitorum brevis muscles; skin on adjacent sides of great and second toes

The Sural Nerve which is form from the Tibial and Common Peroneal via the medial and lateral Sural cutaneous (respectively) is purely sensory.

Circulation of the Lower Extremities





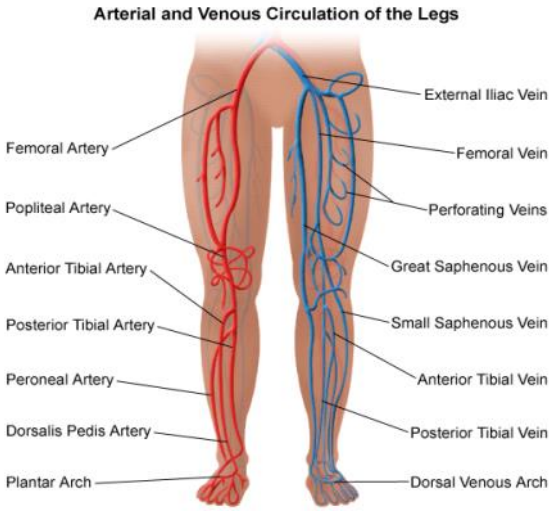


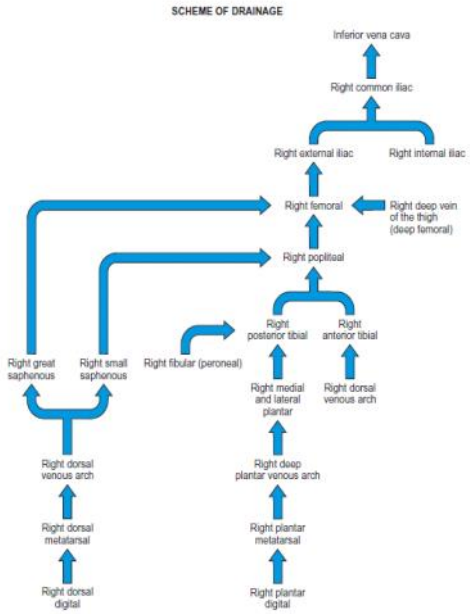
Arterial and Venous Circulation of the Legs

Arteries

The *abdominal aorta* is the start of the circulation for the lower extremities. It continues on and splits into the *common iliac artery* (L4) which goes on shortly until splitting between the *external and internal iliac artery* (at L5,S1). The external will continue downwards and once passing the inguinal ligament, it changes name to the *femoral artery*. The internal iliac artery will continue on to the *superior and inferior gluteal artery* and the *obturator artery*. The femoral artery will split into the *profunda femoris artery* (will provide for the hamstrings, adductors and quadriceps) the *lateral* and *medial femoral circumflex arteries* and the *perforating arteries*(pierces the adductor magnus). The femoral artery goes into the adductor canal and exit as the *popliteal artery* around the posterior knee, it'll spread genicular arteries. The popliteal artery will then divide into *the anterior and posterior tibial artery*. The anterior tibial artery goes through a hole in the interrosseous membrane. At around the retinaculum, posterior tibial artery splits into the lateral and medial plantar arteries. The peroneal artery emerges from the posterior tibial artery.
The anterior tibial artery will accompany the deep peroneal and will split into the dorsalis pedis (ankle) and make the plantar arches.

Veins





Veins

Veins are very similar to the arteries but tributary. Starting from the venae comitantes and dorsal venous arch, there the great saphenous vein which is long and connect straight to the femoral vein through the saphenous opening which is covered by the cribriform fascia. From the dorsal arch to dorsalis pedis, there`s a branch for the small saphenous vein to go to the popliteal vein below the femoral vein.

It also extends to the anterior tibialis veins. The lateral and medial plantar veins will join to form the posterior tibialis vein. Together they form the popliteal vein and goes to be the femoral vein (femoral vein will get the great saphenous, popliteal and profundas femoris vein dumping into it). It will move on to the external iliac vein (once passing the inguinal ligament) and meet with the internal iliac vein (superior and inferior gluteal veins and the obturator vein will dump into it) to form the common iliac vein and it will continue to the inferior vena cava.