REVIEW OF LOWER EXTREMITY

I. OVERVIEW - UPPER AND LOWER EXTREMITY ROTATION, DERMATOME MAP, REFLEXES

II. REGIONS - HIP, KNEE, ANKLE, FOOT
Arms and legs initially have the same orientation, perpendicular to the spinal column (think of a baby sitting - palms touch, soles of feet touch).

Upper extremity rotates laterally.

Thumb is lateral.

Lower extremity rotates medially.

Big toe is medial.

Clapping baby's hands and feet.
MOVEMENTS OF LOWER LIMB

Hip joint - ball and socket
Flexion - Anterior
Extension - Posterior
Adduction - Medial
Abduction - Lateral
Rotation - movement about long axis of femur

Knee joint - condylar joint
Flexion - Posterior
Extension - Anterior
Rotation (small) - movement about long axis of leg (tibia)

Ankle and Foot
Dorsiflexion
Plantar flexion
Inversion - sole faces medially
Eversion - sole faces laterally

Plantar flexion
Dorsiflexion
Eversion
Inversion

Ankle and Foot
DERMATOME MAP IN ADULT - REFLECT ROTATION

DERMATOMES OF LOWER EXTREMIY

Hand - higher spinal levels lateral
C6 thumb lateral
C8 little finger medial

Foot - higher spinal levels medial
L4 big toe medial
S1 little toe lateral

Patient: Complete lack of sensation at big toe. Which spinal nerve would be compressed? L4
STRETCH (TENDON TAP) REFLEXES OF LOWER EXTREMITY

KNEE JERK - QUADRICEPS MUSCLE

L3, L4

ANKLE JERK - GASTROCNEMIUS MUSCLE

S1

CLINICAL - Patient has numbness of skin overlying little toe. Ankle jerk reflexes reduced. What spinal level affected? S1
OVERVIEW OF ARTERIAL SUPPLY: COURSE REFLECTS ROTATION

HIP (ANTERIOR VIEW)
External Iliac
- Inguinal ligament
- FEMORAL
  courses first anteriorly, then posteriorly
- Adductor hiatus
- POPLITEAL

KNEE

POPLITEAL ARTERY

LEG AND FOOT
POST. VIEW
- TAKE PULSE med. side

ANT. VIEW
- ANTERIOR TIBIAL ARTERY
  supplies foot
- POSTERIOR TIBIAL ARTERY
- Dorsalis Pedis Artery
FASCIA LATA - deep fascia of thigh is thick; superiorly attached to the pelvis, Scarpa’s fascia and the inguinal ligament.

Saphenous opening - allows for passage of Great Saphenous vein; located inferior to inguinal ligament, anterior to Femoral artery and vein.

GREAT SAPHENOUS VEIN courses on medial side of leg (SMALL SAPHENOUS VEIN is on post side of leg).
FEMORAL TRIANGLE

- LATERAL - SARTORIUS
- SUPERIOR - INGUINAL LIGAMENT
- MEDIAL - ADDUCTOR LONGUS

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

REMEMBER NAVL

FEMORAL SHEATH

- SHEATH IS CONTINUATION OF TRANSVERSALS FASCIA OF ABDOMEN
- SURROUNDS ARTERY, VEIN, LYMPHATICS NOT NERVE
**FEMORAL CANAL**

*transversalis fascia*

**FEMORAL CANAL** -
contains **LYMPHATICS IN MEDIAL PART OF SHEATH**

**Femoral Canal** - is contained in medial part of femoral sheath; contains lymph vessels from lower limb that drain to external iliac nodes; opening is called **Femoral Ring**.

**FEMORAL HERNIA**

**Femoral Hernia** - Femoral ring is point of potential weakness of abdomino/pelvic wall; loop of bowel can protrude into Femoral Canal and become strangulate; more common in females (inguinal hernias more common in males).
**CLINICAL QUESTION:**

Mother of 4 children lifts heavy load and feels bulge on anterior groin or thigh.

**CAUSES OF FEMORAL HERNIA:**

1) carrying or pushing heavy loads  
2) more frequent in older females  
3) more common in women who have had one or more pregnancies  
4) overweight (obese)  
5) cough  
6) constipation

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**Differentiating Femoral and Inguinal Hernias** - reference is INGUINAL LIGAMENT

**Femoral Hernia** - neck of hernia is BELOW inguinal ligament

**Inguinal Hernia** - neck of hernia is ABOVE inguinal ligament.

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**Technique:**

1. Index finger on ASIS
2. Thumb on pubic tubercle
3. Ant. Sup. Iliac Spine
4. To locate - VEE TECHNIQUE

**Inguinal Hernia:**
- Index finger on ASIS
- Thumb on pubic tubercle
- Ant. Sup. Iliac Spine
- To locate - VEE TECHNIQUE

**Femoral Hernia:**
- Index finger on ASIS
- Thumb on pubic tubercle
- Ant. Sup. Iliac Spine
- To locate - VEE TECHNIQUE
ANTERIOR THIGH: 'HIP POINTER'

SARTORIUS -
Origin - Ant. Sup. Iliac Spine
Insert - Tibia

QUADRICEPS FEMORIS -
Insert - to Patella to Tibia

INNERVATION: FEMORAL NERVE

Clinical Note: Contusion of muscles at Anterior Superior Iliac spine (origin of Sartorius and Tensor Fascia Lata) is called a Hip Pointer - Symptom - Bruise on Hip
MUSCLES OF MEDIAL THIGH: PULLED GROIN

Clinical: PULLED GROIN - Tear of Adductor Muscle group at PUBIS; PLAYING SPORTS, INTENSE PAIN IN GROIN, DIFFICULTY WALKING

ADDUCTORS:
- LONGUS BREVIS
- GRACILIS

ORIGIN:
- PUBIS

INNERSVATION: OBTURATOR NERVE

ADDUCTOR MAGNUS

ORIGIN:
- PUBIS, ISCHIAL TUBEROSITY

HIATUS - passage FEM. A. AND V.
POSTERIOR THIGH - PULLED HAMSTRINGS

ORIGIN ALL - Ischial Tuberosity

Semi-tendinosus
Semi-membranosus
both insert to Tibia

long head from Ischial Tub.
short head from Femur
both heads insert to Fibula

Biceps femoris

Action - All Extend thigh and flex leg except Biceps Short head only flex leg

PULLED HAMSTRINGS - TEAR MUSCLE OR AVULSE FROM ISCHIAL TUBEROSITY

Clinical - ex. Tear when running; sudden excruciating pain in back of thigh
GLUTEAL MUSCLES

**Gluteus Maximus**
- ORIGIN - Ilium
- Maximus - also sacrum, coccyx, sac.tub.lig
- Inn - Inferior Gluteal N.
- I - Femur, IT tract
- Act - Extend, Laterally rotate

**Gluteus Medius**
- ORIGIN - Ilium
- Medius + Minimus
- Inn both - Superior Gluteal N.
- I - Femur (Greater Trochanter)
- Act - Abduct, Medially rotate

**Gluteus Minimus**
- ORIGIN - Ilium
- Minimus
- Inn both - Superior Gluteal N.
- I - Femur (Greater Trochanter)
- Act - Abduct, Medially rotate
GLUTEAL GAIT

Clinical - caused by injury to Superior Gluteal nerve or poliomyelitis (also congenital dislocation of hip joint). Paralyze Gluteus Medius and Minimus. In walking, pelvis tilts down on non-paralyzed side when lift foot of opposite, non-paralyzed leg.

Positive Trendelenburg sign - WHEN LIFT OPPOSITE LEG, PELVIS TILTS DOWN ON (NON-PARALYZED) OPPOSITE SIDE.
Profunda Femoris - largest branch of femoral; branches:

a. Medial Femoral Circumflex - provides most of blood supply to head of femur.

b. Lateral Femoral Circumflex - supplies lateral side of thigh, neck of femur; has Descending branch that is part of Genicular anastomosis at knee joint.
CLINICAL: CRUCIATE ANASTOMOSIS

Inferior Gluteal - from Int. Iliac

Med. Femoral Circ.

Lat. Femoral Circ.

First Perforating A.

Clinical - Stab wound or bleeding in Femoral Artery
Can: Ligate External Iliac or Femoral between
1) Internal Iliac
2) Profunda femoris
FRACTURE OF NECK OF FEMUR

Note: Fracture of neck of femur - common in the elderly; leg is rotated laterally due to action of gluteus maximus and short rotators of hip.

Fracture of neck of femur leaves Greater Trochanter attached to femur.
FRACTURE CAN PRODUCE AVASCULAR NECROSIS OF HEAD OF FEMUR

Note: Fracture of neck of femur - head and neck of femur receive blood from branches of **Obturator artery** (through ligament of head) and branches of **Medial and lateral femoral circumflex**; after fracture, supply from circumflex arteries is disrupted; if obturator supply is inadequate, avascular necrosis may occur requiring artificial replacement of head and neck of femur.
Note: Dislocation - traumatic dislocation is rare due to strength of intrinsic ligaments; congenitally, upper lip of acetabulum may fail to form and head of femur may dislocate superiorly; leg is rotated medially (action gluteus medius and minimus); also appears to be shorter.
KNEE JOINT - femur abuts against tibia; fibula not part of joint

Anterior cruciate ligament

Posterior cruciate ligament

Lateral (fibular) collateral ligament

Medial (tibial) collateral ligament

Patellar ligament

ACL - lateral to medial; points forward

Strengthens joint anteriorly
ANTERIOR AND POSTERIOR CRUCIATE LIGAMENTS ALLOW FOR FREE FLEXION AND EXTENSION OF KNEE

ACL - PREVENTS ANTERIOR MOVEMENT OF TIBIA

PCL - PREVENTS POSTERIOR MOVEMENT OF TIBIA
TESTS FOR TEARS IN CRUCIATE LIGAMENTS

**ANTEOR DRAWER SIGN** - pull tibia anteriorly

Tear Anterior Cruciate Ligament - can draw tibia anteriorly.

**POSTERIOR DRAWER SIGN**

Tear Posterior Cruciate Ligament - can push tibia posteriorly.
Clinical Note: **Terrible Triad of the Knee joint**: Knee joint is stable in extension but ligaments are slackened by joint flexion; **blow to lateral side** of the knee when the leg is flexed (as can occur in football tackles) or rotate and force lateral movement of body; can tear **Tibial (Medial) collateral ligament, Anterior cruciate ligament and Medial meniscus** (because it is firmly fixed to the medial collateral ligament).
Prepatellar bursa in subcutaneous tissue between skin and patella; inflammation - 
HOUSEMAID'S KNEE

BURSAE OF KNEE CAN BECOME INFLAMMED

Inflammation of Prepatellar bursa - HOUSEMAIDS KNEE

Superficial infrapatellar bursa between skin and patellar ligament - 
CLERGYMAN'S KNEE

HOUSEMAID'S KNEE

CLERGYMAN'S KNEE
Clinical Note: Damage to Common Peroneal Nerve - most commonly damaged nerve in lower extremity; very superficial when winds around neck of fibula; can be severed by fracture of fibula or damaged from tight plaster cast; sign is FOOT DROP; patient cannot lift foot.

FOOT DROP

TIBIAL NERVE

Common Peroneal Nerve

DAMAGE AT neck of fibula

SCIATIC NERVE

COMMON PERONEAL NERVE

TIBIAL NERVE
Clinical Note: **Anterior Leg Syndrome** - fascia surrounding anterior leg muscles is very tough and tight; muscles can swell in compartment due to exercise or when fracture tibia; symptom is **FOOT DROP** (=loss of dorsiflexion of foot) due to compression of **Deep Peroneal Nerve**; treated by fasciotomy (surgically splitting fascia). (Note: 'shin splints' is different term, inflammation of the periosteum of the tibia)
ORDER OF STRUCTURES ON MEDIAL SIDE OF ANKLE - TOM, DICK AND HARRY - Tibialis posterior (tendon), Flexion Digitorum Longus, Posterior Tibial Artery, Tibial Nerve and Flexor Hallucis Longus.

Note: Order is important as accidents can happen that sever tendons (i.e. ax strikes ankle when chopping wood).
Note: **Flexor Retinaculum** - tendons of deep muscles pass beneath flexor reticulum on medial side of ankle joint; muscle tendons are covered *synovial sheaths* under retinaculum.

Clinical Note: **Tarsal Tunnel Syndrome** - Tarsal Tunnel is area beneath flexor retinaculum; Tarsal Tunnel Syndrome results from *swelling of synovial sheaths*; can compress **Tibial Nerve**; symptoms are *numbness of sole of foot, toes and weakened flexion of toes* (intrinsic muscles of foot).
Note: **Intermittent Claudication** (L. claudico, limping) - Narrowing of posterior tibial artery due to arteriosclerosis; produces ischemia; patients have painful cramps when walking but subsides after rest.

Note: **Pulse of Posterior Tibial Artery** - taken between medial malleolus and tendo calcaneus.
BONES OF FOOT

MED. VIEW

• calcaneus
• talus
• navicular
• cuneiforms
• metatarsal bones
• phalanges

LAR. VIEW

• calcaneus
• talus
• metatarsal
• cuboid
ANKLE JOINT: DORSIFLEXION/PLANTAR FLEXION

- Subtalar joint (between talus and calcaneus)
- Transverse tarsal joint (between talus and navicular bones medially, calcaneus and cuboid bones laterally.)

TIBIA AND FIBULA AND TALUS

JOINTS OF INVERSION AND EVESION

- Inversion
- Eversion
ANKLE JOINT: LIGAMENTS

MEDIAL - LIGAMENT STRONG

DELTOID LIGAMENT

LATERAL - LIGAMENTS WEAKER

Posterior Talofibular

Anterior Talofibula

Calcaneofibular ligament

LIGAMENTS ALLOW FREE DORSIFLEXION AND PLANTAR FLEXION PREVENT EXCESSIVE EVERSION AND INVERSION
Note: **Sprains** of ankle are usually caused by excessive inversion; Anterior talofibular and **Calcaneofibular ligaments** are commonly stretched or partially torn.

Symptom - pain on LATERAL side of ANKLE
POTT'S FRACTURE: EXCESSIVE EVERSION

Note: Pott's fractures are caused by excessive eversion; strong Deltoid ligament does not rupture but medial malleolus is fractured; also break shaft of fibula.

SYMPTOM - pain in ankle

Fibula is fractured

Medial malleolus is fractured
Medial Longitudinal arch - highest arch, responsible for 'fallen arches'
-formed by - calcaneus, talus, navicular, cuneiforms and medial three metatarsal bones.

\[ F = k \times x \]

- Load springs when put weight on foot on ground

- \( F = \text{force} \)
- \( x = \text{vertical displacement} \)
- supported by ligaments and muscles
  i. **Plantar Calcaneonavicular Ligament** - 'Spring' ligament, most important ligament, keeps head of talus high off ground.
  ii. **Tibialis Posterior and Tibialis Anterior** - insert to medial side of foot and support arch.

Note: *Flat* Feet - weakening of Medial Longitudinal arch - associated with stretching of **Plantar Calcaneonavicular ligament**.
GOOD LUCK!
2. **Lateral Longitudinal arch** - smaller
   a. formed by - **calcaneus, cuboid and lateral two metatarsals**
   b. supported by
      i. Long Plantar Ligament and Plantar Aponeurosis
      ii. Peroneal tendons
b. supported by
i. **Long Plantar Ligament** and Plantar Aponeurosis
ii. **Peroneal tendons**

**LATERAL ARCH**

- Peroneal tendons
- Long Plantar Ligament
3. Transverse arch
   a. formed by cuneiform and cuboid bones and metatarsals

   Plane of Transverse arch

   Cuneiform bone
   Cuboid bones
   Metatarsals

   Supported by Interosseus muscles and Peroneus longus tendon
1. Superior Medial Genicular artery - anastomoses with Descending Genicular artery (from Femoral Artery)
2. Superior Lateral Genicular artery - anastomoses with Descending branch of Lateral femoral circumflex artery
3. Inferior Medial Genicular artery - anastomoses with Recurrent branch of Anterior Tibial artery
4. Inferior Lateral Genicular artery - anastomoses with Recurrent branch of Anterior Tibial artery
1. Superior Medial Genicular artery - anastomoses with Descending Genicular artery (from Femoral Artery)
2. Superior Lateral Genicular artery - anastomoses with Descending branch of Lateral femoral circumflex artery
3. Inferior Medial Genicular artery AND
4. Inferior Lateral Genicular artery - BOTH anastomose with Recurrent branch of Anterior Tibial artery
When moving to full extension of knee joint, femur rotates medially during last 30 degrees of movement. This pulls all major ligaments of the knee joint taut, 'locking' the knee and making it very stable; to flex knee from full extension, joint must first be unlocked by contracting the popliteus muscle which rotates the femur laterally (foot is firmly on ground).