بِسْمِ اللّٰہِ الرَّحْمٰنِ الرَّحِیْمِ

سورۃ طٰہٰ	قرآنی دعائیں	آیت نمبر 25-28

رَبِّ اشْرَحْ لِي صَدْرِي ﴿٢٥﴾ وَيَسِّرْ لِي أَمْرِي ﴿٢٦﴾
وَاحْلُلْ عُقْدَةً مِّن لِّسَانِي ﴿٢٧﴾ يَفْقَهُوا قَوْلِي ﴿٢٨﴾

پروردگار، میرا سینہ کھول دے، اور میرے کام کو میرے لیے
آسان کر دے اور میری زبان کی گرہ سلجھا دے تاکہ لوگ میری
بات سمجھ سکیں

The Biomechanics of the Human Lower Extremity

DR.AYESH
BSPT, PP.DPT. M.Phil*

Hip joint

- One of the largest and most stable joint:

  The hip joint

- Rigid ball-and-socket configuration

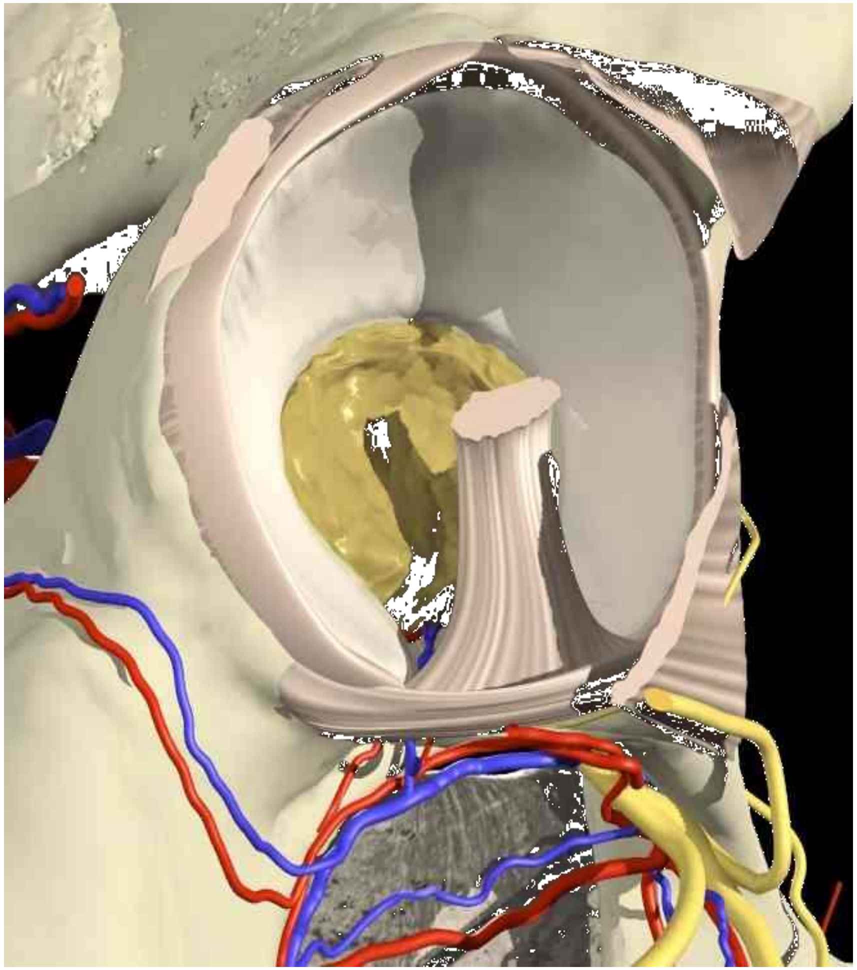
  (Intrinsic stability)

The femoral head

- Femoral head : convex component
- Two-third of a sphere,   Cover with cartilage
- Rydell (1965) suggested :   most load----- superior quadrant
- Femur Long, strong & most weight bearing bone.
- But most weakest structure of it is its neck.
- **During walk in single leg support move medially to support C0G.** This results in the leg being shortened on non-weight bearing side.
- Fracture of femur-neck common as bone tissue in the neck of the femur is softer than normal.

Acetabulum

- Concave component of *ball and socket joint*
- Facing obliquely forward, outward and downward
- Covered with articular cartilage
- Provide static stability



Labrum: a flat rim of fibro cartilage

- Acetabular labrum

- The entire periphery of the acetabulum is rimmed by a ring of wedge-shaped fibrocartilage called the acetabular labrum

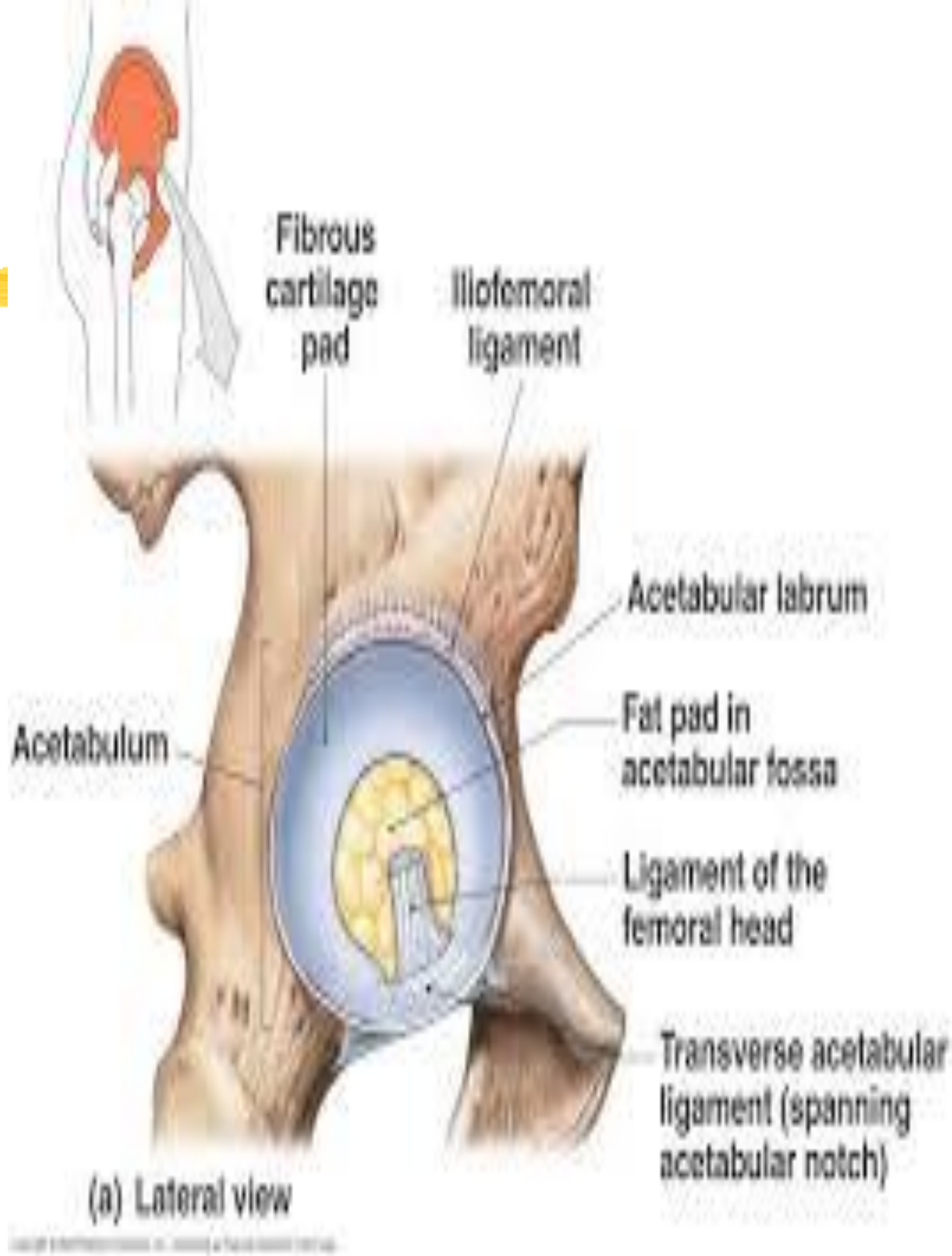
- Deepens the socket, increases the concavity of the acetabulum, grasping the head of the femur to maintain contact with the acetabulum

- It enhances joint stability by acting as a seal to maintain negative intra-articular pressure

- Also provide proprioceptive feedback

Acetabulum

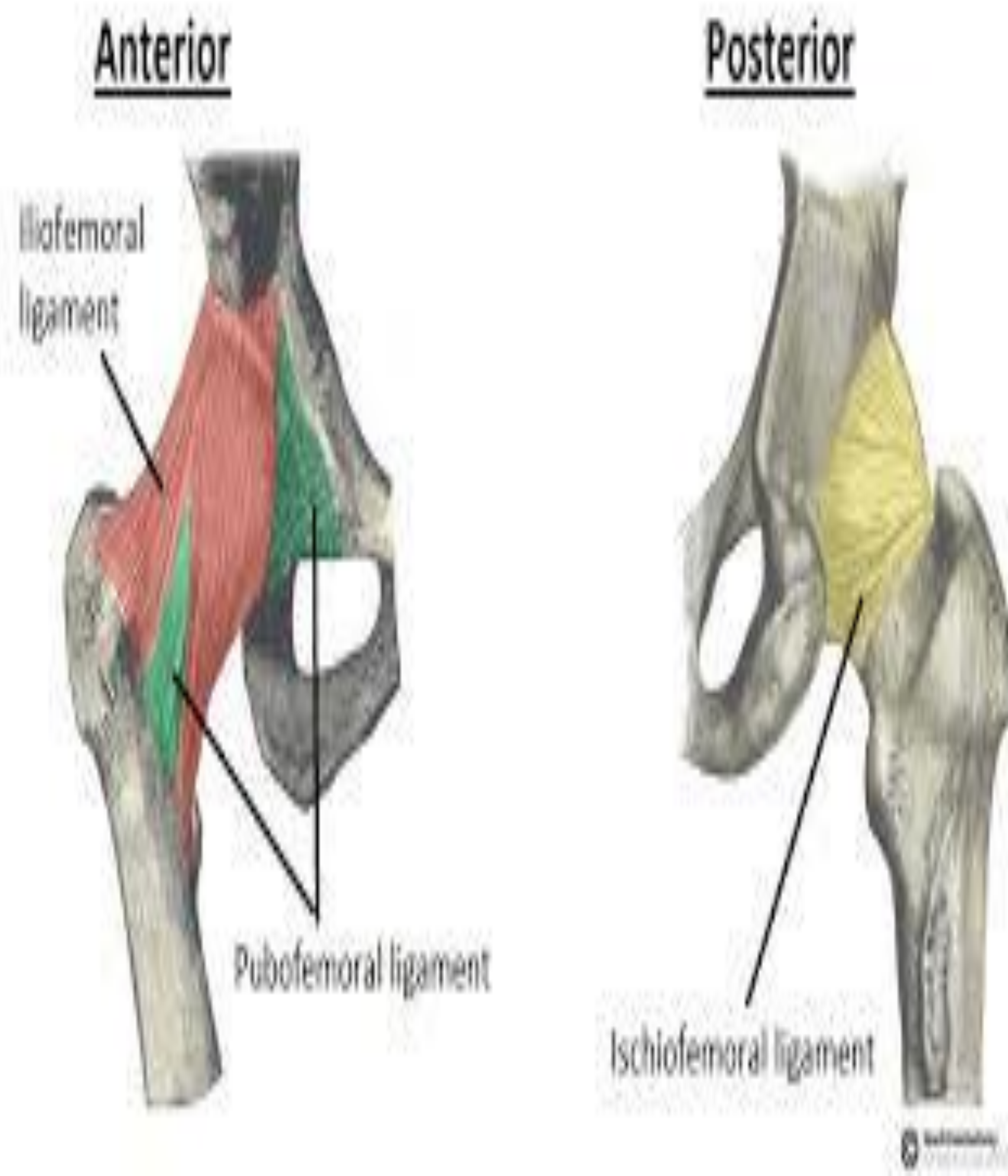
- Also contain Transverse acetabular ligament
- provide stability

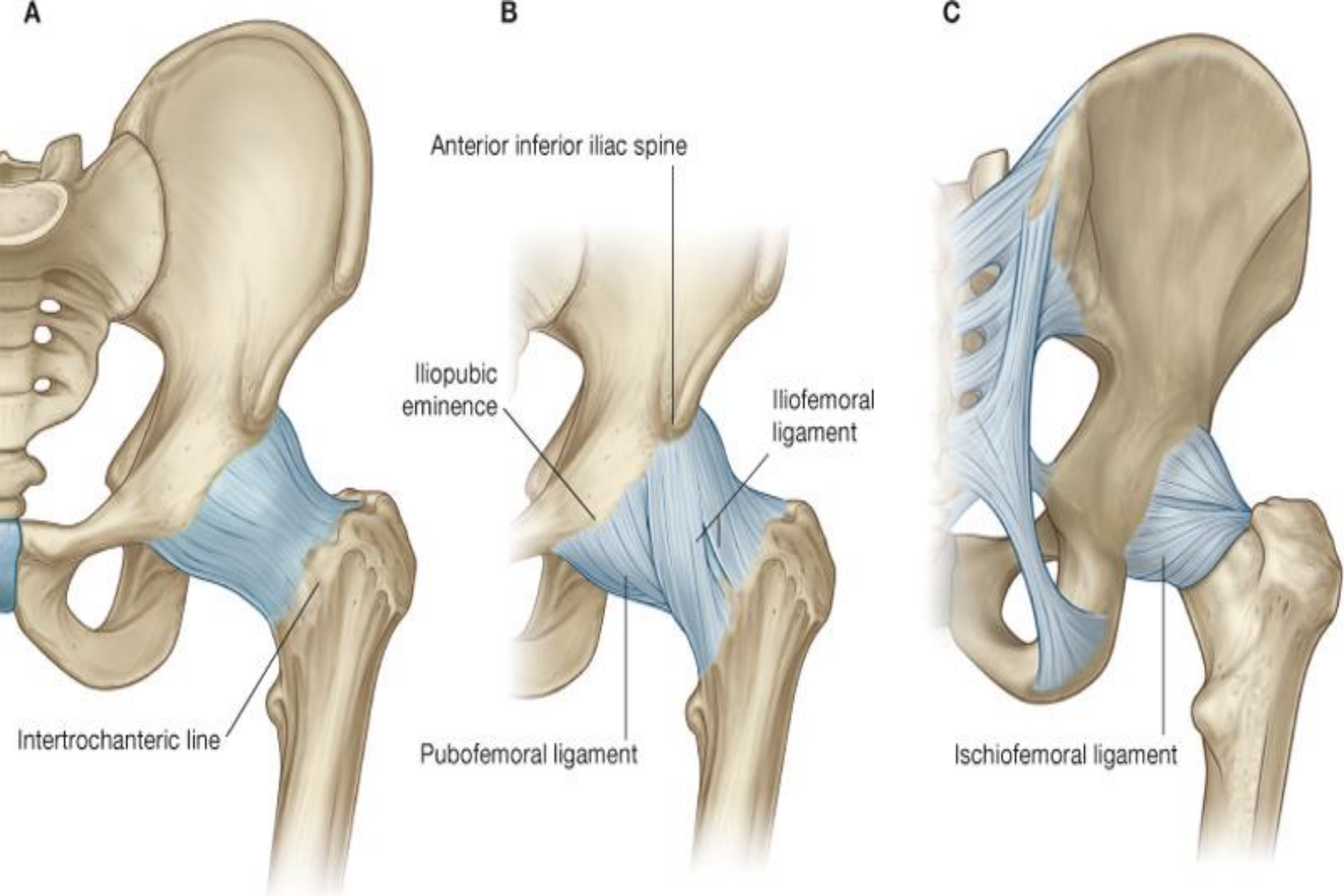


Ligaments and Bursae

•**<u>Iliofemoral ligament:</u>** Y shaped extremely strong= anterior stability

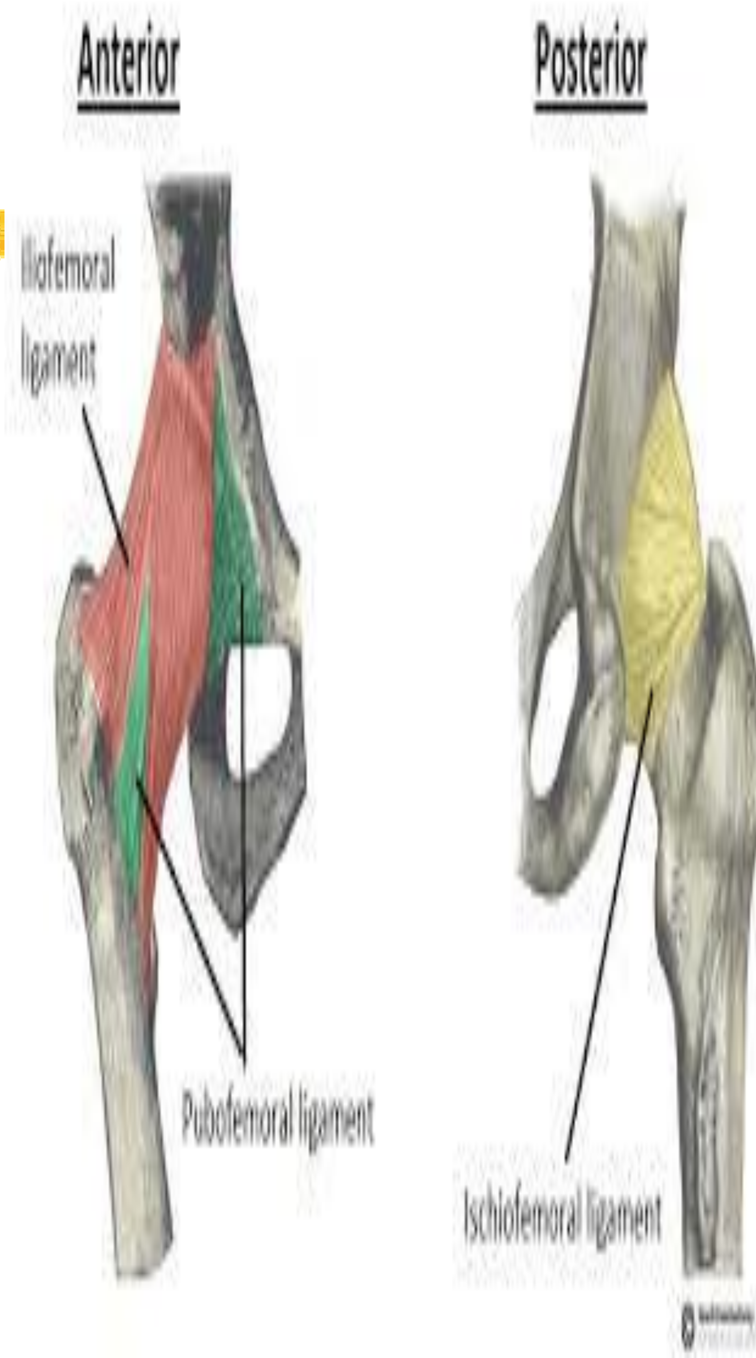
•**<u>Pubofemoral ligament:</u>** anterior stability



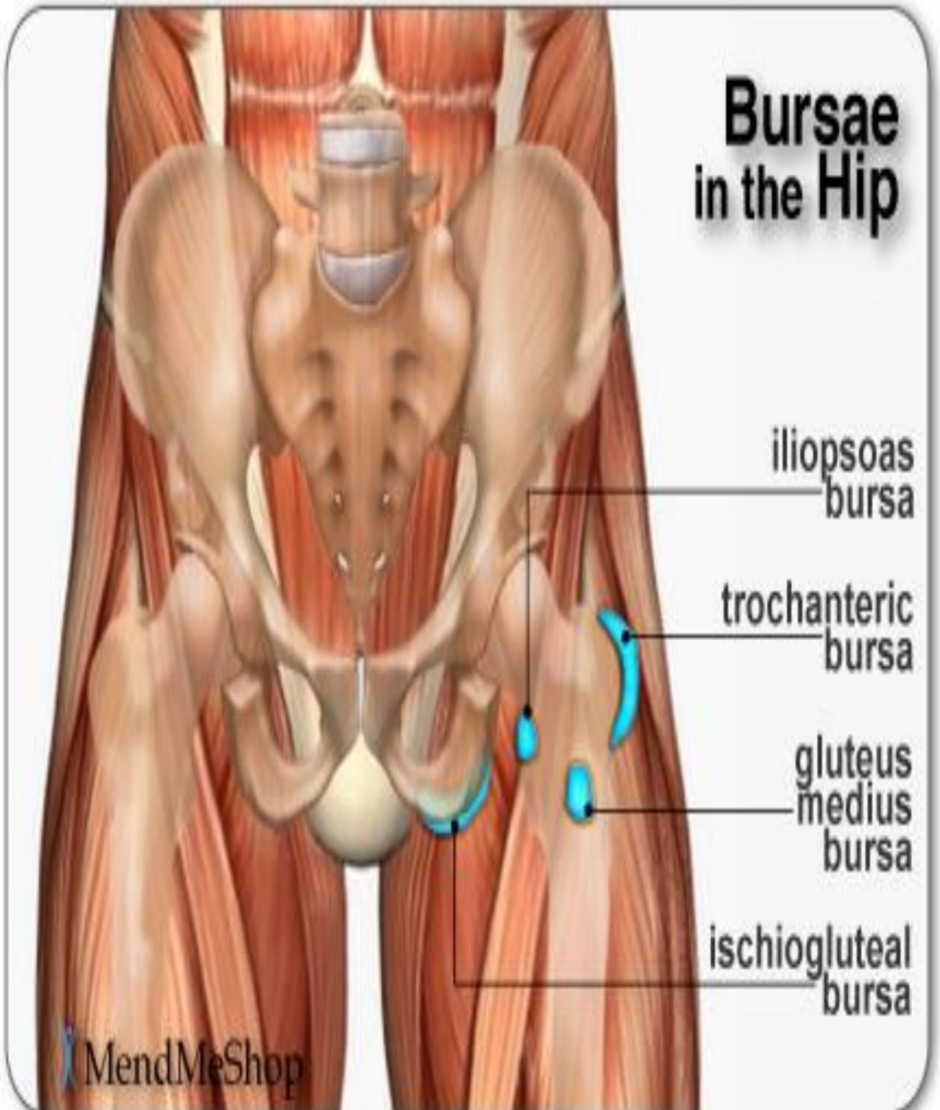


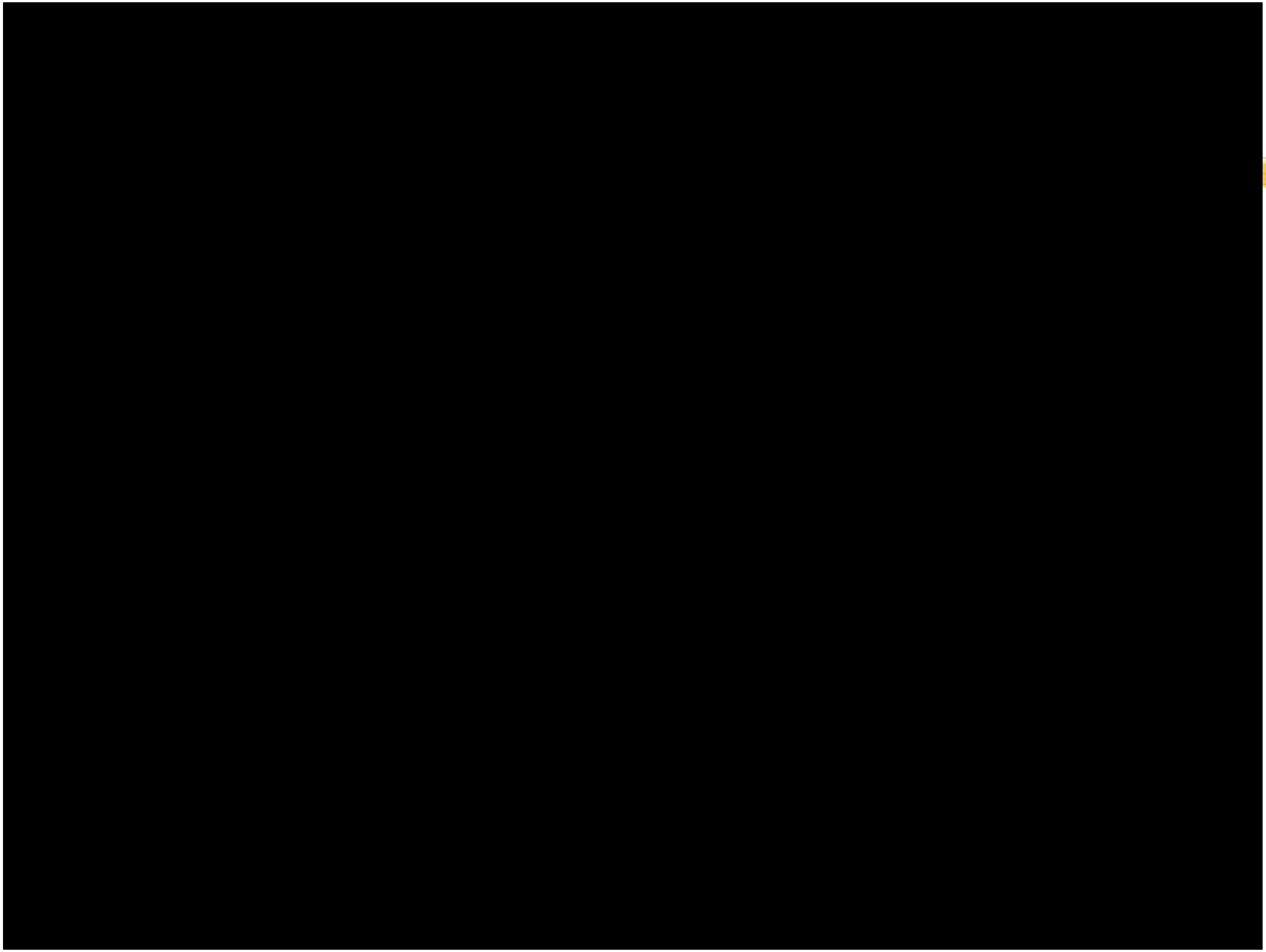
Drake: Gray's Anatomy for Students, 2nd Edition.

- **Ischiofemoral ligament:** posterior stability
- **Ligamentum teres**supplies a direct attachment from rim of acetabulum to head of femur

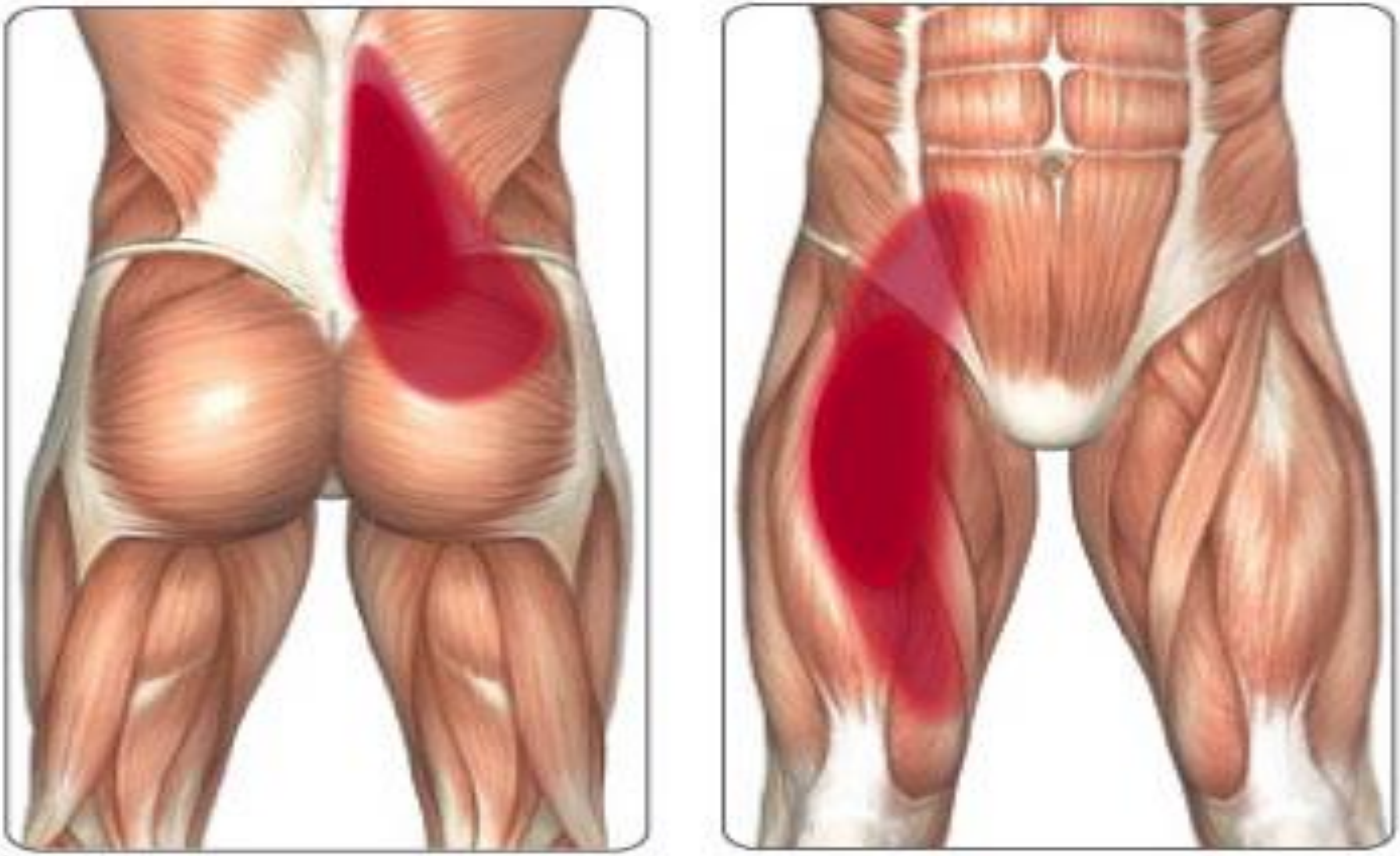


Iliopsoas burs b/w illiopsoas & capsule

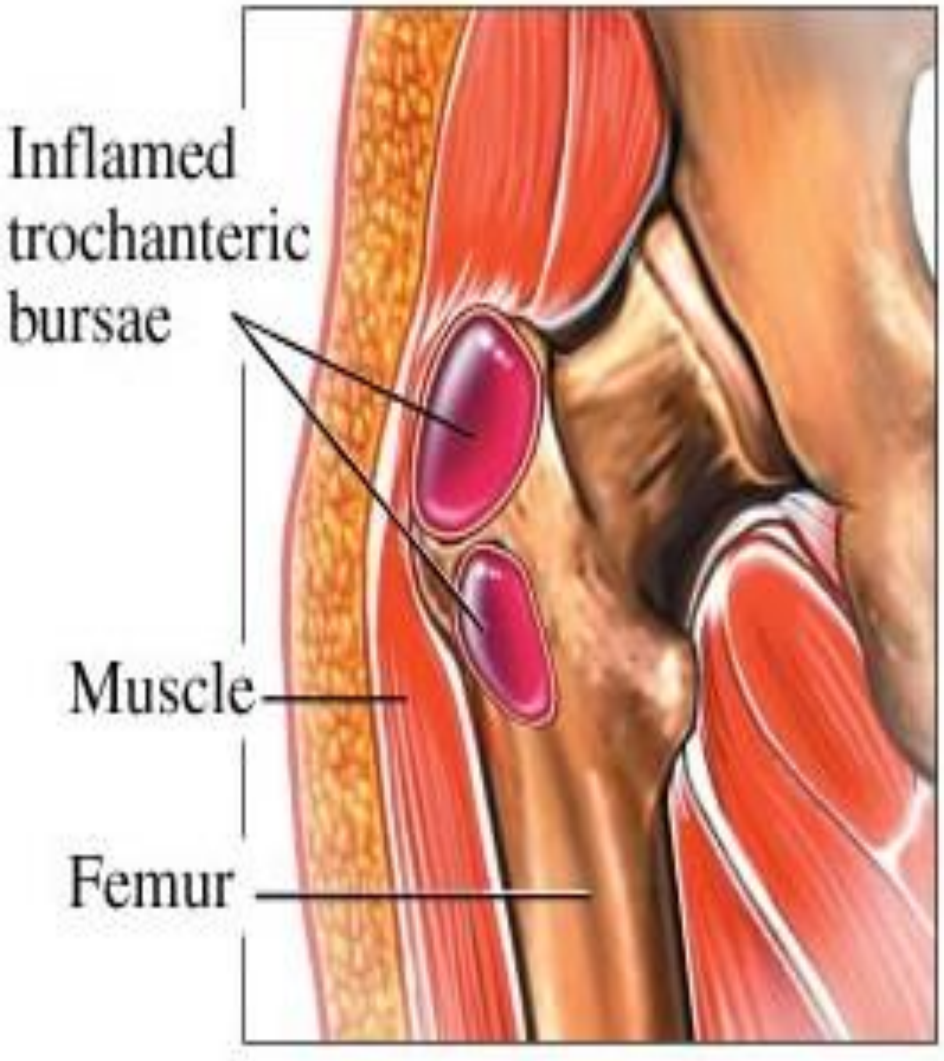


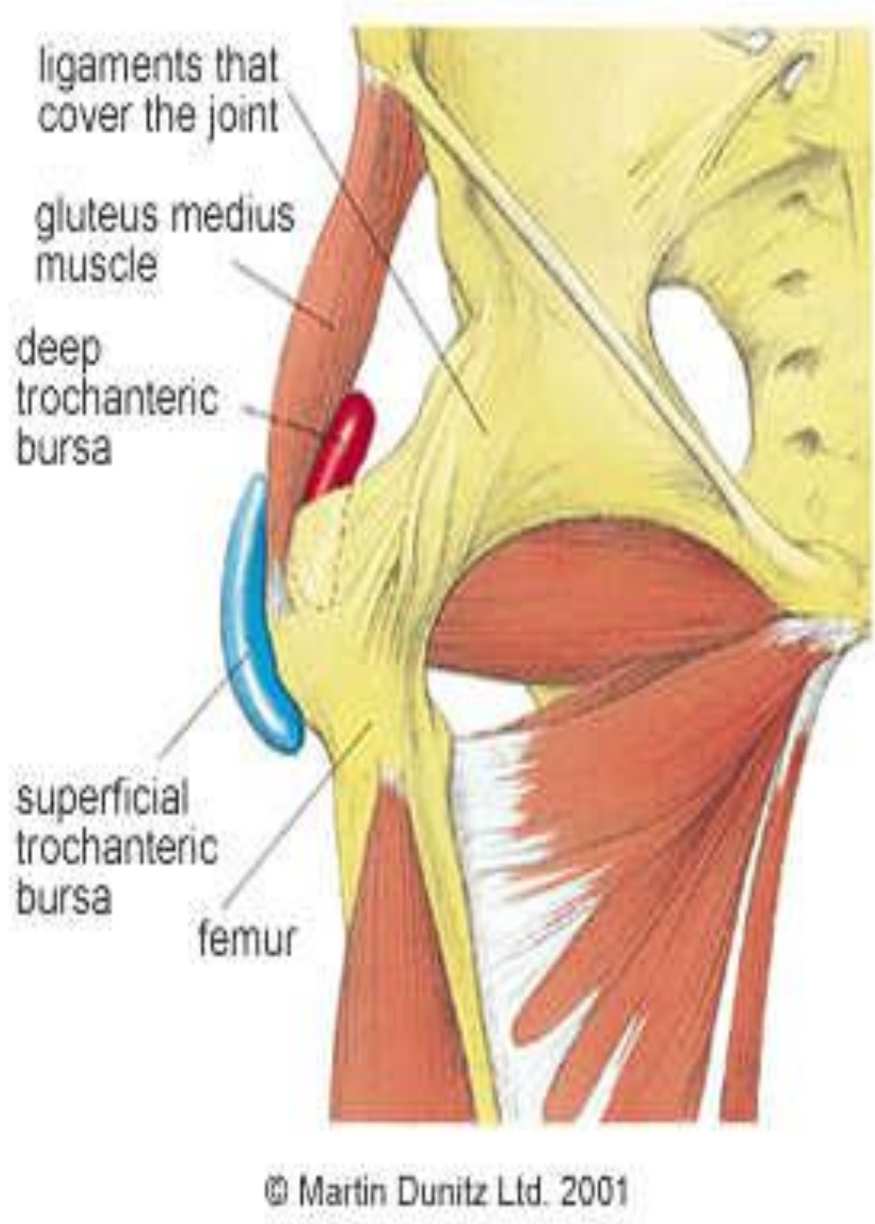


Iliopsas Bursitis Pain Pattern

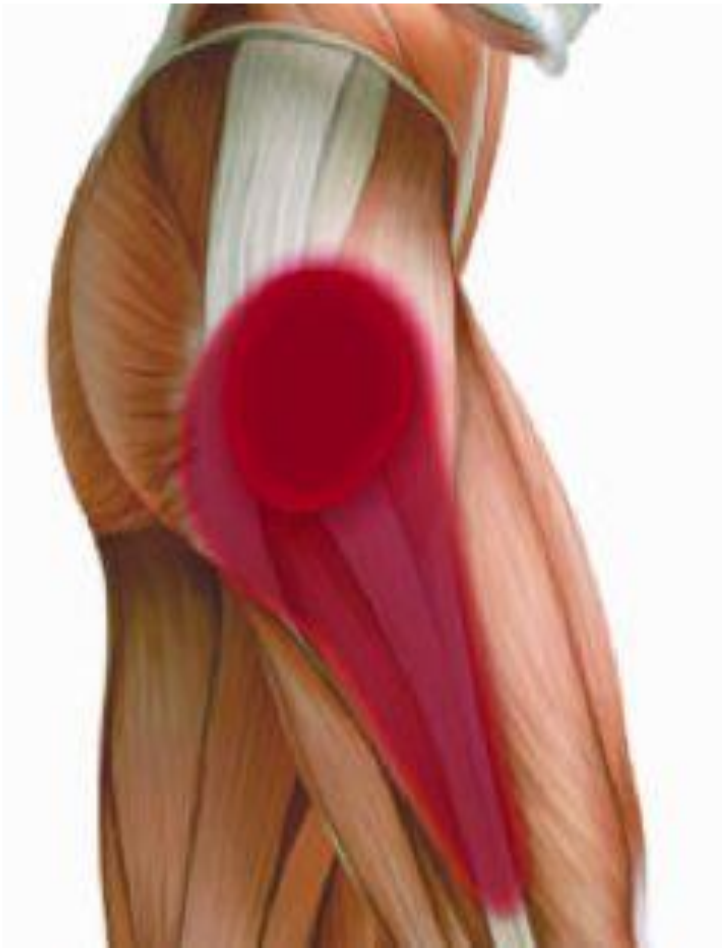


Deep trochanteric bursa b/w G.maximus & G.trochanter





Trochantric bursitis



The femoral neck

- Frontal plane (the neck-to-shaft angle/ angle of inclination),
- Transverse plane (the angle of anteversion)

- Neck-to-shaft angle : 125º, vary from 90º to 135º
- Effect : lever arms

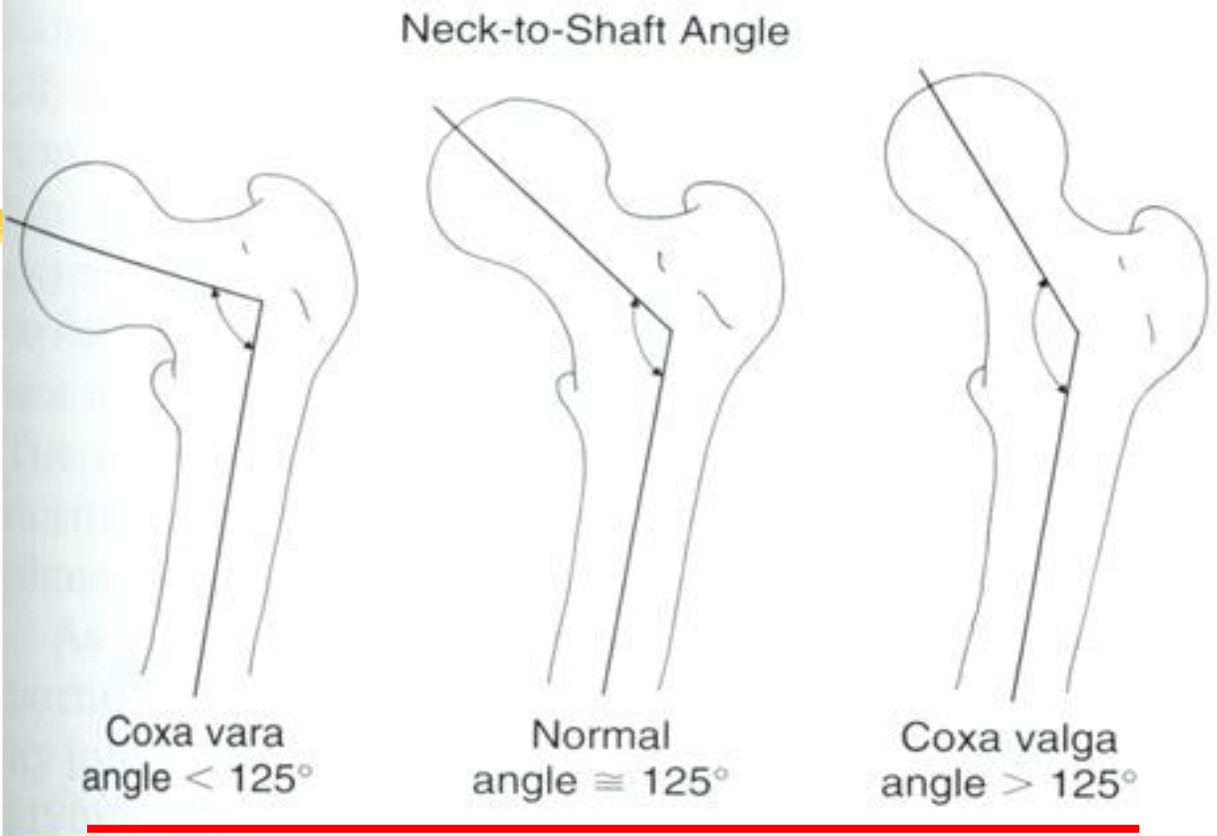


FIG. 8-4

The normal neck-to-shaft angle (angle of inclination of the femoral neck to the shaft in the frontal plane) is approximately 125°. The condition in which this angle is less than 125° is called coxa vara. If the angle is greater than 125°, the condition is called coxa valga.

1.ANGLE IF INCLINATION OF FEMUR

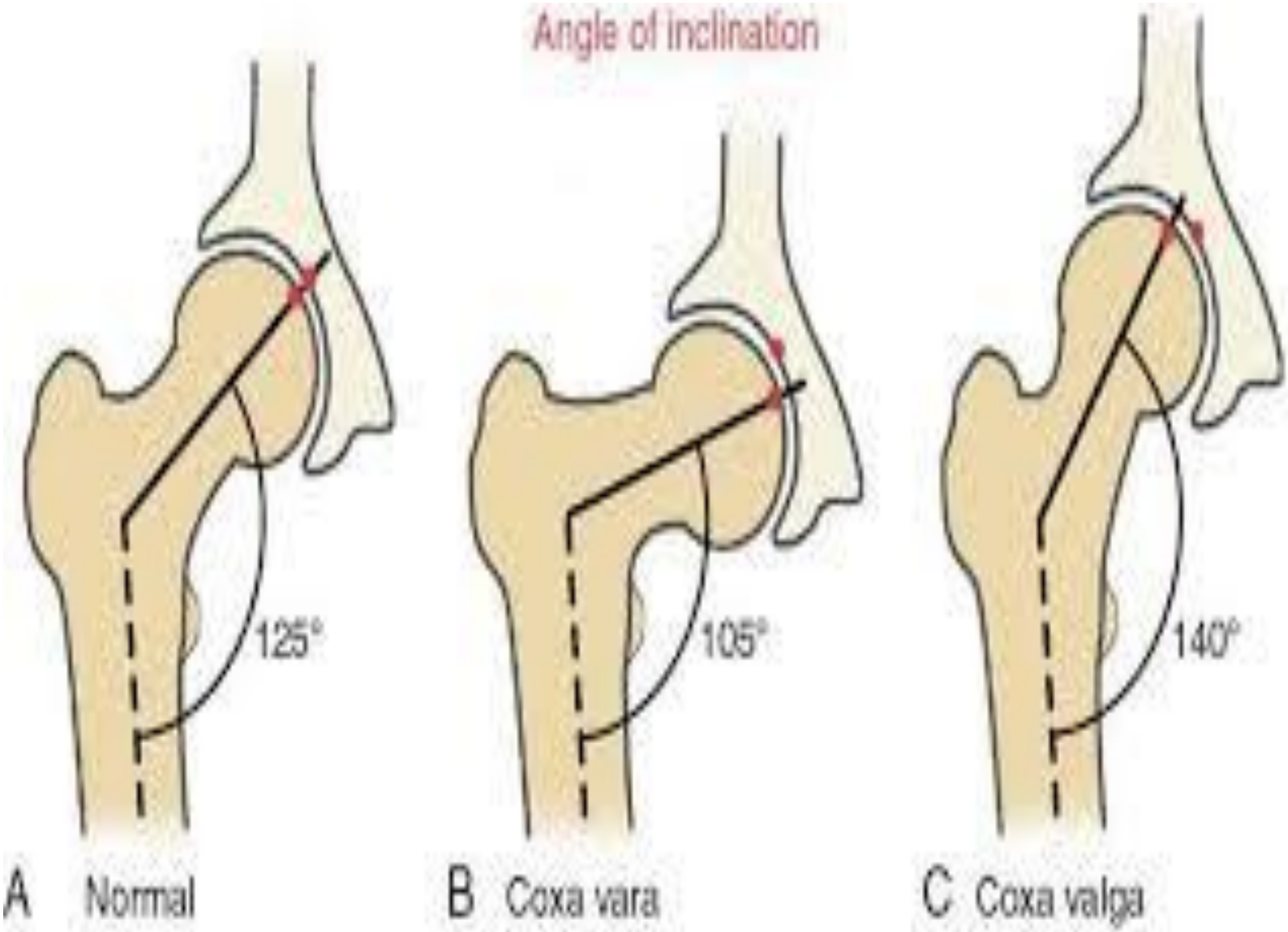
- The angle of inclination of the femur approximates 125°
- Normal range from 110° to 144° in the unimpaired adult
- With a normal angle of inclination, the greater trochanter lies at the level of the center of the femoral head
- A pathological increase in the medial angulation between the neck and shaft is called coxa valga
- A pathological decrease is called coxa vara

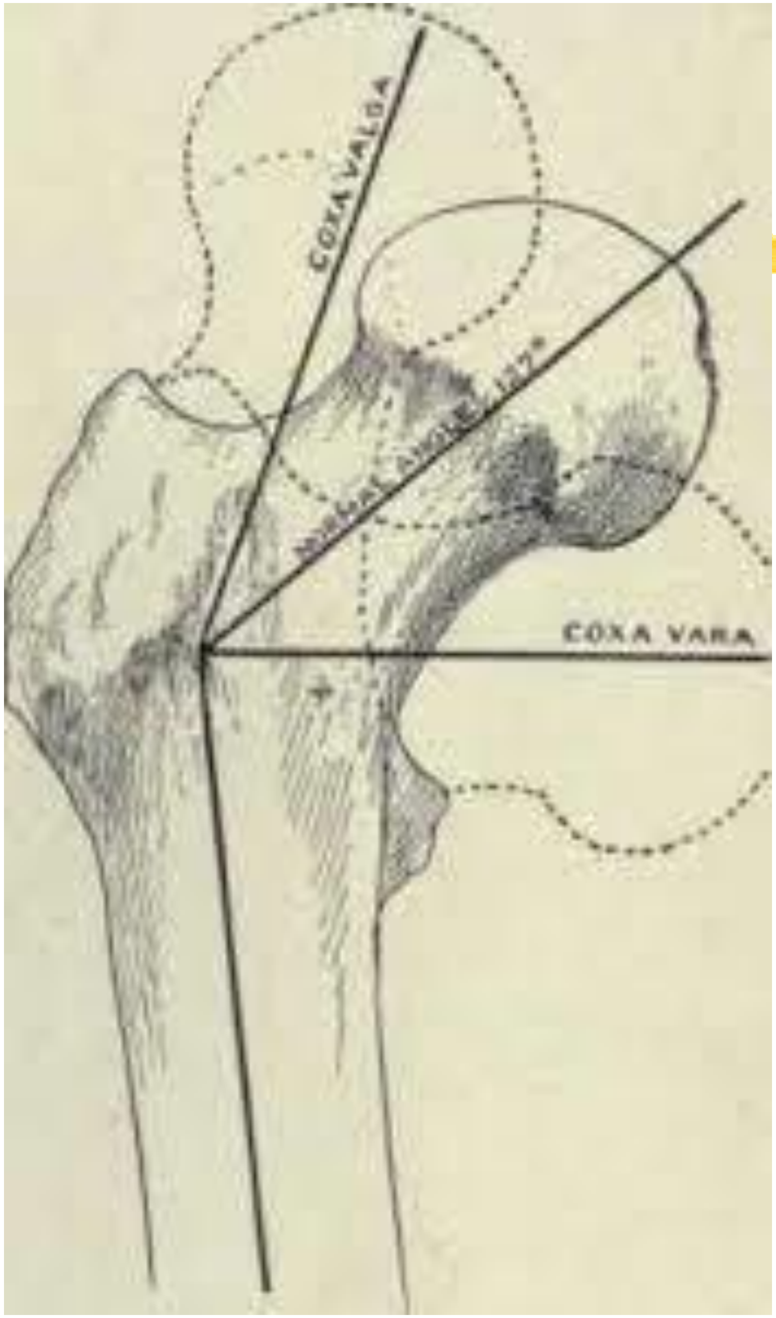
COXA VARA

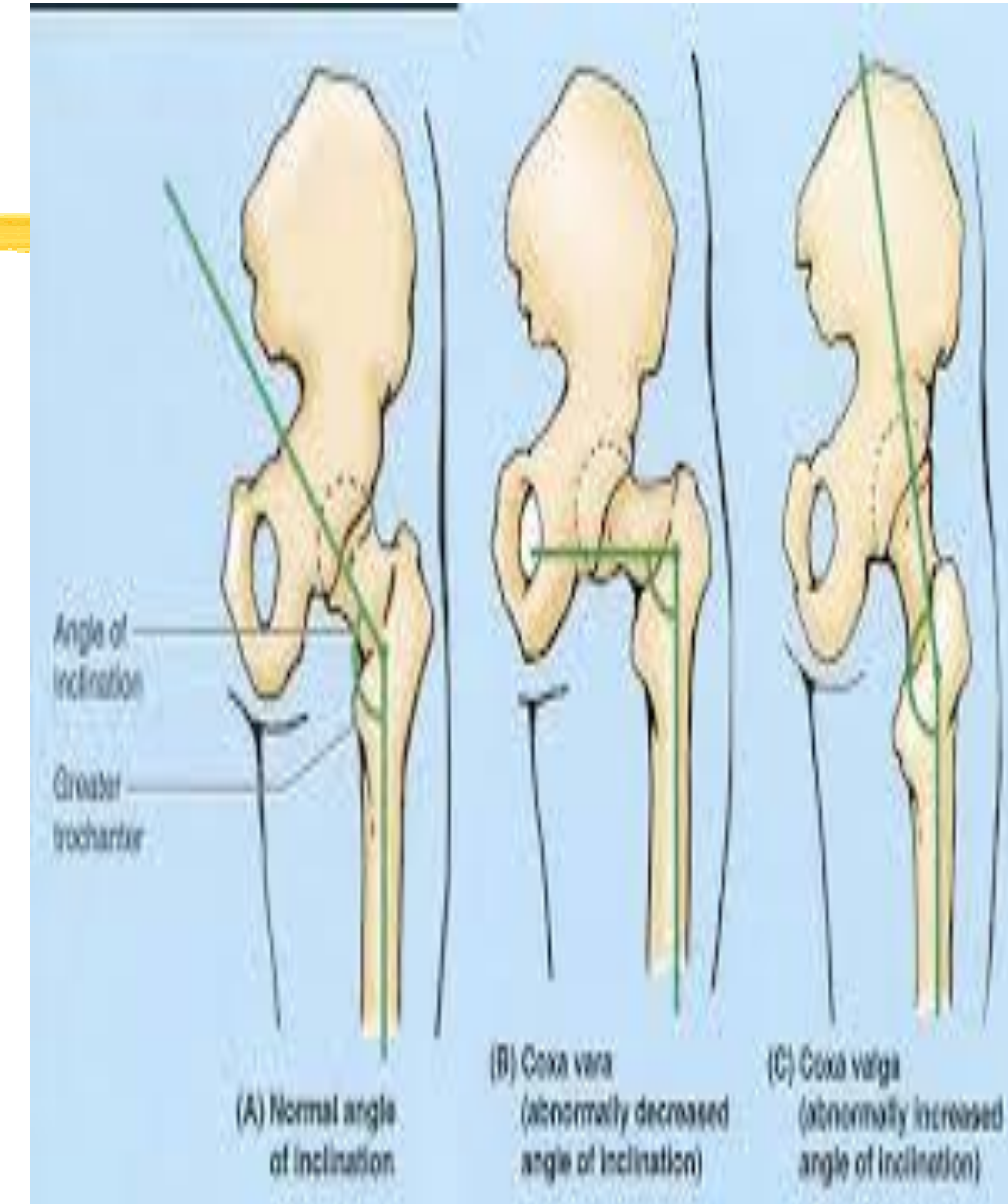
- In adolescence, growth of the bone results in a more oblique orientation of the epiphyseal plate
- The epiphyseal obliquity makes the plate more vulnerable to shear forces at a time when the plate is already weakened by the rapid growth that occurs during this period of life

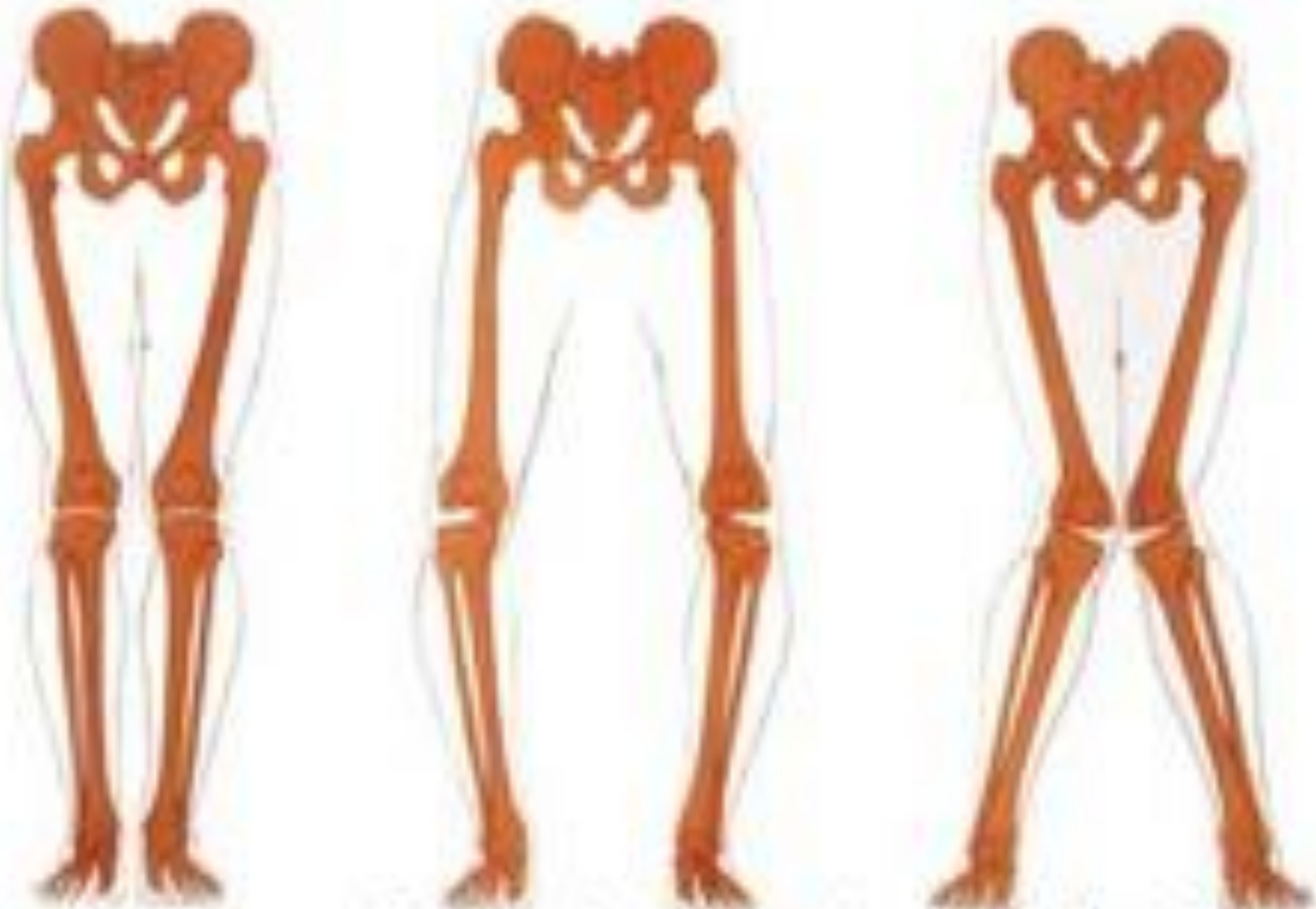
COXA VALGA

- Coxa valga also decreases the amount of femoral articular surface in contact with the dome of the acetabulum.
- As the femoral head points more superiorly, there is a decreasing amount of coverage from the acetabulum superiorly.
- Consequently, decreases the stability of the hip and predisposes the hip to dislocation
- The resulting need for additional abductor muscle force may predispose the joint to arthrosis or may functionally weaken the joint, producing energy-consuming and wearing gait deviations


Angle of inclination
125°
105°
140°
A Normal
B Coxa vara
C Coxa valga


COXA VALGA
COXA VARA


Angle of inclination
Greater trochanter
(A) Normal angle of inclination
(B) Coxa vara (abnormally decreased angle of inclination)
(C) Coxa valga (abnormally increased angle of inclination)



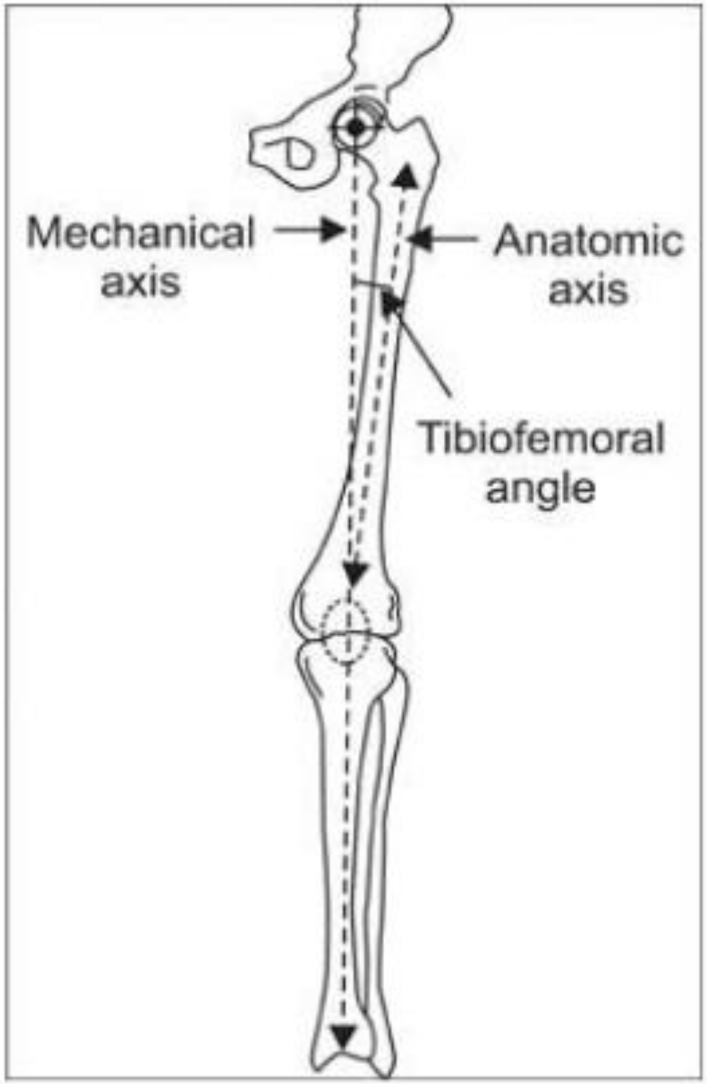
Normal Bowleggedness (Varous) Knock Knees (Valous)

Axis of lower limb

- Mechanical axis line passes between center of hip joint and center of ankle joint.

- Anatomic axis line is between tip of greater trochanter to center of knee joint.

- Angle formed between these two is around 7^0



Biomechanics

- Forces acting across hip joint

➢ Body weight
➢ Abductor muscles force
➢ Joint reaction force

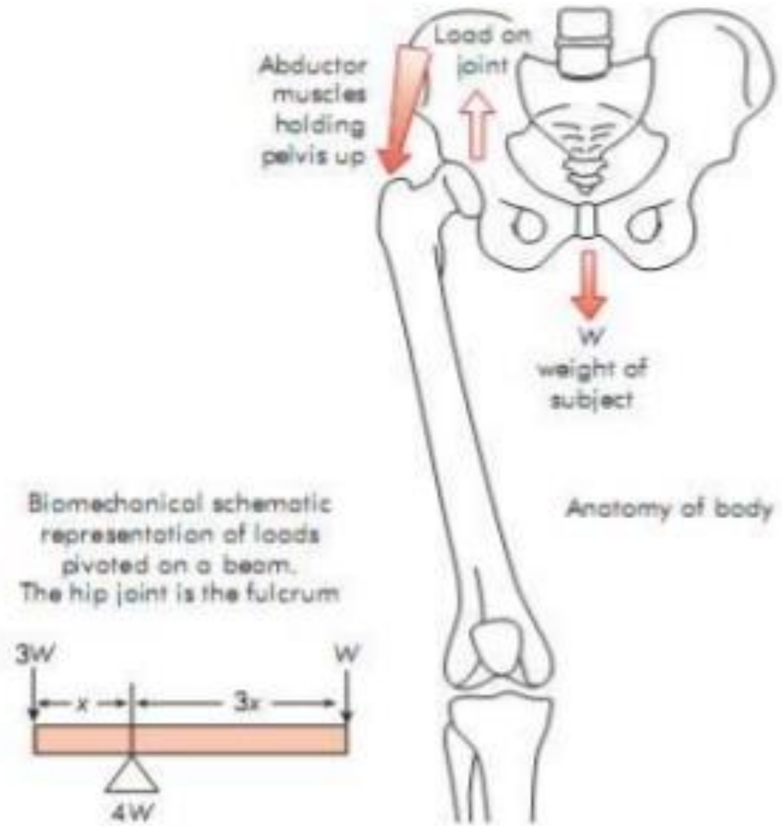


Figure 35.2 Load on the hip joint when subject (weighing W) stands on one leg. Hopping increases the load from 4 to 10W.

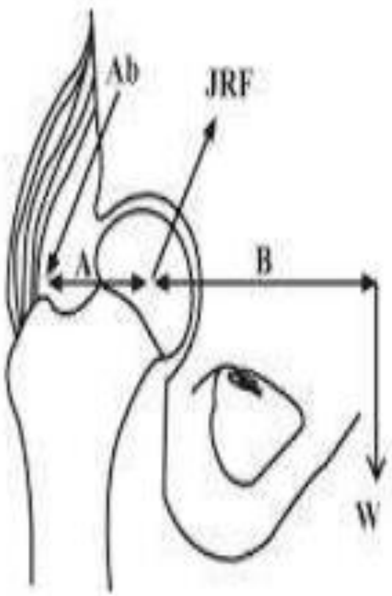
Joint reaction force

- defined as force generated within a joint in response to forces acting on the joint

- in the hip, it is the result of the need to balance the moment arms of the body weight and abductor tension

- maintains a level pelvis

- Joint reaction force
  - -2W during SLR
  - - 3W in single leg stance
  - -5W in walking
  - -10W while running

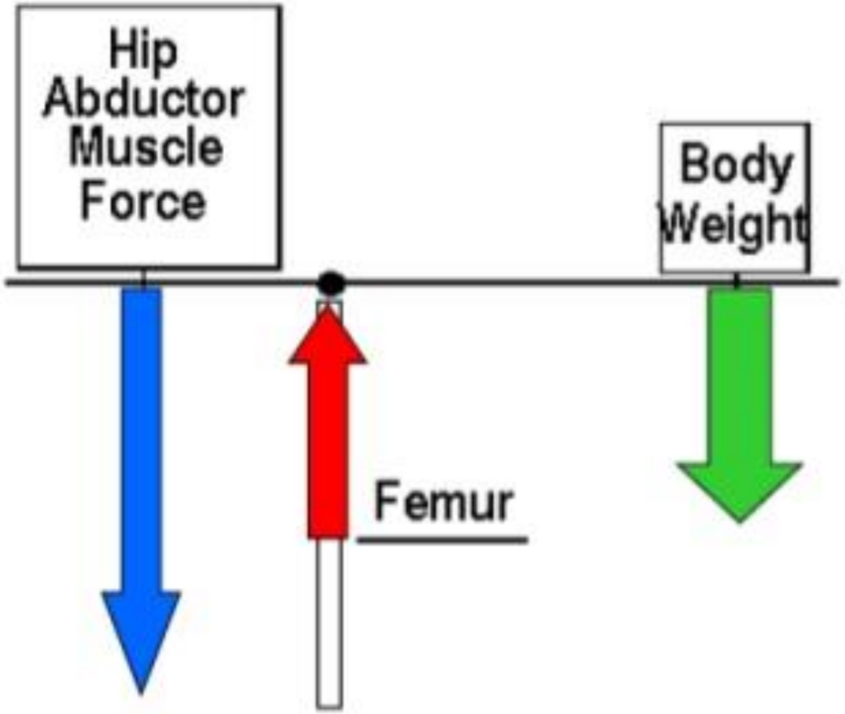


Ab - Abductor force
A - Abductor moment arm
B - Moment arm of body weight
JRF - Joint reaction force
W - Body weight

Normal hip

- Joint reaction force (JRF) calculation

JRF (↑) = Body Weight (↓) + Abductor Force (↓)



JRF is always higher than the body weight

- Angle of anteversion :12º

- Effect : during gait
- >12º :internal rotation
- <12º :external rotation

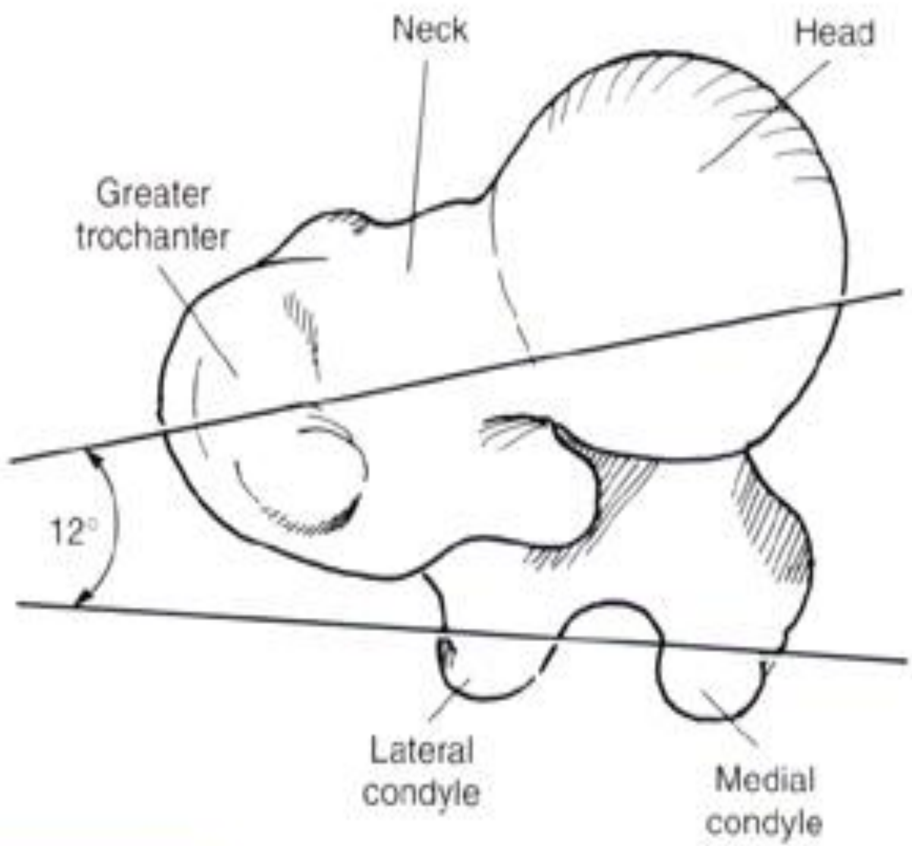


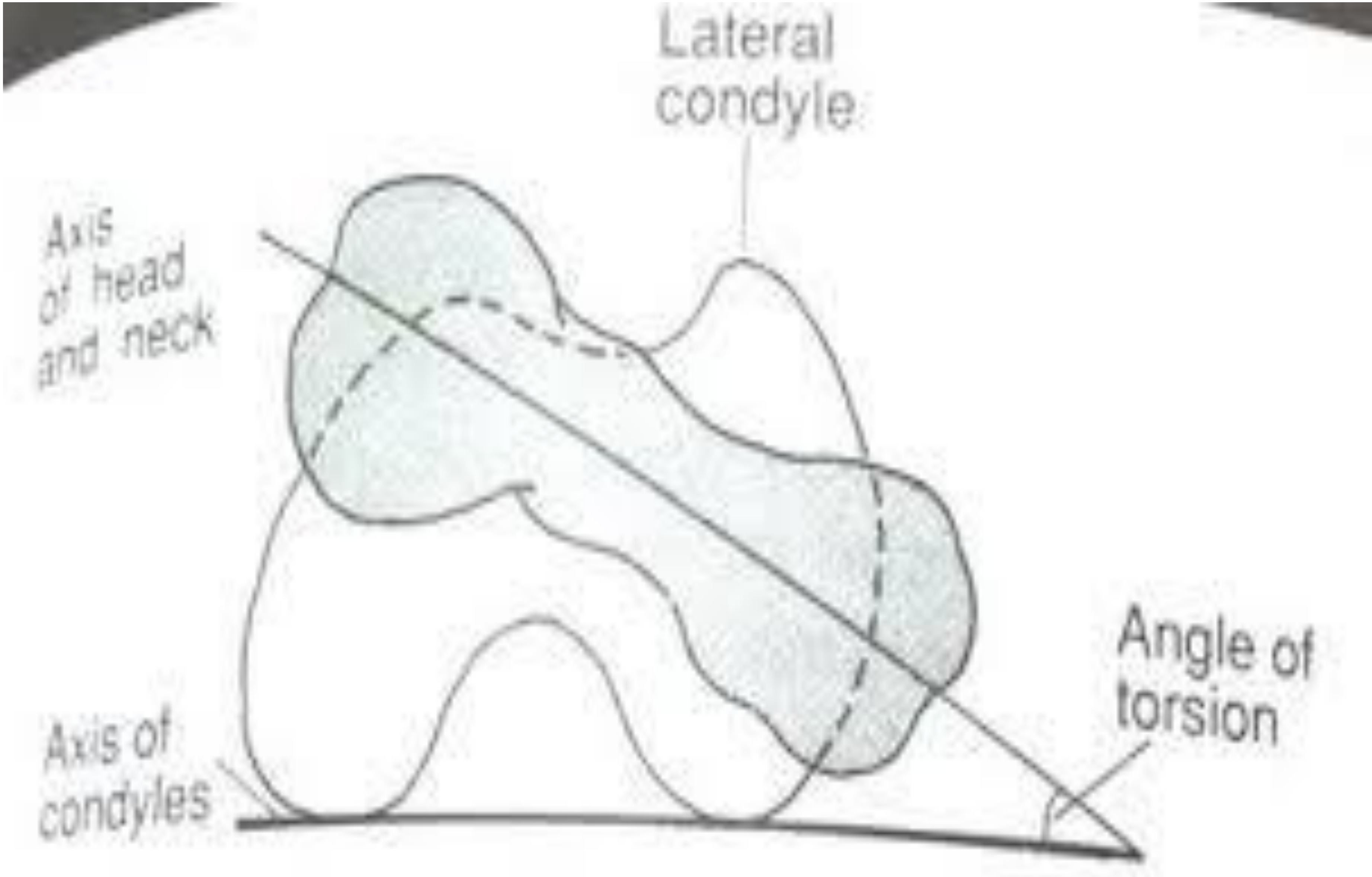
FIG. 8-5

Top view of the proximal end of the left femur showing the angle of anteversion, formed by the intersection of th long axis of the femoral head and the transverse axis of the femoral condyles. This angle averages approximately 12° in adults.

- When the femoral head is anteverted, pressure from the anterior capsuloligamentous structures and the anterior musculature may push the femoral head back into the acetabulum, causing the entire femur to rotate medially
- The knee joint axis through the femoral condyles is now turned medially
- Medial rotation of the femoral condyles alters the plane of knee flexion/extension and results, at least initially,in a toe-in gait and a compensatory lateral tibial torsion develop

- An anteverted femur will also affect the biomechanics of the patellofemoral joint at the knee and of the subtalar joint in the foot

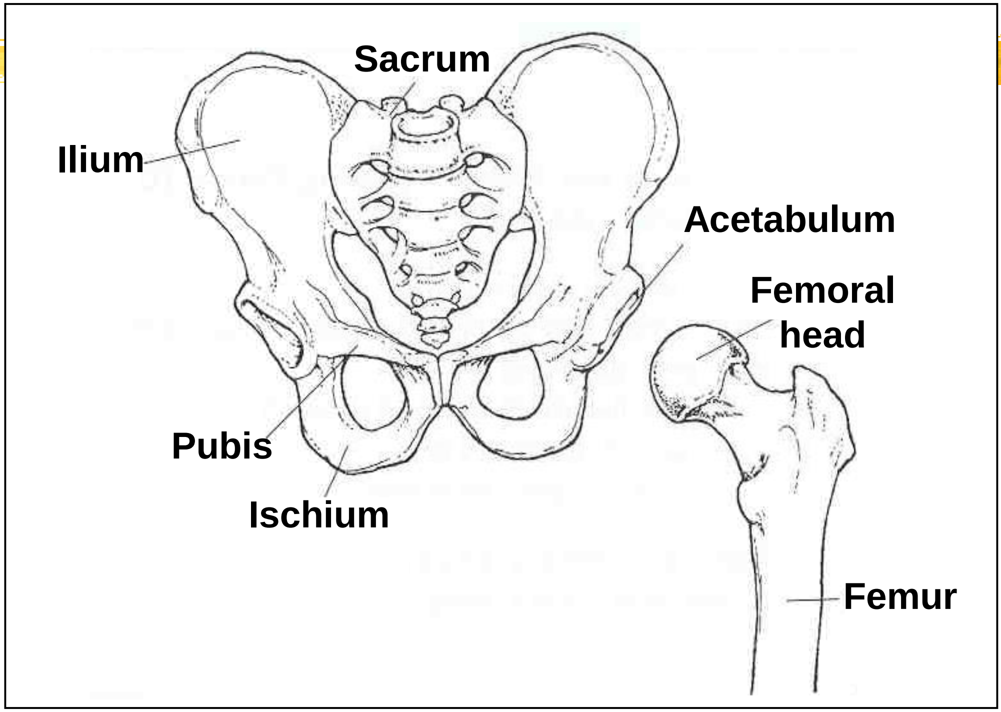
- The effect of femoral anteversion may also be seen at the knee joint


Lateral condyle
Axis of head and neck
Angle of torsion
Axis of condyles


Femoral
(thigh bone)
anteversion
Internal
tibial
(shin bone)
torsion
Fig. 2


بسم الله الرحمن الرحيم

Structure of the Hip



The **pelvic girdle** includes the two ilia and the sacrum,. It can be rotated forward, backward, and laterally to optimize positioning of the hip.

MOTION OF PELVIS ON THE FEMUR

- Whenever the hip joint is weight-bearing, the femur is relatively fixed, and motion of the hip joint is produced by movement of the pelvis on the femur

- Anterior and Posterior Pelvic Tilt

- Anterior and posterior pelvic tilts are motions of the entire pelvic ring in the sagittal plane around a coronal axis

- In the normally aligned pelvis, the anterior superior iliac spines (ASISs) of the pelvis lie on a horizontal line with the posterior superior iliac spines and on a vertical line with the symphysis pubis

- Anterior and posterior tilting of the pelvis on the fixed femur produce hip flexion and extension

- Hip joint extension through posterior tilting of the pelvis
- Hip flexion through anterior tilting of the pelvis

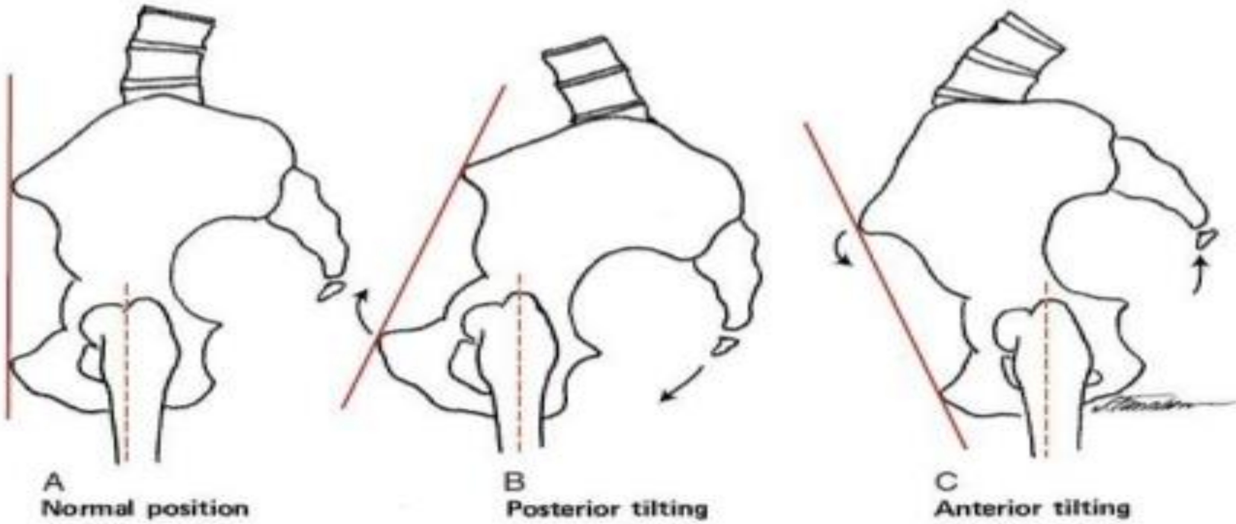


Figure 10–20 Flexion and extension of the hip occurring as tilting of the pelvis in the sagittal plane. **A.** The pelvis is shown in its normal position in erect stance. **B.** Posterior tilting of the pelvis moves the symphysis pubis superiorly on the fixed femur. The hip joint extends. **C.** In anterior tilting, the anterior superior iliac spines move inferiorly on the fixed femur. The hip joint flexes.

- Lateral Pelvic Tilt

- Lateral pelvic tilt is a frontal plane motion of the entire pelvis around an anteroposterior axis

- In the normally aligned pelvis, a line through the anterior superior iliac spines is horizontal

- In lateral tilt of the pelvis in unilateral stance, one hip joint (e.g., the left hip joint) is the pivot point or axis for motion of the opposite side of the pelvis (e.g., the right side) as that side of the pelvis elevates (pelvic hike) or drops (pelvic drop).

- If a person stands on the left limb and hikes the pelvis, the left hip joint is being abducted because the medial angle between the femur and a line through the anterior superior iliac spines increases.
- If a person stands on the left leg and drops the pelvis, the left hip joint will adduct because the medial angle formed by the femur and a line through the anterior superior iliac spines will decrease

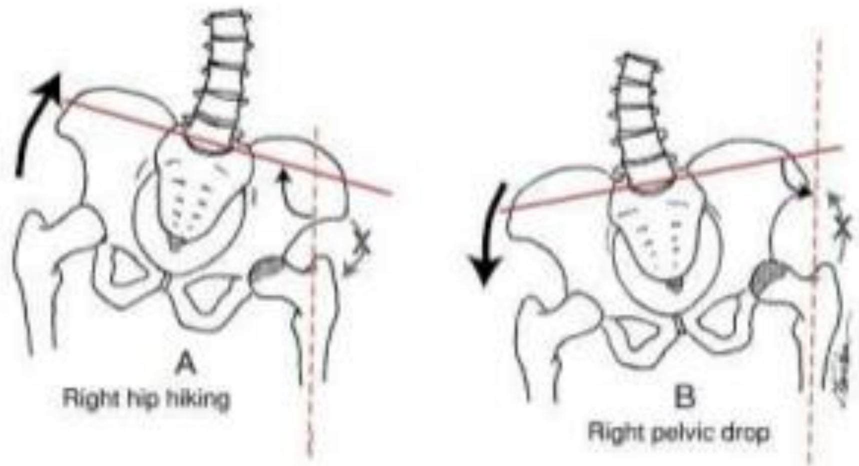


Figure 10–21 Lateral tilting of the pelvis around the left can occur either as hip hiking (elevation of the opposite side of the pelvis) or as pelvic drop (drop of the opposite side of the pelvis). **A.** Hiking of the pelvis around the left hip joint results in left hip abduction. **B.** Dropping of the pelvis around the left hip joint results in left hip joint adduction. Although it is visually tempting to name the direction of lateral tilt by the motion of the side of the pelvis *nearest* the hip (gray arrows that are "crossed out"), this is incorrect.

➢Lateral Shift of the Pelvis

- With **pelvic shift,** the pelvis cannot hike; it can only drop.
- Because there is a closed chain between the two weight-bearing feet and the pelvis, both hip joints will move in the frontal plane in a predictable way as the pelvic tilt (or pelvic shift) occurs

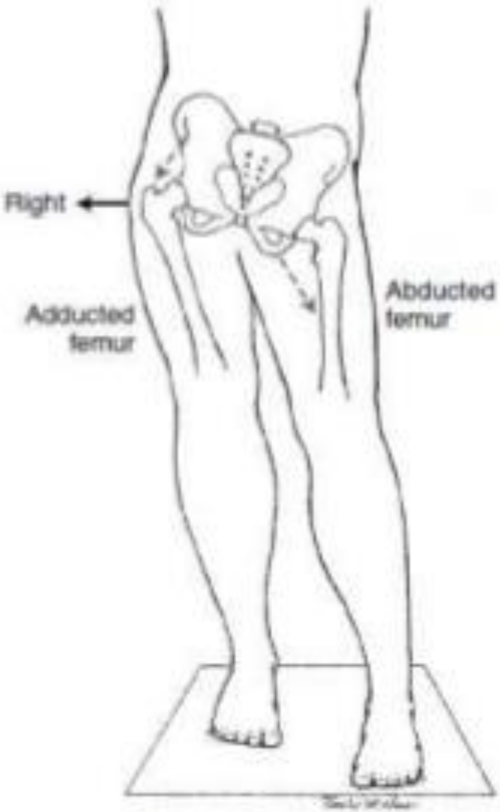


Figure 10-22 When the pelvis is shifted to the right in bilateral stance, the right hip joint will be adducted and the left hip joint will be abducted. To return to neutral position while continuing to bear weight on both feet, the right abductor and left adductor muscles work synergistically to shorten and shift the weight back to center.

- Forward (anterior) rotation of the pelvis occurs in unilateral stance when the side of the pelvis opposite to the weight-bearing hip joint moves anteriorly from the neutral position

- Forward rotation of the pelvis produces medial rotation of the weight-bearing hip joint

- Backward (posterior) rotation of the pelvis occurs when the side of the pelvis opposite the weight-bearing hip moves posteriorly
- Backward rotation of the pelvis produces lateral rotation of the supporting hip joint

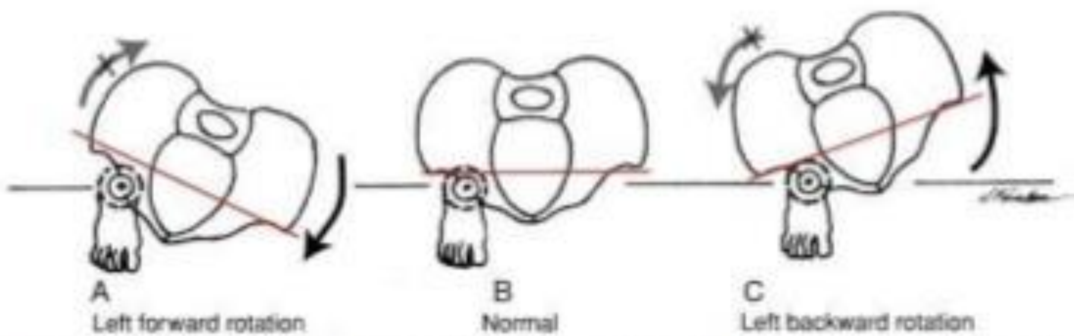
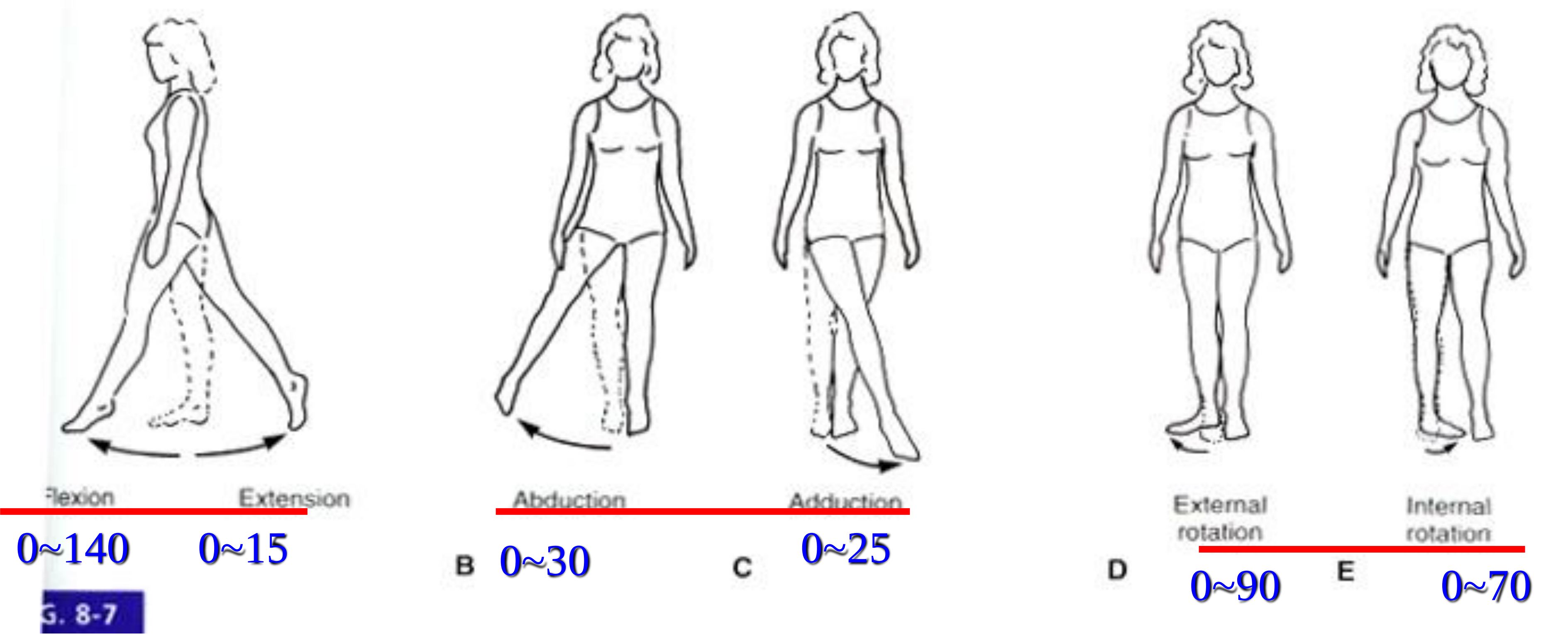


Figure 10–23 A superior view of rotation of the pelvis in the transverse plane. **A.** Forward rotation of the pelvis around the right hip joint results in medial rotation of the right hip joint. **B.** Neutral position of the pelvis and the right hip joint. **C.** Backward rotation of the pelvis around the right hip joint results in lateral rotation of the right hip joint. The reference for forward and backward rotation is the side *opposite* the supporting hip, although the eye often erroneously catches the opposite motion of the pelvis on the same side (gray crossed-out arrows).

Kinematics

- Rang of motion in all three planes: sagittal, frontal, transverse



Movements at the Hip

movements of the femur are facilitated by pelvic tilt

Pelvic tilt direction	Femoral movement
posterior	flexion
anterior	extension
lateral (to opposite side)	abduction

Movements at the Hip

What muscles contribute to **flexion** at the hip?

- iliacus
- Psoas Major
- Assisted by:
  - Pectineus
  - Rectus femoris
  - Sartorius
  - Tensor fascia latae

Movements at the Hip

extension at the hip joint?

- Gluteus maximus
- Hamstrings
  - Biceps Femoris
  - Semimembranosus
  - Semitendinosus

Movements at the Hip

abduction at the hip joint

- gluteus medius
- assisted by:
  - gulteus minimus

Movements at the Hip

adduction at the hip joint?

- adductor magnus
- adductor longus
- adductor brevis
- assisted by:
  - gracilis

Movements at the Hip

lateral rotation at the hip joint?

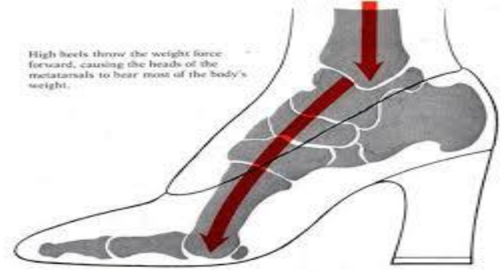
- Piriformis
- Gemellus superior
- Gemellus inferior
- Obturator internus
- Obturator externus
- Quadratus femoris

Movements at the Hip

medial rotation at the hip joint?

- gluteus minimus
- Assisted by:
  - TFL
  - Semimembranosus
  - Semitendinosus
  - Gluteus medius

LOADS ON THE HIP



- Highly specialized and well designed
- **Compressive forces due to following::::**

•Amount of load **(more** than ½ of body weight above hip +tension in surrounding muscles)..

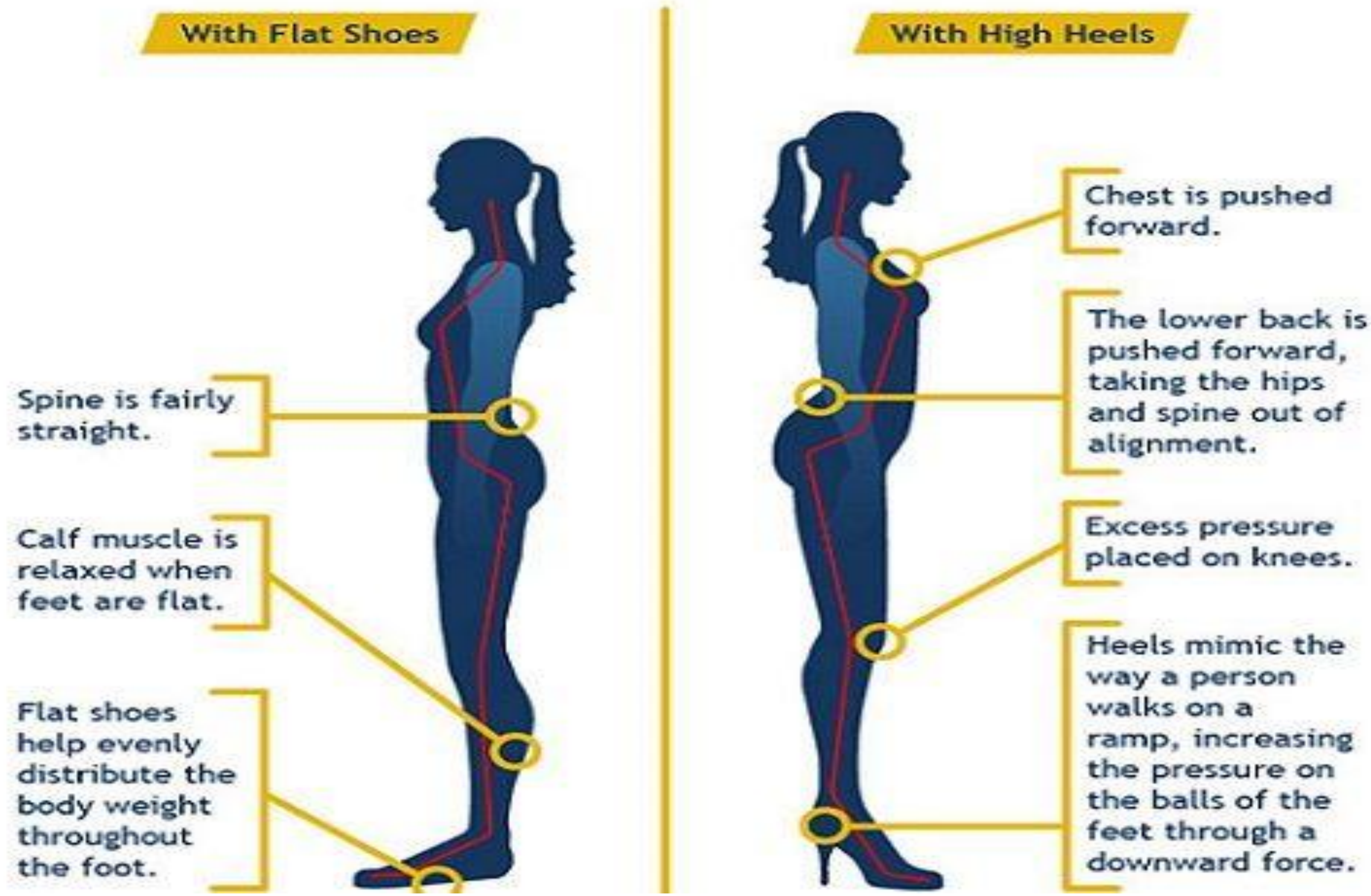
•Effect of speed→increase speed increase load., **Foot wear** also effect load.

Load decrease due to smooth gait pattern & soft heel strike…

•Training surface………..

•Painful conditions……….

A woman's body will attempt to compensate for the off-kilter balance heels cause by flexing or forward bending the hips and spine. In order to maintain balance, the calf, hip, and back muscles become tense. At the end of the day, this makes for excess muscle fatigue and strain. Over time, wearing high heels can also cause the calf muscles to cramp and bulge.[2.1]

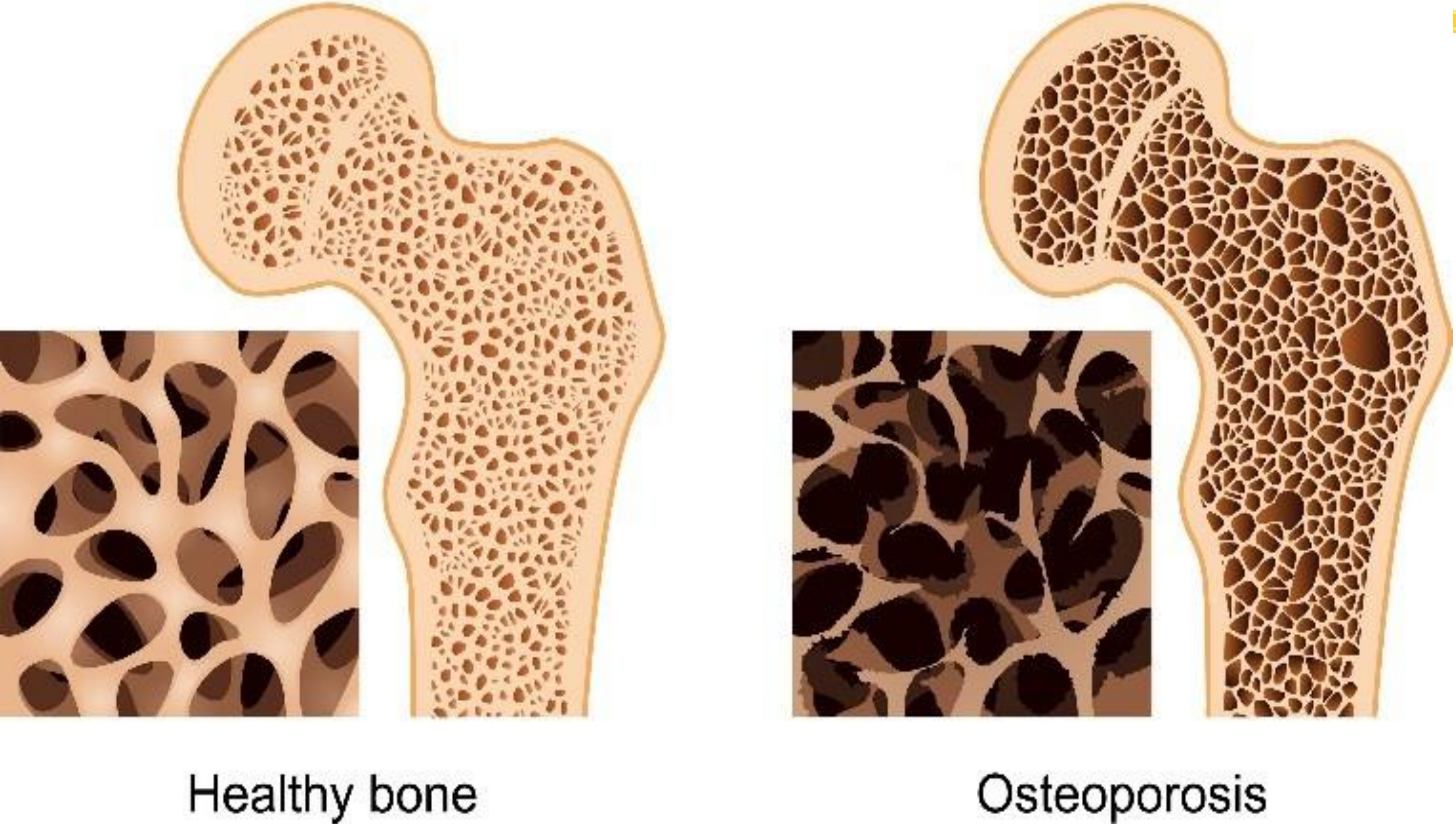


COMMON INJURIES OF THE HIP

Fractures

- Hip is subjected to high repetitive loads---4-7 times the body weight during locomotion
- **Fractures of femoral** neck…(aging, osteoporosis)
- Loss of balance and fall fracture………
- Treatment:
- Regular physical activity

Osteoporosis

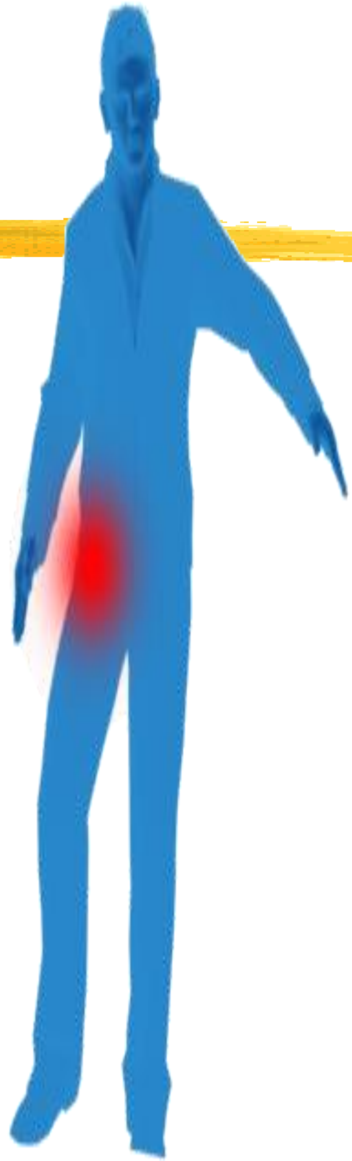


Injuries contd…

CONTUSIONS

•Anterior aspect muscles--- prime location for direct injury in Contact sports----→Internal hemorrhaging---→Appearance of bruises mild to severe

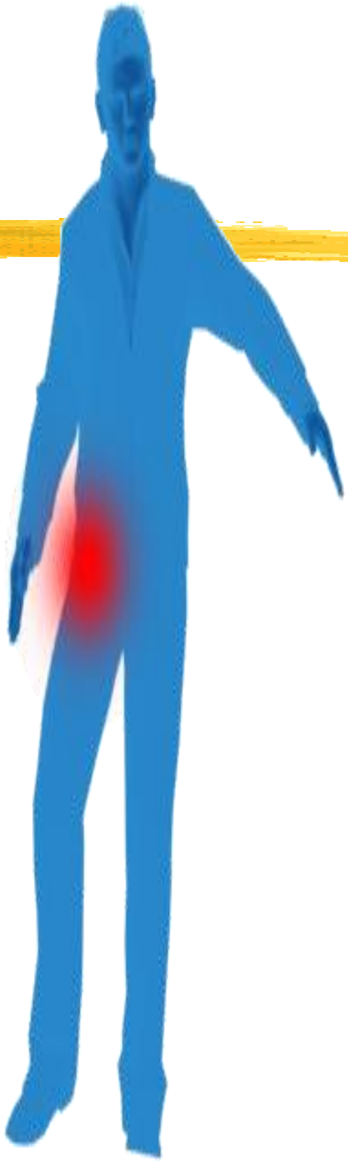
❑Uncommon but **serious complication** as syndrome in which internal hemorrhage-→compression on nerves, vessels, muscle----→tissue death



Injuries contd…

STRAINS

- **Hamstring strain**…….late stance or late swing phase as ecentric contraction. (simultaneous hip flexion &knee extension)
- **Groin Strain**….forceful thigh movement in abduction causes strain in adductors(ice hockey players



بِسْمِ اللّٰہِ الرَّحْمٰنِ الرَّحِیْمِ

سورۃ طٰہٰ	قرآنی دعائیں	آیت نمبر 25-28

رَبِّ اشْرَحْ لِي صَدْرِي ﴿٢٥﴾ وَيَسِّرْ لِي أَمْرِي ﴿٢٦﴾
وَاحْلُلْ عُقْدَةً مِّن لِّسَانِي ﴿٢٧﴾ يَفْقَهُوا قَوْلِي ﴿٢٨﴾

پروردگار، میرا سینہ کھول دے، اور میرے کام کو میرے لیے
آسان کر دے اور میری زبان کی گرہ سلجھا دے تاکہ لوگ میری
بات سمجھ سکیں

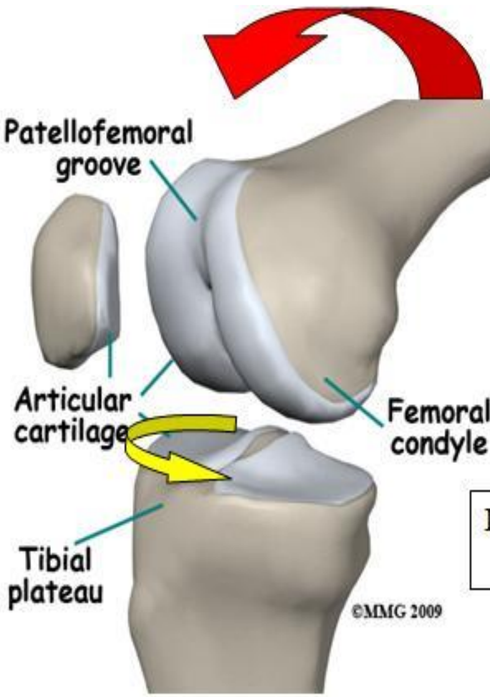
KNEE BIOMECHANICS

Structure of the Knee

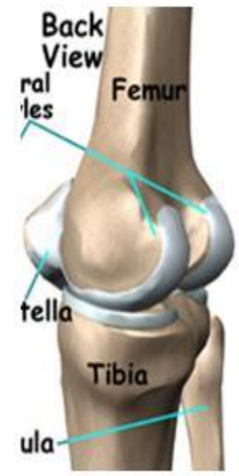
Modified hinge joint. Formed by Tibofemoral & patello femoral joit

Tibiofemoral joint?

- **Dual** condyloid articulations between medial and lateral condyles of tibia and the femur; composing the main hinge joint of the knee



Right knee joint

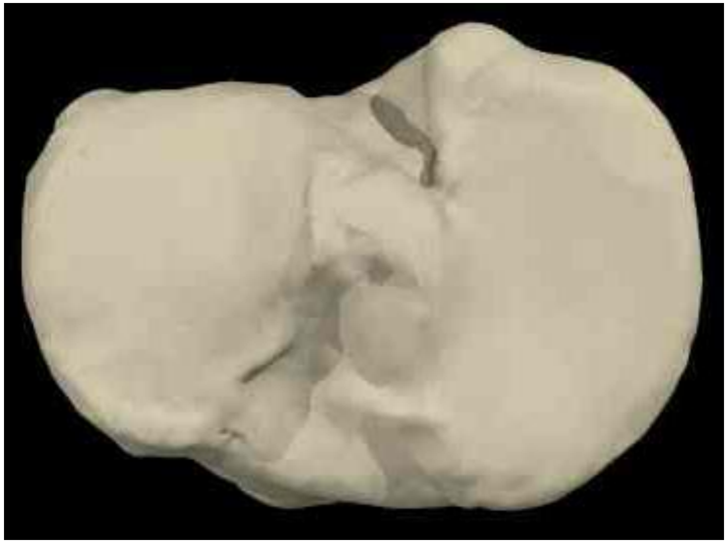


Femur

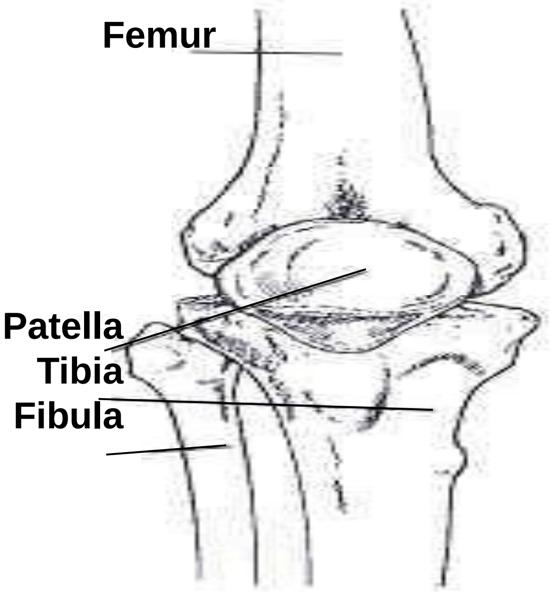
- Medial and lateral condyles
  - Convex, asymmetric
  - Medial larger than lateral

Tibia

- Medial tibial condyle: concave
- Lateral tibial condyle: flat or concave
- Medial 50% larger than lateral

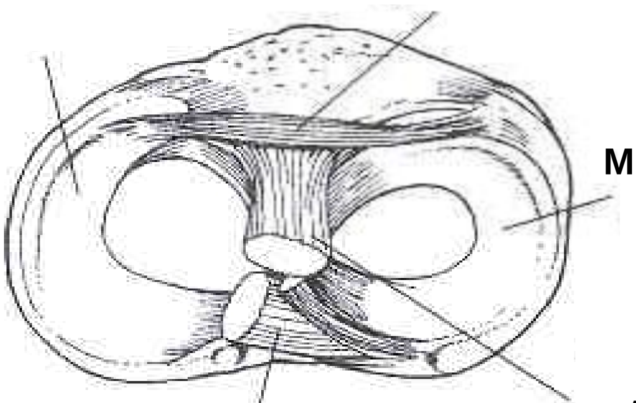


Structure of the Knee



Bony structure of the tibiofemoral joint.

Structure of the Knee

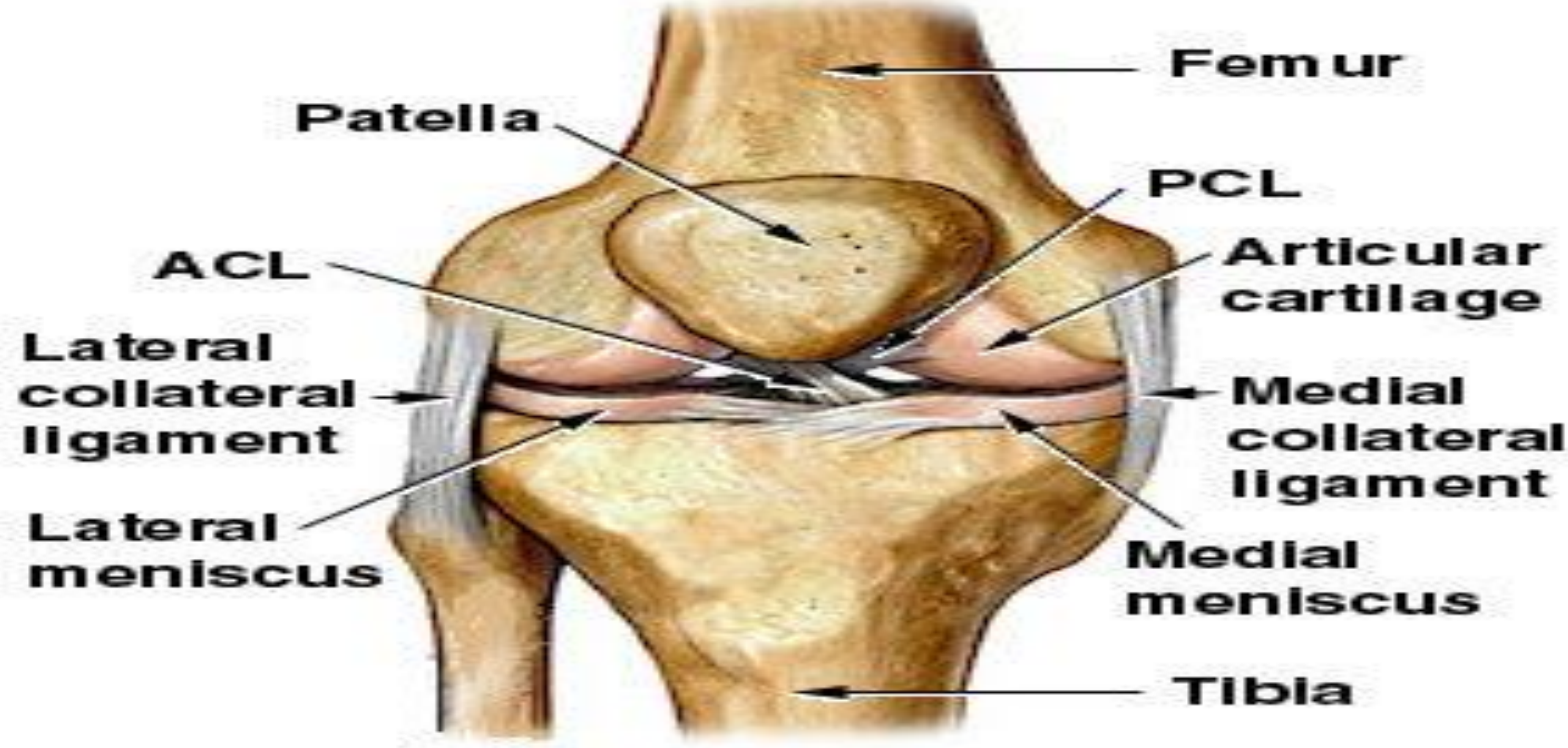


Superior view

- **The menisci of the knee.** **Medial meniscus is also attached directly to the medial collateral ligament**

- **The menisci of the knee.**
- Deepens the articulating depression of tibial plateaus
- Load transmission and shock absorption
- Without menisci the weight of the femur would be concentrated to one point on the tibia and stress may reach up to 3 times
- Increased likelihood of degenerative conditions

Knee Ligaments:



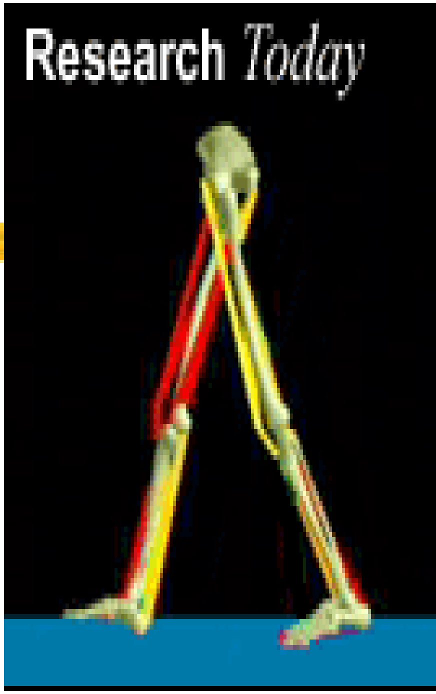
Medial & lateral stabilizers (mostly ligaments)

- Ligaments
  - most important static & dynamic stabilizers by ligaments & muscles
  - tensile strength - related to composition of muscle
  - Primary valgas restraint -57-78% restraining moment of knee(MCL)
  - Tense in lateral rotation, lax in flexion

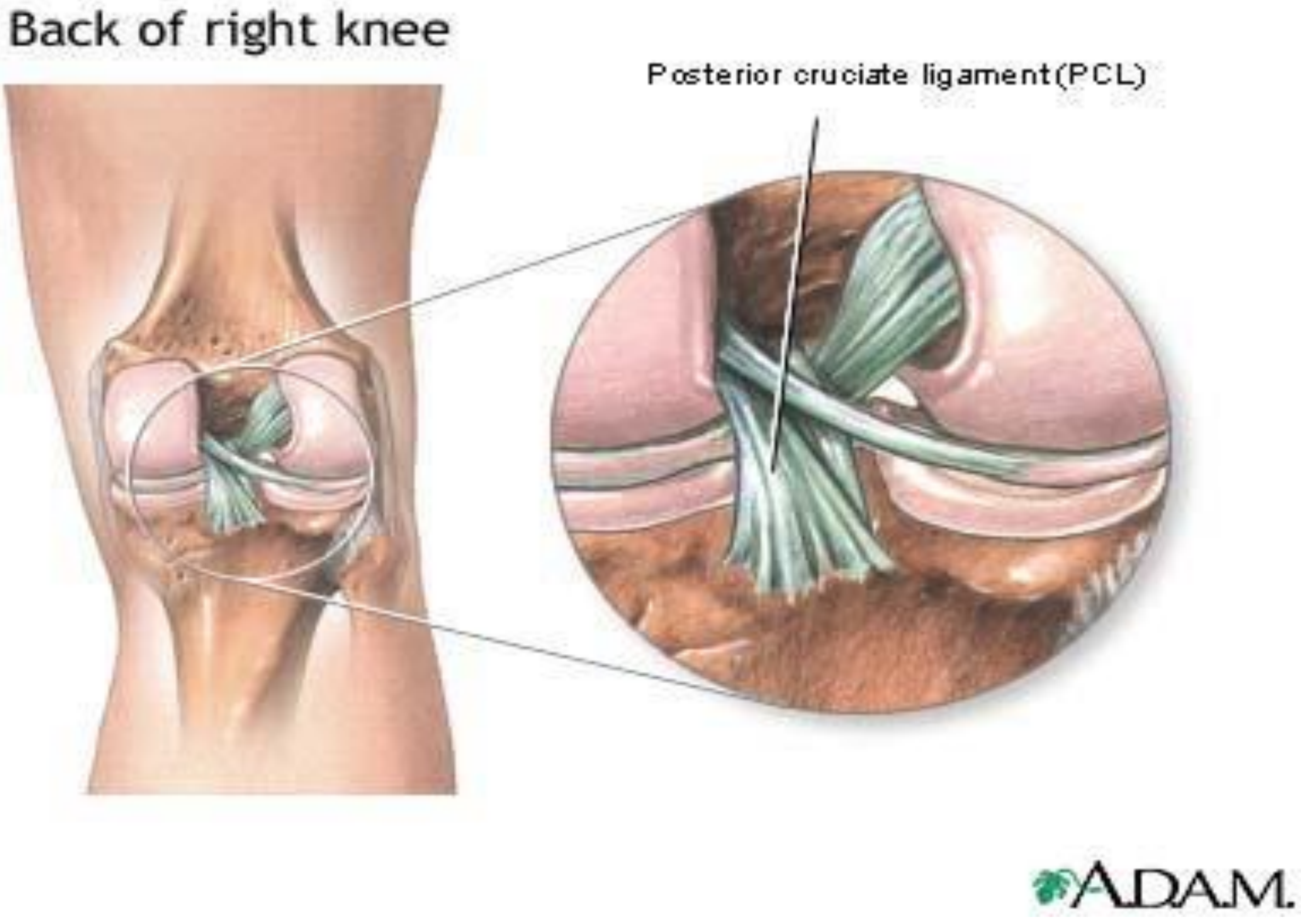
Lateral side

- LCL
  - Primary Varus restraint
  - lax in extension
  - Taut in medial rot

Cruciates



- ACL
  - Primary static restraint to anterior displacement
- tense in extension, 'lax' in flexion
- **PCL**
  - Primary restraint to post Displacement - 90%
  - relaxed in extension, tense in flexion
  - restraint to Varus/ valgus force
  - resists rotation, esp.int rot of tibia on femur


Back of right knee
Posterior cruciate ligament(PCL)
A.D.A.M.

Structure of the Knee

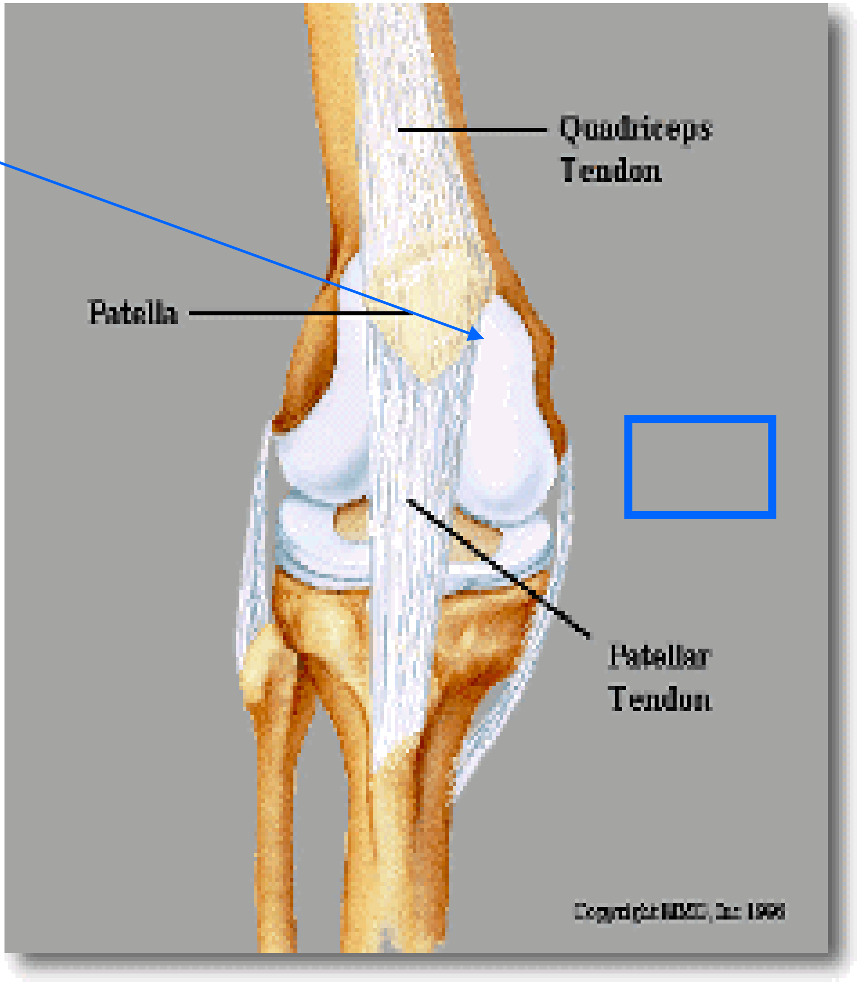
What is the patellofemoral joint?

- articulation between the patella and the femur
- (the patella improves the mechanical advantage of the knee extensors by as much as 50%)

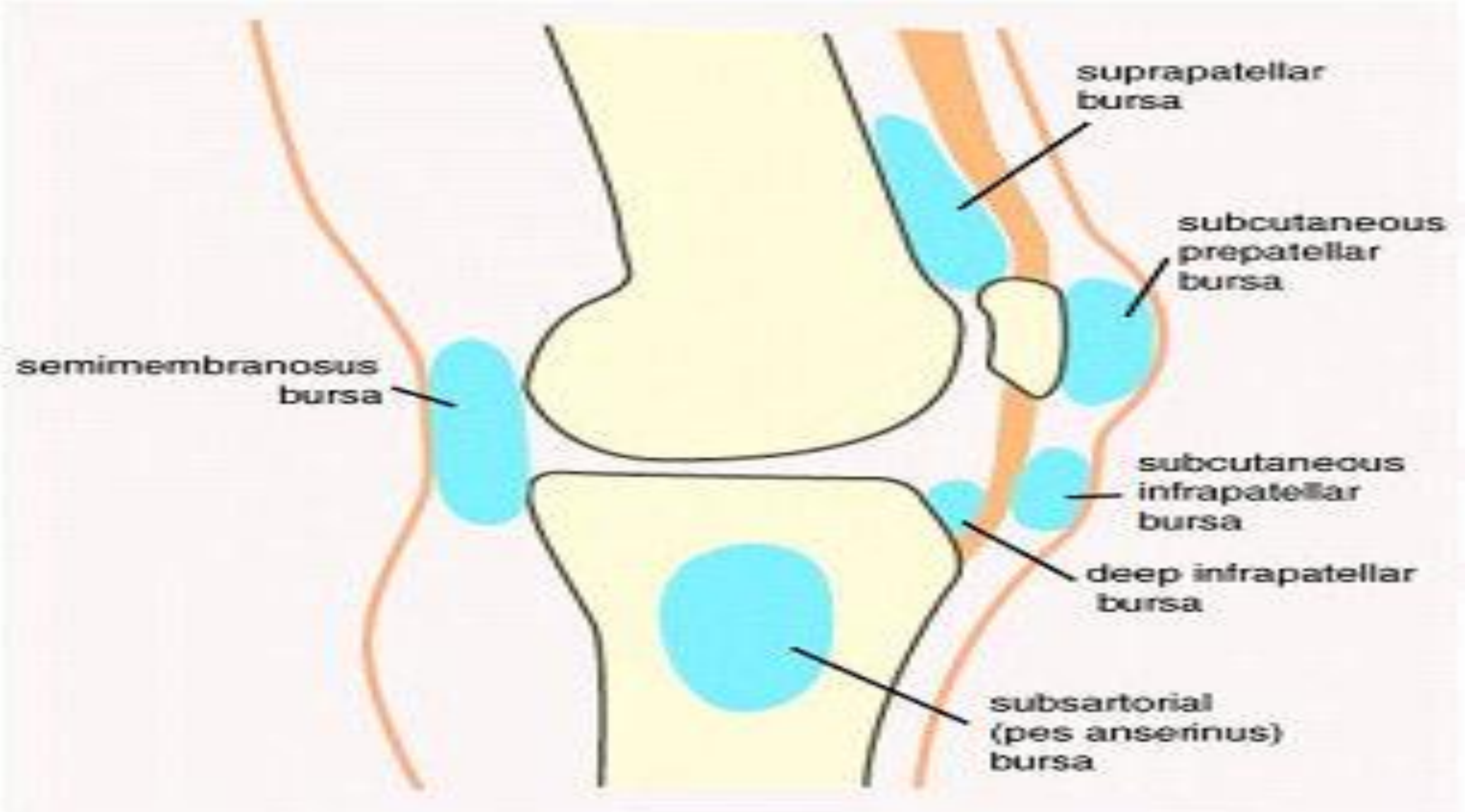
•**Close pack position**= full extension

Other Important Structures

- Articular cartilage
  - 1/4 inch thick
  - tough and slick
- Patella and patellar tendon
  - Tibial tuberoscity
  - Patellofemoral groove
  - Patella acts like a fulcrum to increase the force of the quadriceps muscles



Bursae OF KNEE



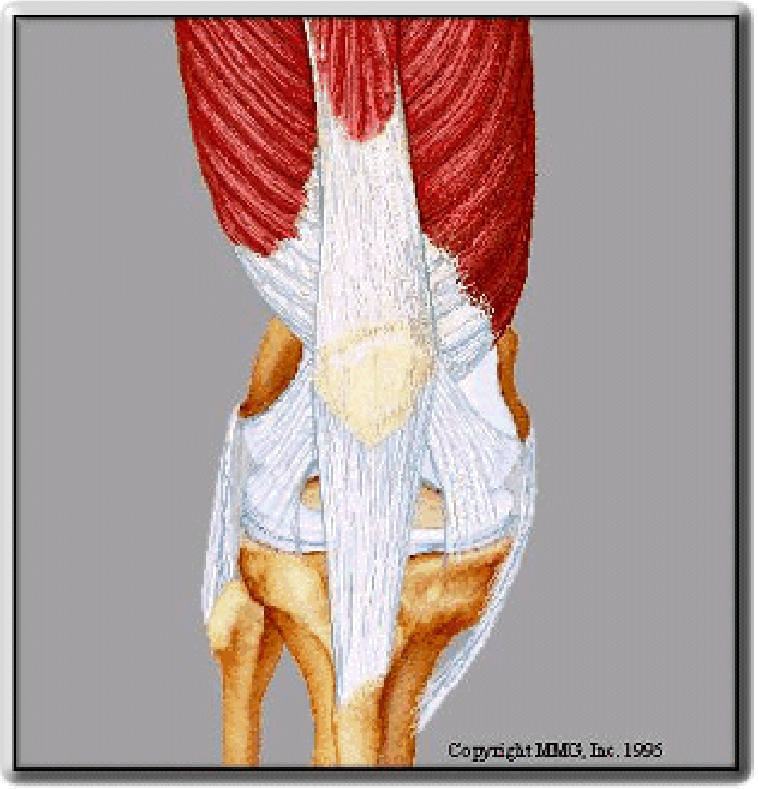
Interactive Knee 1.1 © 2000 Primal Pictures Ltd.

Patellofemoral joint motion

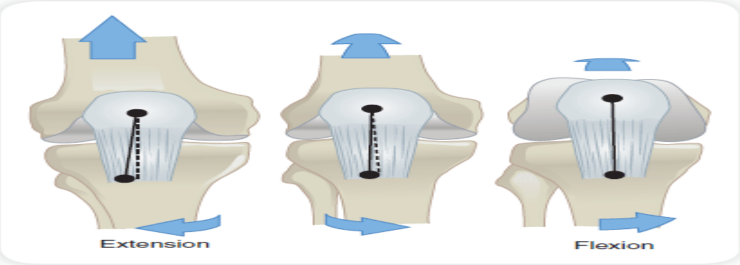
- Gliding movements== 7 cm in vertical direction
- Superior glide
- Inferior glide
- Lateral and medial shifting **(v.little)**

Muscles

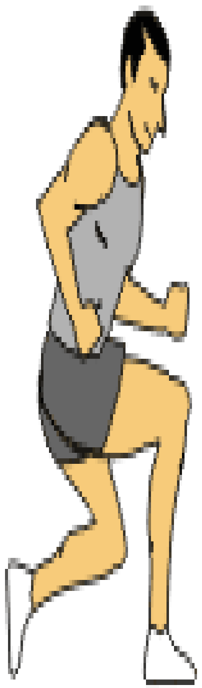
- Quadriceps - extension
- Hamstrings - flexion
- IT band from the gluteus maximus and tensor fascia latae



- **Screw home –locking mechanism:**
- A key element to knee stability for standing upright, is the rotation between the tibia and femur.
- It occurs at the end of knee extension, between full extension (0 degrees)&20 degrees of knee flexion.
- The tibia rotates internally during the swing phase and externally during the stance phase.
- External rotation occurs during terminal degrees of knee extension and results in tightening of both cruciate ligaments, which locks the knee.
- The tibia is then in the position of maximal stability with respect to the femur.
- Vice versa by poplitius muscle



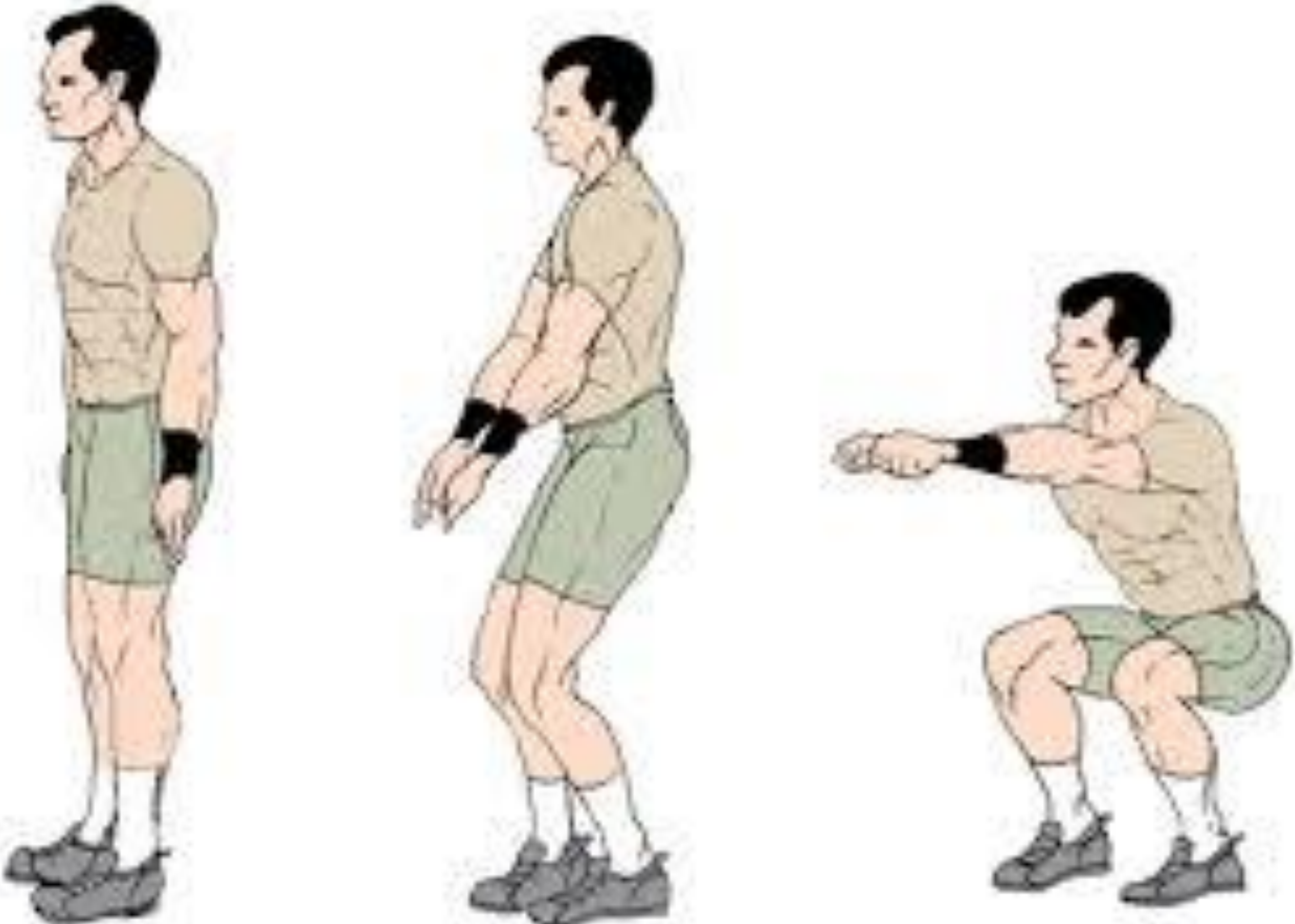
- **Open chain:**
- When distal part of joint moves during movement & proximal part of joint remain stationary.(flex, ext etc)
- **closed chain movements?**
- When proximal part of joint moves during movement & distal part remain stationary.(squat movement, pushups)



Loads on the knee joint

Tibiofemoral joint:

- Compression loading more in stance phase
- **Shear loading**= tendency of the femur to displace anteriorly on tibial plateaus(**glide)**
- Knee flexion angle exceeding than 90 degree result in larger shear forces.
- **Full squats not recommended for novice athletes**

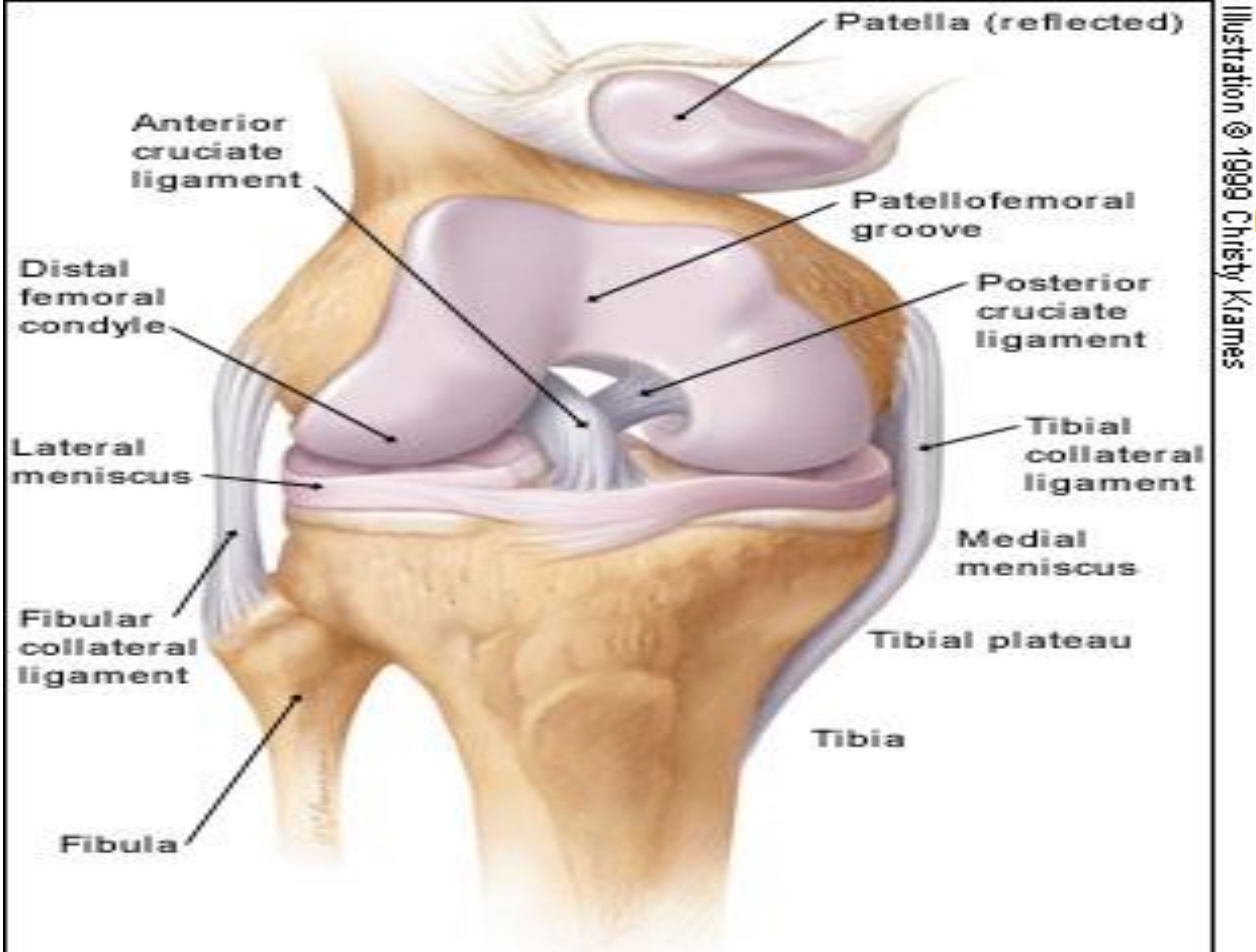


forces at Patellofemoral joint

- 1/3rd of body weight compressive forces during normal walking
- 3 times the body weight during stair climbing--→High compressive forces during knee flexion
- Squatting highly stressful to the knee complex


Thank You

Common Injuries of the Knee & Lower Leg



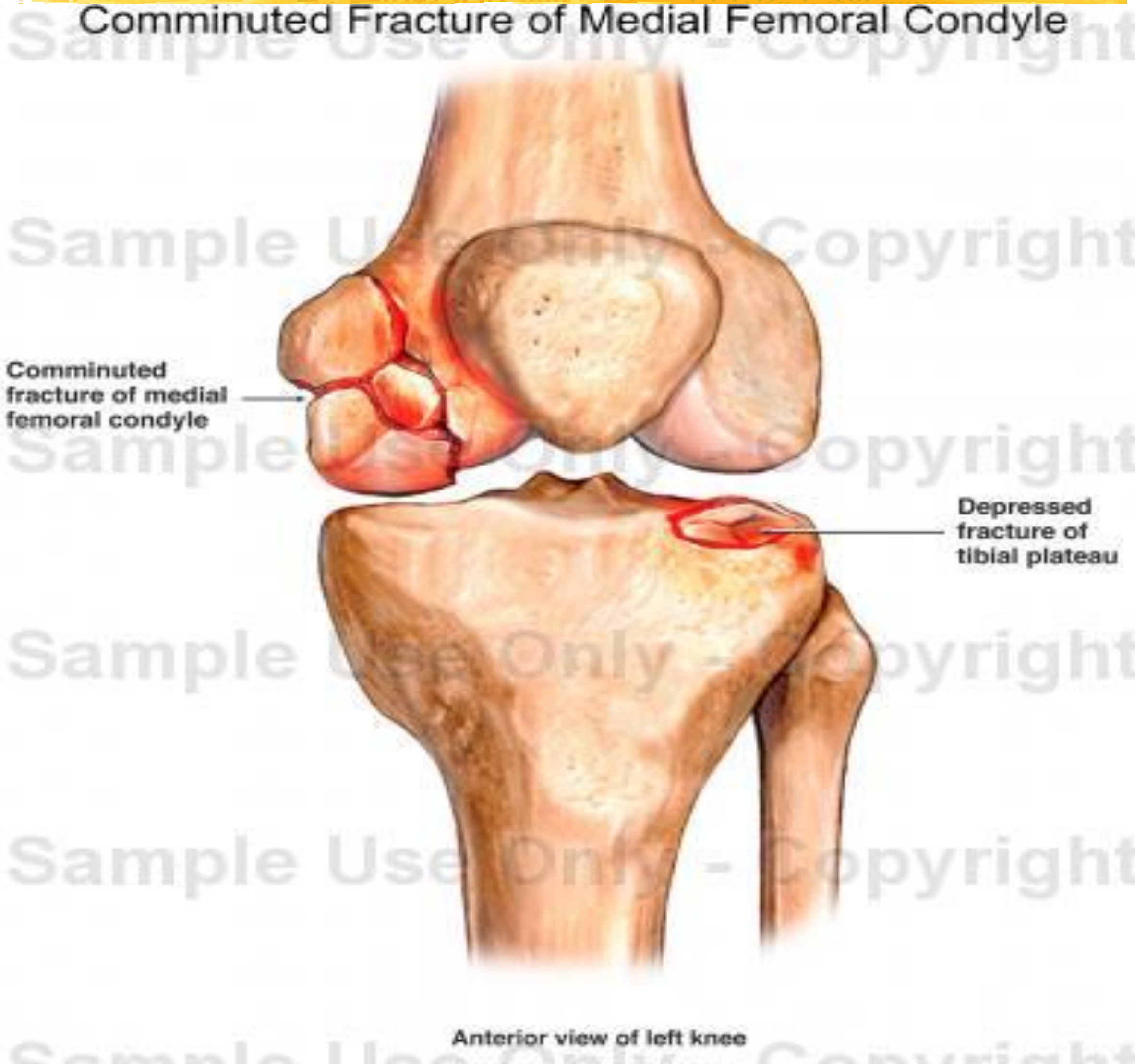
Patella (reflected)
Anterior cruciate ligament
Patellofemoral groove
Distal femoral condyle
Posterior cruciate ligament
Tibial collateral ligament
Lateral meniscus
Medial meniscus
Fibular collateral ligament
Tibial plateau
Tibia
Fibula
Illustration © 1999 Christy Krames

Patella Fractures

- Result from direct blow such as knee hitting dashboard in MVA, fall on flexed knee, forceful contraction of quad. Muscle.
- Transverse fractures most common

Femoral Condyle Fractures

- These injuries secondary to direct trauma from fall w/axial loading or blow to distal femur.

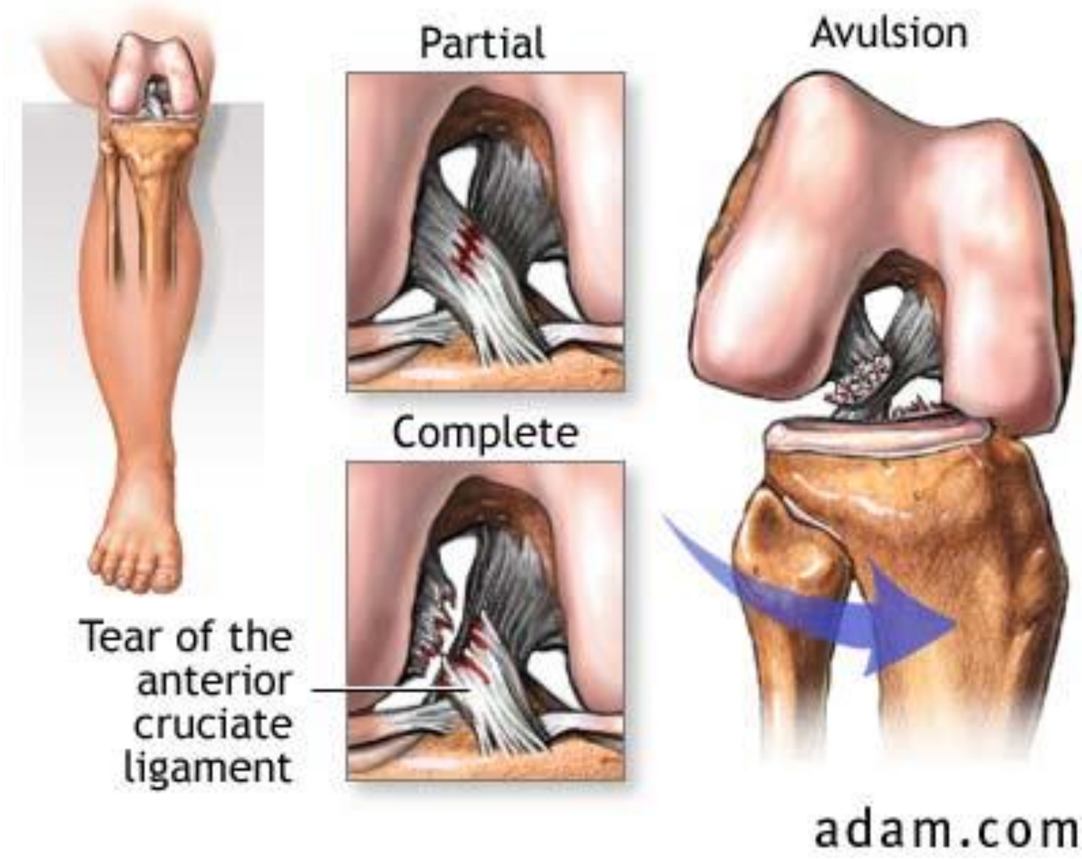


Anterior Cruciate Ligament

- Can withstand approximately 400 pounds of force
- Common injury particularly in sports (3% of all athletic injuries)
- a deceleration, hyperextension or internal rotation of tibia on femur
- May hear “pop”, swelling, assoc. w/medial meniscal tear
- Excessive anterior translation or rotation of femur on the tibia

- Incidence of ACL injuries is more in females
- Notable lessening of flexion extension range of motion at the knee due to **quadriceps avoiding**
- Altered joint kinetics== subsequent inset of osteoarthritis

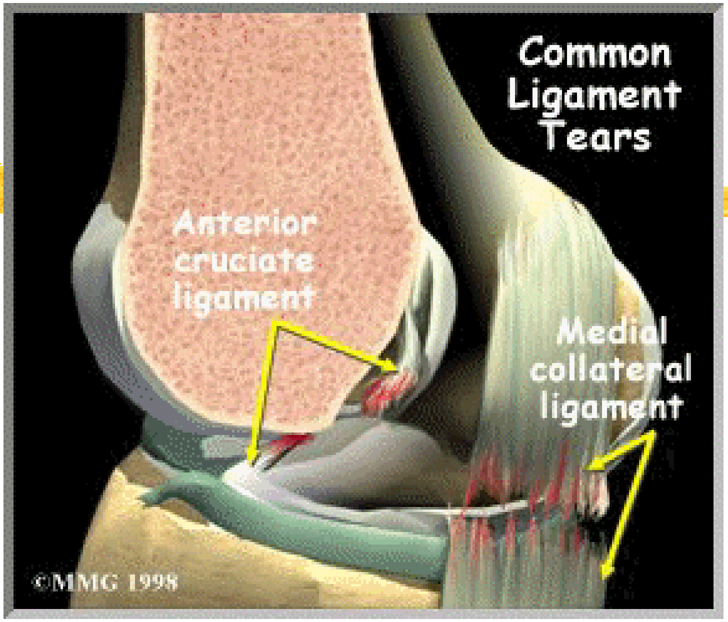
Types of ACL Tears

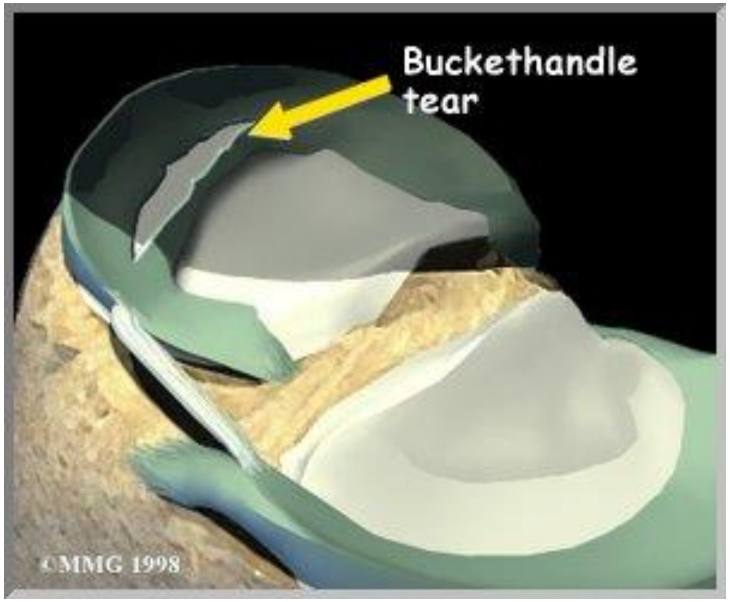


- Surgical repair through middle third of patellar tendon
- Notable weakness in quadriceps, impaired joint range and proprioception
- **Muscle inhibition:** inability to activate all motor units of a muscle during maximal voluntary contraction

Unhappy Triad

1. ACL
2. Medial collateral ligament
3. Medial meniscus



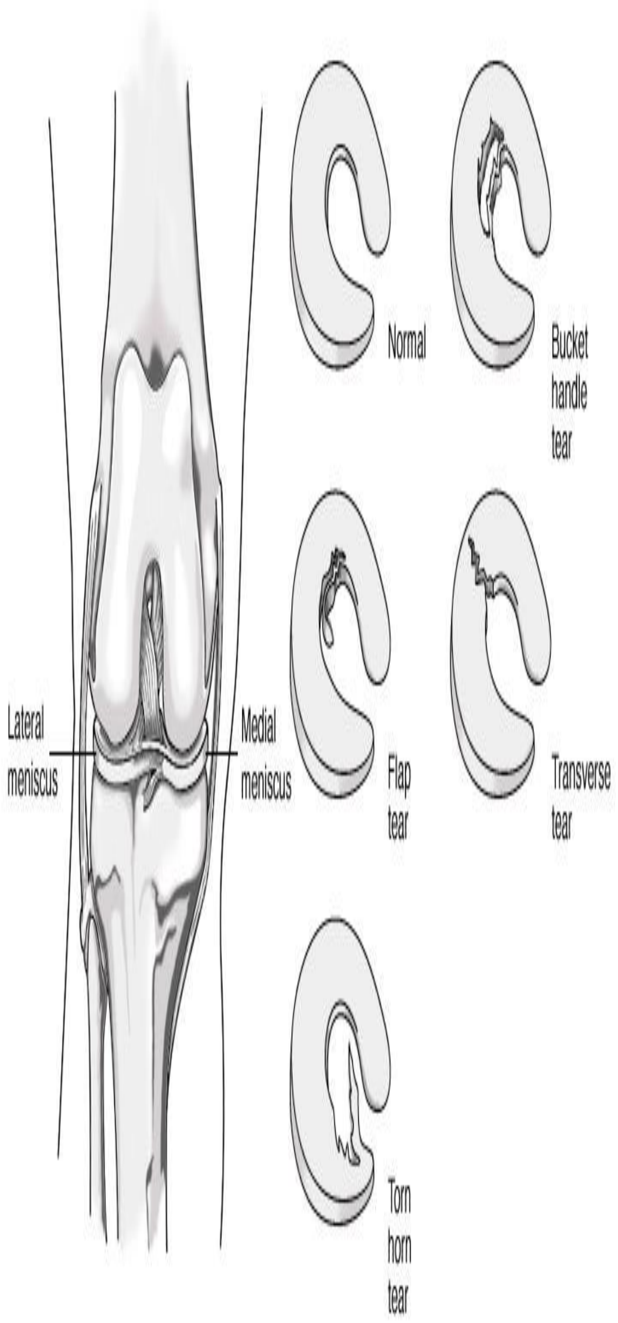


Meniscus Injuries

- One of the most commonly injured parts of the knee
- Mechanism is usually squatting or twisting maneuvers. ___ OR
- Meniscal tears occur during twisting motions with the knee flexed
- Also, they can occur in combination with other injuries such as a torn ACL (anterior cruciate ligament).
- Older people can injure the meniscus without any trauma as the cartilage weakens and wears thin over time, setting the stage for a degenerative tear.
- Combination injuries

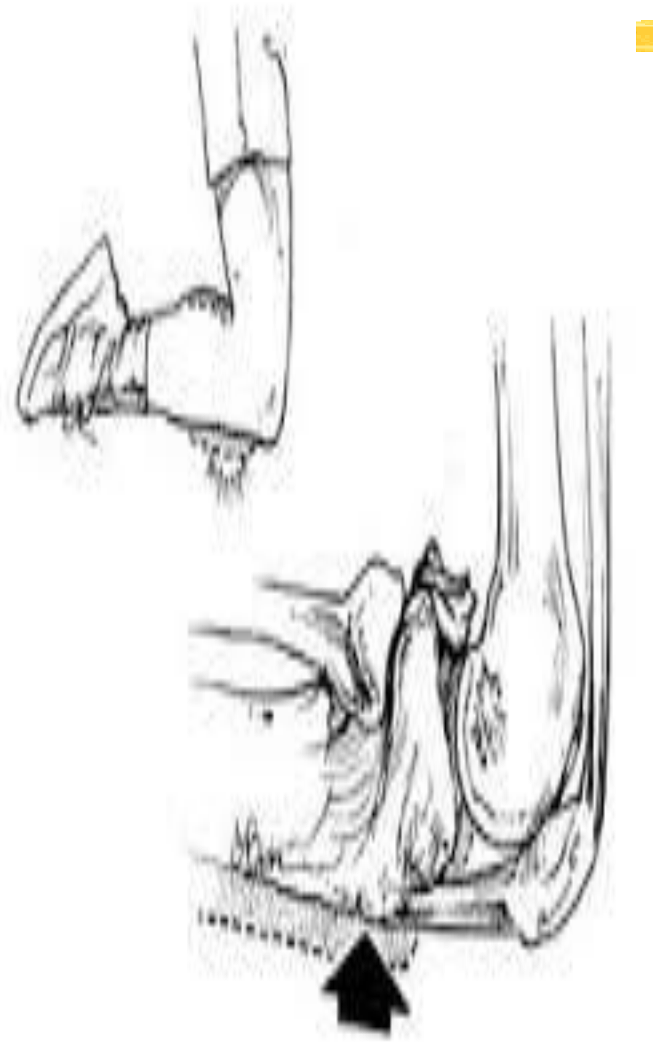
Meniscal injuries

- Symptoms include pain, catching and buckling
- Signs include tenderness and possible clicking
- There is locking of the knee on flexion or extension that is painful or limits activity.
- Medial meniscus more commonly damaged due to its attachment with the MCL



Posterior Cruciate Ligament

- Less common than ACL injury
- Mechanism is hyperflexion of knee with foot plantarflexed
- PCL sprains usually occur because the ligament was pulled or stretched too far, anterior force to the knee, or a simple misstep.



PCL Injuries

- Impact with dash board during motor vehicle accident
- Direct force on proximal anterior tibia
- PCL injuries disrupt knee joint stability because the tibia can sag posteriorly.
- The ends of the femur and tibia rub directly against each other, causing wear and tear to the thin, smooth articular cartilage.
- This abrasion may lead to arthritis in the knee.

Figure: Mary Albury-Noyes

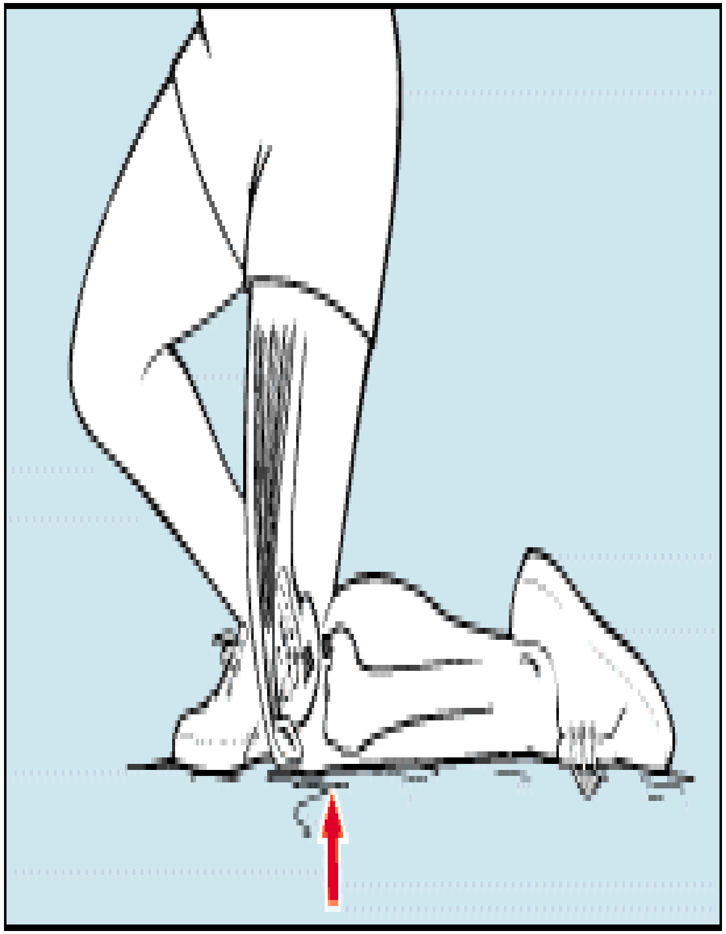


Figure 1. One of the mechanisms of injury for a posterior cruciate ligament (PCL) tear is a fall onto a flexed knee with the foot plantar flexed, which applies posterior force to the proximal tibia.

Medial collateral ligament injury

- Blows to the lateral side more common
- Valgus stress
- Contact sports= football= MCL injury more common
- Both MCL and LCL injured in wrestling


AON

جھوٹا خواب نہ بناؤ

"اور حضرت ابن عمرؓ سے روایت ہے کہ رسول کریم ﷺ نے فرمایا بڑے
بہتانوں میں سے ایک بڑا بہتان یہ بھی ہے کہ کوئی شخص اپنی آنکھوں سے وہ
چیز دکھلائے جو حقیقت میں آنکھوں نے نہیں دیکھی ہے۔" (بخاری)

Prophylactiion: knee bracing

- To prevent knee ligament injuries in contact sports….(Matter of contention
- Protection from torsional loads
- Reduced sprinting speed and earlier onset of fatigue

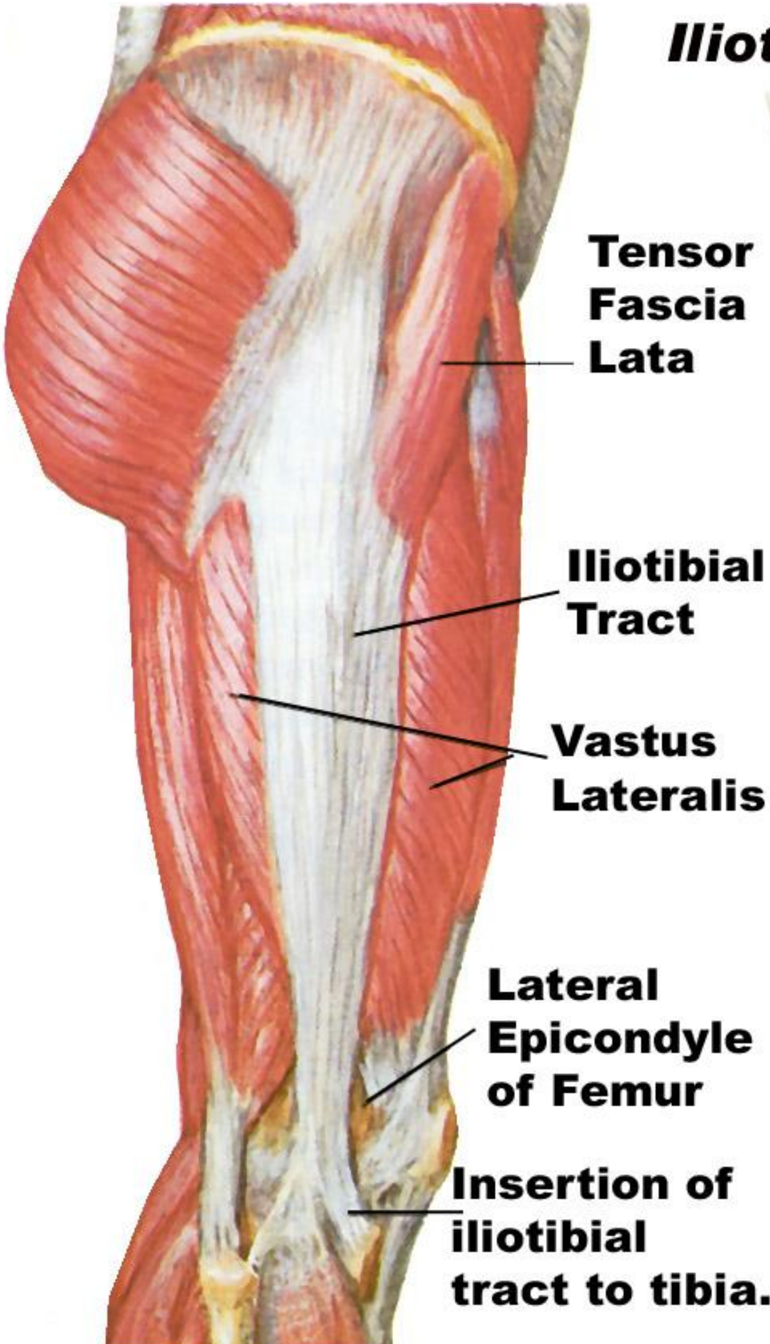
Patellar Tendonitist

- Due to high deceleration or eccentric forces of the quadriceps at the knee during landing
- As you land the hamstrings cause your knee to flex to absorb the shock of impact
- In order to control or decelerate the flexion produced by the hamstrings, the quadriceps muscles contract eccentricly
- Eccentric contractions occur as the muscle is being lengthened or stretch
- Eccentric contractions produces high amounts of force, and therefore stress to the patellar tendon

Iliotibial band friction syndrome

- Friction of posterior edge of Iliotibial band against the lateral condyle of the femur during foot strike
- Very common in distance runners, hence referred as runner’s knee
- Training errors and anatomical malalignments
- **Excessive tibial lateral torsion, femoral anteversion, genu valgum, genu varum, increased Q angle etc,**

Iliotibial Band Friction Syndrome



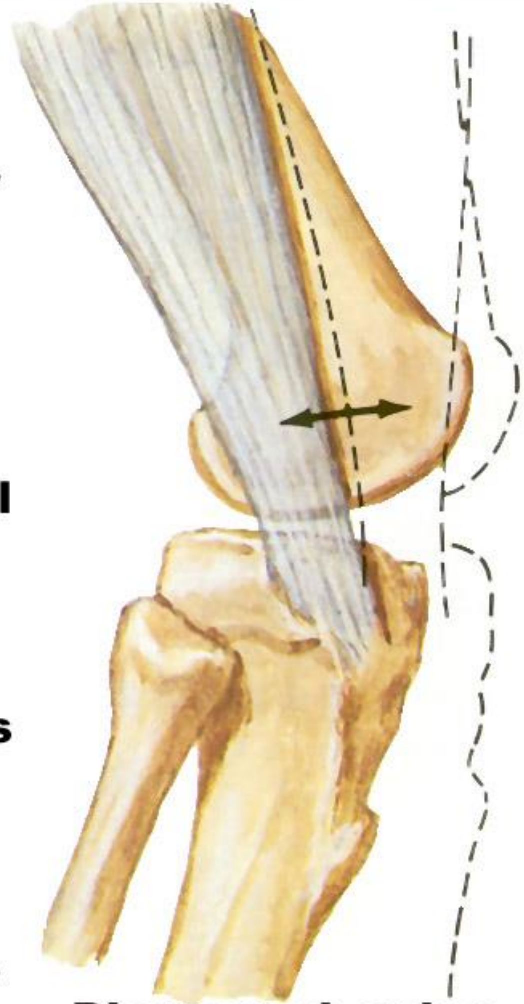


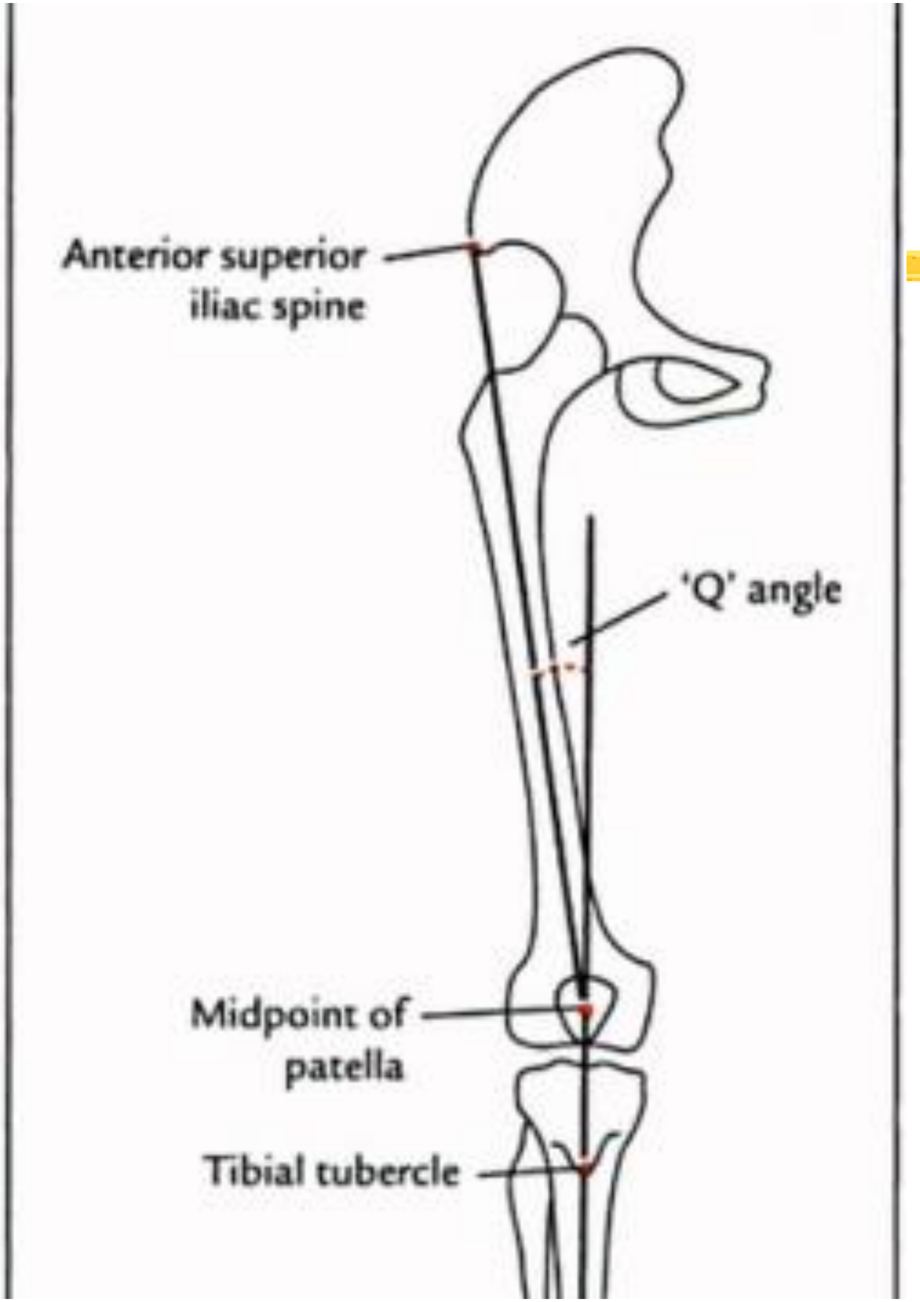
Diagram showing friction of iliotibial tract on lateral femoral epicondyle as the fasical tract glides back and forth.

Area of diffuse pain and tenderness.

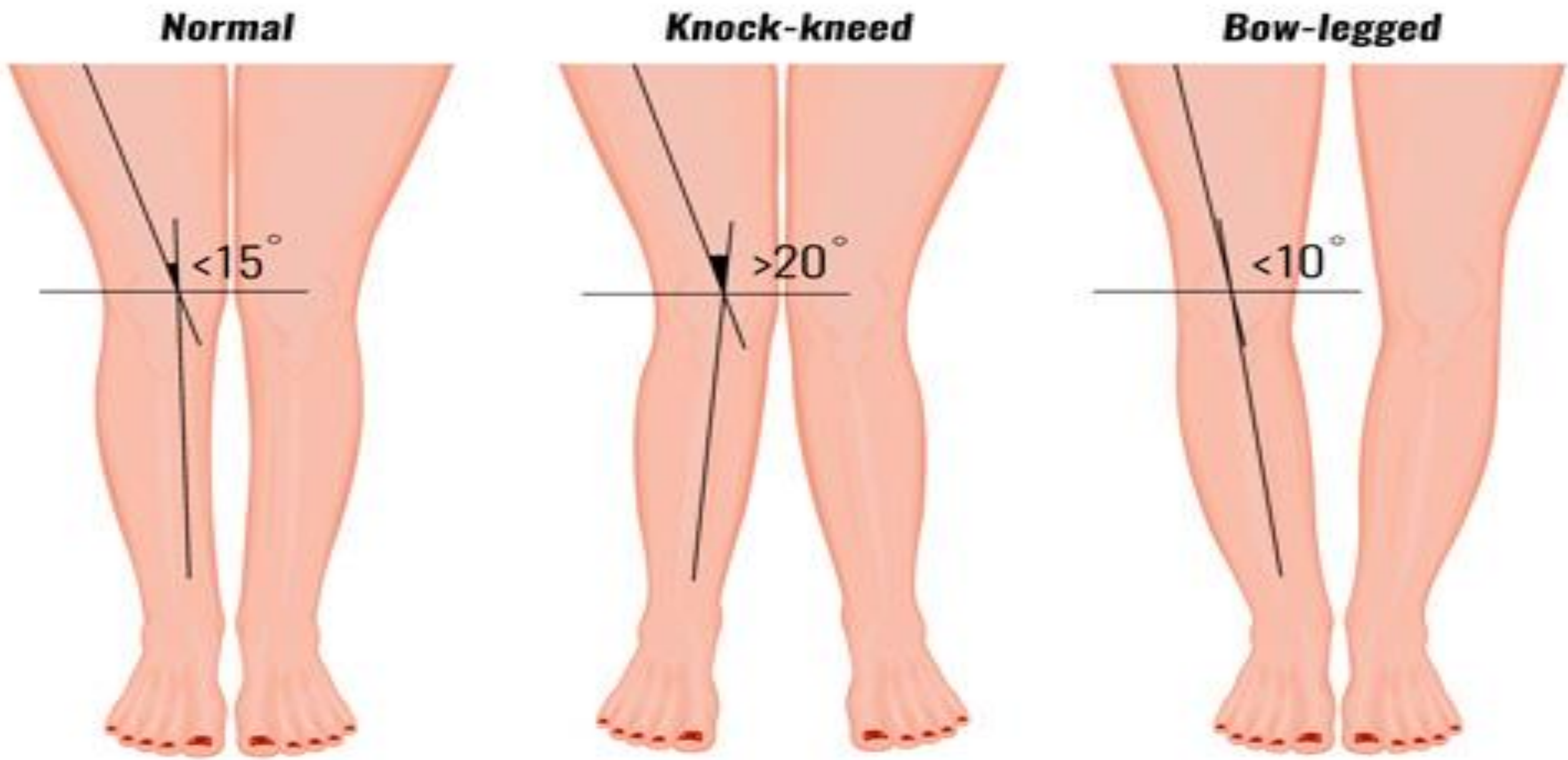
Q ANGLE

Two lines; ASIS to Mid of Patella; the other from Tibial Tuberiosity to Mid of Patella. Angle of intersection called ‘Q angle’.

Normal angle=10-15



Q Angle of the Knee



- The greater the Q angle, the greater the tendency to move the patella laterally against the lateral femoral condyle.

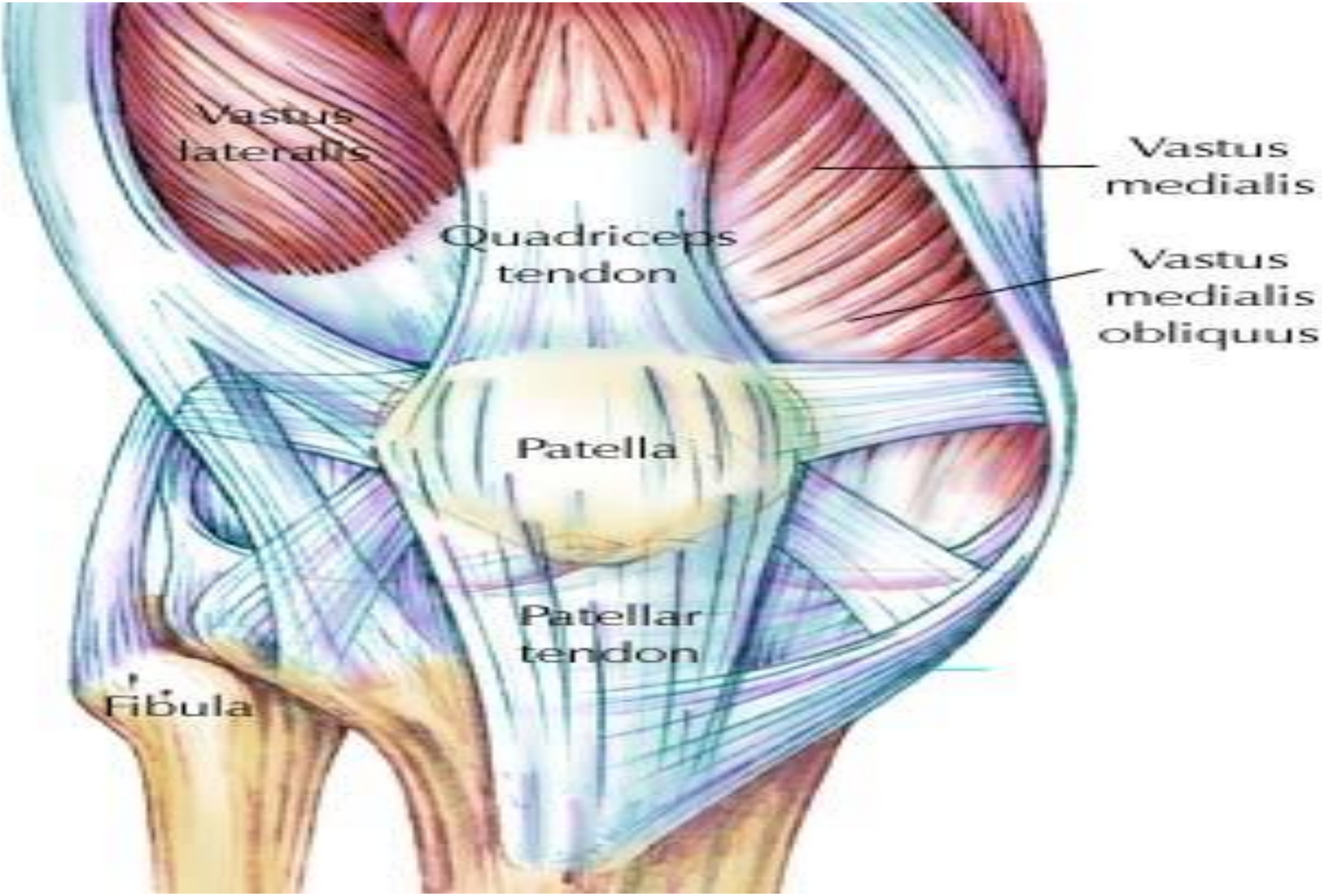
- A large Q angle plus strong quad contraction can dislocate pat.

Breaststroker's knee

- Forceful whipping together of the lower leg produces propulsive thrust
- Excessive abduction of the knee
- Irritation of the MCL and medial border of the patella
- Hip abduction less than 37 or greater than 42 degree == increased onset of knee pain

Patellofemoral pain syndrome

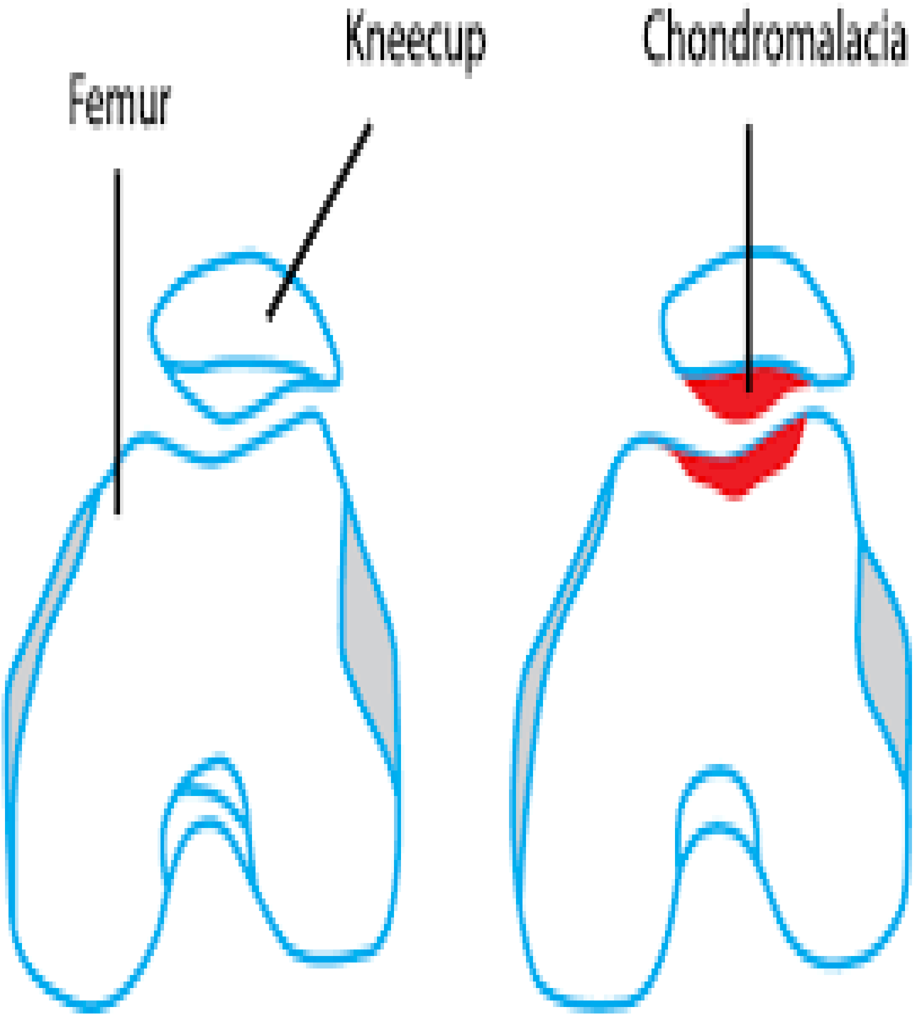
- Painful Patellofemoral joint motion involving anterior knee pain after activities requiring repeated flexion at the knee
- Anatomical malalignments
- Weak Vastus Medialis Oblique and Vastus Lateralis strong
- Large Q angle responsible
- Patellar maltracking



Vastus lateralis
Vastus medialis
Quadriceps tendon
Vastus medialis obliquus
Patella
Patellar tendon
Fibula


Patellofemoral Pain Syndrome
Front View
Side View
Femur
Quadriceps Tendon
Inflammation
Patella
Inflammation
Fibula
Tibia
ePainAssist.com


Patellofemoral Pain
Front view of knee joint
Side view of knee joint
Quadriceps tendon
Femur
Patella
Inflammation
Patella ligament
Tibia
Fibula



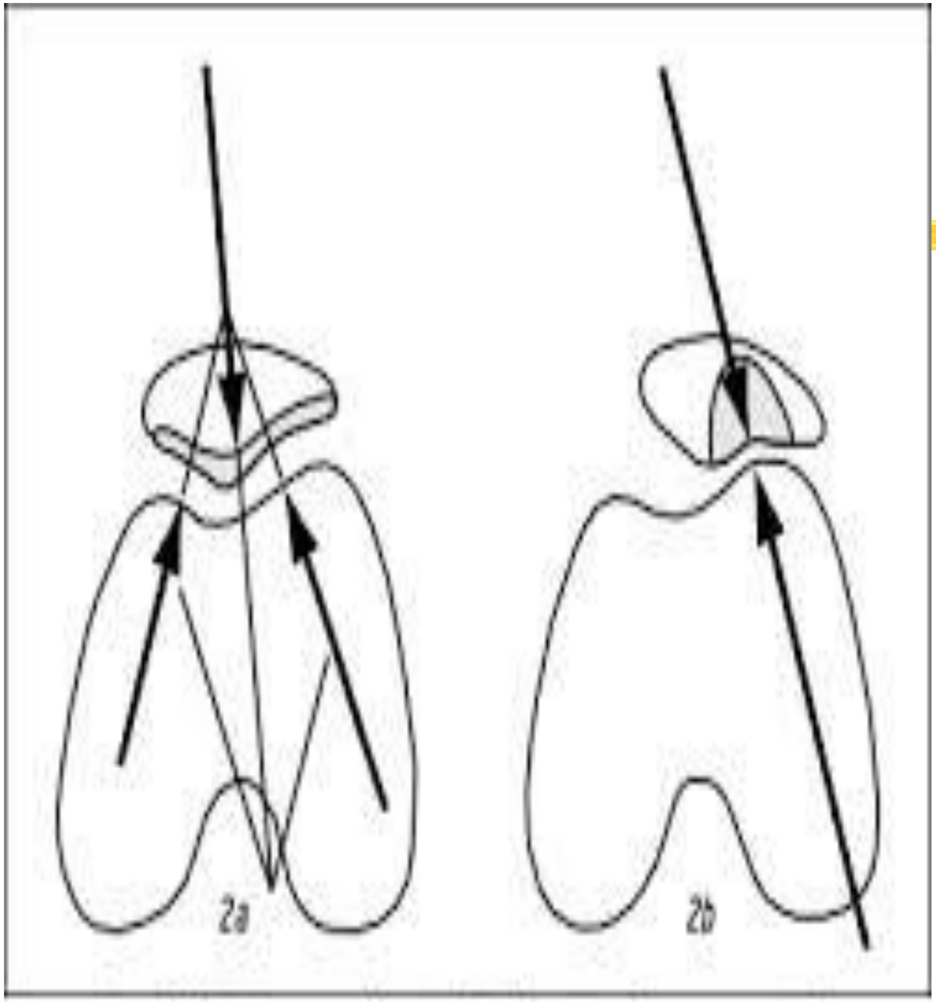
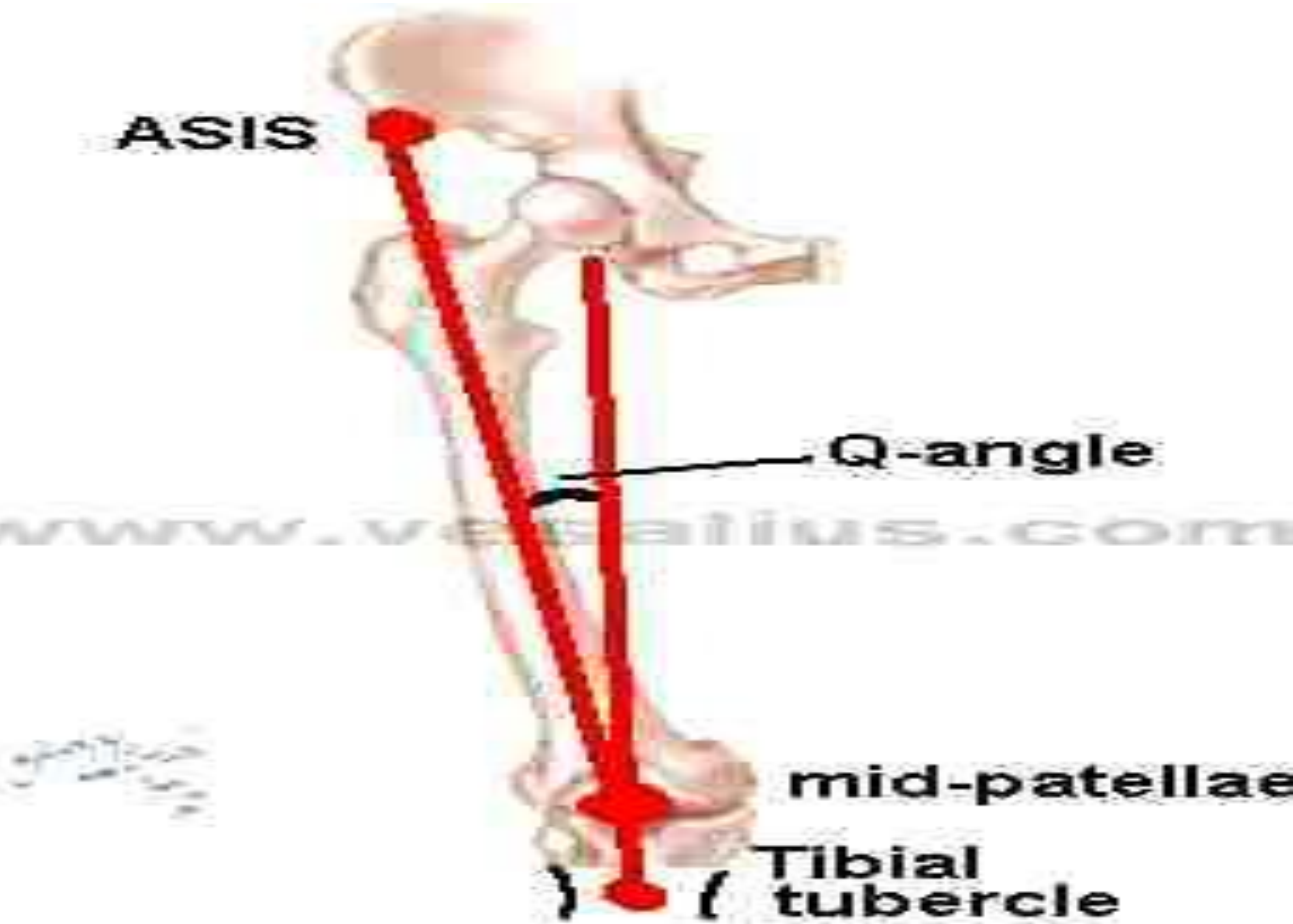
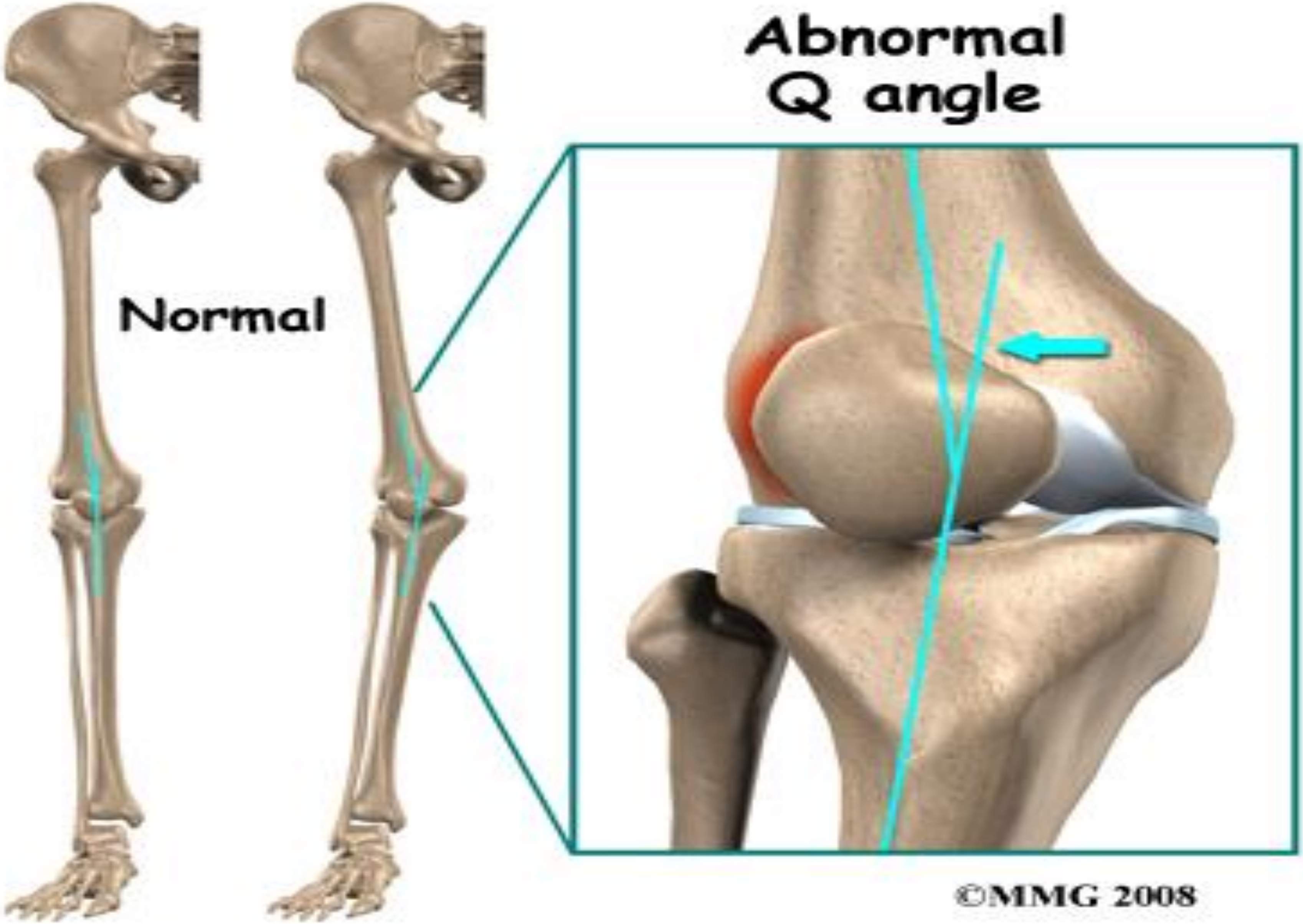


Figure 2a and 2b. Diagram showing distribution of compressive forces on back of kneecap with normal patellar tracking (2a) and abnormal patellar tracking (2b).


ASIS
Q-angle
mid-patellae
Tibial
tubercle


Abnormal
Q angle
Normal
©MMG 2008

Chondromalacia Patellae

- Overuse syndrome of patellar cartilage characterized by <u>softening & fissuring of the articular cartilage of the patella</u>
- Caused by aging and mechanical defects that include::: patello-femoral malalignments which leads to tracking abnormality of patella putting excessive lateral pressure on articular cartilage
- Seen in young active women, pain worse w/stair climbing and rising from a chair

Figure 3: Mary Albury-Noyes

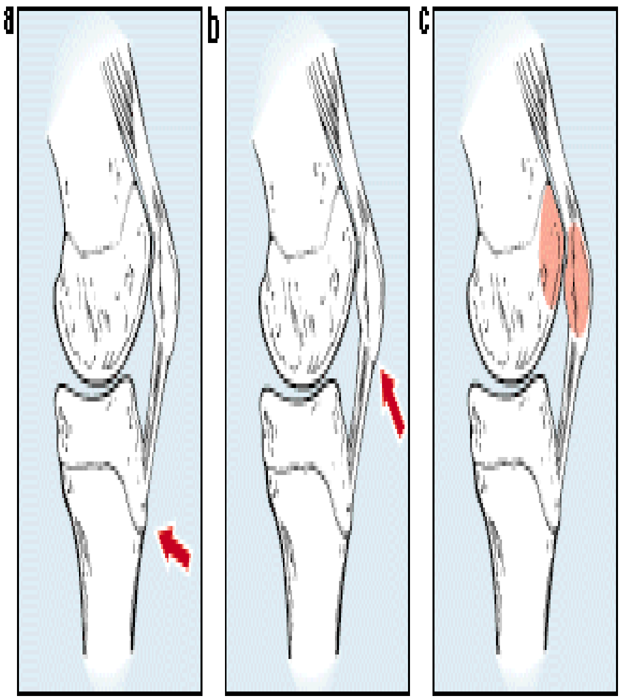
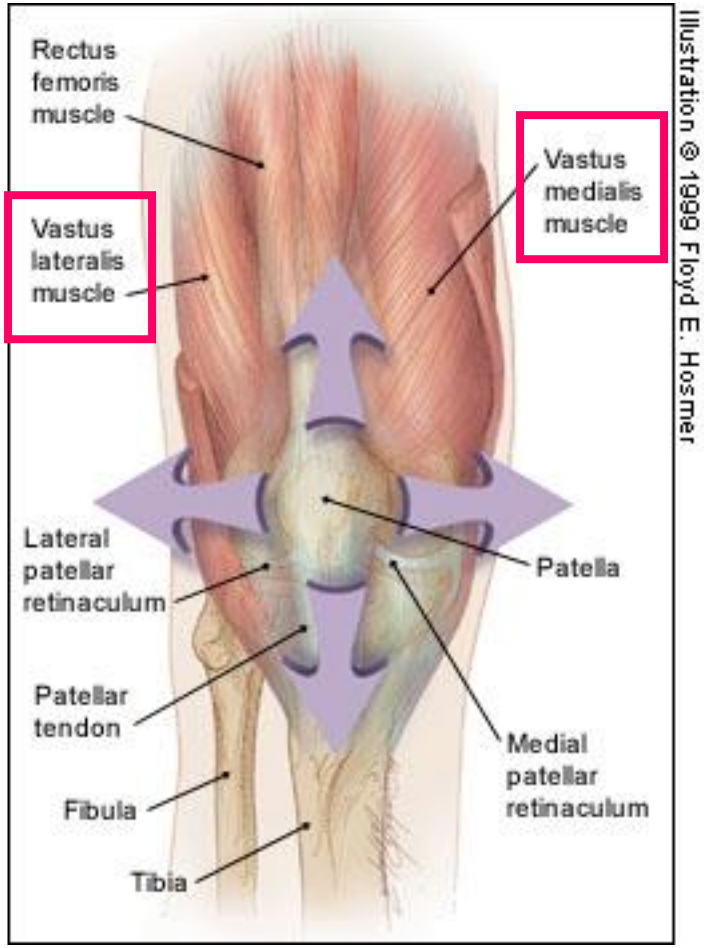


Figure 3. Chronic anterior knee pain in adolescents may be a result of OSD or other conditions. OSD is a disturbance at the junction of the patellar tendon and the tibial tubercle apophysis (a, arrow). Snding-Larsen-Johansson disease involves pain, swelling, and tenderness of the inferior patellar pole at the origin of the patellar tendon (b, arrow). Patients who have patellofemoral syndrome (c, shaded areas) have poorly localized peripatellar pain.

Risk Factors: Subluxation and Chondromalacia

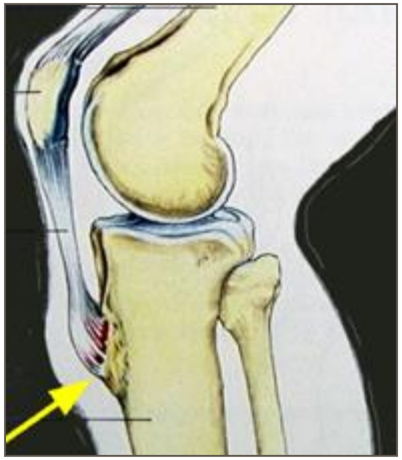
1. Training errors
   - Increasing intensity too soon
2. Weak vastus medialis muscle
3. Large Q angle
   - Greater than 25 for women and 20 for men
4. Gender - more common in women
5. Poor footwear and/or surface




بسم اللہ الرحمن الرحیم
حضرت عبداللہ بن بسر رضی اللہ عنہ فرماتے ہیں
کہ نبی کریم صلی اللہ علیہ وسلم نے ارشاد فرمایا:
خوشخبری ہے اس شخص کے لئے
جو اپنے اعمال نامے میں (قیامت کے دن)
زیادہ استغفار پائے۔
(ابن ماجہ)

4. Osgood- Schlatter Disease

- Overuse syndrome , not a diesease.
- **Osgood–Schlatter disease** (**OSD**), also known as **apophysitis of the tibial tubercle**, is inflammation of the patellar ligament at the tibial tuberosity.
- It is characterized by a painful bump just below the knee that is worse with activity and better with rest.
- Episodes of pain typically last a few months.
- One or both knees may be affected and flares may recur
- Most common in adolescents (8-13 year olds girls and 10-15 year old boys); age of rapid bone growth



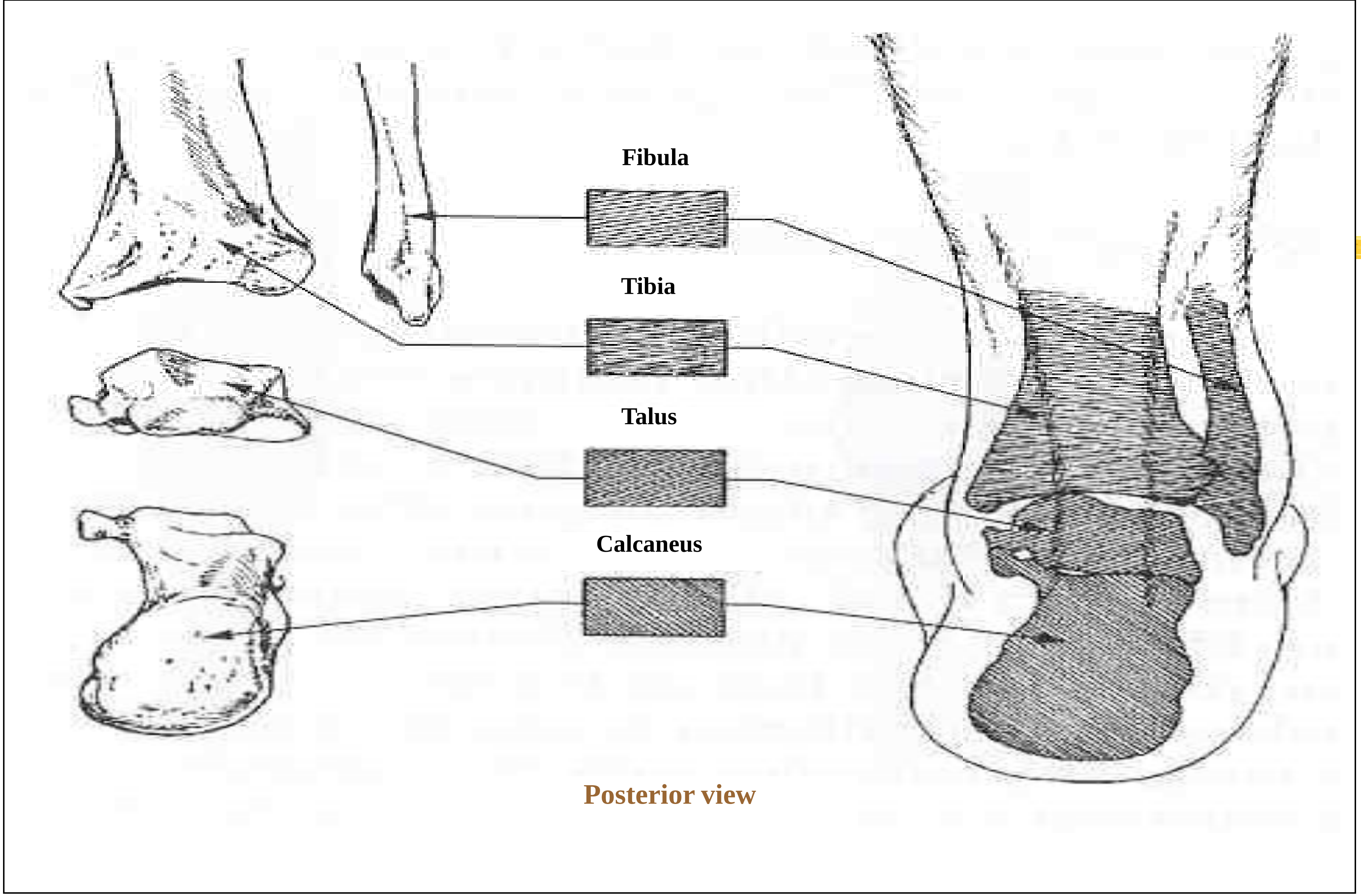
Shin Splints

- Generalized pain along the anterolateral or posteromedial aspect of the lower leg is commonly known as shin splints
- Overuse injury often associated with running, dancing on the hard surface and running uphill

Structure of the Ankle

Tibiotalar joint

- Hinge joint where the convex surface of the superior talus articulates with the concave surface of the distal tibia
- considered to be *the* ankle joint



The bony structure of the ankle.

Movements at the Ankle

Dorsiflexion at the ankle

- Tibialis anterior
- extensor digitorum longus
- peroneus tertius
- assisted by:
    - extensor hallucis longus

Movements at the Ankle

plantar flexion at the ankle

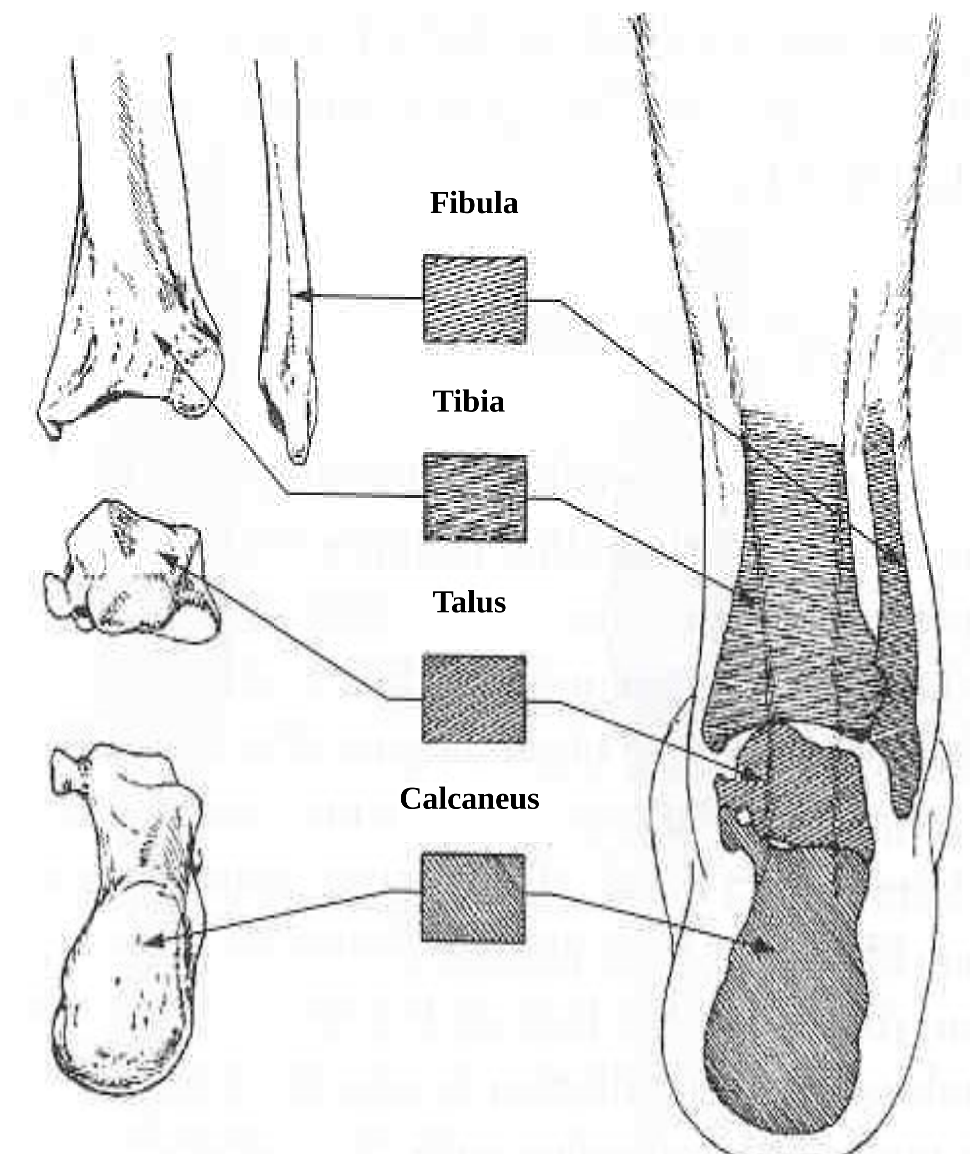
- Gastrocnemius
- soleus
- assisted by:

  Tibialis posterior, Plantaris, peroneus longus, peroneus brevis ,flexor hallucis longus,, flexor digitorum longus

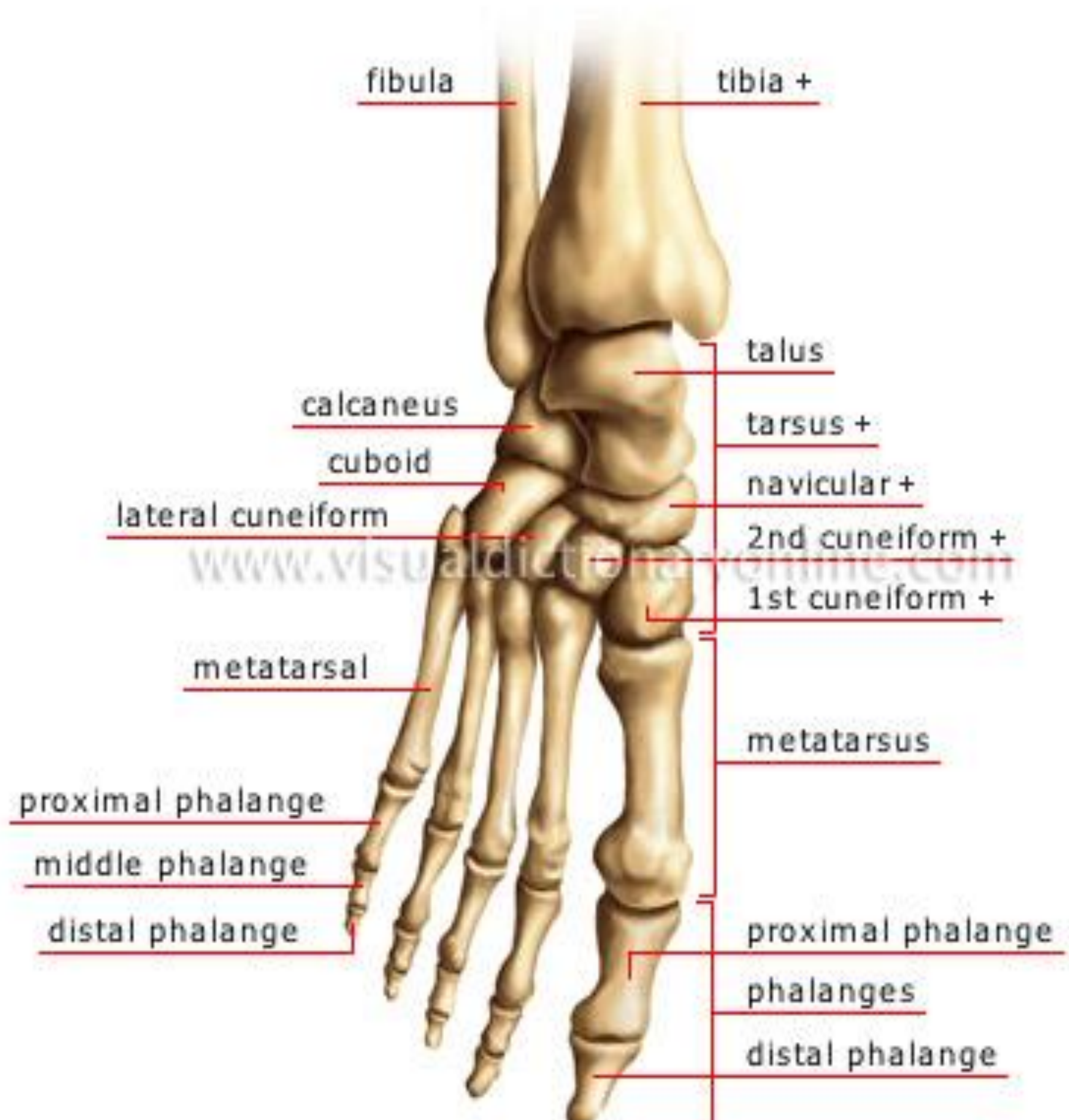
Structure

Subtalar joint

(the anterior and posterior facets of the talus articulate with the sustenta-culum tali on the superior calcaneus)



Posterior view


fibula
tibia +
talus
calcaneus
tarsus +
cuboid
navicular +
lateral cuneiform
2nd cuneiform +
www.visualdictionaryonline.com
1st cuneiform +
metatarsal
metatarsus
proximal phalange
middle phalange
distal phalange
proximal phalange
phalanges
distal phalange

Structure of the Foot

tarsometatarsal and intermetatarsal joints

- Nonaxial joints that permit only gliding movements
- Enable the foot to function as a semirigid unit and to adapt flexibly to uneven surfaces during weight bearing

Structure of the Foot

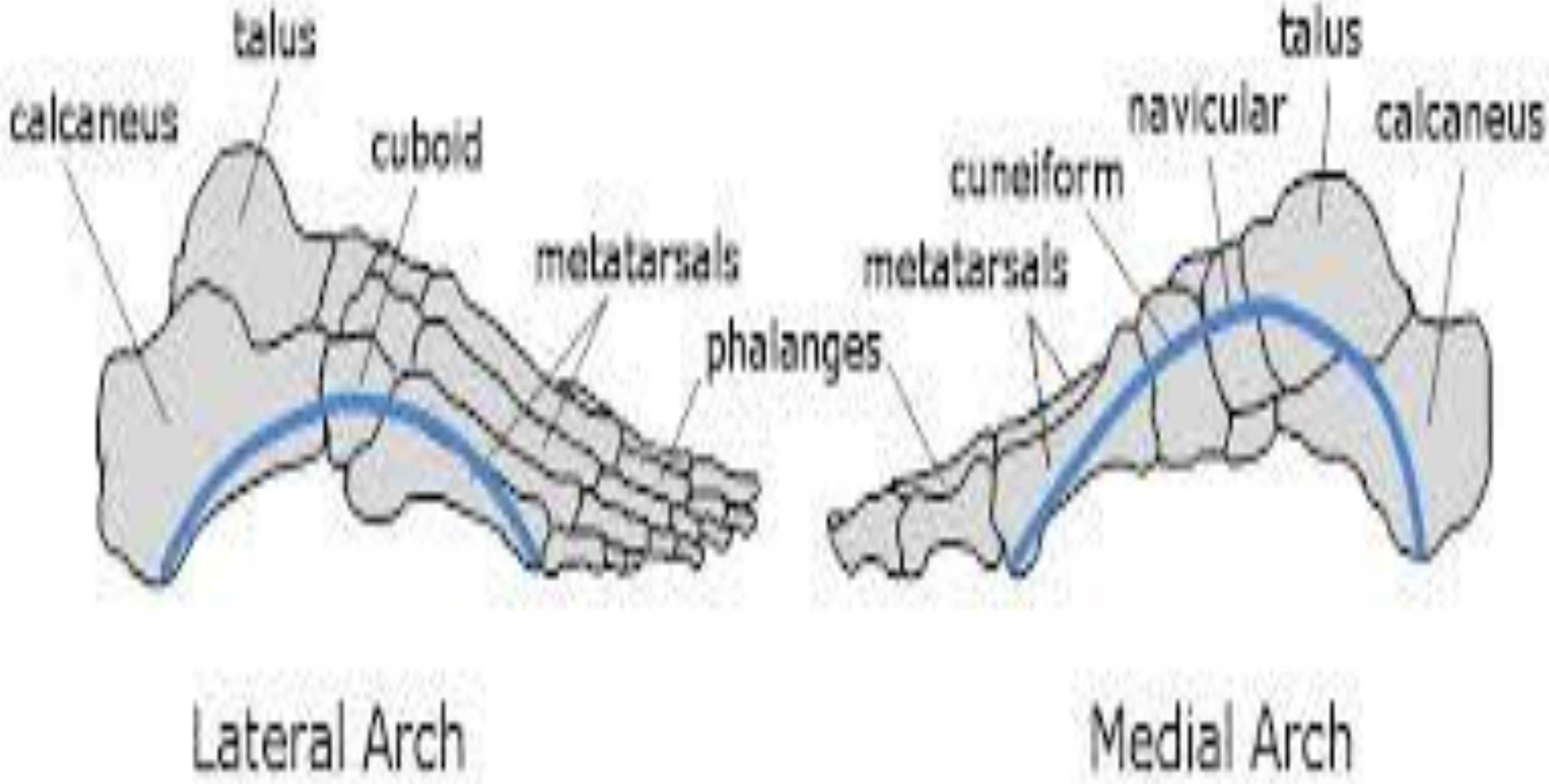
metatarsophalangeal and interphalangeal joints

- Condyloid and hinge joints, respectively
- Toes function to smooth weight shift to the opposite foot during walking and help maintain stability during weight bearing by pressing against the ground when necessary

Structure of the Foot

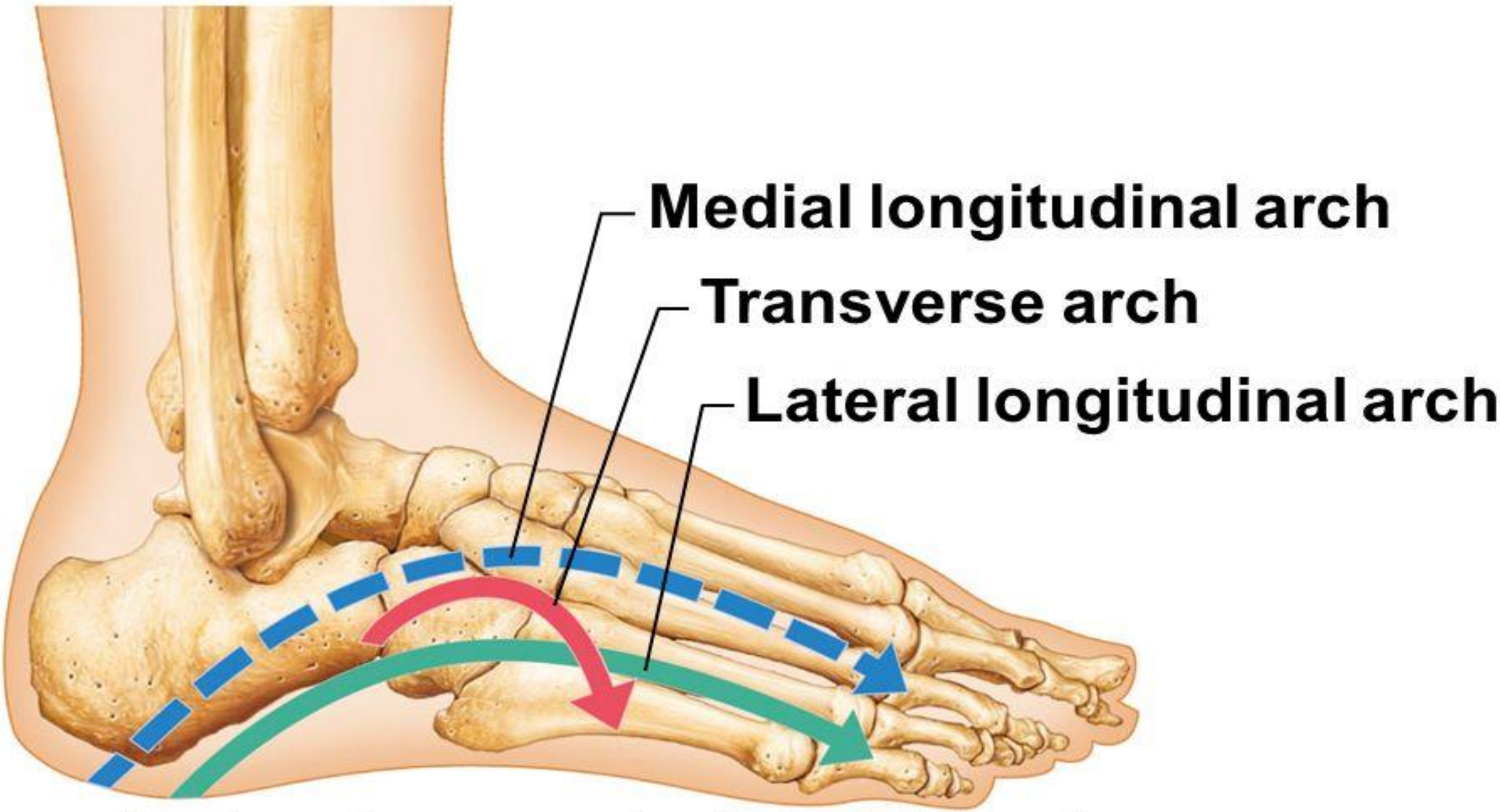
plantar arches

- The medial and lateral longitudinal arches stretch **form the calcaneus to the metatarsals and tarsals**
- The transverse arch is formed by the base of the metatarsal bones

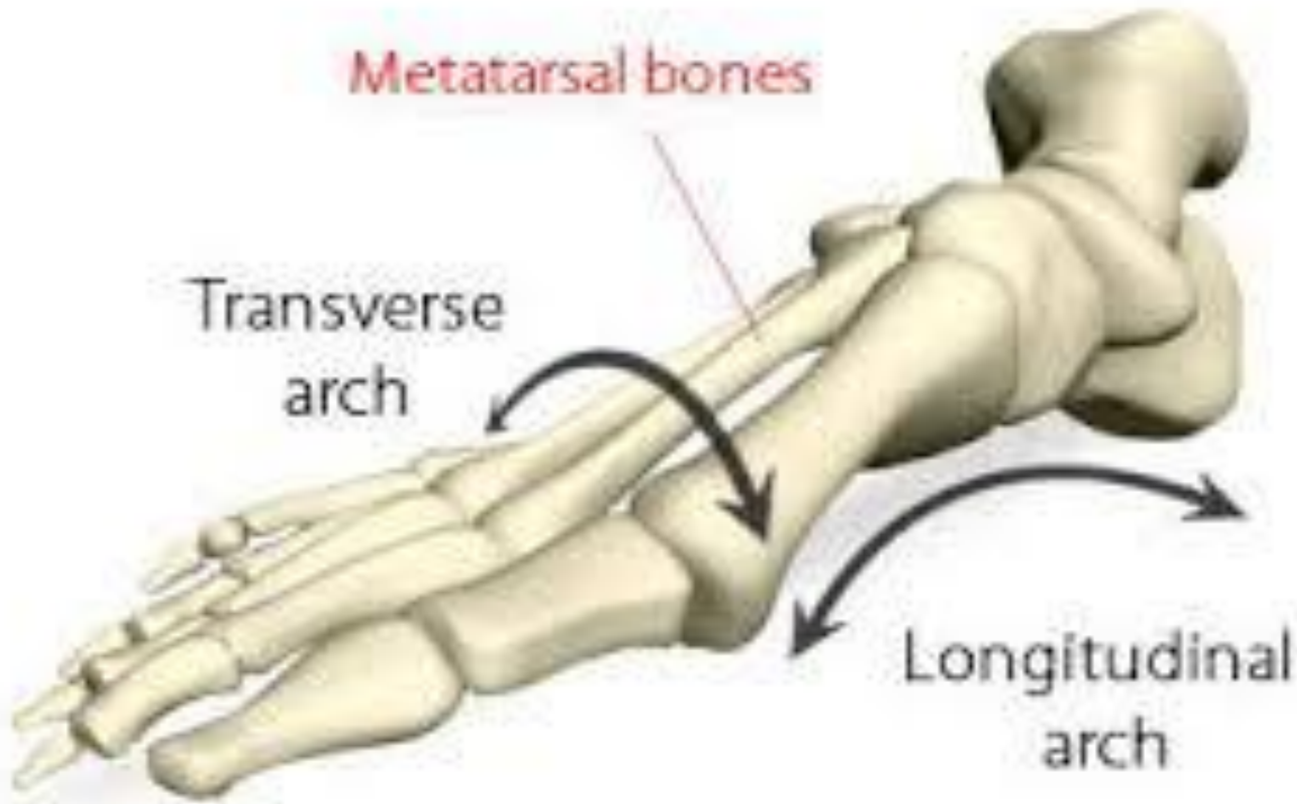


talus
calcaneus
cuboid
metatarsals
phalanges
Lateral Arch
talus
navicular
calcaneus
cuneiform
metatarsals
Medial Arch

Figure 7.35a Arches of the foot.



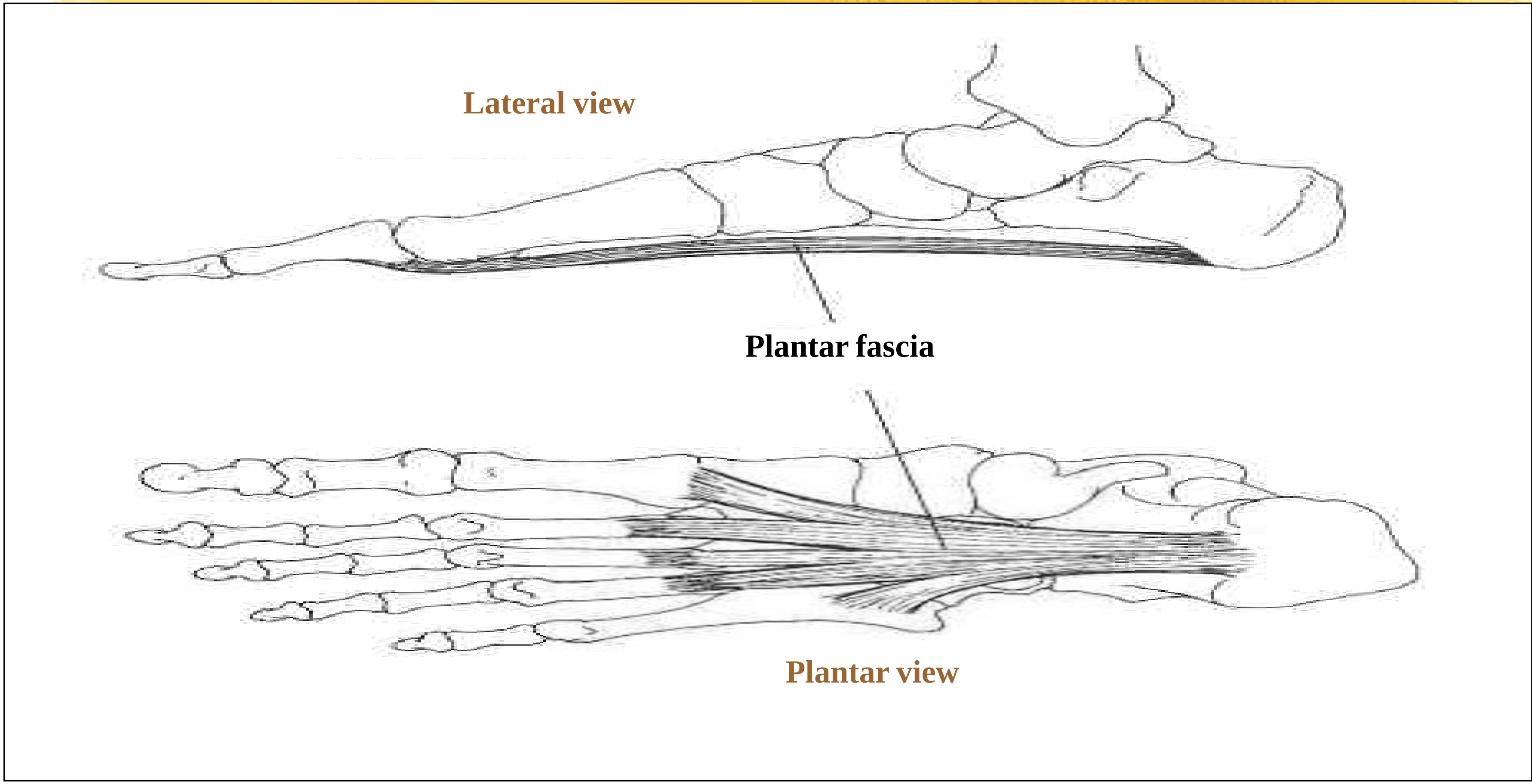
(a) Lateral aspect of right foot


Metatarsal bones
Transverse
arch
Longitudinal
arch

Plantar Fascia

- Thick bands of fascia that cover the plantar aspects of the foot
- **During weight bearing**= mechanical energy is stored in the stretched ligaments, tendons, and plantar fascia of the foot.
- This energy is released to assist with push-off of the foot from the surface.

Structure of the Foot



The plantar fascia.

Movements of the Foot

Toe flexion and extension

- **Flexion** - flexor digitorum longus, flexor digitorum brevis, lumbricals, Interossei
- **Extension** - extensor hallucis longus, extensor digitorum longus, extensor digitorum brevis

Movements of the Foot

Inversion and eversion

- **Inversion -** Tibialis posterior, Tibialis anterior
- **Eversion -** peroneus longus, peroneus brevis, assisted by peroneus tertius


Inversion
Damaged Ligaments


Eversion
Damaged Ligaments
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Common injuries of the ankle and foot

- **Ankle injuries**
- Inversion sprains= stretching or rupture of lateral ligaments (ATFL, PTFL, CFL)
- Medial = deltoid ligament very strong (ATTL, PTTL, TCL, TNL)
- **Ankle bracing or taping (Mild injury treatment)**

Ankle sprain

- Greater inversion increases the potential for over-stretching of the lateral ligaments.
- Most sprains involve the lateral ligaments from excessive inversion.
- Deltoid ligament is sprained less often (25% of ankle sprains)
- Of the lateral ligments, the ATFL is sprained the most often followed by the CFL
- Sprains occur most often with the foot in plantar flexion and inversion
- The medial malleolus is shorter than the lateral mallelous so there is naturally more inversion than eversion.


Tears in lateral collateral ligaments (LCL)
Grade I
Grade II
Grade III
Posterior talofibular ligament
Anterior talofibular ligament
Calcaneofibular ligament
Hackner & Müller LLC


Normal Anatomy
Ankle ligaments
GRADE I
GRADE II
GRADE III


1.
2.
3.
4.
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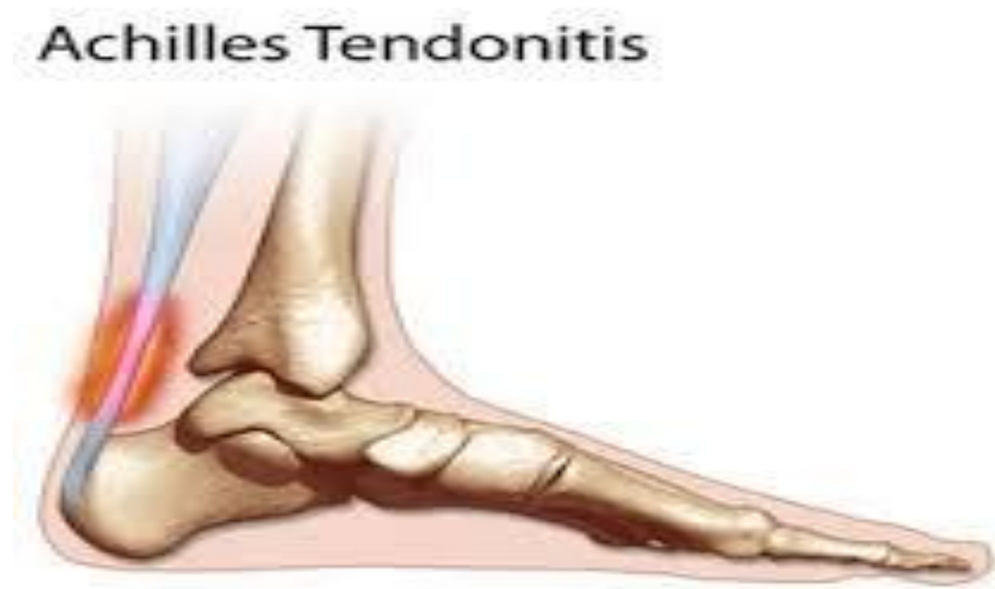
OVERUSE INJURIES

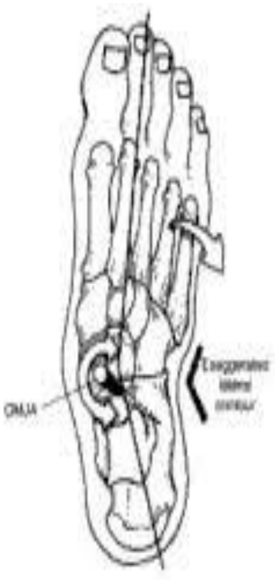
- Achilles tendinitis
- Plantar fascitis
- Stress fractures

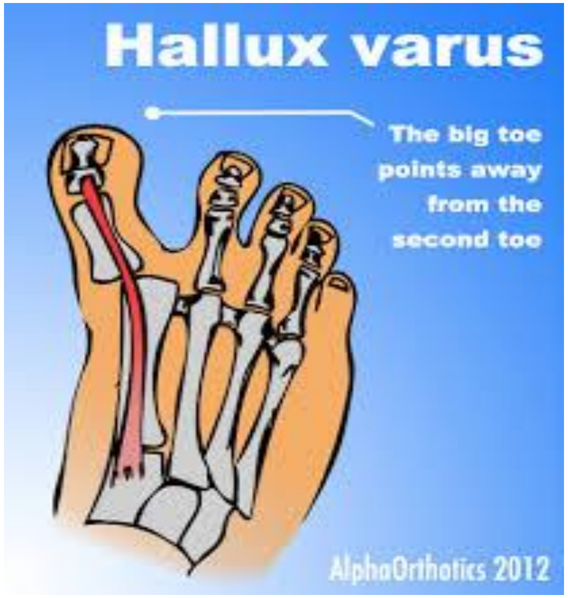


- *Dancing en pointe* = stressed second metatarsal

Alignment anomalies of the foot

- Forefoot Valgus
- Forefoot Varus
- Hallux Valgus
- Hallux Varus





Injuries related to high and low arch structures

High arches(pes cavus)= increased incidence of ankle sprains, plantar fascitis, ITB friction syndrome, 5th metatarsal fracture

Low arches (pes planus)= knee pain, patellar tendinitis, plantarfascitis,

END OF LECTURE