

REVIEW OF LOWER EXTREMITY

APPROACH TO WRITTEN EXAM

- 1. ALL MATERIAL IS FROM HANDOUTS.**
- 2. QUESTIONS IN CLINICAL VIGNETTE FORMAT**
- 3. PROBLEM: UNDERSTANDING WHAT IS BEING ASKED: Possible solution:**

READ LAST SENTENCE FIRST

THEN READ ANSWERS

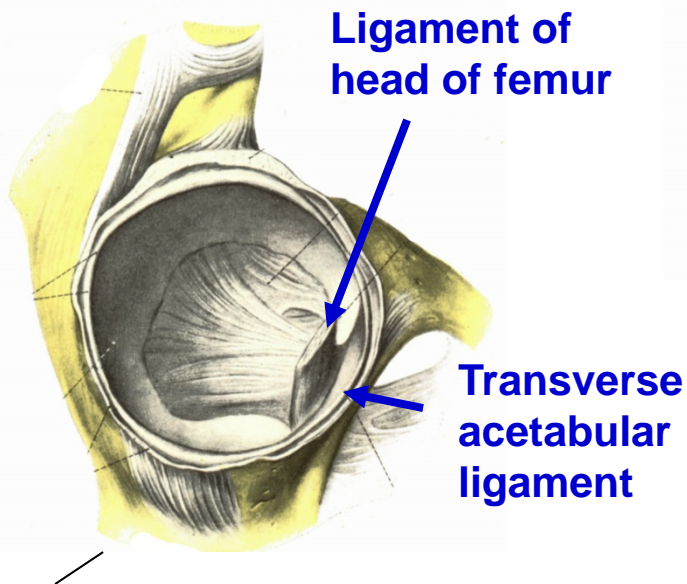
THEN READ QUESTION.

1. An 81 year-old women with a history of osteoporosis goes shopping at the mall with her 61 year-old daughter and 41 year old granddaughter. The women enter a department store that has a steep escalator. The 81 years suffers a fall while descending the escalator. She feels a sharp pain in her hip and cannot stand. She is then taken to the hospital and radiographs of the hip joint show fracture of the neck of the femur. The physician is concerned about the possibility of Avascular necrosis of the head of the femur. **Which of the following arteries is likely to be compromised by the fracture and result in insufficient blood supply to the head of the femur?**

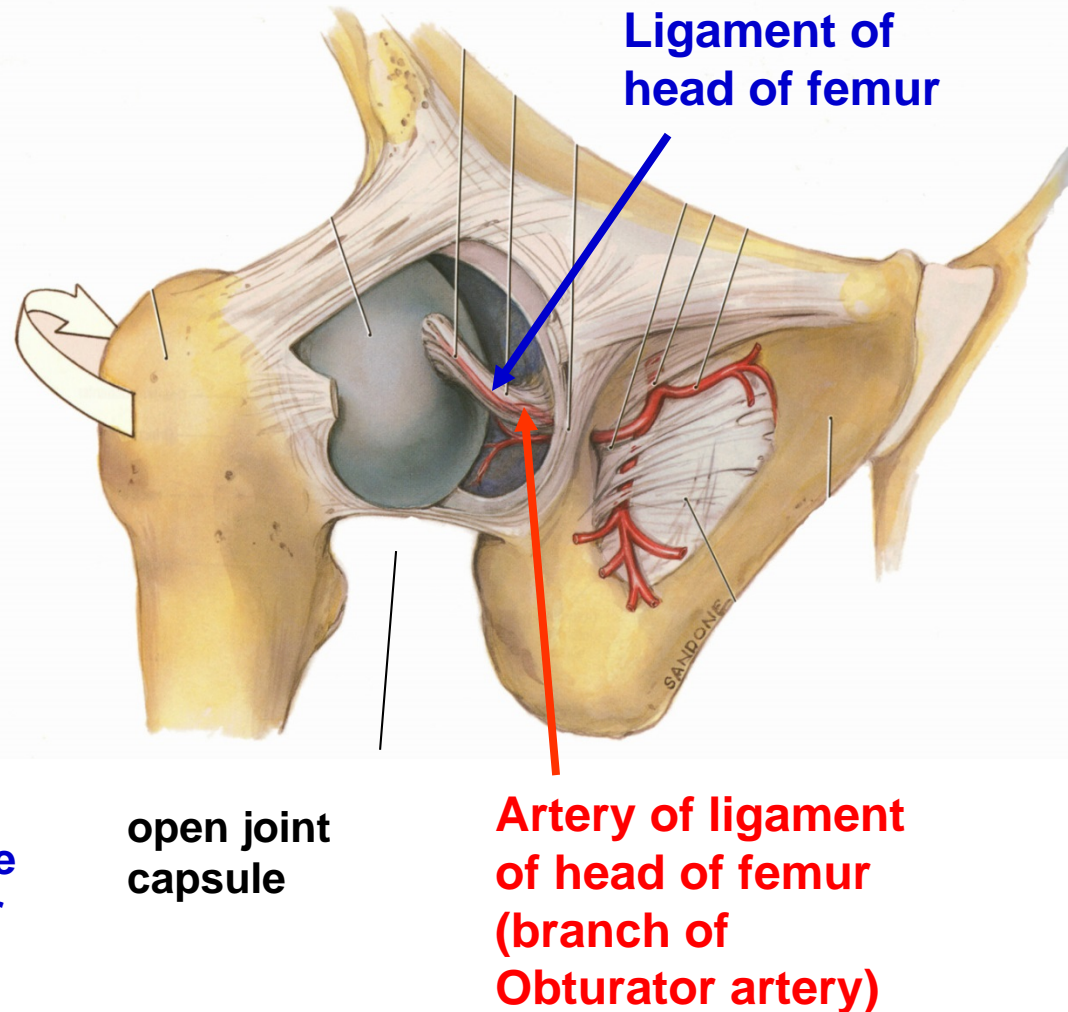
- A. Lateral Femoral Circumflex artery**
- B. Medial Femoral Circumflex artery**
- C. Inferior Epigastric artery**
- D. Inferior Gluteal artery**
- E. Superficial External Pudendal artery**

HIP JOINT - LIGAMENTS

C. **Ligament of head of femur** - inside joint capsule; attached to head of femur at fovea capitis and to transverse acetabular ligament; transmits **Artery of ligament of head of femur (branch of Obturator artery)**.

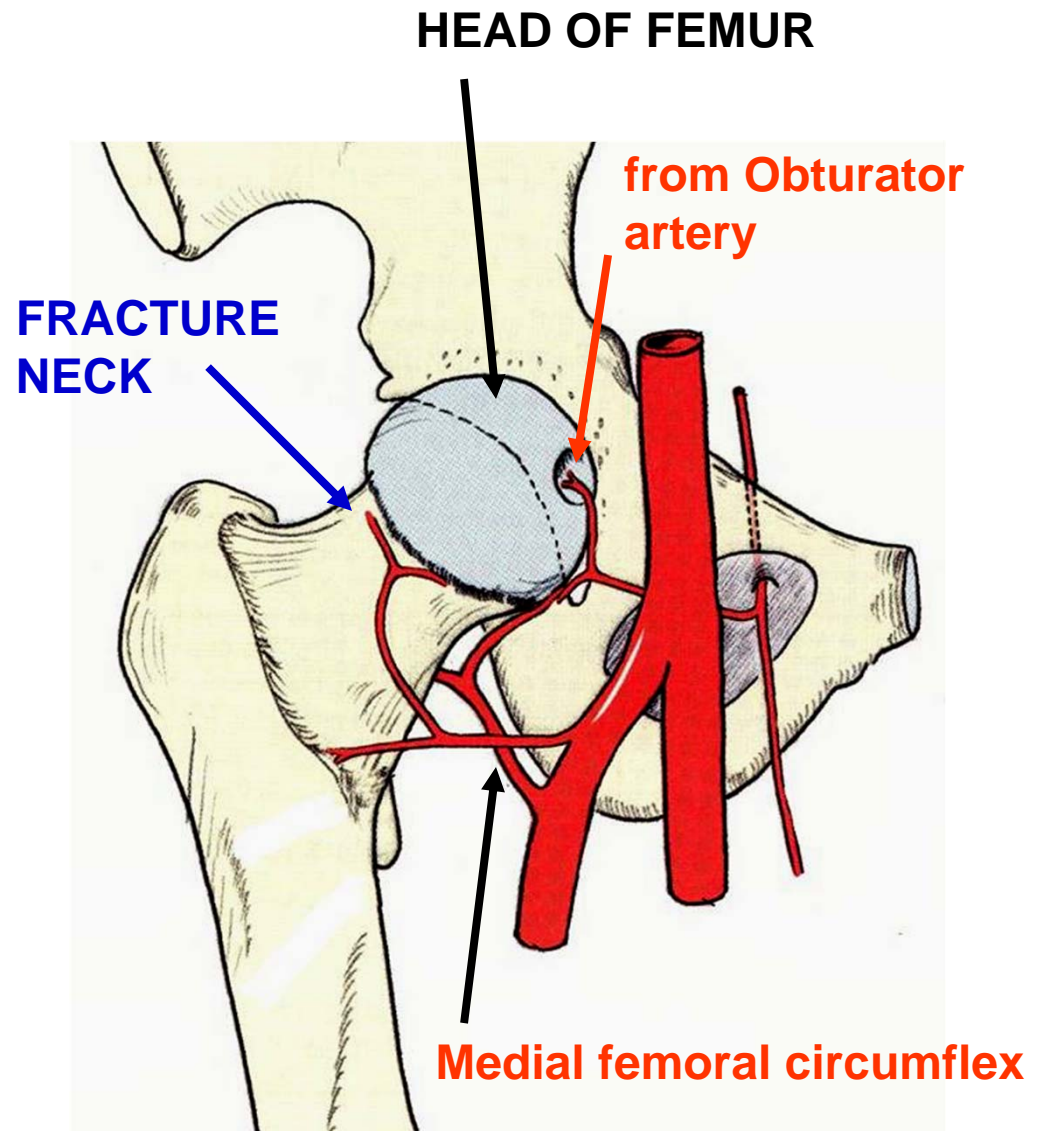


look inside joint after remove femur



FRACTURE CAN PRODUCE AVASCULAR NECROSIS OF HEAD OF FEMUR

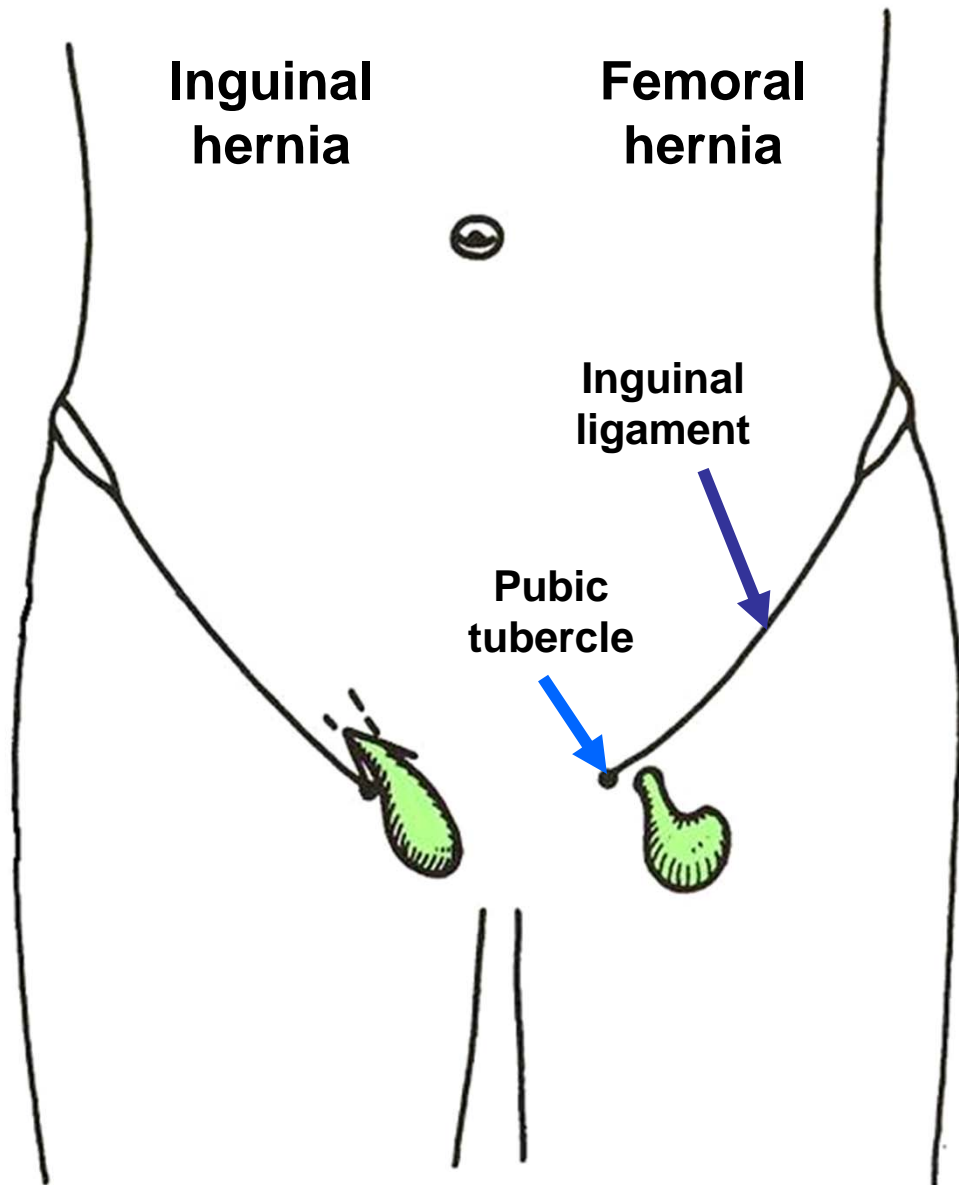
Note: **Fracture of neck of femur** - head and neck of femur receive blood from branches of **Obturator artery** (through ligament of head) and branches of **Medial and lateral femoral circumflex**; after fracture, supply from circumflex arteries is disrupted; if obturator supply is inadequate, **avascular necrosis** may occur requiring artificial replacement of head and neck of femur.



2. A 63 year-old obese grandmother lifted her 7 year-old grandson and felt a sharp pain on the anterior side of her hip joint. She is admitted to the emergency room. Examination by palpation is complicated by the woman's obesity. A large bulge can be palpated anterior to the hip joint and the physician suspects that the patient has suffered a hernia. **Which of the following structures could be used to confirm the diagnosis and determine the type of hernia that had occurred?**

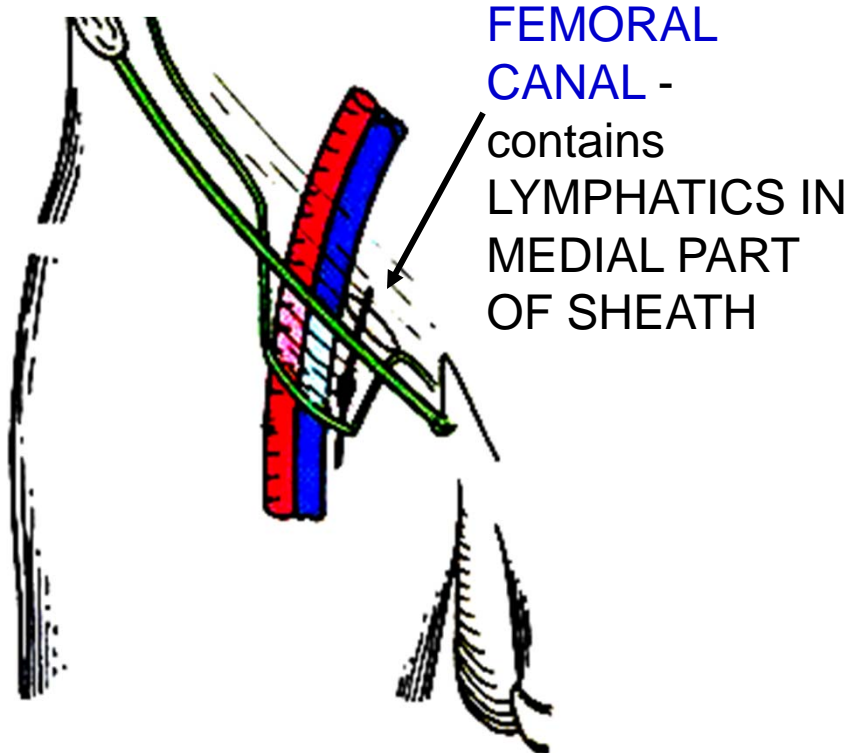
- A. Iliotibial tract**
- B. Iliofemoral ligament**
- C. Inguinal ligament**
- D. Adductor hiatus**
- E. Anterior inferior iliac spines**

Clinical Note:
Differentiating Femoral and Inguinal Hernias - made by comparing location of neck of hernia (entrance to abdomen) to inguinal ligament;
Femoral Hernia - neck of hernia is below inguinal ligament;
Inguinal Hernia - neck of hernia is above inguinal ligament.



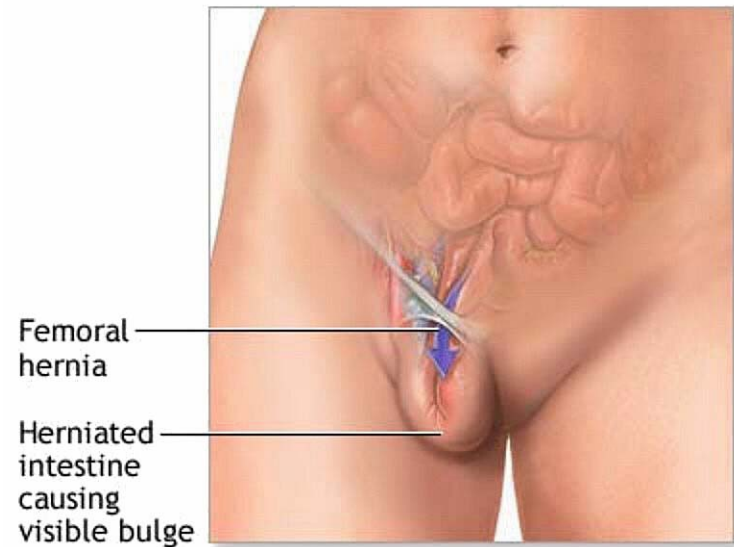
FEMORAL CANAL

transversalis fascia



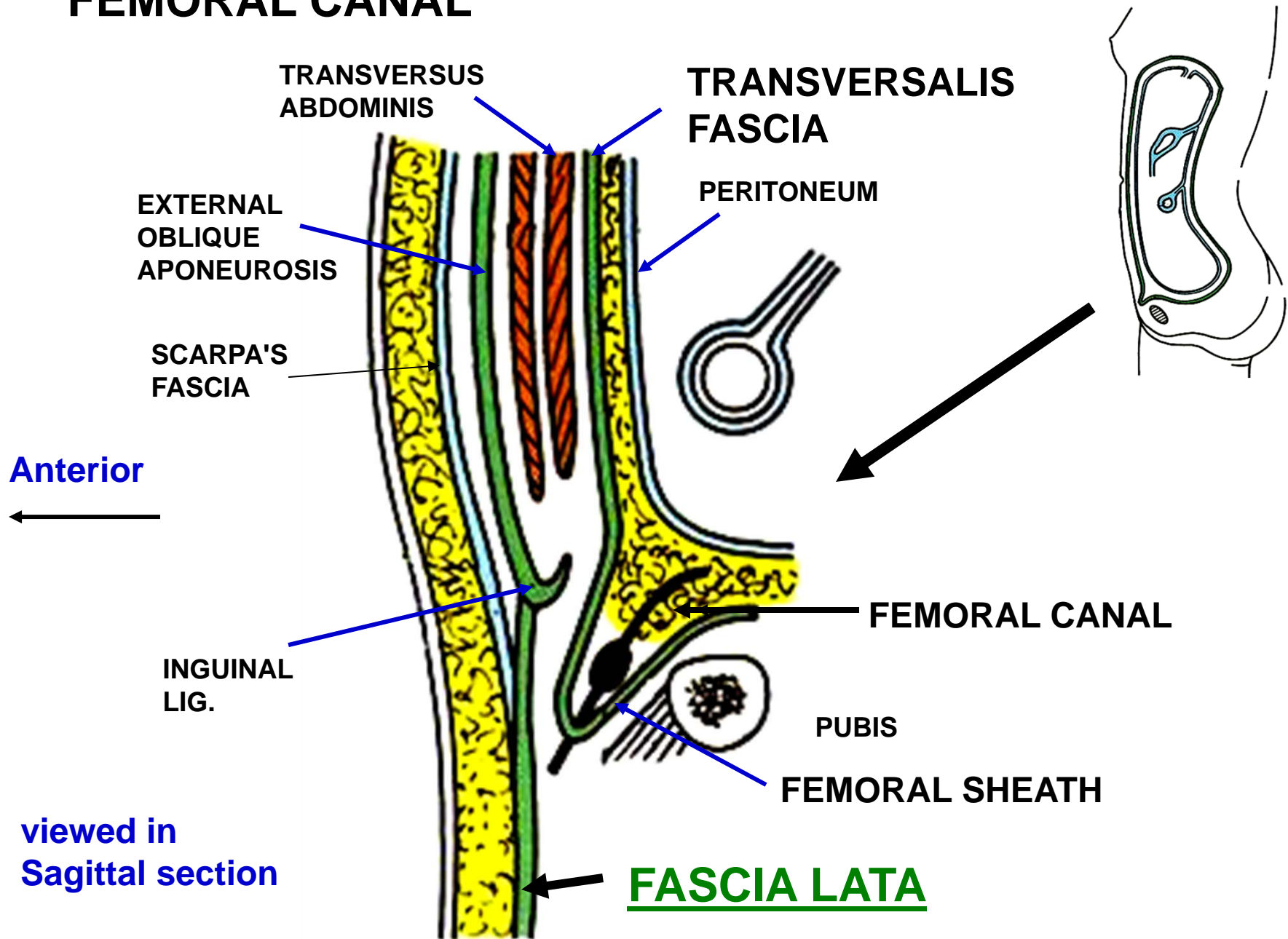
Femoral Canal - is contained in medial part of femoral sheath; contains **lymph vessels from lower limb that drain to external iliac nodes** ; opening is called **Femoral Ring**.

FEMORAL HERNIA



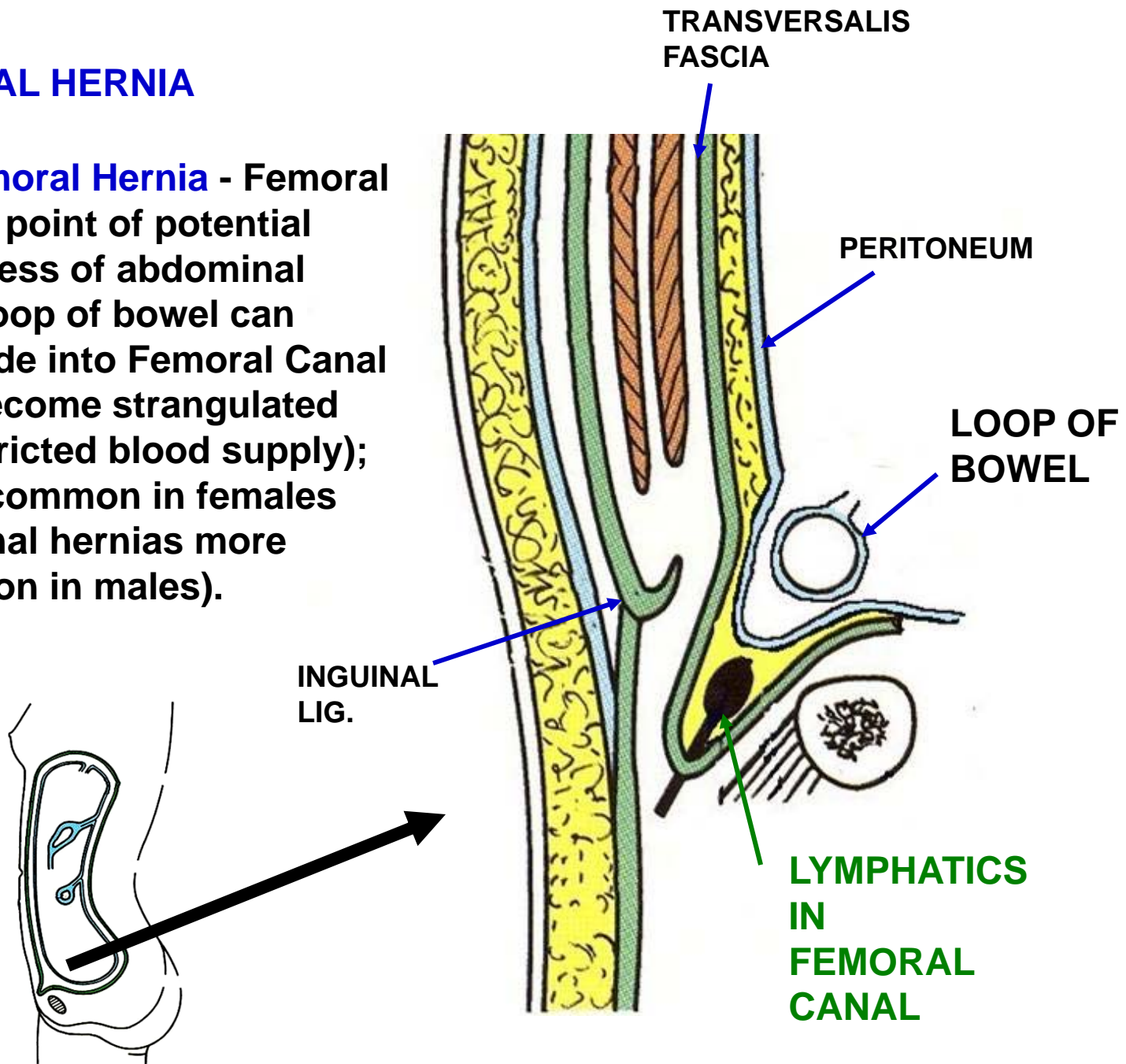
Femoral Hernia - Femoral ring is point of potential weakness of abdomino/pelvic wall; loop of bowel can protrude into Femoral Canal and become strangulate; more common in females (inguinal hernias more common in males).

FEMORAL CANAL



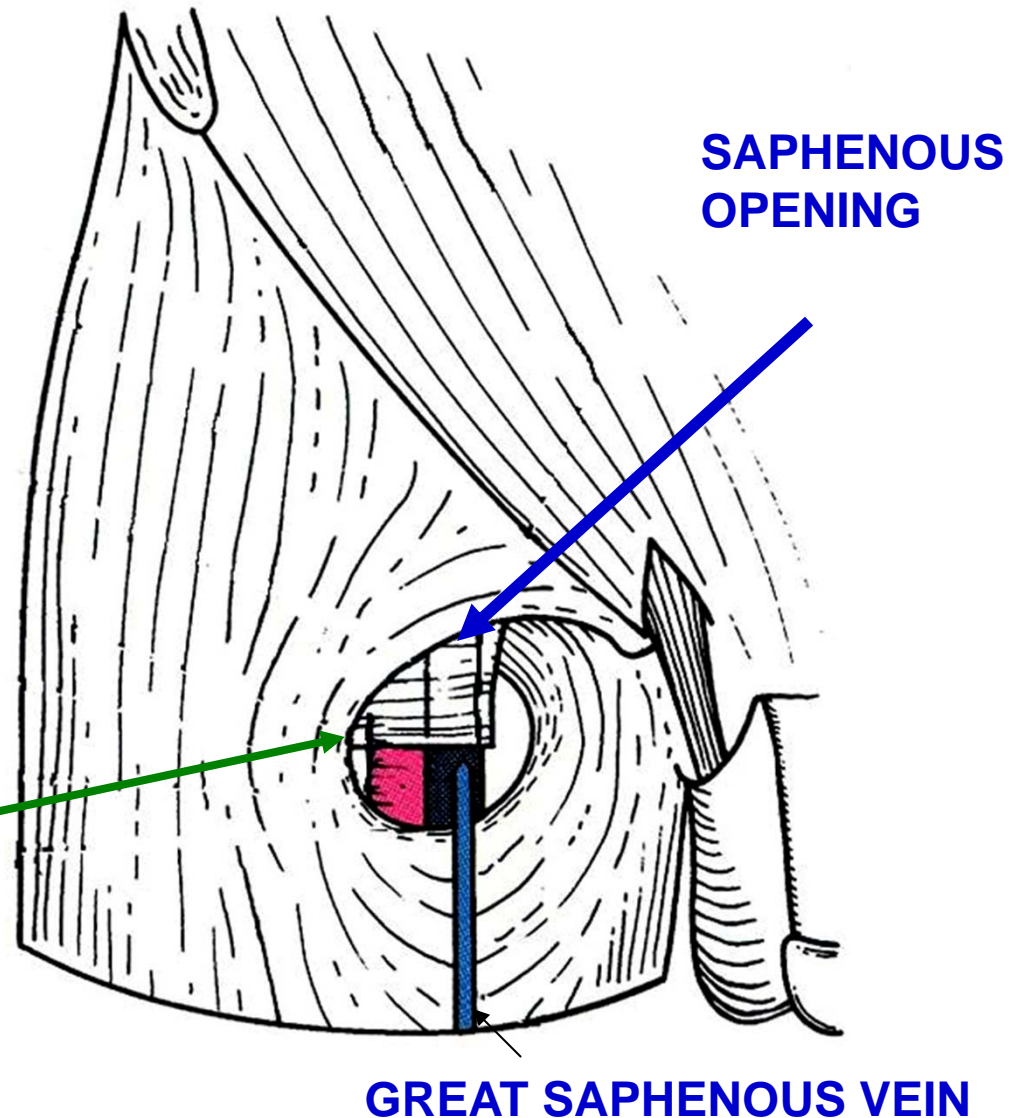
FEMORAL HERNIA

2. **Femoral Hernia** - Femoral ring is point of potential weakness of abdominal wall; loop of bowel can protrude into Femoral Canal and become strangulated (constricted blood supply); more common in females (inguinal hernias more common in males).



SAPHENOUS OPENING

B. Saphenous opening - oval shaped defect in deep fascia, allows for passage of Great Saphenous vein (superficial vein on medial side of leg); located inferior to inguinal ligament, anterior to Femoral artery and vein; Saphenous opening has sharp edged lateral side (**Falciform margin**), smooth medial side.



CLINICAL VIGNETTE FORMAT OF ANATOMY QUESTIONS

3. A cross country runner was attempting to pass another runner in a race and stepped off the path. His foot landed on a small stump resulting in hyperinversion of the foot. Subsequent x-ray showed no fractures of the tarsal bones, distal tibia or fibula but the ankle was swollen and painful. **Which of the following structures were (was) most likely to be damaged.**

- A. deltoid ligament.
- B. long plantar ligament.
- C. spring ligament.
- D. calcaneofibular and anterior talofibular ligaments.
- E. calcaneofibular and posterior talofibular ligaments.

MOVEMENTS OF LOWER LIMB

D. Inversion-Eversion -

Inversion - turn foot so sole faces medially

Eversion - turn foot so sole faces laterally

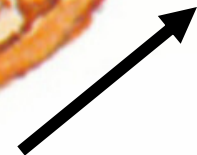
Inversion - sole faces medially

Eversion - sole faces laterally

big toe raised

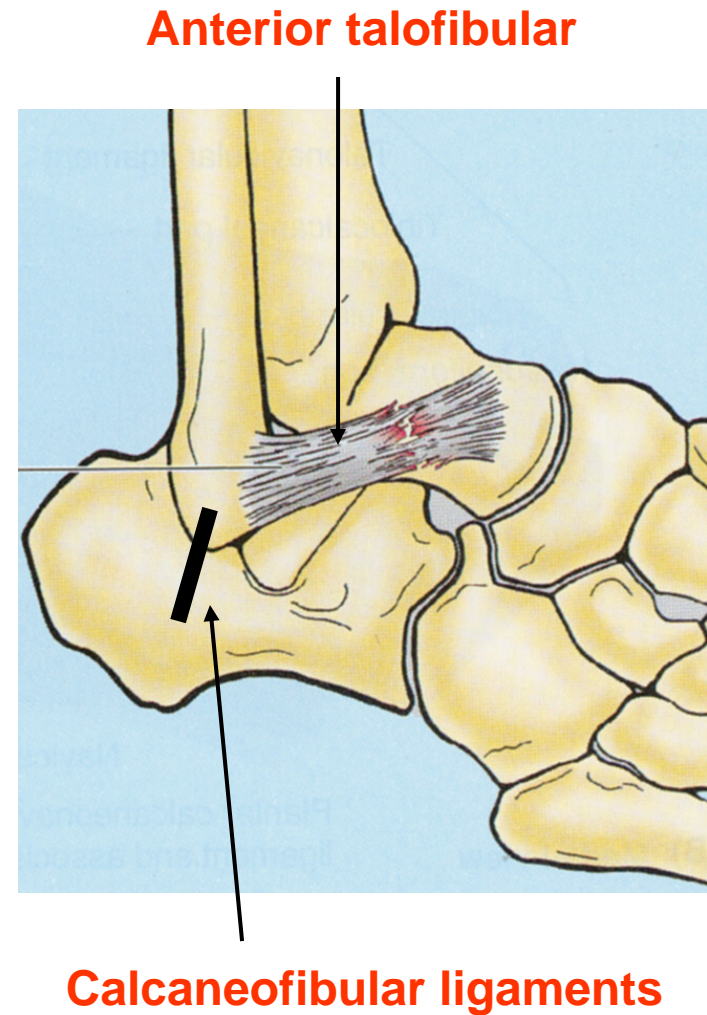
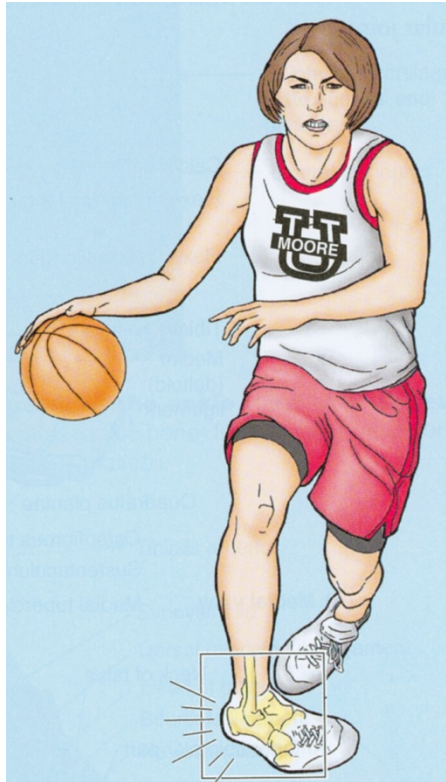


big toe turned down



SPRAINED ANKLE: EXCESSIVE INVERSION

Note: **Sprains** of ankle are usually caused by **excessive inversion**; **Anterior talofibular** and **Calcaneofibular ligaments** are commonly **stretched** or **partially torn**.

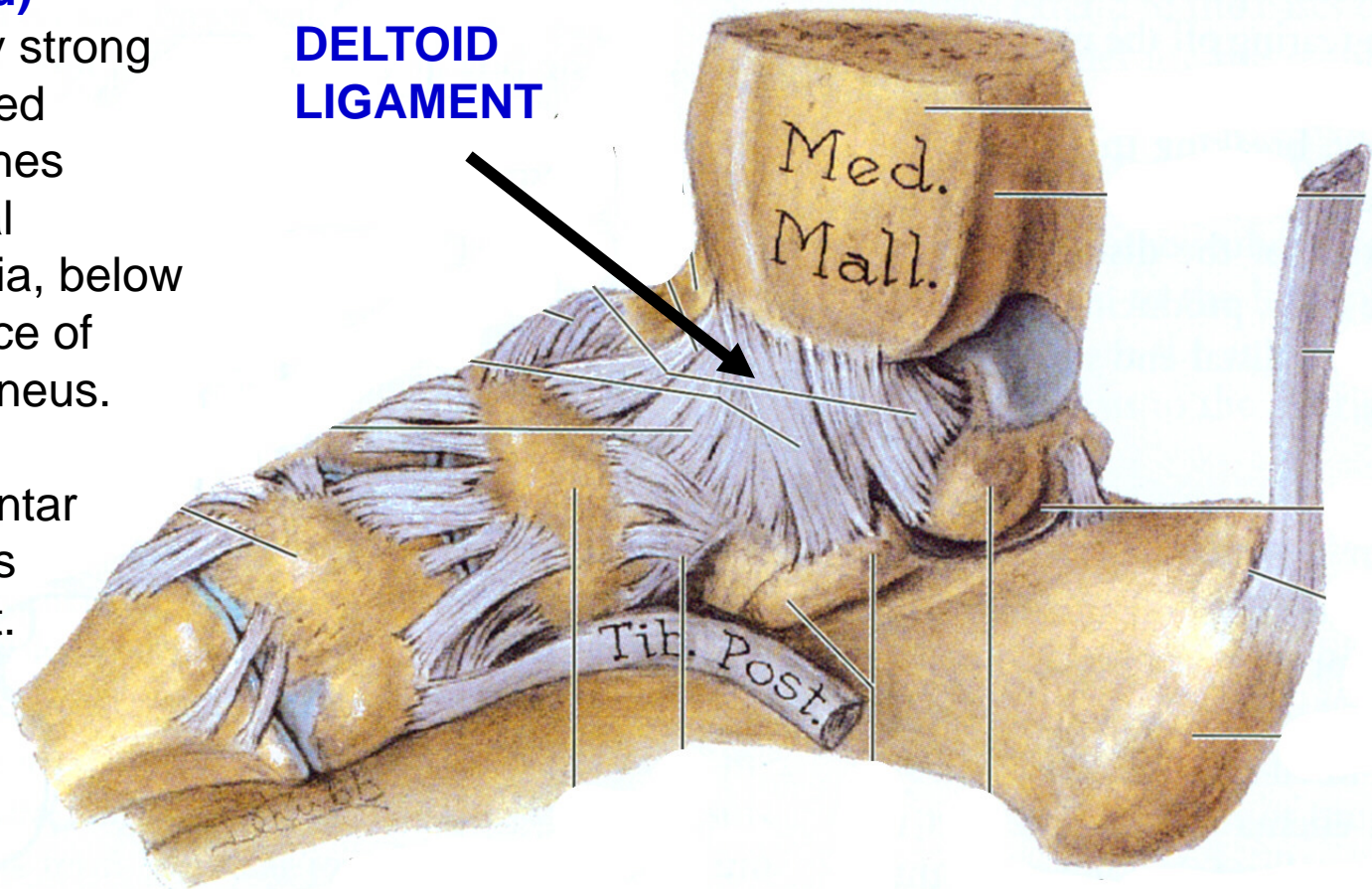


ANKLE JOINT: LIGAMENTS

Medial (Deltoid)

ligament - very strong triangular shaped ligament; attaches above to medial malleolus of tibia, below to medial surface of talus and calcaneus. Permits free dorsiflexion/plantar flexion but limits eversion of foot.

DELTOID LIGAMENT



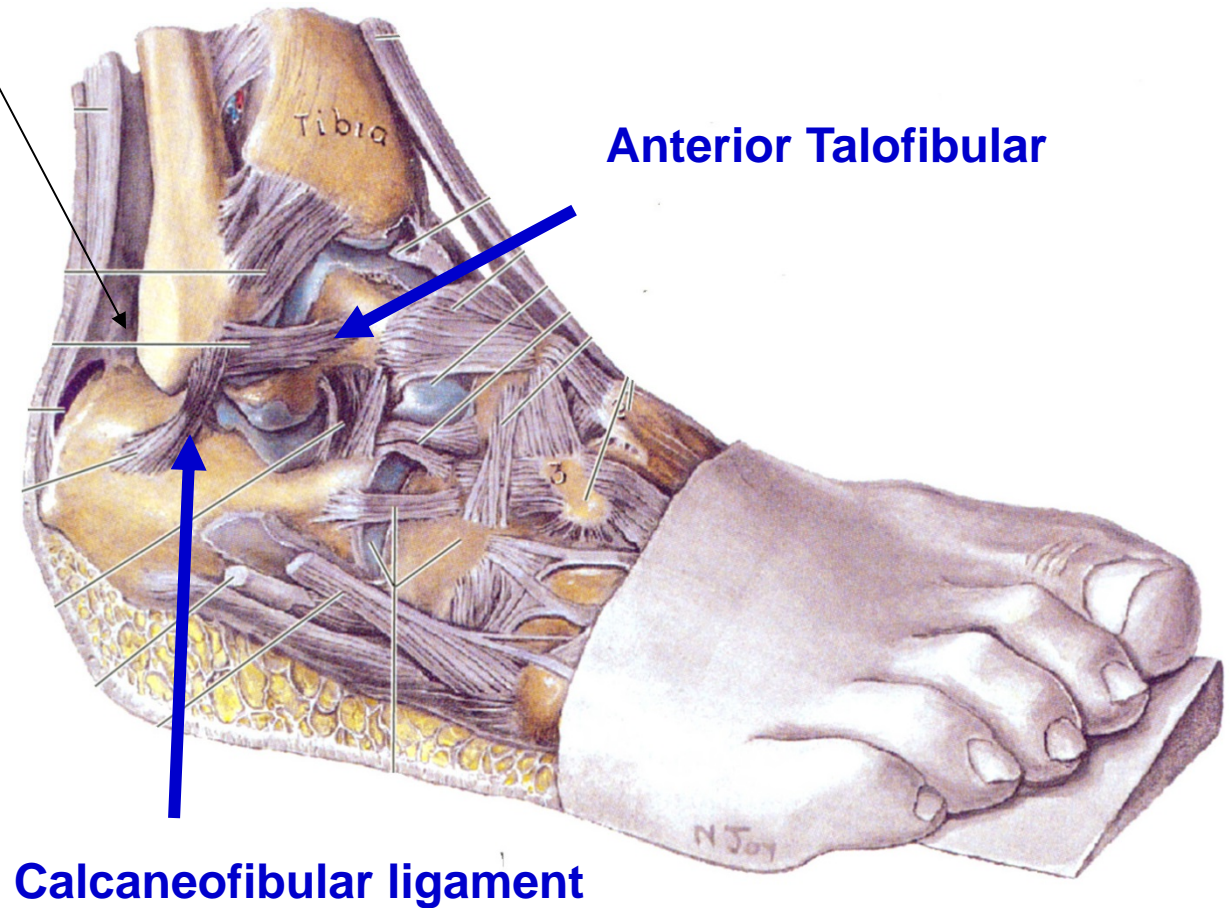
ANKLE JOINT: LIGAMENTS

Lateral ligaments
- weaker; all attach above to **lateral malleolus of fibula**; permit free dorsiflexion/plantar flexion but limit inversion of foot.

- a. **Anterior and Posterior Talofibular** ligaments to talus.
- b. **Calcaneofibular ligament** to calcaneus.

Posterior Talofibular

Anterior Talofibular



4. A runner accelerated toward the finish line and suddenly felt a pop on the back of his thigh. He then fell down in excruciating pain. MRI imaging showed an avulsion of tendons from their origin on the innominate bone. A small piece of bone remained attached to the muscle tendons. **This piece of bone was probably part of**

- A. pubis**
- B. ischial spine**
- C. ischial tuberosity**
- D. acetabulum**
- E. ilium**

POSTERIOR THIGH - HAMSTRING MUSCLES

ORIGIN ALL HAMSTRINGS - Ischial Tuberosity: PULLED HAMSTRING

1) **Semimbranosus**
(named for flattened tendon),

2) **Semitendinosus**
(named for long tendon distally),

3) **Biceps femoris**
(two heads, long head from Ischial tuberosity, short head from Linea aspera of femur),

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

Semitendinosus

Semimbranosus

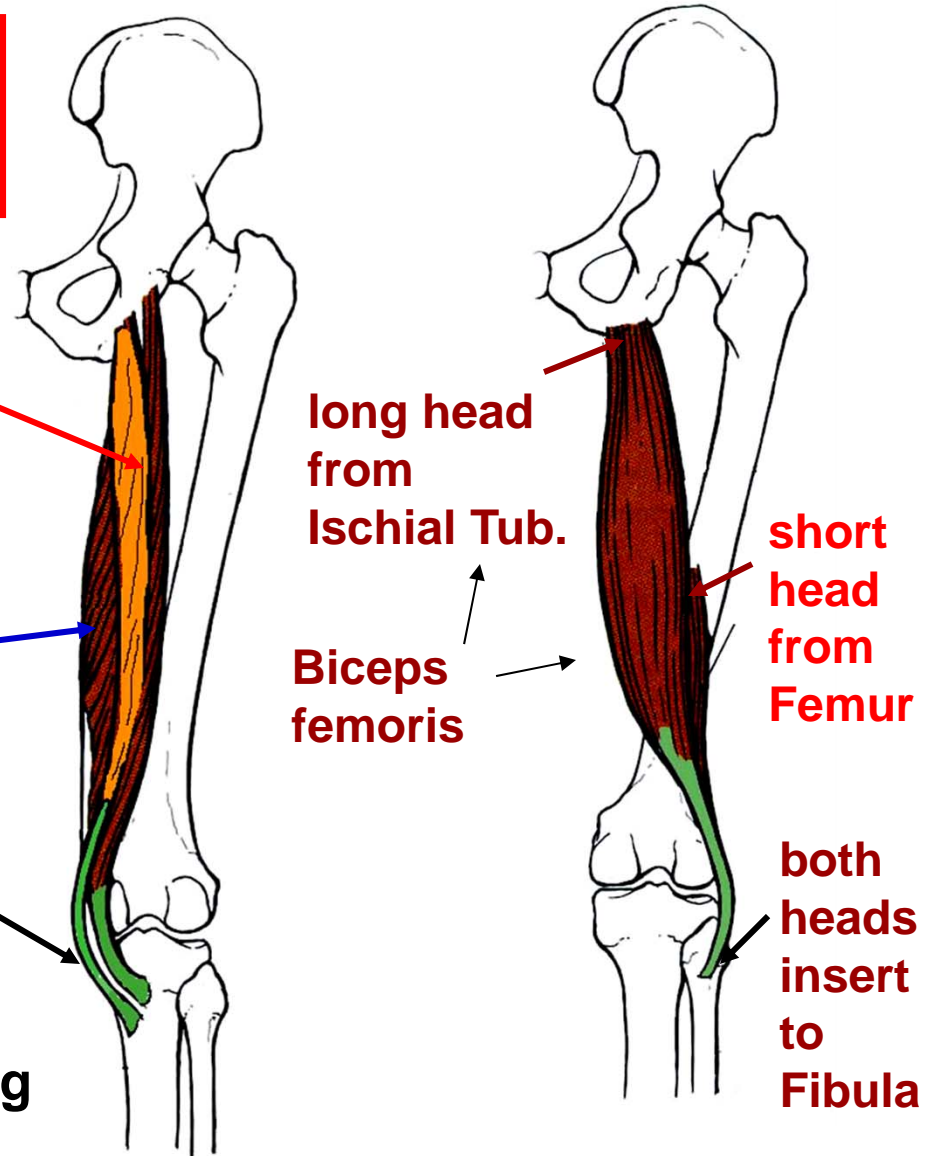
both insert to Tibia

long head from Ischial Tub.

Biceps femoris

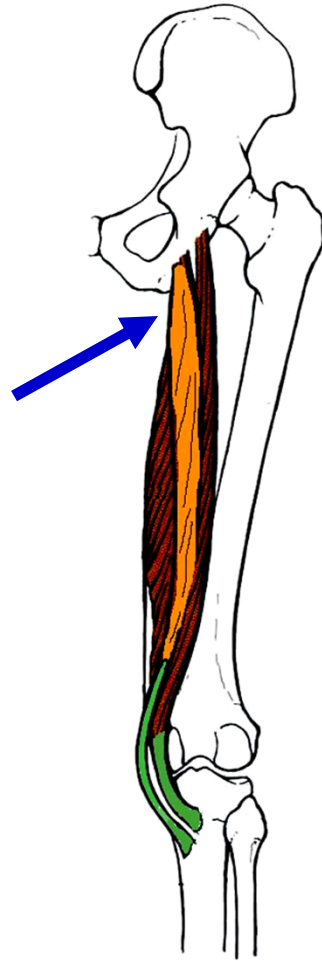
short head from Femur

both heads insert to Fibula



PULLED HAMSTRINGS - TEAR OR AVULSE FROM ISCHIAL TUBEROSITY

Clinical note: Pulled Hamstrings - can tear or avulse (pull off) part of origin of muscles from Ischial tuberosity; can occur in **running** or when **extend knee** (contract Quadriceps) when hamstrings are **not relaxed**; extremely **painful**, person writhes in unbearable agony.



**IN EXTREME CASES: AVULSION
WITH FRACTURE OF ISCHIAL
TUBEROSITY**

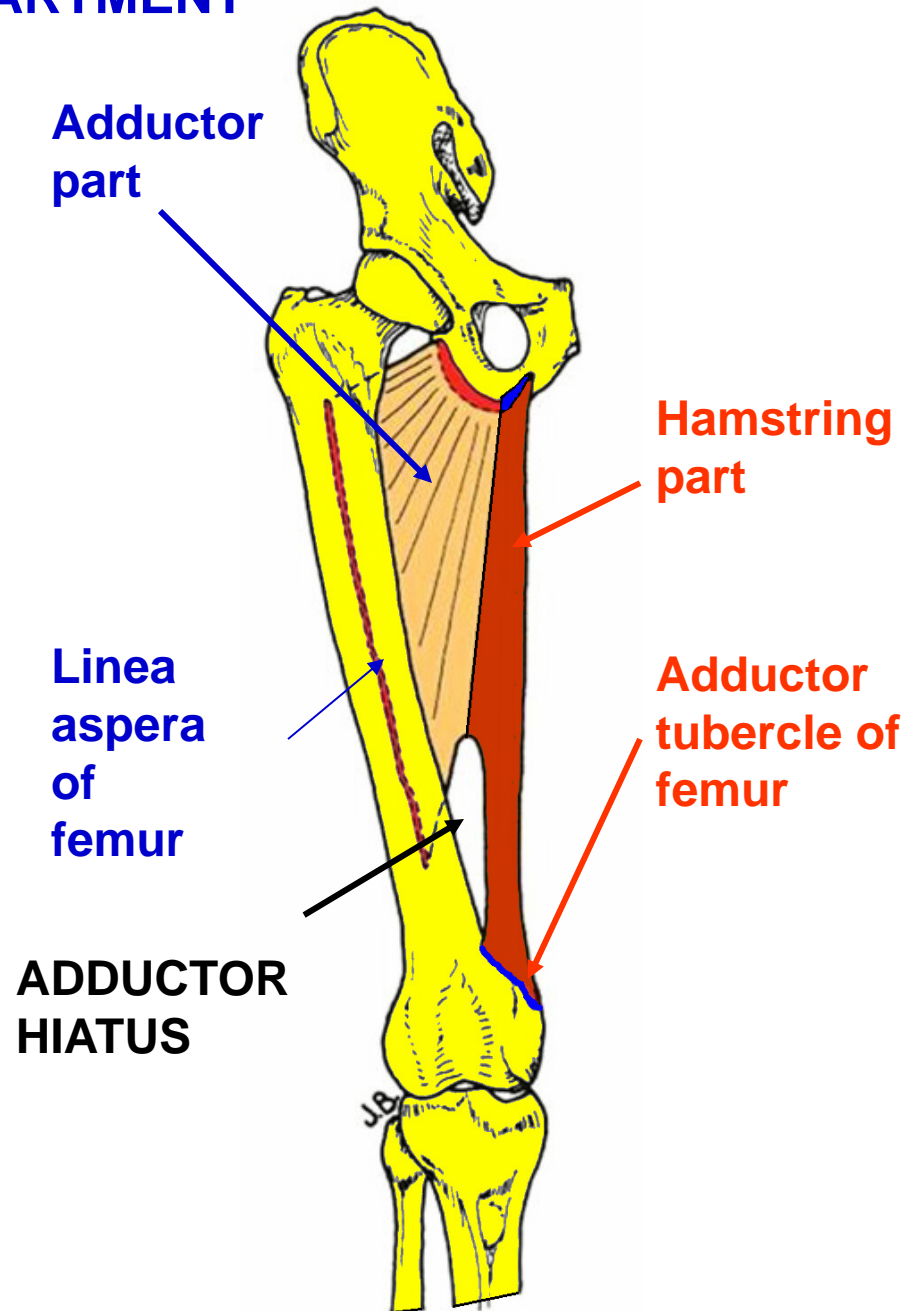
IV. MUSCLES OF MEDIAL COMPARTMENT

1. **Adductor Magnus** - has two parts;

a. **Adductor part** -
origin: pubis and ischium, insert:
Linea aspera of femur; action:
Adduct thigh; innervation:
Obturator nerve.

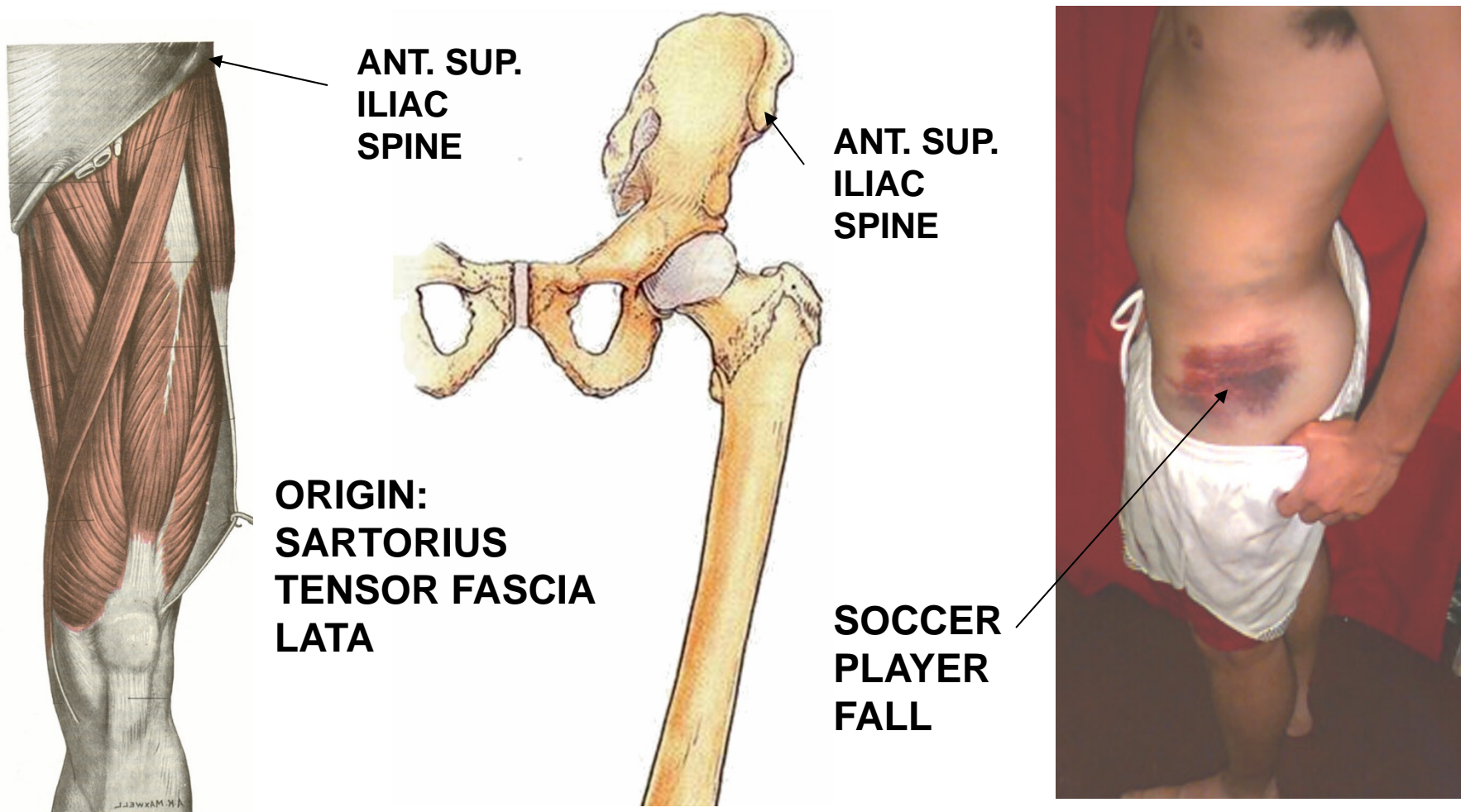
b. **Hamstring part** -
origin Ischial tuberosity, inserts to
Adductor tubercle of femur;
action: Extends thigh (because of
more posterior origin);
innervation: **Tibial part of
Sciatic nerve**.

Clinical Note: Tear or stretch of
adductor group at pubis is
called a **Pulled Groin**.



'HIP POINTER'

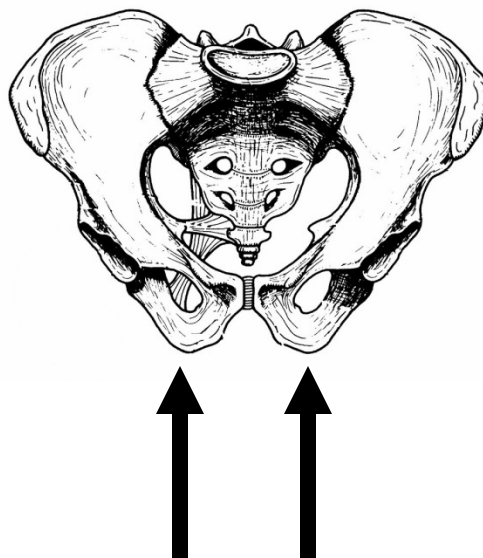
Clinical Note: Contusion of muscles at anterior superior iliac spine (origin of Sartorius) is called a **Hip Pointer**



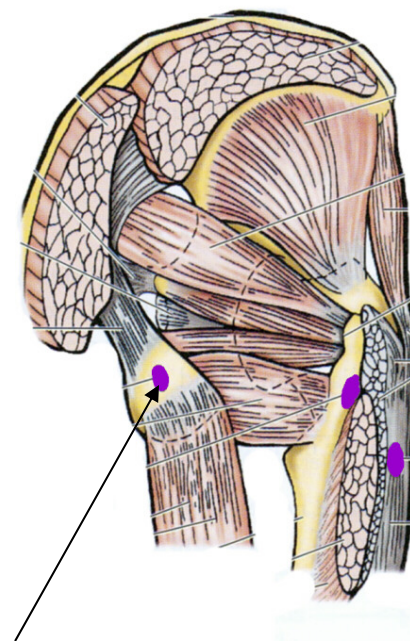
ISCHIAL BURSITIS CALLED WEAVER'S BOTTOM



Weaver on Treadle



Sit on Ischial
Tuberosities



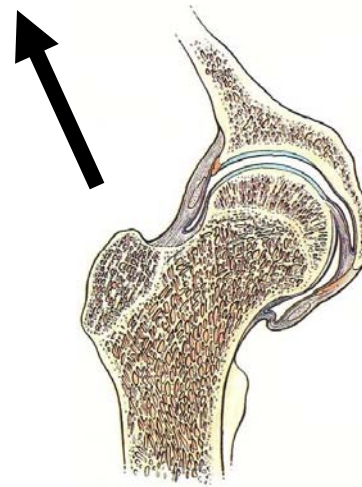
Movement Inflames
Ischial Bursa

Note: Weaver's Bottom - Inflammation of Ischial Bursae; when sitting, weight of body rests on Ischial tuberosities (**Gluteus maximus covers Ischial tuberosities when standing, but not when sitting**); Ischial bursae may become inflamed due to excess friction (Weavers used legs to power treadles by repeated leg extension, causing inflammation of Ischial bursae); may also become inflamed in paraplegics.

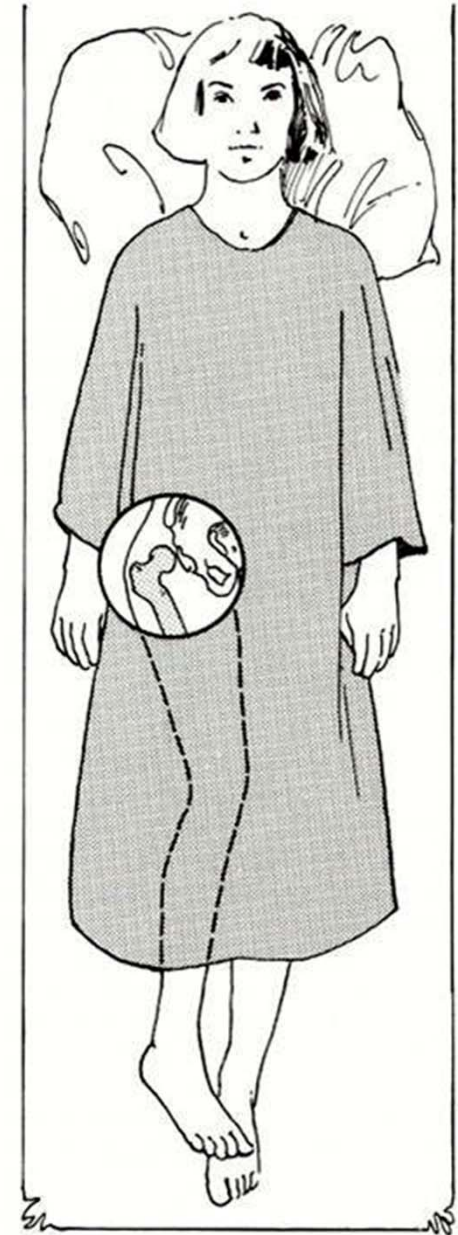
DISLOCATE HIP JOINT

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

If congenital, dislocate superiorly

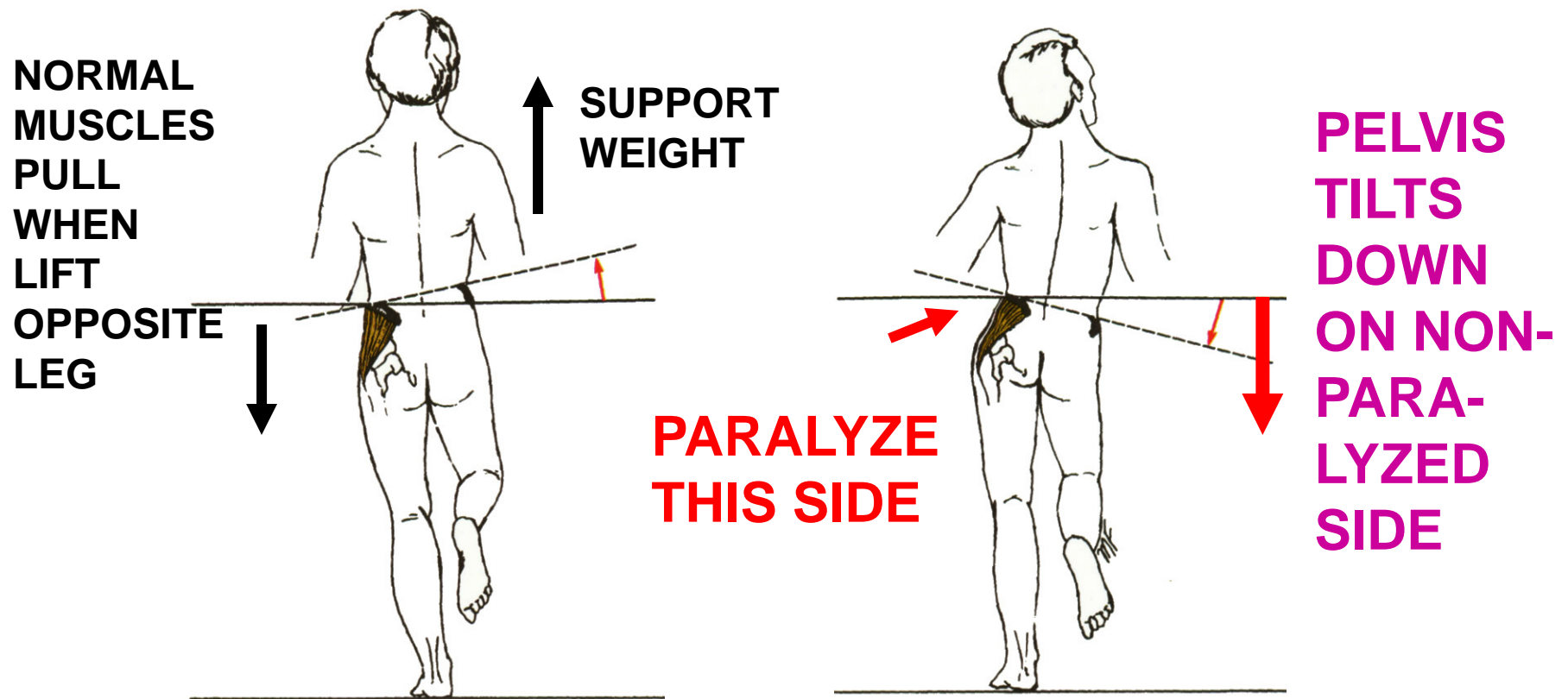


Leg is rotated medially and appears to be shorter



GLUTEAL GAIT -

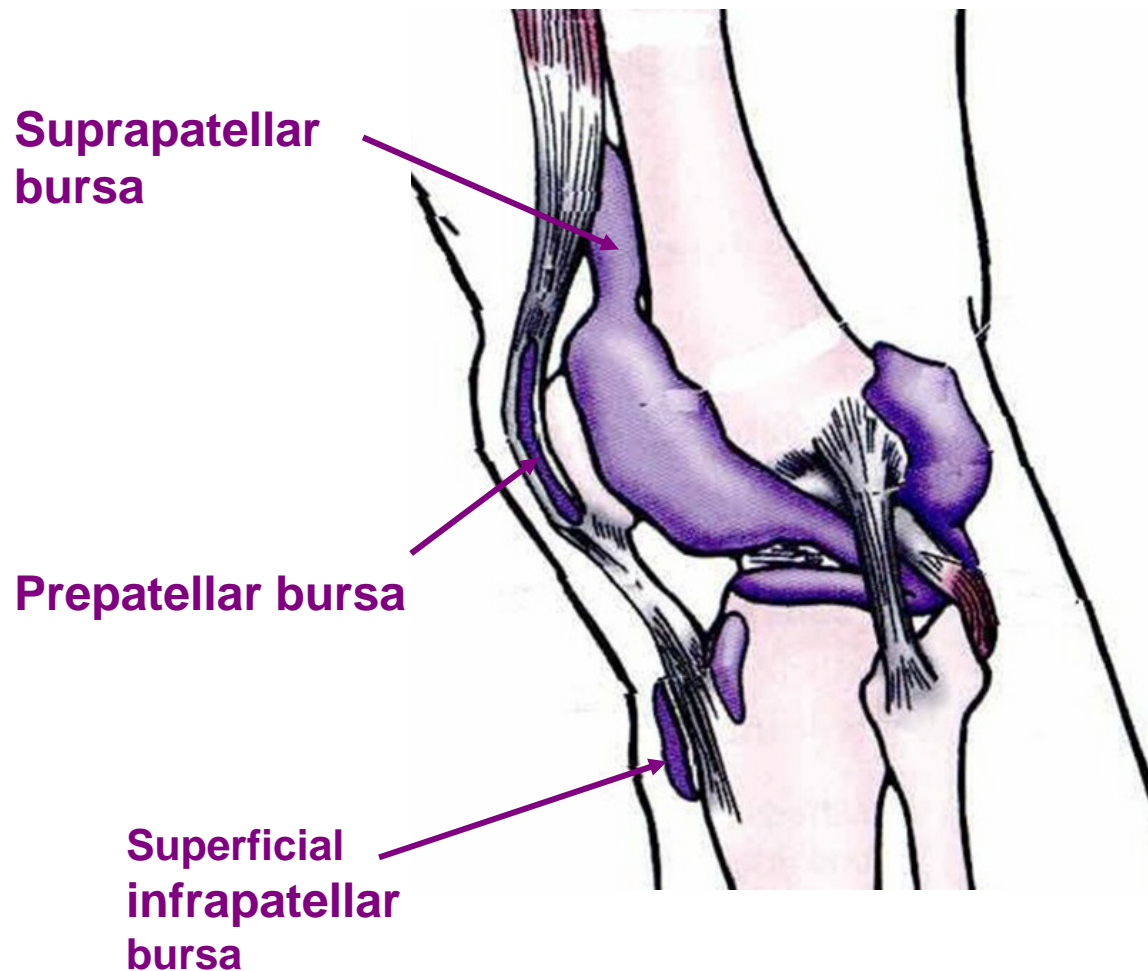
caused by injury to Superior Gluteal nerve or poliomyelitis (also congenital dislocation of hip joint). Paralyze Gluteus Medius and Minimus. In walking, pelvis tilts down on non-paralyzed side when lift foot of opposite, non-paralyzed leg.



Positive Trendelenburg sign - WHEN LIFT OPPOSITE LEG, PELVIS TILTS DOWN ON (NON-PARALYZED) OPPOSITE SIDE.

BURSAE OF KNEE

Bursae - bags of synovial fluid with synovial lining; some connect to main synovial sac of knee joint; become inflamed with repeated contact with ground when kneeling.



1. Suprapatellar bursa - outpocketing of synovial cavity of knee joint posterior to quadriceps tendon.

2. Prepatellar bursa - in subcutaneous tissue between skin and patella

3. Superficial infrapatellar bursa - between skin and patellar ligament.

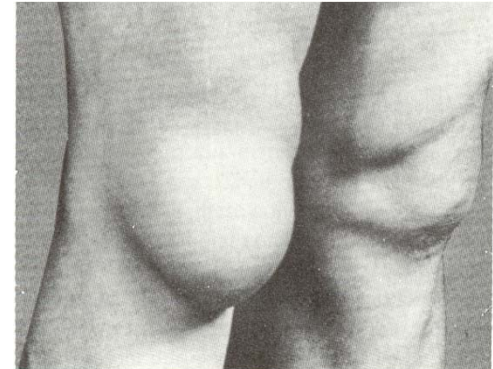
BURSAE OF KNEE CAN BECOME INFLAMMED

Prepatellar bursa in subcutaneous tissue between skin and patella; inflammation - **HOUSEMAID'S KNEE**



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

Inflammation of Prepatellar bursa - **HOUSEMAIDS KNEE**

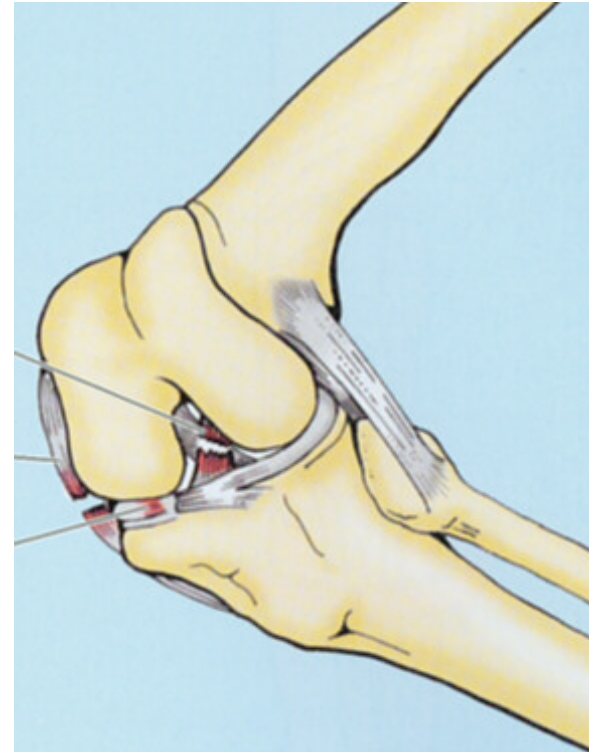
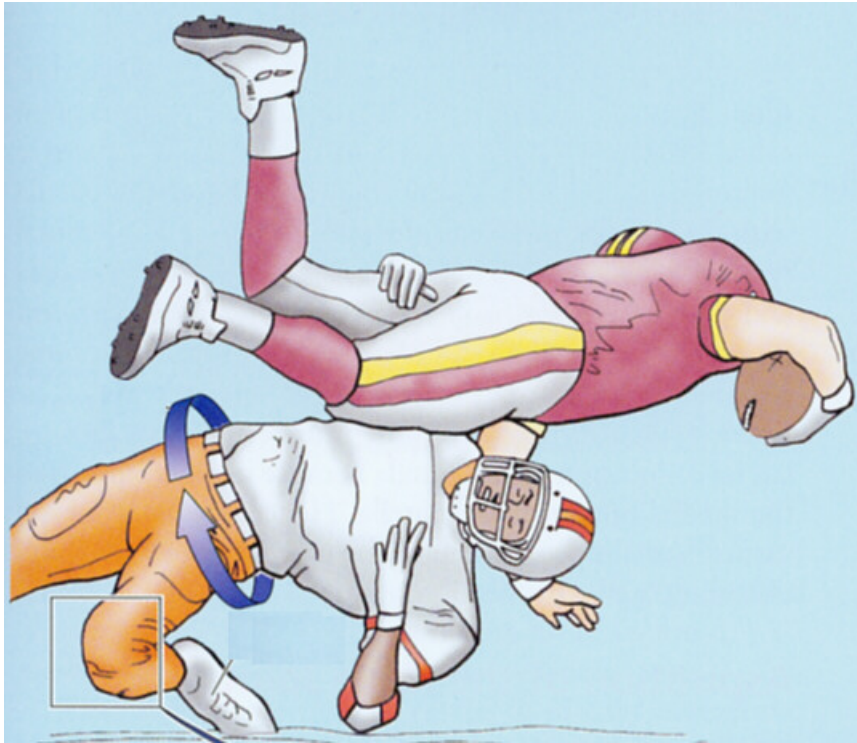


HOUSEMAID'S KNEE.



CLERGYMAN'S KNEE

TERRIBLE TRIAD OF KNEE JOINT

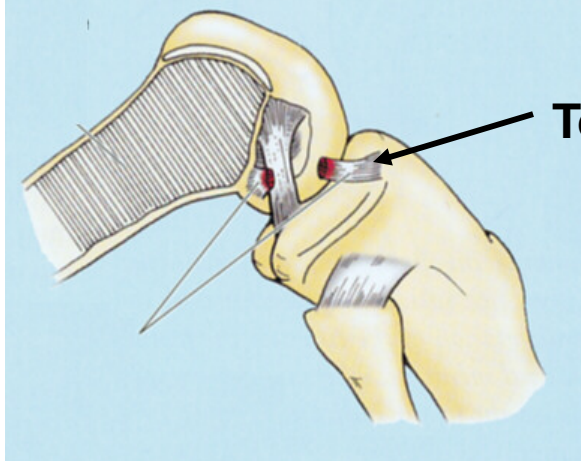
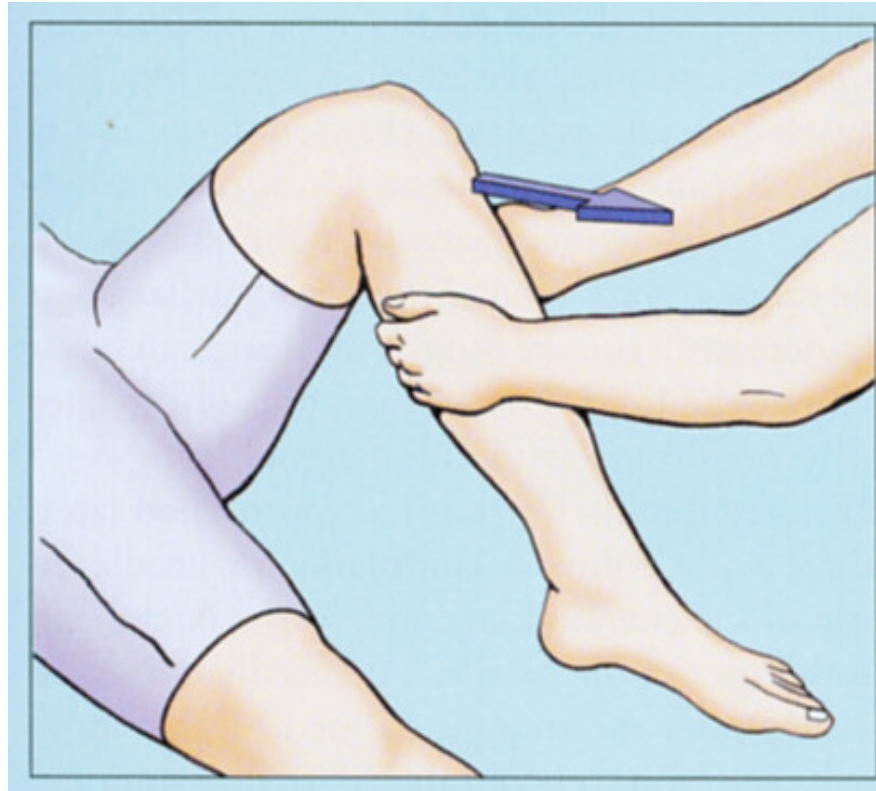


Clinical Note: **Terrible Triad of the Knee joint**: Knee joint is stable in extension but ligaments are slackened by joint flexion; **blow to lateral side** of the knee when the leg is flexed (as can occur in football tackles) or rotate and force lateral movement of body; can tear **Tibial (Medial) collateral ligament, Anterior cruciate ligament and Medial meniscus** (because it is firmly fixed to the medial collateral ligament).

TESTS FOR TEARS IN CRUCIATE LIGAMENTS

ANTERIOR DRAWER SIGN

**Tear Anterior
Cruciate
Ligament -
can draw
tibia
anteriorly.**



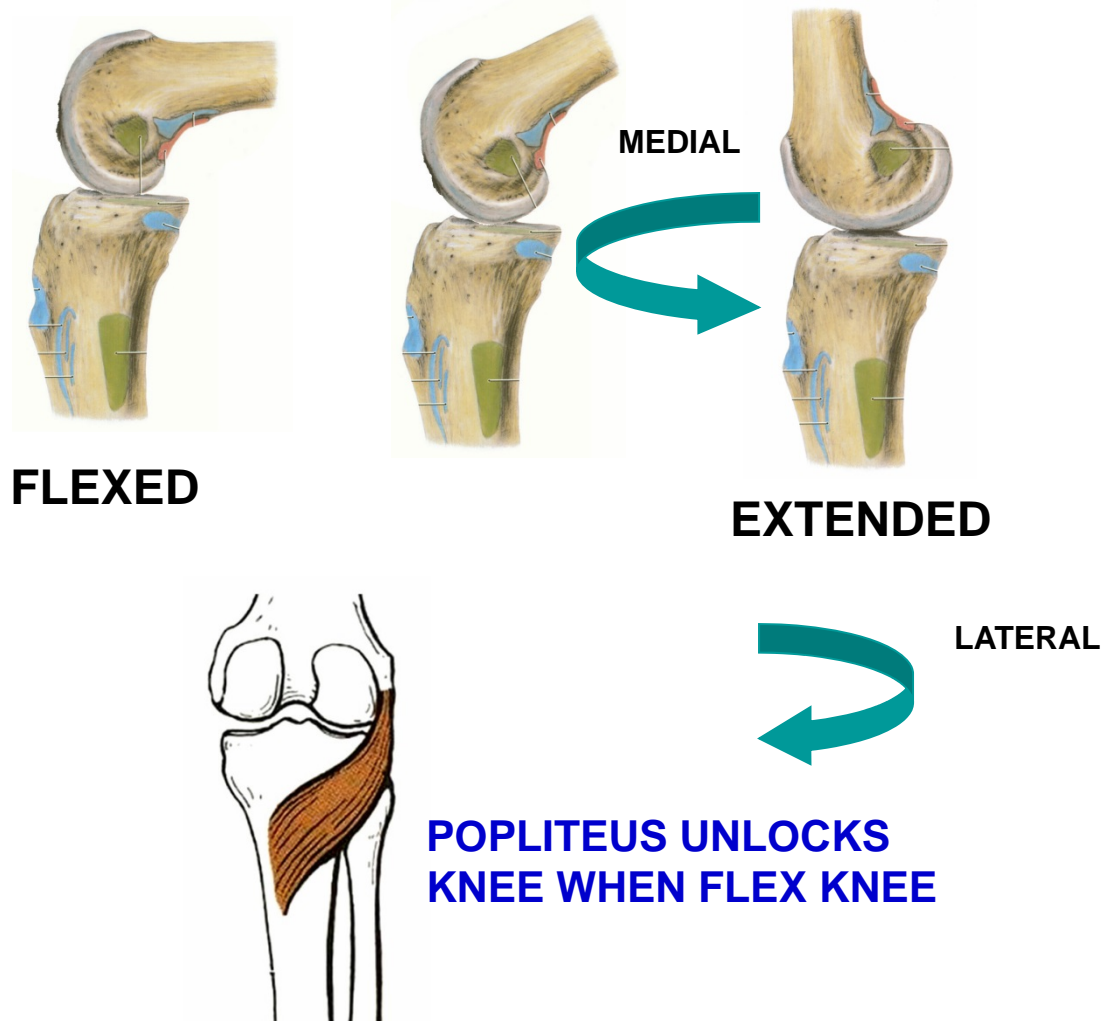
Tear Anterior Cruciate

LOCKING AND UNLOCKING KNEE JOINT

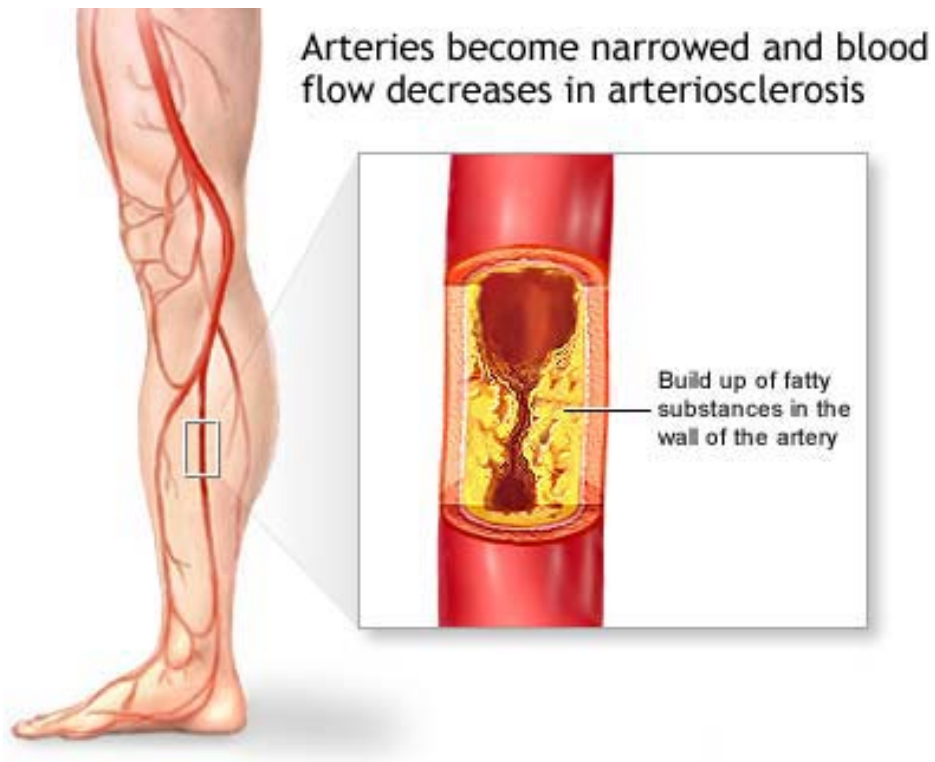
Note: **LOCKING AND UNLOCKING KNEE JOINT**

- 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) producing relaxation of ligaments. (LOCK femur rotates **MEDIAL**LY; UNLOCK femur rotates **LATERAL**LY)

femur rotates medially during last 30 degrees of extension, due to shape of condyles

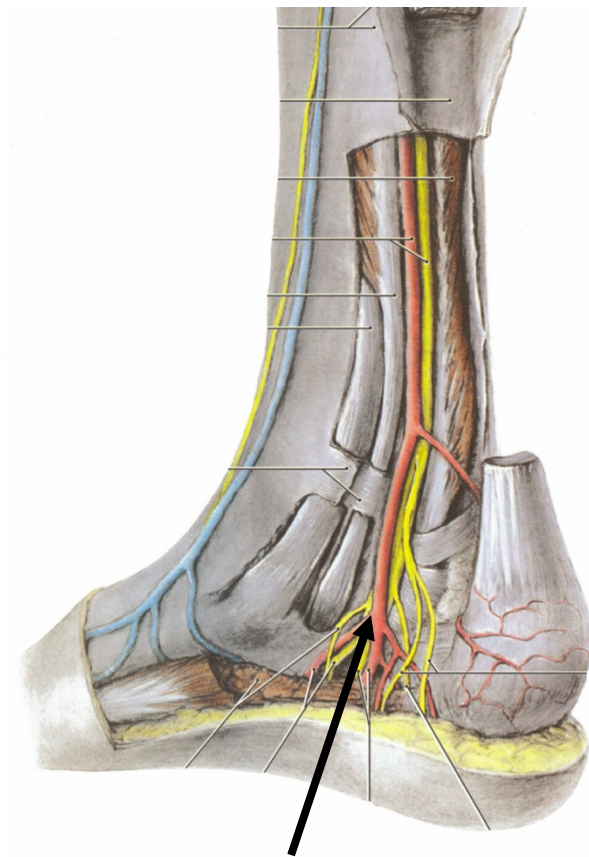


INTERMITTENT CLAUDICATION



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**.

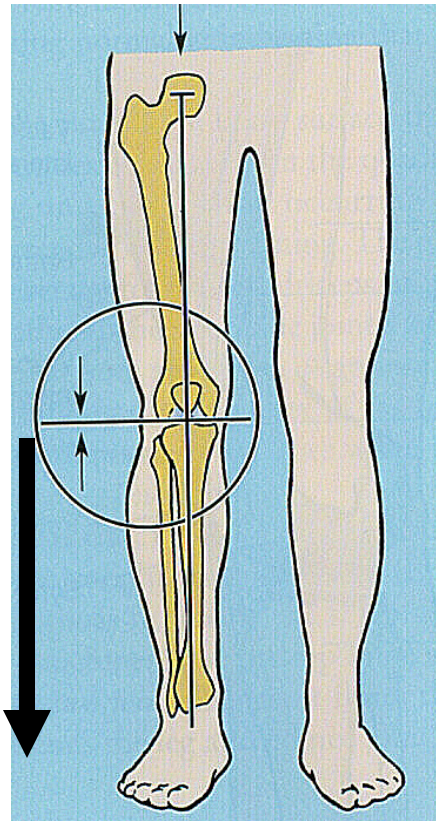
ARTERIES



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

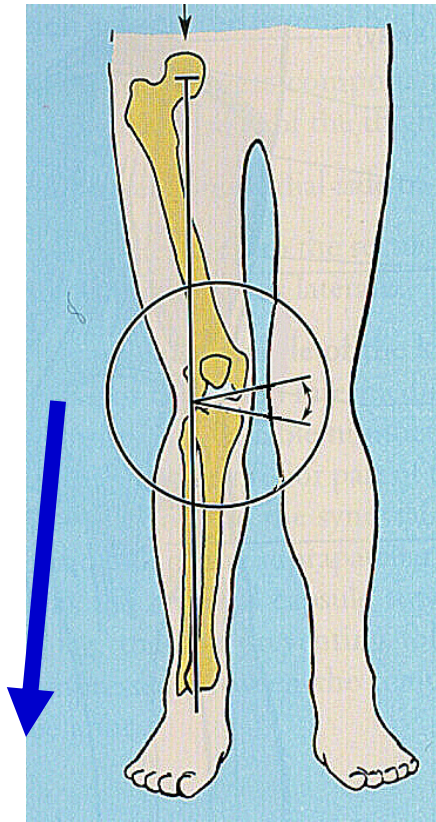
X. DEFORMITIES OF LOWER LIMB: TERMINOLOGY – Valgus and Varus

Normal - Distal bone in joint is parallel to midline



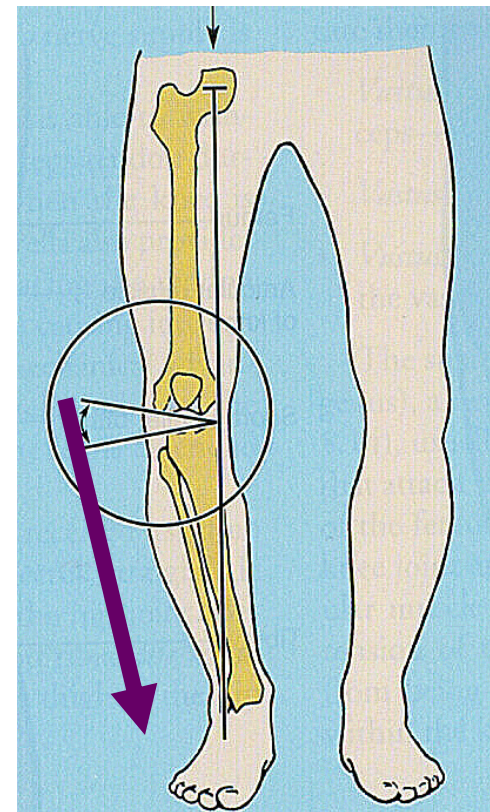
(It's vulgar to be knock-kneed) →

Valgus - Distal bone at a joint is deviated laterally away from midline of body



Genu valgus = knock-kneed;
normal in infants 3-5

Varus - Distal bone at a joint is deviate toward midline



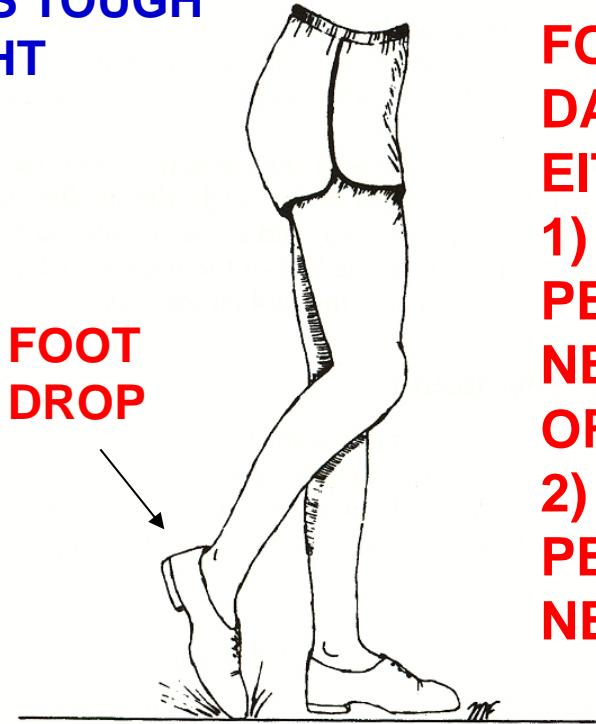
Genu varus = bow-legged;
normal in infants to age 3

ANTERIOR COMPARTMENT



FASCIA IS TOUGH
AND TIGHT

FOOT
DROP

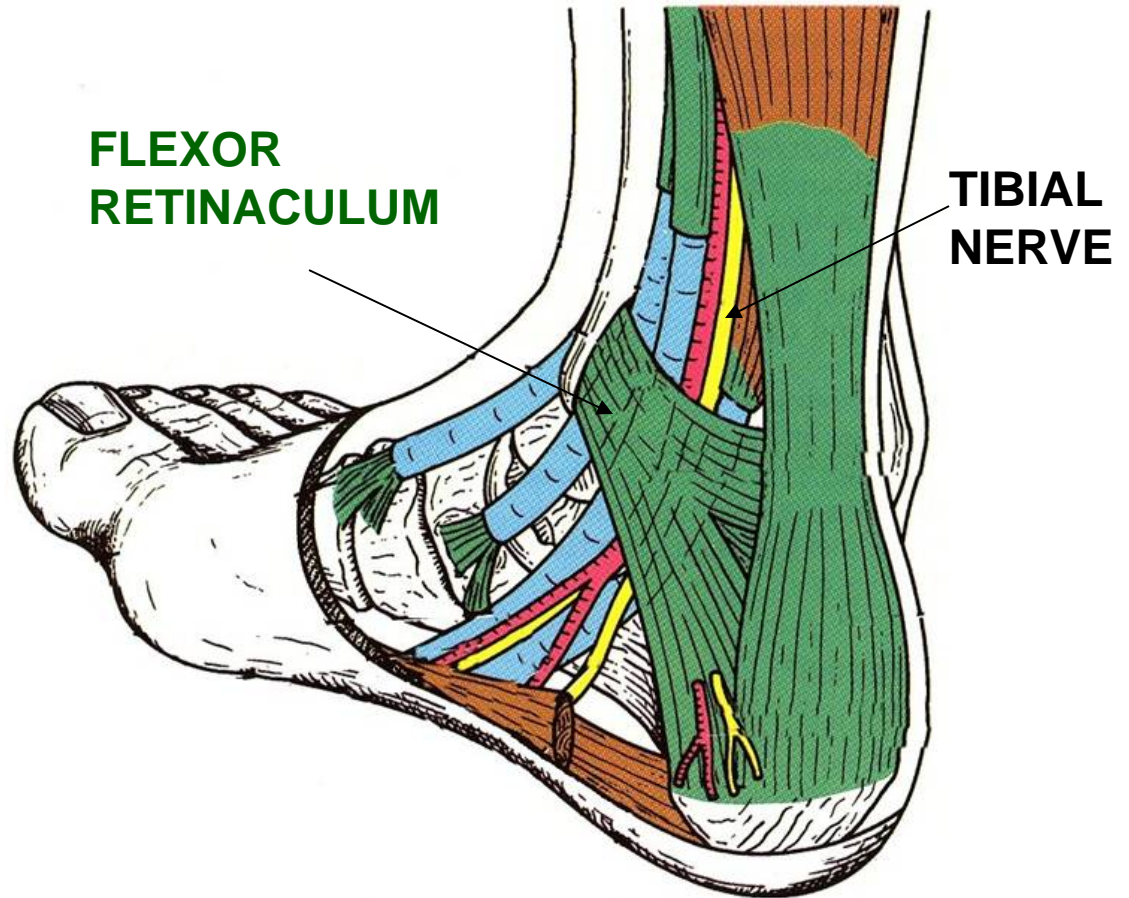


FOOT DROP:
DAMAGE
EITHER
1) COMMON
PERONEAL
NERVE
OR
2) DEEP
PERONEAL
NERVE

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)

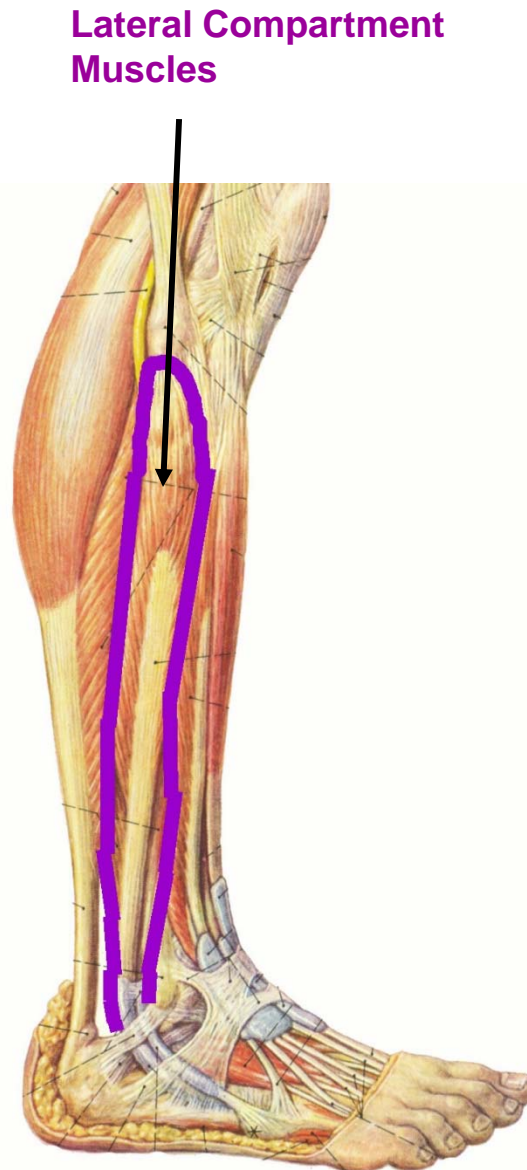
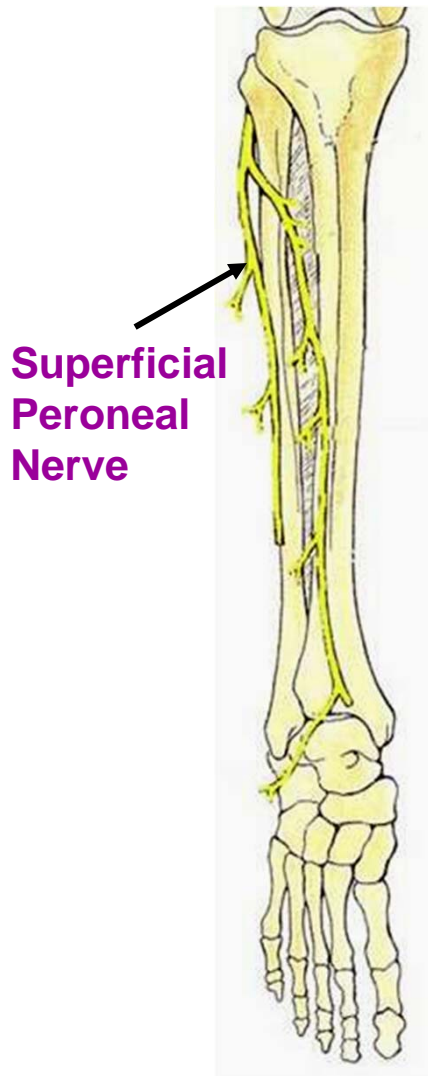
FLEXOR RETINACULUM AND TARSA TUNNEL SYNDROME

Note: **Flexor Retinaculum** - tendons of deep muscles pass beneath flexor reticulum on medial side of ankle joint; muscle tendons are covered by **synovial sheaths** under retinaculum

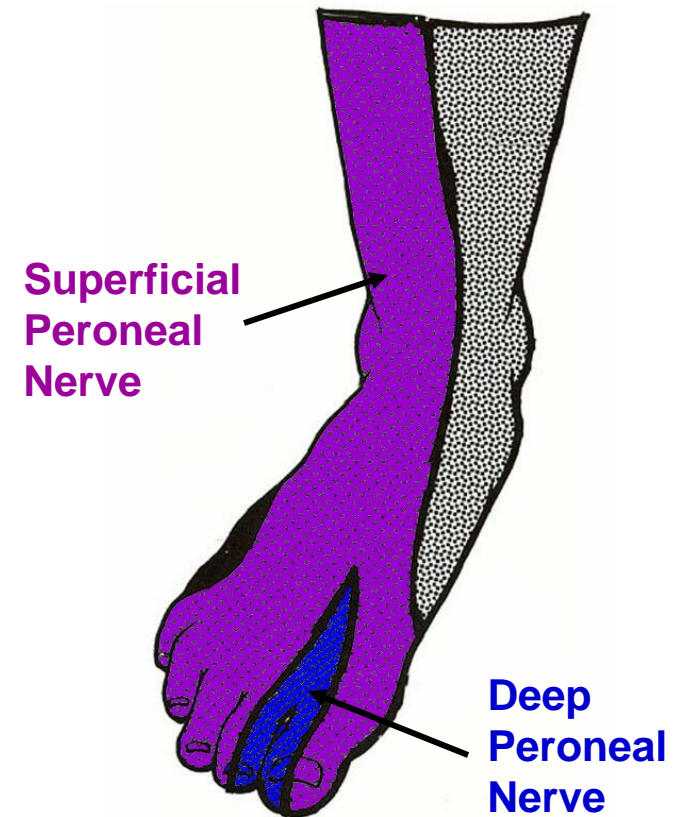


Clinical Note: **Tarsal Tunnel Syndrome** - Tarsal Tunnel is area beneath flexor retinaculum; Tarsal Tunnel Syndrome results from **swelling of synovial sheaths**, can compress **Tibial Nerve**; symptoms are **numbness of sole of foot, toes and weakened flexion of toes** (intrinsic muscles of foot).

b. **Superficial Peroneal Nerve** - supplies muscles of lateral compartment;

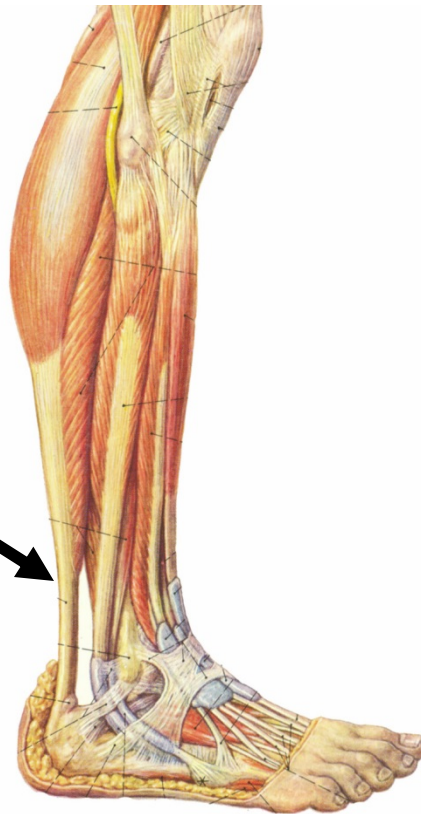


Superficial and Deep Peroneal Nerves provide sensory innervation to dorsum of Foot



RUPTURE OF ACHILLES TENDON

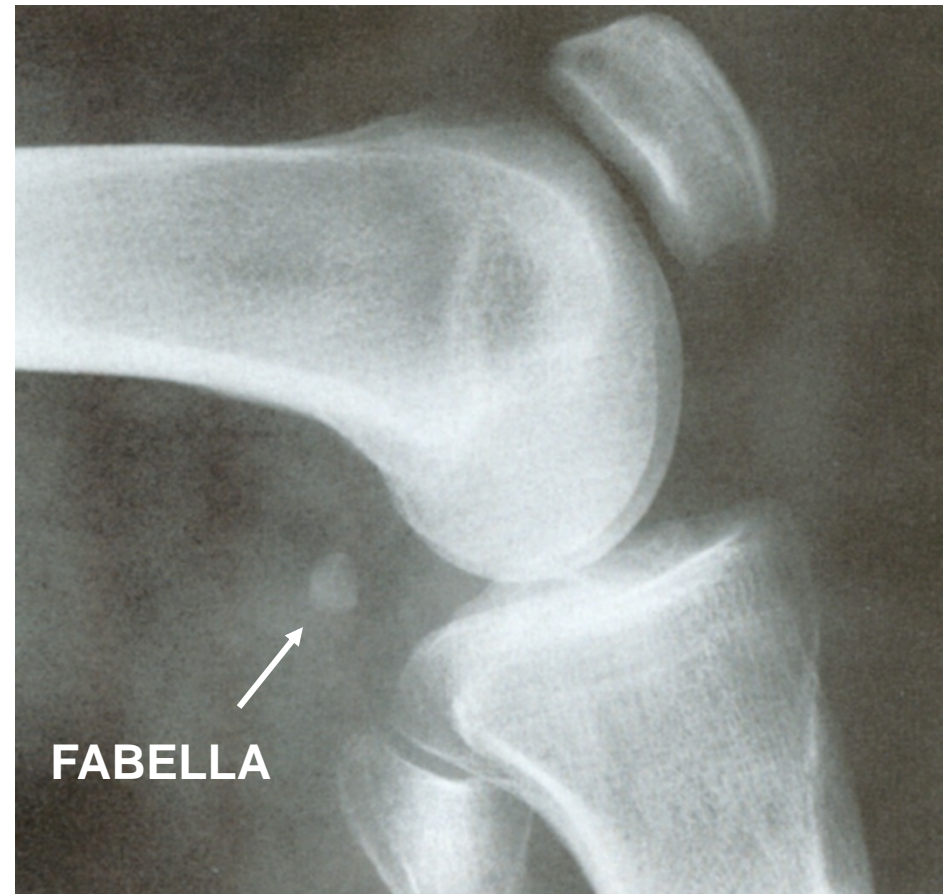
**ALL
SUPERFICIAL
ANKLE
PLANTAR
FLEXORS
INSERT
TO
ACHILLES
TENDON**

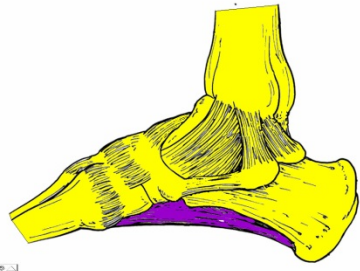


**Tendon can rupture,
accompanied by tearing of
muscles and bleeding.**

FABELLA

**Clinical note: Lateral head of Gastrocnemius
sometimes contains sesamoid bone, called
the Fabella (L. bean). Fabella can be mistaken
for a fracture on x-ray**

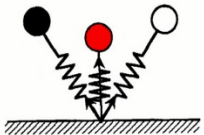




MEDIAL ARCH

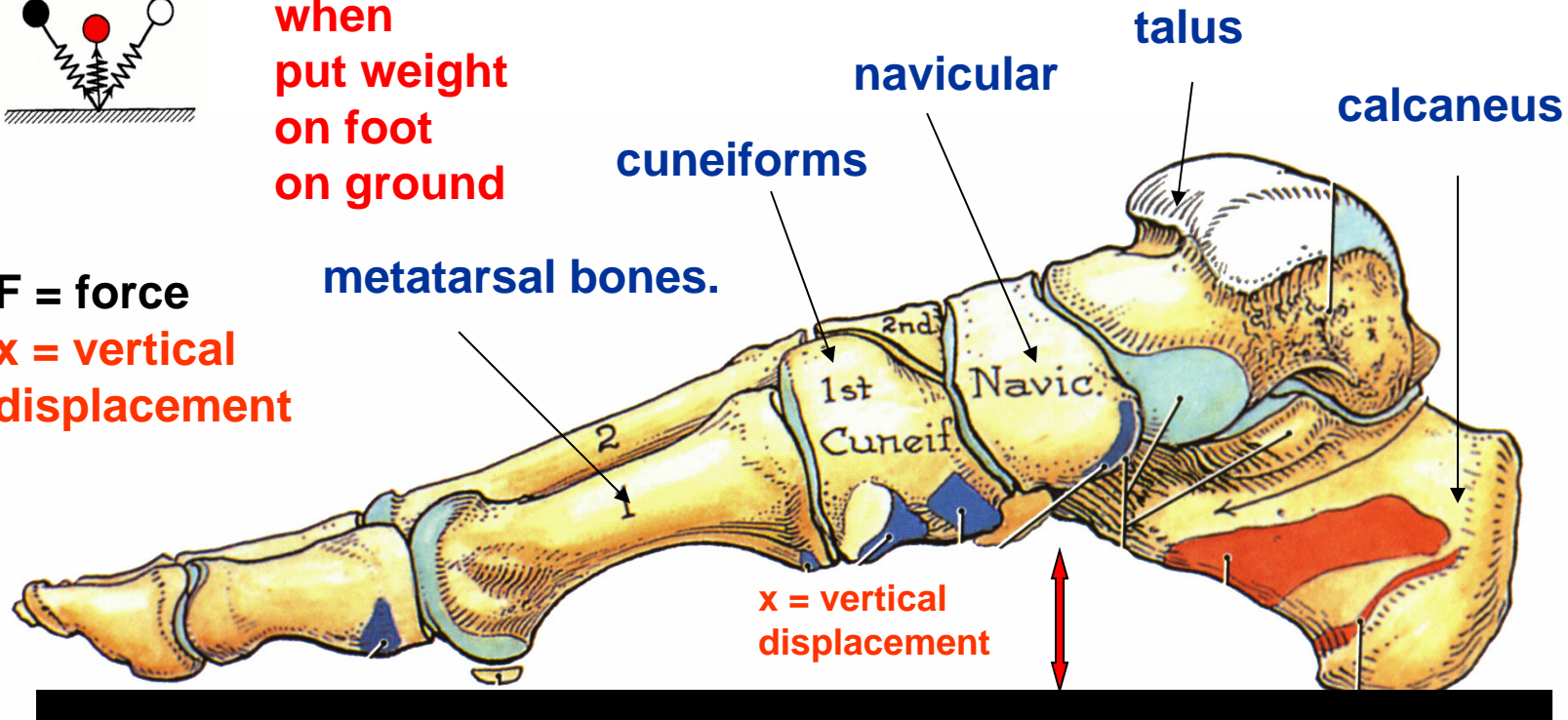
1. **Medial Longitudinal arch** - highest arch, responsible for 'fallen arches'
 - a. formed by - **calcaneus, talus, navicular, cuneiforms and medial three metatarsal bones.**

$$F = k \cdot x$$



**Load
springs
when
put weight
on foot
on ground**

**F = force
x = vertical
displacement**



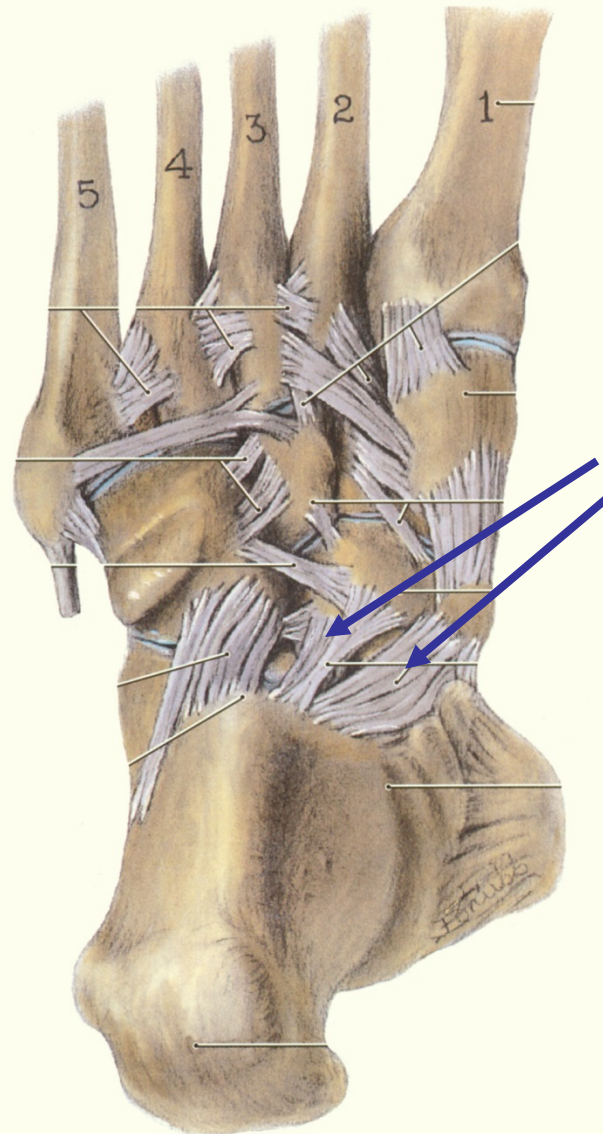
MEDIAL ARCH

b. 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.



**Plantar
Calcaneonavicular
Ligament - 'Spring'
ligament,**

Note: **'Flat' Feet - weakening of Medial Longitudinal arch** - associated with stretching of Plantar Calcaneonavicular ligament.

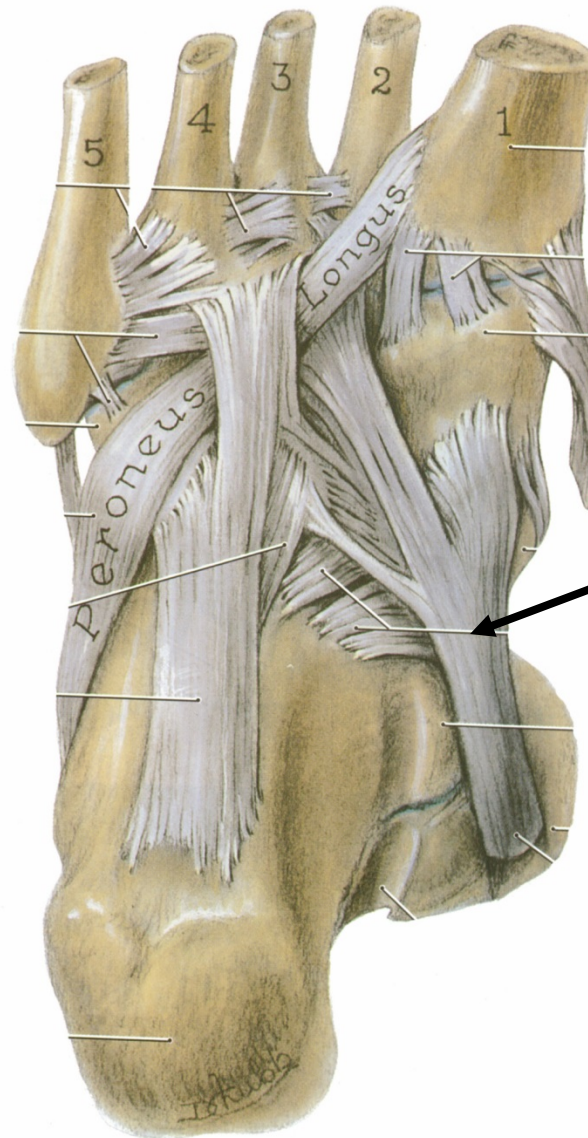
MEDIAL ARCH

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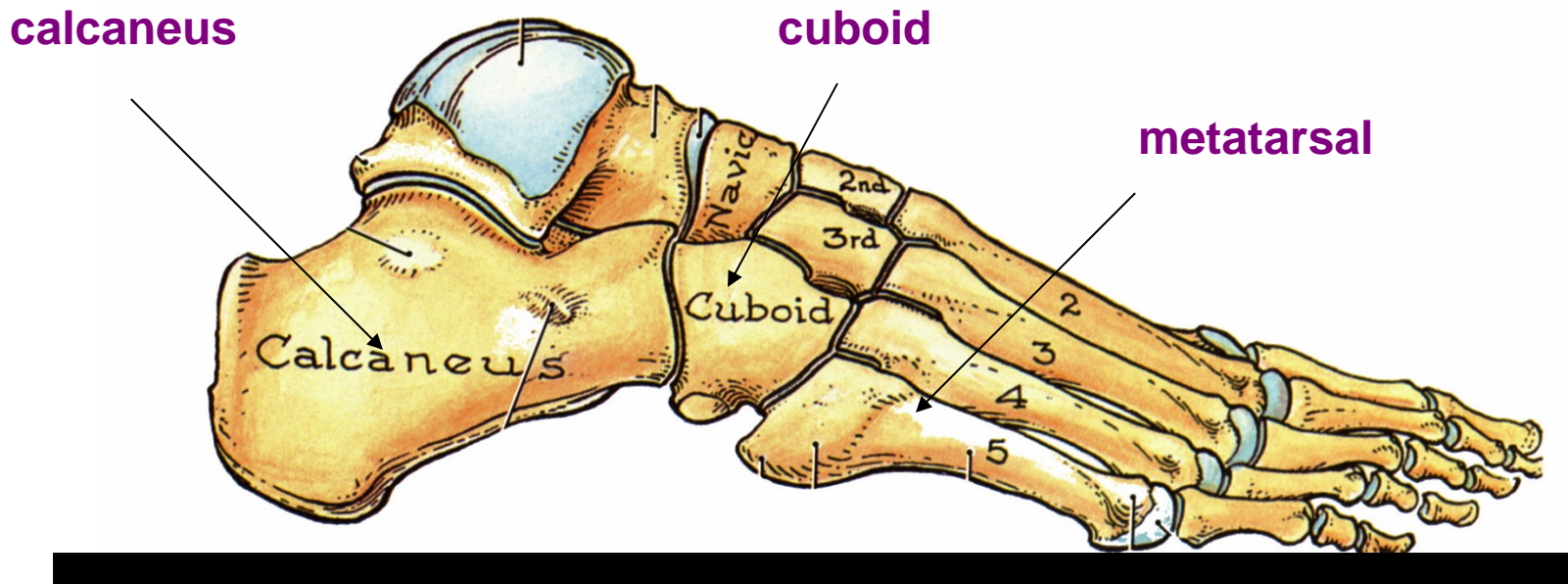


Tibialis Posterior

Tuberosity of navicular bone, cuneiform, cuboid, and bases of metatarsals 2-4

LATERAL ARCH

- 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



LATERAL ARCH

b. supported
by

- i. **Long Plantar Ligament**
and Plantar Aponeurosis
- ii. **Peroneal tendons**

**Peroneal
tendons**

**Long
Plantar
Ligament**

