CLINICAL ANATOMY OF THE LOWER LIMB

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CLINICAL ANATOMY OF THE LUMBOSACRAL PLEXUS
**Femoral Nerve** L2-L4
Largest branch of the lumbar plexus
Flexors of hip & extensors of knee
Skin of the anterior and lateral thigh, medial leg and foot

**Saphenous nerve**
Skin of medial aspects of leg and foot

**Obturator Nerve** L2-L4
Adductor muscles of leg
Skin on the superior medial thigh

Iliacus, psoas major, pectineus, quadriceps femoris (rectus femoris, vastus intermedius, vastus lateralis and vastus medialis), sartorius

External oblique, pectineus, adductor longus, adductor brevis, adductor magnus, and gracilis.
**Sciatic Nerve** L4-S3  
Hamstring muscles  
Extension at the hip joint  
Flexion at the knee joint  

- **Common fibular nerve**  
- **Sural communicating nerve** lower posterolateral side of the leg  
- **Lateral sural cutaneous nerve** upper lateral leg  

**Muscles of the leg**  

**Ant. Compartment**  
Dorsiflexors of ankle  
Deep fibular nerve (L4, L5)  

**Lateral Compartment**  
Evertors of foot & weak plantarflexors of ankle  

**Superficial fibular nerve (L5, S1, S2)**  

**Posterior Compartment**  
Plantar flexors of ankle  

**Tibial nerve (S1, S2)**  

**Sural nerve skin on** the lower posterolateral surface of the leg and the lateral side of the foot and little toe  
**Medial calcaneal nerve skin on the medial surface and sole of the heel**.
Femoral Nerve Injury
Injured in stab or gunshot wounds, complete division of the nerve is rare. Weakness of hip flexion, loss of knee extension (no patellar reflex), sensory loss on anteromedial thigh, knee, leg, and foot. along the medial border of the foot as far as the ball of the big toe; this area is normally supplied by the saphenous nerve.
Sciatic Nerve Injury
- Penetrating wounds
- Fractures of the pelvis
- Dislocations of the hip joint

Most frequently injured during I.M. injections

Most nerve lesions are incomplete

Common peroneal part of the nerve most affected
most superficial in the sciatic nerve
Sciatic Nerve Injury

**Motor:** Hamstring muscles paralyzed, but weak flexion of the knee is possible tnx to sartorius (femoral nerve) & gracilis (obturator nerve).
All the muscles below the knee are paralyzed, **foot drop**.

**Sensory:** Sensation is lost below the knee, except for a narrow area down the medial side of the lower part of the leg and along the medial border of the foot as far as the ball of the big toe, which is supplied by the saphenous nerve (femoral nerve).
Sciatica [Sciatic neuralgia]

**Definition:** The condition in which patients have pain along the sensory distribution of the sciatic nerve.

**Symptom:** Pain in the posterior aspect of the thigh, the posterior and lateral sides of the leg, and the lateral part of the foot.

**Causes:** Prolapse of an intervertebral disc with pressure on one or more roots of the lower lumbar and sacral spinal nerves, intrapelvic tumor, inflammation of the sciatic nerve or its terminal branches.
Obturator Nerve Injury

Rare

penetrating wounds, anterior dislocations of the hip joint, abdominal herniae through the obturator foramen.

pressed on by the fetal head during parturition.

**Motor:** All the adductor muscles paralyzed except the hamstring part of the adductor magnus supplied by the sciatic nerve.

**Sensory:** The cutaneous sensory loss is minimal on the medial aspect of the thigh.
Referred Pain from the Hip Joint
The femoral nerve supplies the hip joint + via intermediate and medial cutaneous nerves of the thigh, skin of the front and medial side of the thigh.

pain originating in the hip joint to be referred to the front and medial side of the thigh.

The posterior division of the obturator nerve supplies both the hip and knee joints. This would explain why hip joint disease sometimes gives rise to pain in the knee joint.
Pressure from the Fetal Head on the Sacral Plexus

During the later stages of pregnancy, when the fetal head has descended into the pelvis, the mother often complains of discomfort or aching pain extending down one of the lower limbs, often relieved by changing position, such as lying on the side in bed.
The nerves of the sacral plexus can become invaded by malignant tumors extending from neighboring viscera.

A carcinoma of the rectum, for example, can cause severe intractable pain down the lower limbs.
Referred Pain from the Obturator Nerve

The obturator nerve lies on the lateral wall of the pelvis and supplies the parietal peritoneum.

An inflamed appendix hanging down into the pelvic cavity

Irritation of the obturator nerve endings

Referred pain down the inner side of the right thigh

*Inflammation of the ovaries*
CLINICAL ANATOMY
OF THE
GLUTEAL REGION
Intramuscular injections

The gluteal region divided into quadrants by two imaginary lines using palpable bony landmarks:

1. Line descends vertically from the highest point of the iliac crest.
2. Line horizontal and passes through the first line midway between the highest point of the iliac crest and the horizontal plane through the ischial tuberosity.

Diagram showing:
- Upper medial quadrant
- Upper lateral quadrant
- Lower medial quadrant
- Lower lateral quadrant
- Ischial tuberosity
- Gluteal fold
- Vertical line
- Horizontal line
- Safe injection site
- Plane through ischial tuberosity
Gluteus Medius and Minimus and Poliomyelitis

Gluteus medius and minimus paralyzed when poliomyelitis involves the lower lumbar and sacral segments of the spinal cord.

**Superior gluteal nerve**
(L4 and 5 and S1)

Problem in the ability of the patient to tilt the pelvis when walking.
Gluteus Maximus and Bursitis

caused by acute or chronic trauma. can be extremely painful.

The bursae associated with the gluteus maximus are prone to inflammation. The gluteus maximus bursitis is

**pain radiating to the posterolateral aspect of the thigh, paraesthesiae in the legs, and tenderness over the iliotibial tract.**
Sciatica caused by compression of the sciatic nerve by the piriformis muscle

Buttock pain, and less commonly low back pain, radiating leg pain are among the symptoms.
**Iliotibial band syndrome**

Most common cause of pain on the outside of the knee in runners, with an incidence as high as 12% of all running-related overuse injuries.

Although it is not difficult to diagnose, it can be a challenge to treat, especially in higher mileage runners who place enormous loads on their bodies.

**Iliotibial Band Friction Syndrome**

**Injection of the anserine bursa and iliotibial tract**

**Iliotibial Band Friction Syndrome and Greater Trochanteric Bursitis**
CLINICAL ANATOMY
OF THE
THIGH
Rupture of the Rectus Femoris
The rectus femoris muscle can rupture in sudden violent extension movements of the knee joint.

Rupture of the Ligamentum Patellae
This can occur when a sudden flexing force is applied to the knee joint when the quadriceps femoris muscle is actively contracting.
Collateral Circulation

If the arterial supply to the leg is occluded, necrosis or gangrene will follow unless an adequate bypass to the obstruction is present—that is, a collateral circulation.

Sudden occlusion of the femoral artery by ligature or embolism, for example, is usually followed by gangrene.
Femoral Artery Catheterization

A long, fine catheter can be inserted into the femoral artery as it descends through the femoral triangle.

**Anatomy of Technique**

The femoral artery is first located just below the inguinal ligament midway between the symphysis pubis and the anterior superior iliac spine. The needle or catheter is then inserted into the artery.

The following structures are pierced:
- Skin
- Superficial fascia
- Deep fascia
- Anterior layer of the femoral sheath
Femoral Artery Catheterization

Anatomy of Complications
Entering into the femoral vein
Piercing the psoas major & entering the hip joint cavity
Traumatic Injury to Arteries of the Lower Limb

Injury to the large femoral artery can cause rapid exsanguination of the patient.

Unlike in the upper extremity, arterial injuries of the lower limb do not have a good prognosis.

The collateral circulations around the hip and knee joints, although present, are not as adequate as that around the shoulder and elbow.

The femoral artery is superficial where it lies in the femoral triangle and in consequence easily injured.
Aneurysms of the Lower Extremity

Much less frequently than abdominal aortic aneurysms, common sites are the femoral and popliteal arteries.

Patients may present in the emergency department with complications, which include sudden embolic obstruction to arteries distal to the aneurysm or sudden thrombotic occlusion of the aneurysm.

Pressure on neighboring nerves may give rise to symptoms; for example, an enlarging popliteal aneurysm may press on the tibial nerve, causing pain in the foot.
Great Saphenous Vein in Coronary Bypass Surgery
Femoral Vein Catheterization

Rapid access to a large vein is needed

**Anatomy of the Procedure**

1. The skin of the thigh below the inguinal ligament is supplied by the genitofemoral nerve; this nerve is blocked with a local anesthetic.

2. The femoral pulse is palpated midway between the anterior superior iliac spine and the symphysis pubis, and the femoral vein lies immediately medial to it.

3. At a site about two fingerbreadths below the inguinal ligament, the needle is inserted into the femoral vein.

**Peripheral & Femoral Vein Cannulation**
CLINICAL ANATOMY OF THE POPLITEAL FOSSA
Arterial Palpation

Arresting a severe hemorrhage or palpate different parts of the arterial tree in patients with arterial occlusion.

Femoral artery

enters the thigh behind the inguinal ligament at a point midway between the anterosuperior iliac spine and the symphysis pubis.

Popliteal artery

passively flexing the knee joint.
CLINICAL ANATOMY OF THE LEG
Gastrocnemius Strain
Tennis leg

- Painful acute injury resulting from partial tearing of the medial belly of the gastrocnemius at or near its musculotendinous junction

- Individuals older than 40 @ risk

- Caused by overstretching the muscle by concomitant full extension of the knee and dorsiflexion of the ankle joint
Poorly conditioned people with a history of calcaneal tendinitis.

Audible snap during a forceful pushoff (plantarflexion with the knee extended) followed immediately by sudden calf pain and sudden dorsiflexion of the plantarflexed foot.

In a completely ruptured tendon, a gap palpable, 1-5 cm proximal to calcaneal attachment.

Ruptured Calcaneal Tendon
Calcaneeal Tendinitis

- Inflammation of the calcaneal tendon constitutes 9-18% of running injuries.

- Often occurs **during repetitive activities**

- Especially in individuals who take up running after prolonged inactivity suddenly increase the intensity of their training,

- Also result from poor footwear or training surfaces.
Fabella in Gastrocnemius

Close to its proximal attachment, lateral head of the gastrocnemius contains a sesamoid bone

**Fabella (L. bean)**

Articulates with the lateral femoral condyle

Visible in lateral radiographs of the knee in 3-5% of people
Superficial Fibular Nerve Entrapment

Chronic ankle sprains may produce recurrent stretching of the superficial fibular nerve.

Pain along the lateral side of the leg and the dorsum of the ankle and foot.

Numbness and paresthesia (tickling or tingling)
Deep Fibular Nerve Entrapment

Excessive use of muscles supplied by the deep fibular nerve (e.g., during skiing, running, and dancing) may result in muscle injury and edema in the anterior compartment.

Compression of the deep fibular nerve and pain in the anterior compartment.

Pain occurs in the dorsum of the foot and usually radiates to the web space between the 1st and 2nd toes.
Injury to Common Fibular Nerve & Footdrop

- Superficial course around fibular neck
- Most injured nerve in the lower limb
- Flaccid paralysis of all muscles in the anterior and lateral compartments of the leg

*dorsiflexors of ankle and evertors of foot*

- Loss of dorsiflexion of the ankle
- Footdrop

further exacerbated by unopposed inversion of the foot
Because the dropped foot makes it difficult to make the heel strike the ground first as in a normal gait, **steppage gait**.

Sometimes an extra “kick” is added as the free limb swings forward in an attempt to flip the forefoot upward just before setting the foot down.
Injury to tibial nerve

**Motor:** All the muscles in the back of the leg and the sole of the foot are paralyzed. The opposing muscles *dorsiflex the foot* at the ankle joint and *evert the foot* at the subtalar and transverse tarsal joints, an attitude referred to as *calcaneovalgus*.

**Sensory:** Sensation is lost on the sole of the foot; later, *trophic ulcers* develop.
**Posterior Tibial Pulse**

Between posterior surface of medial malleolus & medial border of calcaneal tendon

**Posterior tibial artery**

passes deep to flexor retinaculum

When palpating have the person invert foot to **relax the retinaculum**

**Absence of posterior tibial pulses**

Sign of occlusive peripheral arterial disease

in people older than 60 years

**Intermittent claudication** characterized by leg pain and cramps, during walking
Varicose Veins

A varicosed vein

- Larger diameter than normal, elongated & tortuous
- Commonly occurs in the superficial veins of the lower limb
- Responsible for considerable discomfort and pain
- Every time the patient exercises, high-pressure venous blood escapes from the deep veins into the superficial veins and produces a varicosity, and gets worse by time.
Passengers who sit immobile for hours on long-distance flights are very prone to deep vein thrombosis in the legs.

Preventative measures include stretching of the legs every hour to improve the venous circulation.

**Prevention of deep vein thrombosis associated with flying**

*Arch Intern Med. 2003;163:2766-2770.*

Popliteal artery occlusion just below the beginning of the artery just below the opening in the adductor magnus muscle.

In some cases extends distally origins of the anterior & posterior tibial arteries, even peroneal artery.

Impaired or absent arterial pulses, lowered skin temperature, color changes, muscle weakness, and trophic changes.

Intermittent claudication, night cramps, and rest pain caused by ischemic neuritis, trophic changes.
CLINICAL ANATOMY OF THE FOOT
Morton's neuroma

Enlarged common plantar nerve @ third interspace between third & fourth toes

- 3rd interspace, lateral plantar nerve often unites with medial plantar nerve.

- "Push off" phase of walking interdigital nerve sandwiched between ground & deep transverse metatarsal ligament above

- Compressing common plantar nerve

- Pain in the third interspace

Figure 1. Morton’s neuroma found between 3rd and 4th toes underneath the deep transverse intermetatarsal ligament.
Compression neuropathy & a painful foot condition where tibial nerve is compressed through the tarsal tunnel

Numbness in the foot, radiating to the big toe and the first 3 toes, pain, burning, electrical sensations, and tingling over the base of the foot and the heel.
Plantar Fasciitis

- Occurs in individuals who do a great deal of standing or walking, pain and tenderness of the sole of the foot.

- Believed to be caused by repeated minor trauma.

- Repeated attacks of this condition induce ossification in the posterior attachment of the aponeurosis, forming a **calcaneal spur**.
Clinical Problems Associated With Arches of the Foot

Medial longitudinal arch
largest & clinically the most important

In the active foot the tone of muscles an important factor in arch support.

Muscles are fatigued
- excessive exercise
- standing for long periods
- overweight
- illness
muscular support gives way, the ligaments are stretched, and pain is produced.
Pes planus (Flat foot)

- Medial longitudinal arch is depressed or collapsed.
- Forefoot is displaced laterally and everted.
- The muscles and tendons are permanently stretched.
- Congenital & acquired
Pes cavus (Clawfoot)

- Condition in which medial longitudinal arch is unduly high.

- Most cases are caused by muscle imbalance, in many instances resulting from poliomyelitis.
Plantar Reflex & Babinski Reflex

Plantar reflex
Stroking lateral part of the sole of the foot with a fairly sharp object produces plantar flexion of the big toe; often there is also flexion & adduction of the other toes.

Babinski reflex
Stroking the sole produces extension (dorsiflexion) of the big toe, often with extension and abduction of the other toes.

The Babinski Sign - A Reappraisal
Plantar reflex protecting the sole of the foot

Abnormal response due to metabolic or structural abnormality in the corticospinal system upstream from the segmental reflex.

Structural lesions such as hemorrhage, brain and spinal cord tumors, and multiple sclerosis.

Abnormal metabolic states such as hypoglycemia, hypoxia, and anesthesia.
Pathways

**Afferent:** Nociception detected in the S1 dermatome and travels up the tibial nerve to *sciatic nerve to roots of L5,S1* and synapse in the anterior horn to elicit the motor response.

**Efferent:** Motor response back through the L5,S1 roots to the sciatic nerve to its bifurcation.

Toe flexors are innervated by tibial nerve.

Toe extensors (extensor hallicus longus, extensor digitorum longus) are innervated by the deep peroneal nerve.