ANATOMY OF THE

Lower Limb

Professor

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Lower Limb Joints 1

- To classify the joints relative to structure & shape
- To describe the anatomy of the hip joint
- To describe the ankle joint
- To memorize their blood & nerve supply

JOINTS:

- Joints are sites where skeletal structures (bones &/or cartilages) are connected to each other
- Joints are designed for movements though some are immobile
- Joints can form between two bones (most joints), two cartilages (like laryngeal joints), or bone & cartilage (like costo-chondral junctions)

Classification

Structural

(according to the material which holds the joint)

- Fibrous
- Cartilagenous
  - Primary
  - Secondary
- Synovial

Morphological

(according to the shape of articulating surfaces)

- Ball & socket
- Condyloid
- Gliding
- Hinge
- Pivot
- Saddle

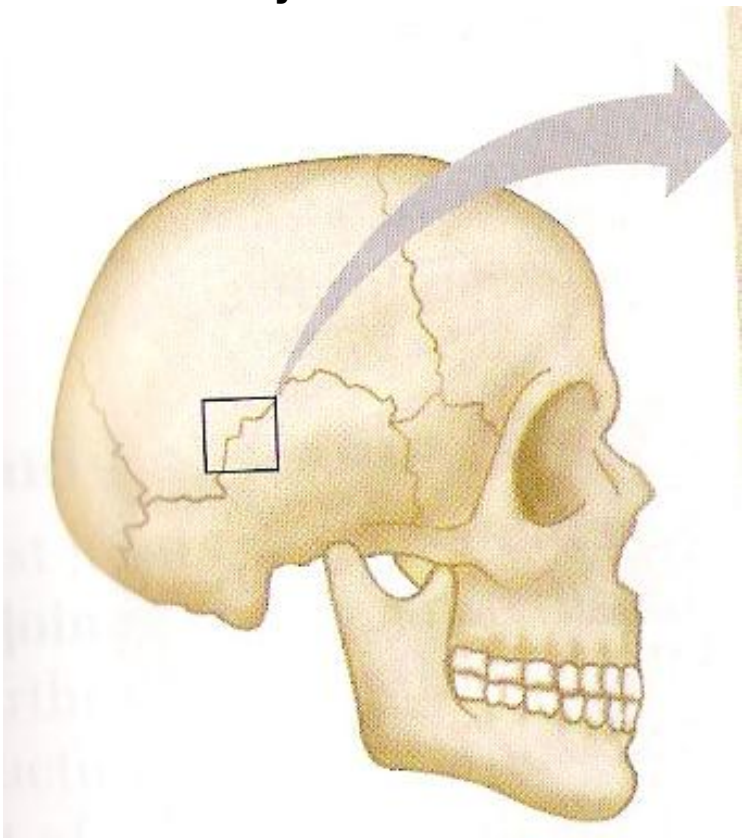
Structural types:

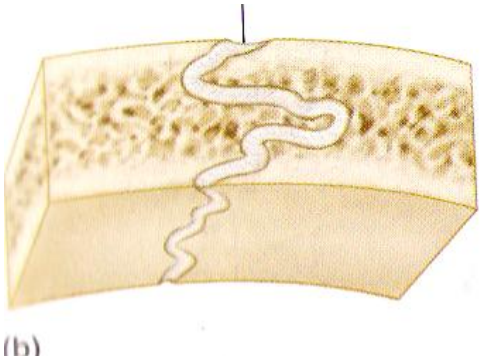
Fibrous joints:

-Articulating surfaces are fastened together by dense connective tissue containing collagen

-Most of them are immobile

-Examples; skull sutures, tibiofibular joints





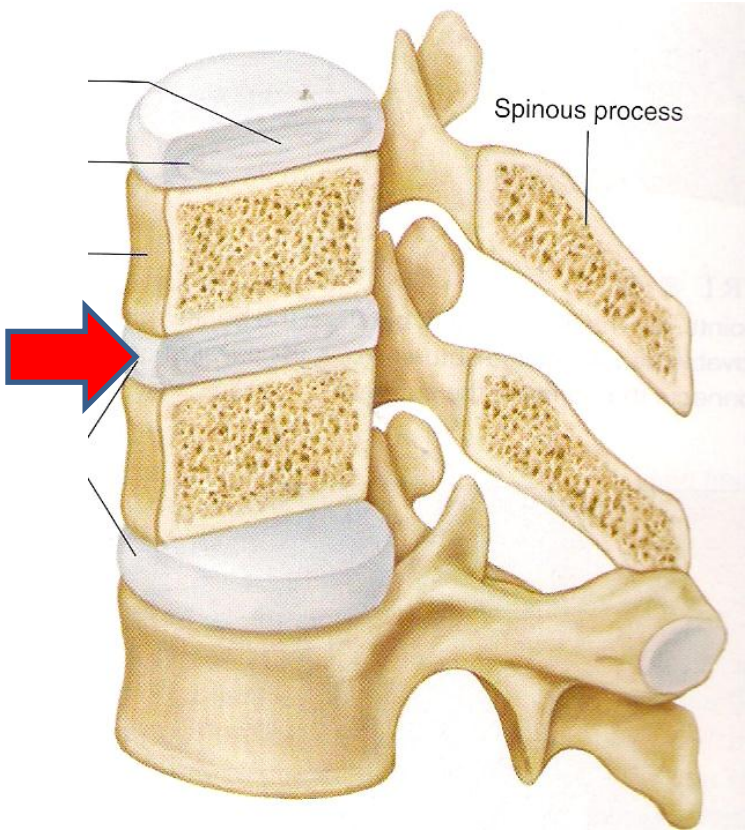
Cartilagenous joints:

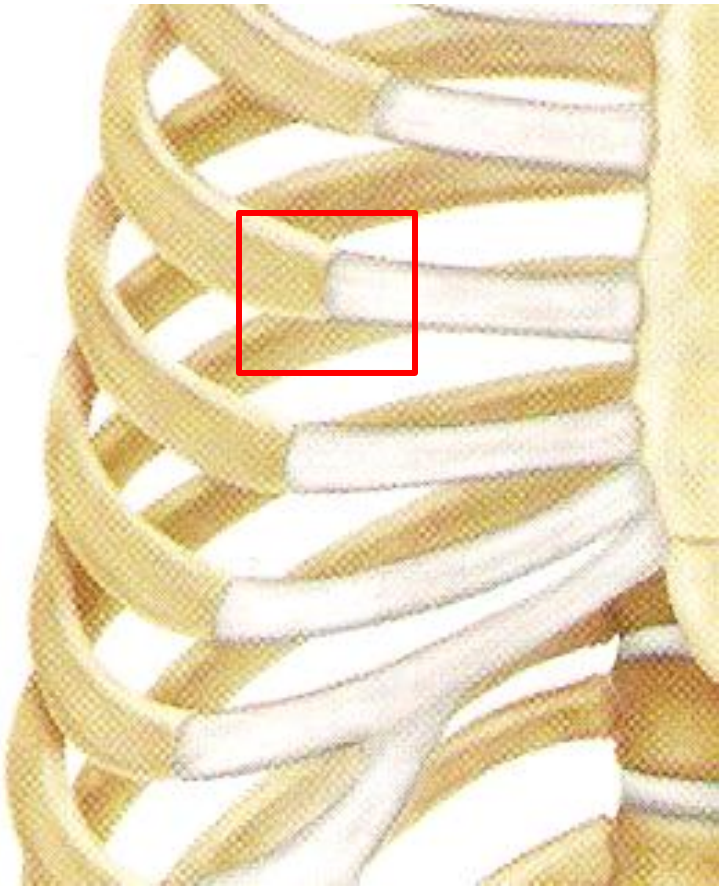
-Articulating surfaces are connected by hyaline cartilage or fibrocartilage

-They provide little or no movement

1- Primary cartilagenous joints; bone meets hyaline cartilage, like the costo-chondral joint

2- Secondary cartilagenous joints (symphesis); Bones covered by a hyaline cartilage & held by fibrocartilage, like intervertebral discs





Synovial joints:

Characterized by:

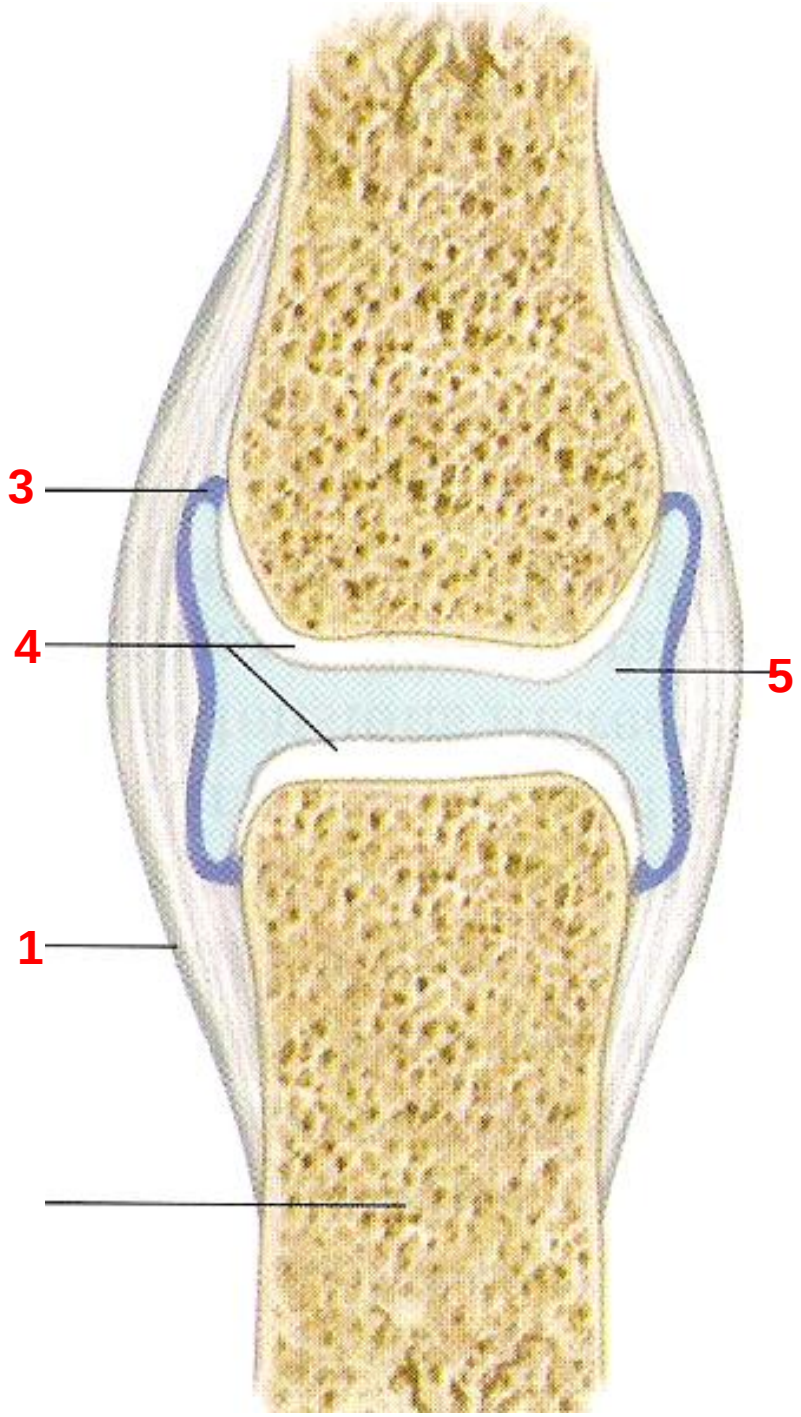
1- Surrounded by a joint capsule

2- Supported by ligaments

3- Lined with synovial membrane

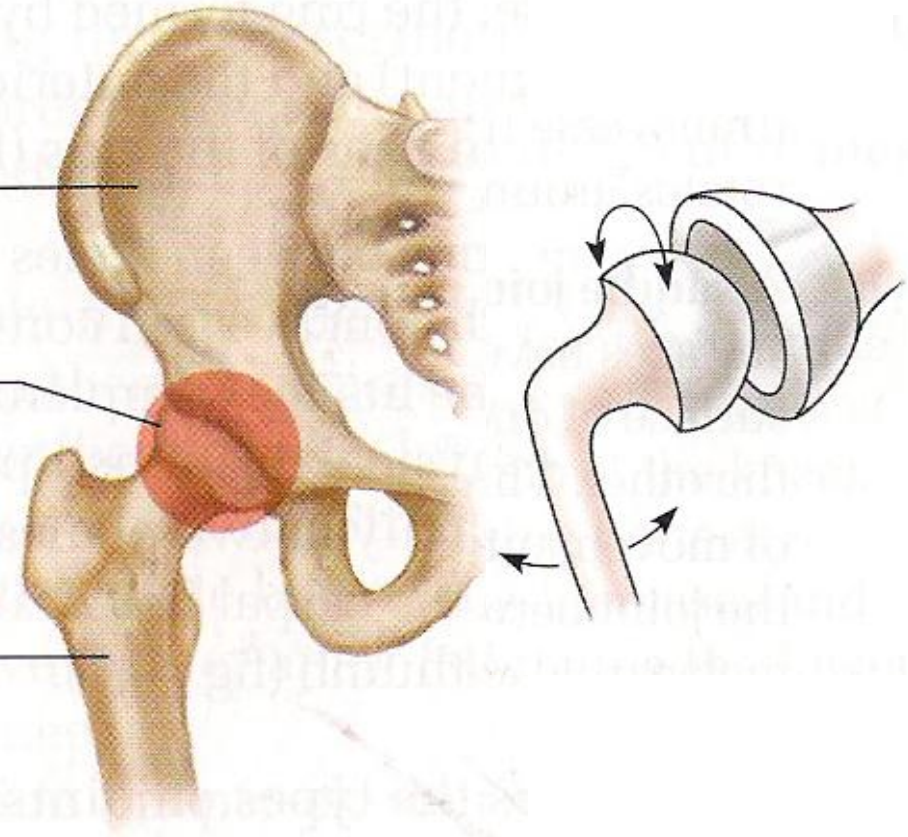
4- Covered by hyaline cartilage

5- Contains synovial fluid

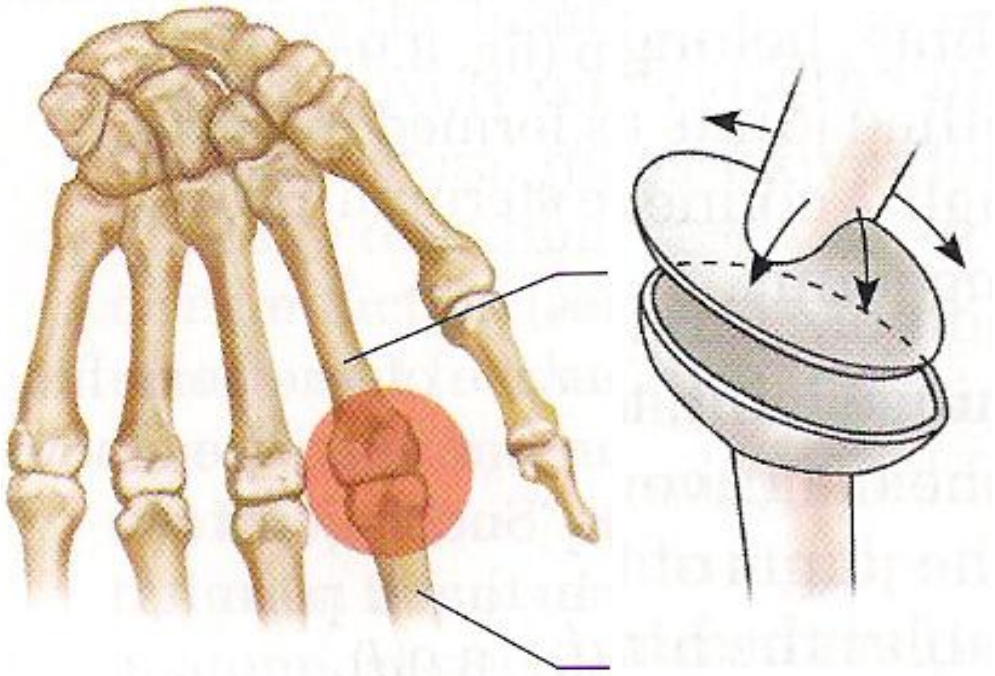


Morphological types:

Joint type	Description	Possible movement	example
1- Ball & socket	Ball-shaped head + cup-shaped socket	Free + rotation	Hip, shoulder
2- Condyloid	Oval condyle + elliptical cavity	Free without rotation	Metacarpo-phalyngeal

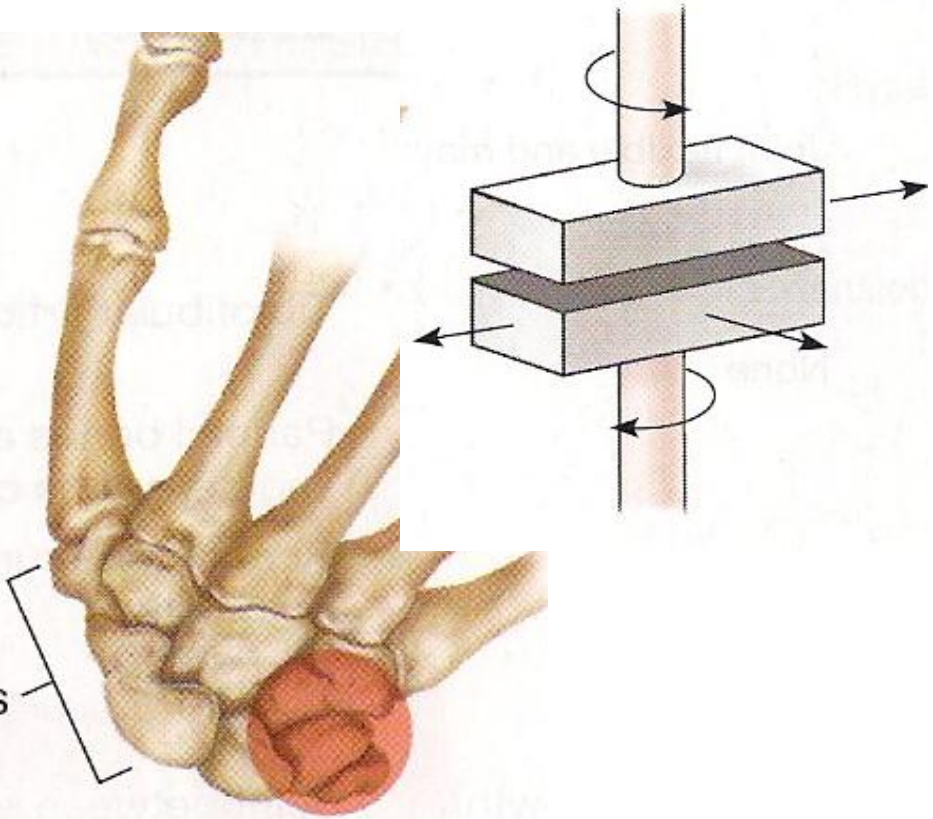


(a) Ball-and-socket joint

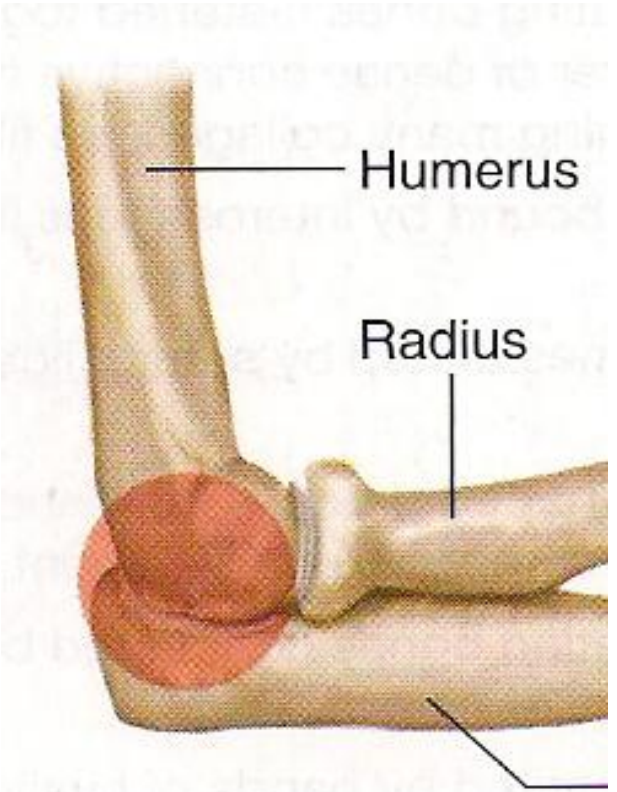


(b) Condyloid joint

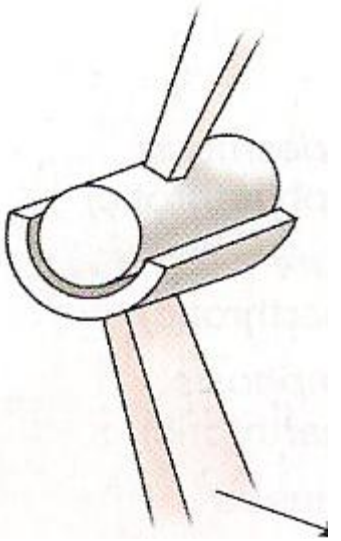
Joint type	Description	Possible movement	example
3- Gliding	Articulating surfaces are flat or slightly curved	Sliding or twisting	Intermetacarpal
4- Hinge	Convex surface + concave one	Flexion-extension	Elbow



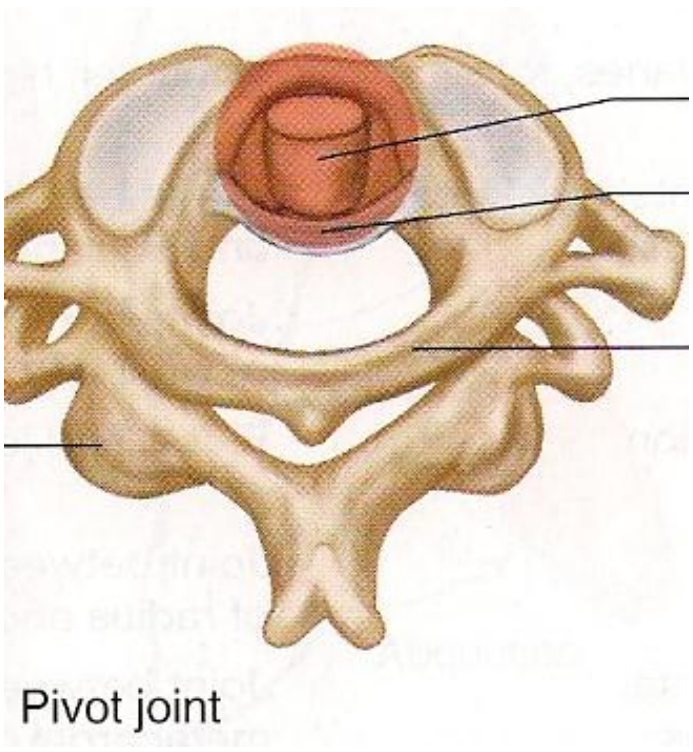
(c) Gliding joint

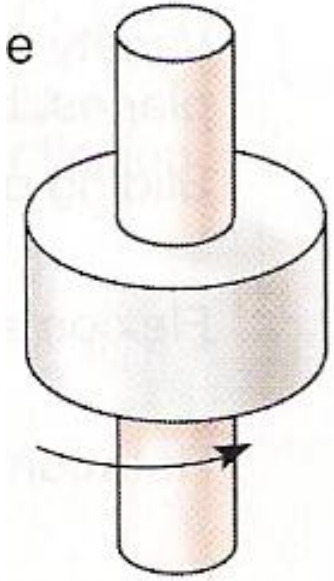


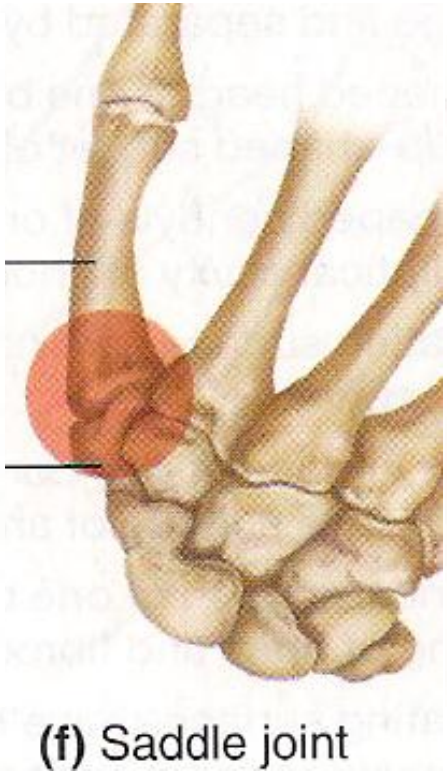
(d) Hinge joint

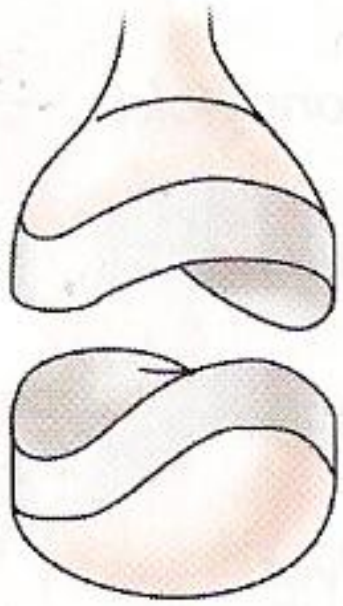


Joint type	Description	Possible movement	example
5- Pivot	Cylindrical surface + ring surface	Rotation	Atlantoaxial
6- Saddle	Articulating surface is both convex & concave against complementary surface	Mainly movements in two planes	Carpometacarpal joint of thumb


Pivot joint




(f) Saddle joint



Joint stability:

The stability of joint is maintained by three main factors, morphological, ligamentous & muscular

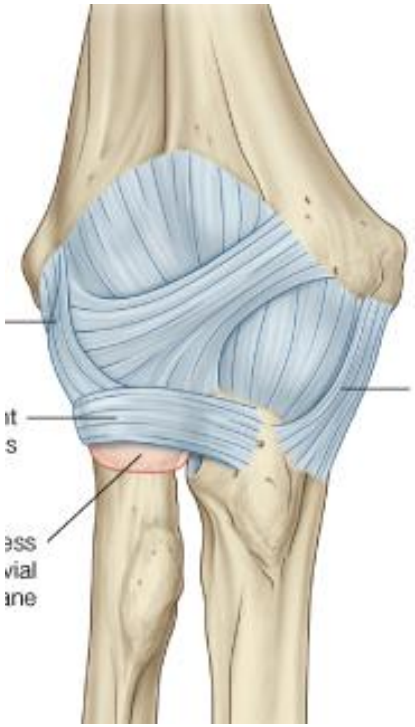
All these factors usually share in joint stability, although one of them will prdominates in specific joints

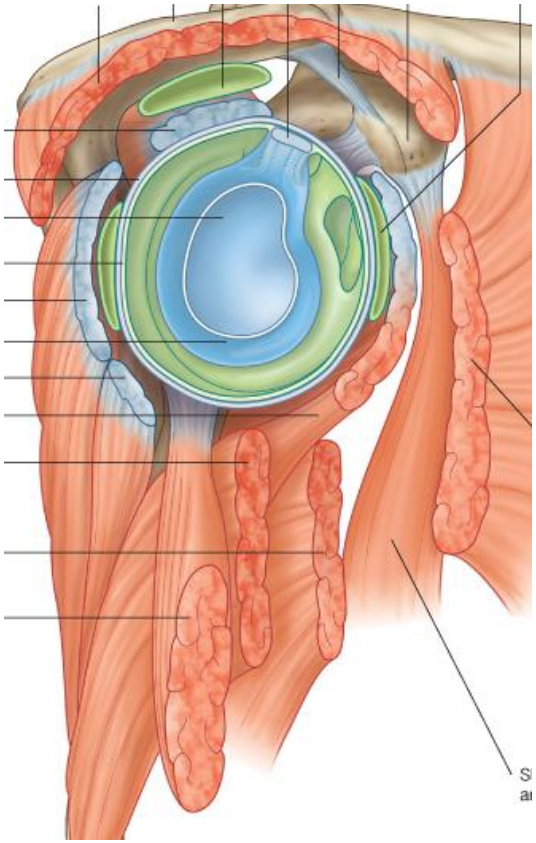
Examples:

1- The shape of the joint is the main stabilizing factor in the hip joint

2- Ligaments are the main stabilizing factor in the elbow joint

3- Muscular factor is the main stabilizing factor in the shoulder joint





Sacro-iliac joints:

-The SIJ transmit forces from the lower limbs to the vertebral column.

-They are synovial joints between the articular facets on the lateral surfaces of the sacrum and similar facets on the iliac parts of the pelvis

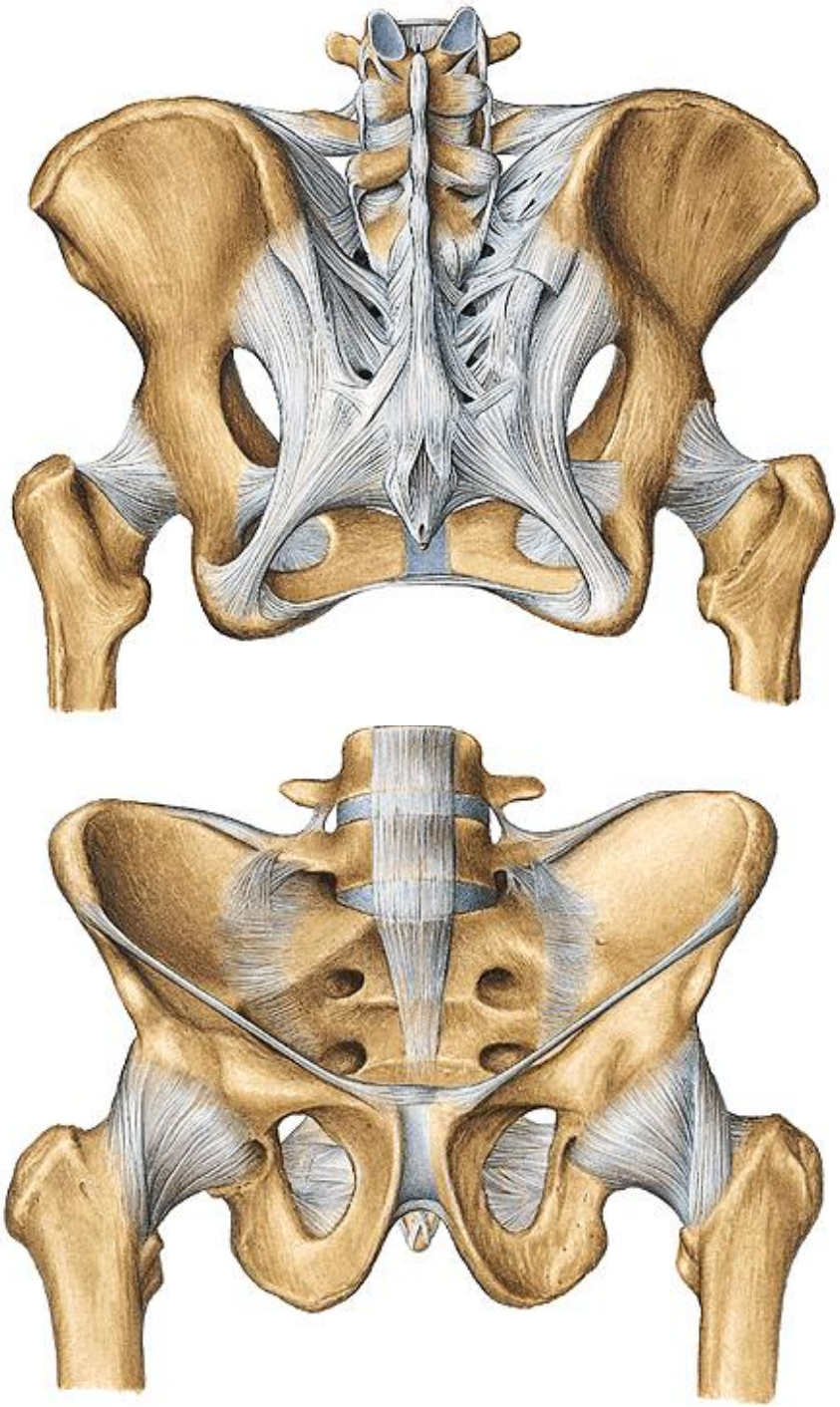
-The joint surfaces have an irregular contour and interlock to resist movement.

Ligaments:

1- Anterior sacro-iliac ligament

2- Interosseous sacro-iliac ligament

3- Posterior sacro-iliac ligament



Pubic symphysis:

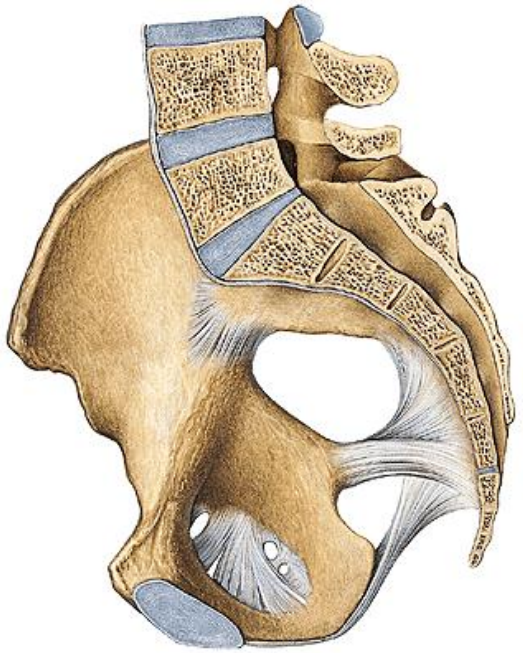
-A secondary cartilagenous joint between the adjacent surfaces of the pubic bones

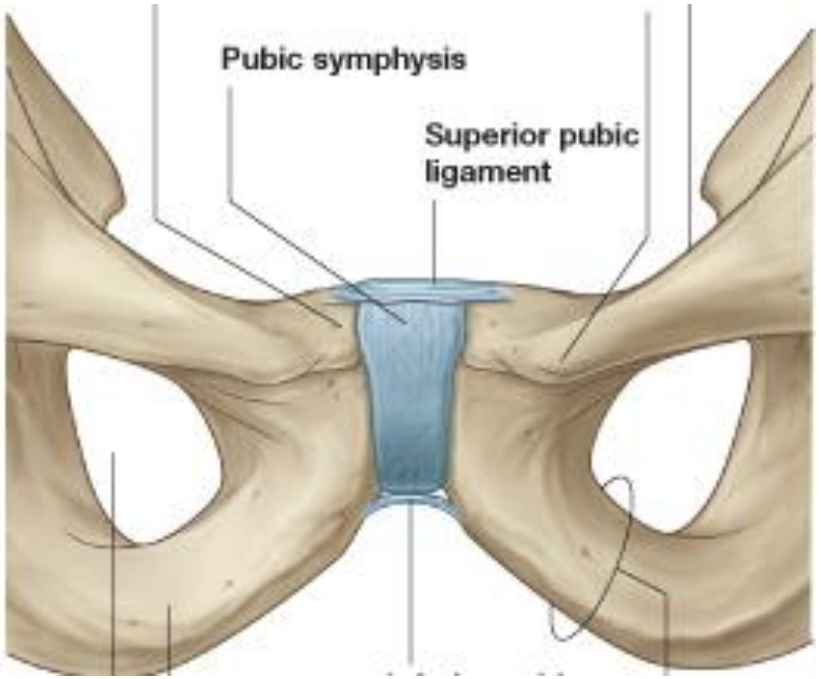
-Joint surfaces are linked across the midline by fibrocartilage

Ligaments:

1- The superior pubic ligament

2- The inferior pubic ligament



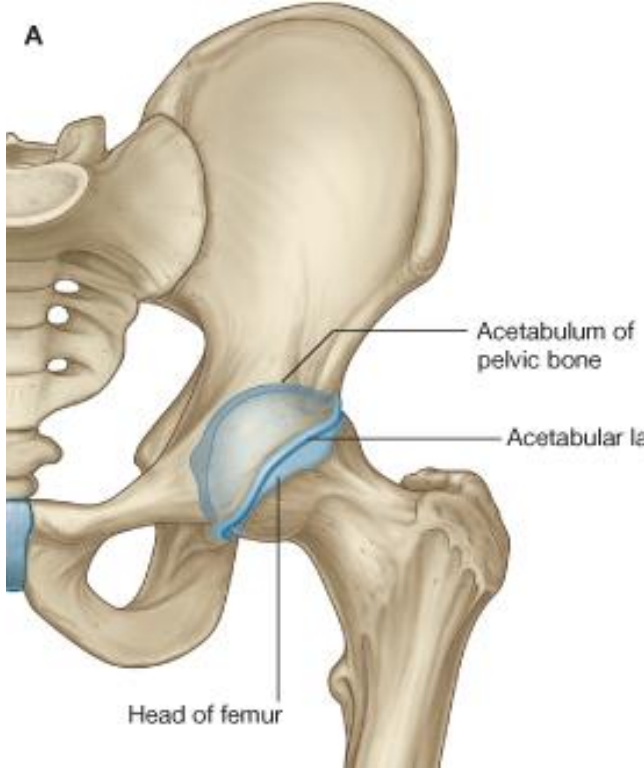


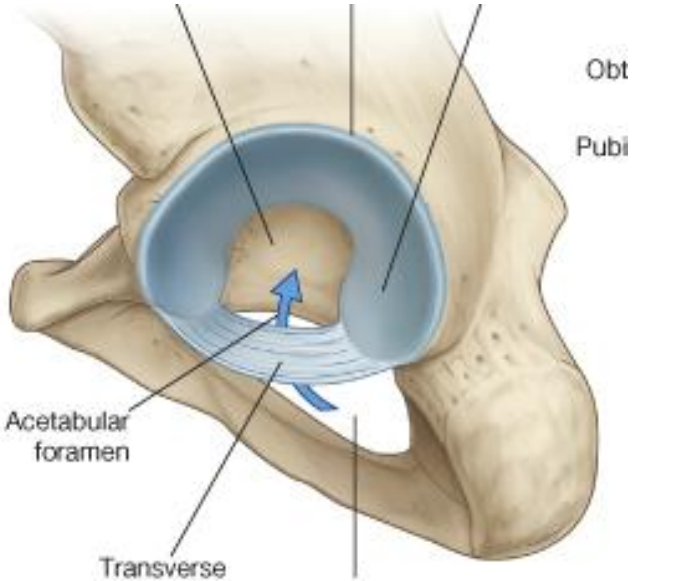
The hip joint:

-Is a synovial articulation between the head of the femur & the lunate surface of the acetabulum of the pelvic bone

-The joint is a multiaxial ball and socket joint designed for stability and weight bearing at the expense of mobility.

-Movements at the joint include flexion, extension, abduction, adduction, medial and lateral rotation, and circumduction.

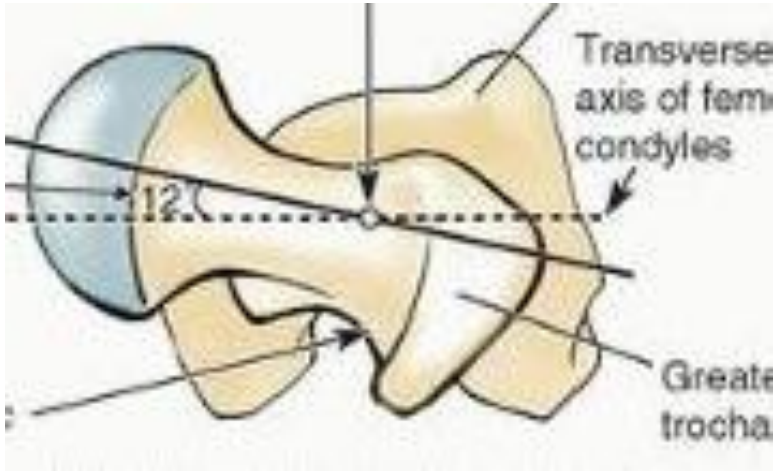




Angles of the femur:

Angle of inclination; The femur is "bent" so that the long axis of the head and neck lies at an angle of about 125^{O} to that of the shaft.

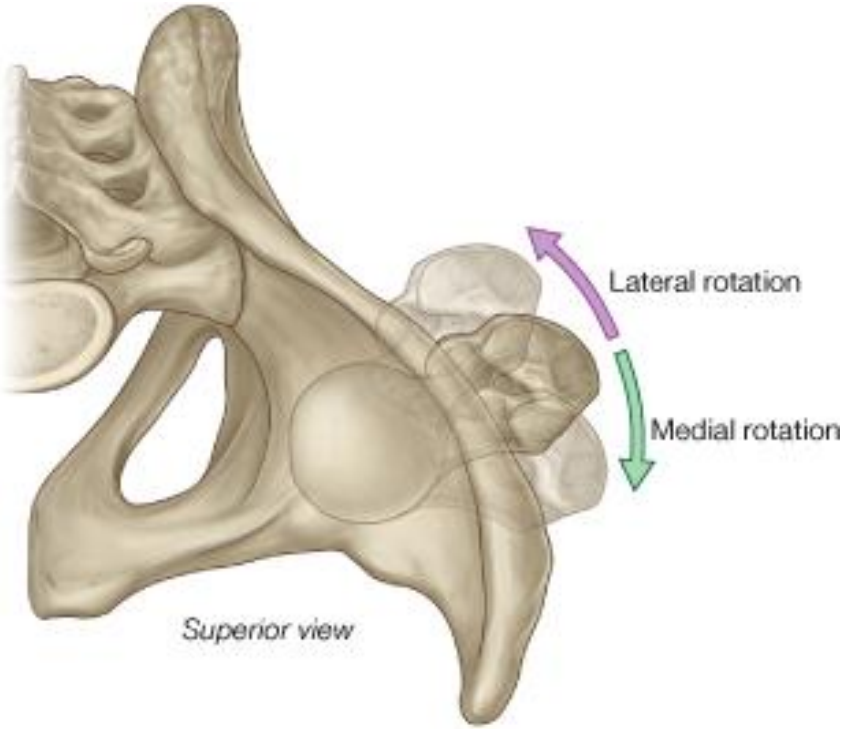
Angle of torsion; when looking at the femur from above, it can be seen that the axis of the head and neck forms a 12° angle with the transverse axis of the femoral condyles

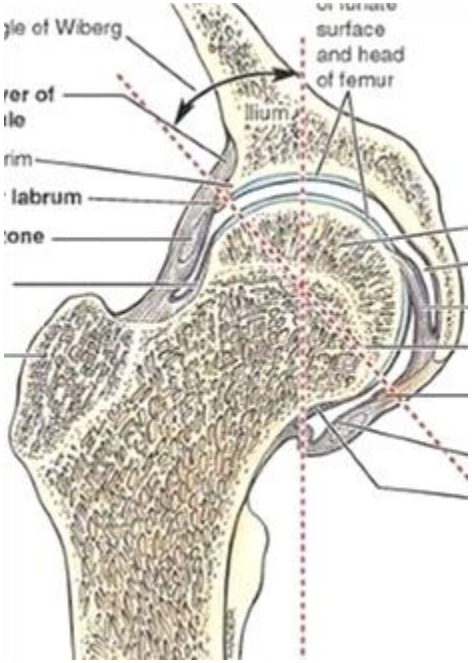


Mechanics:

When considering the effects of muscle action on the hip joint, these angles must be borne in mind.

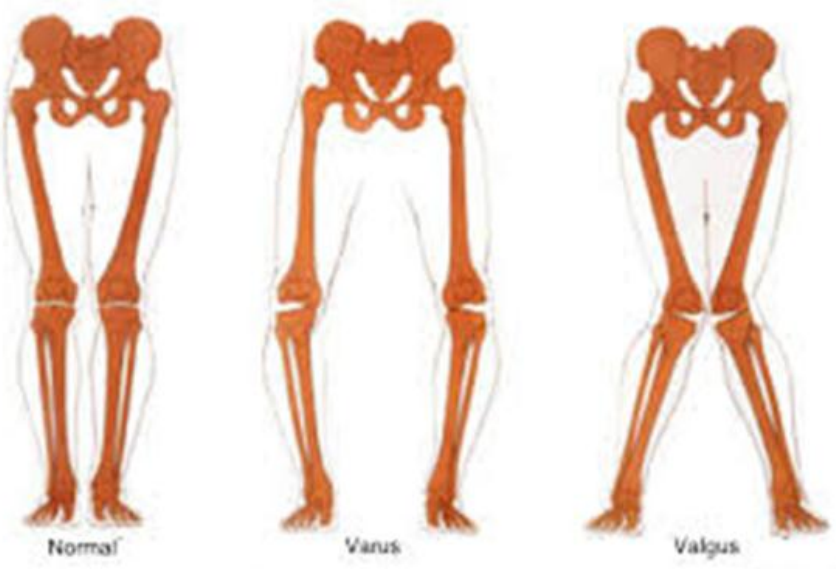
For example, medial and lateral rotation of the femur involves muscles that move the greater trochanter forward and backward, respectively, relative to the acetabulum

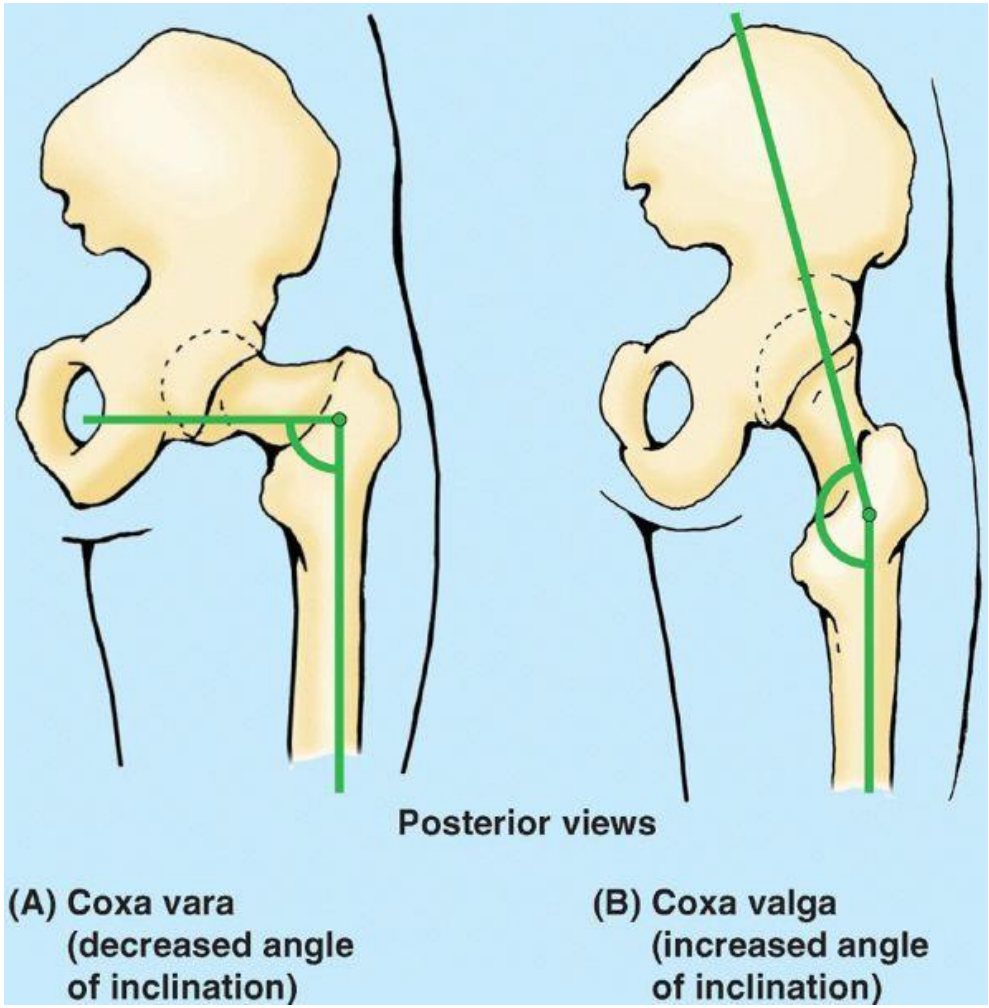




Abnormal inclination angle

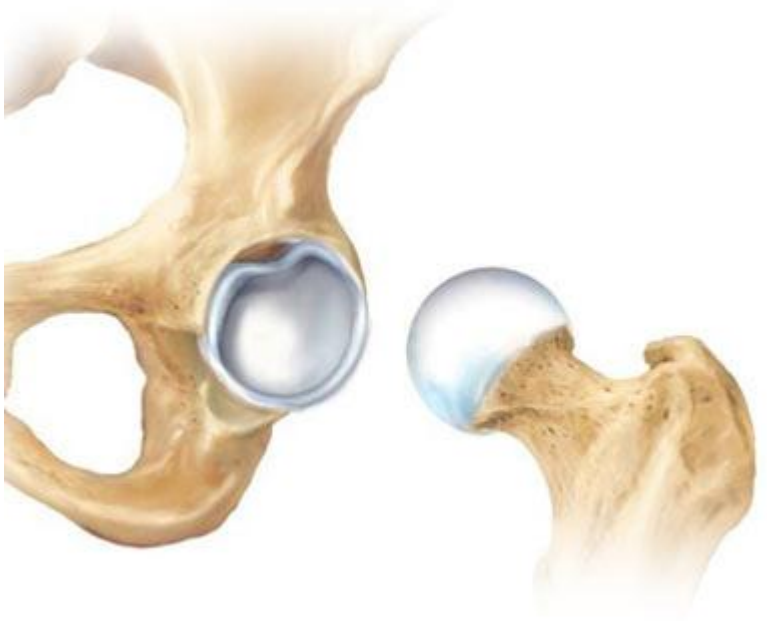
Limits certain movements





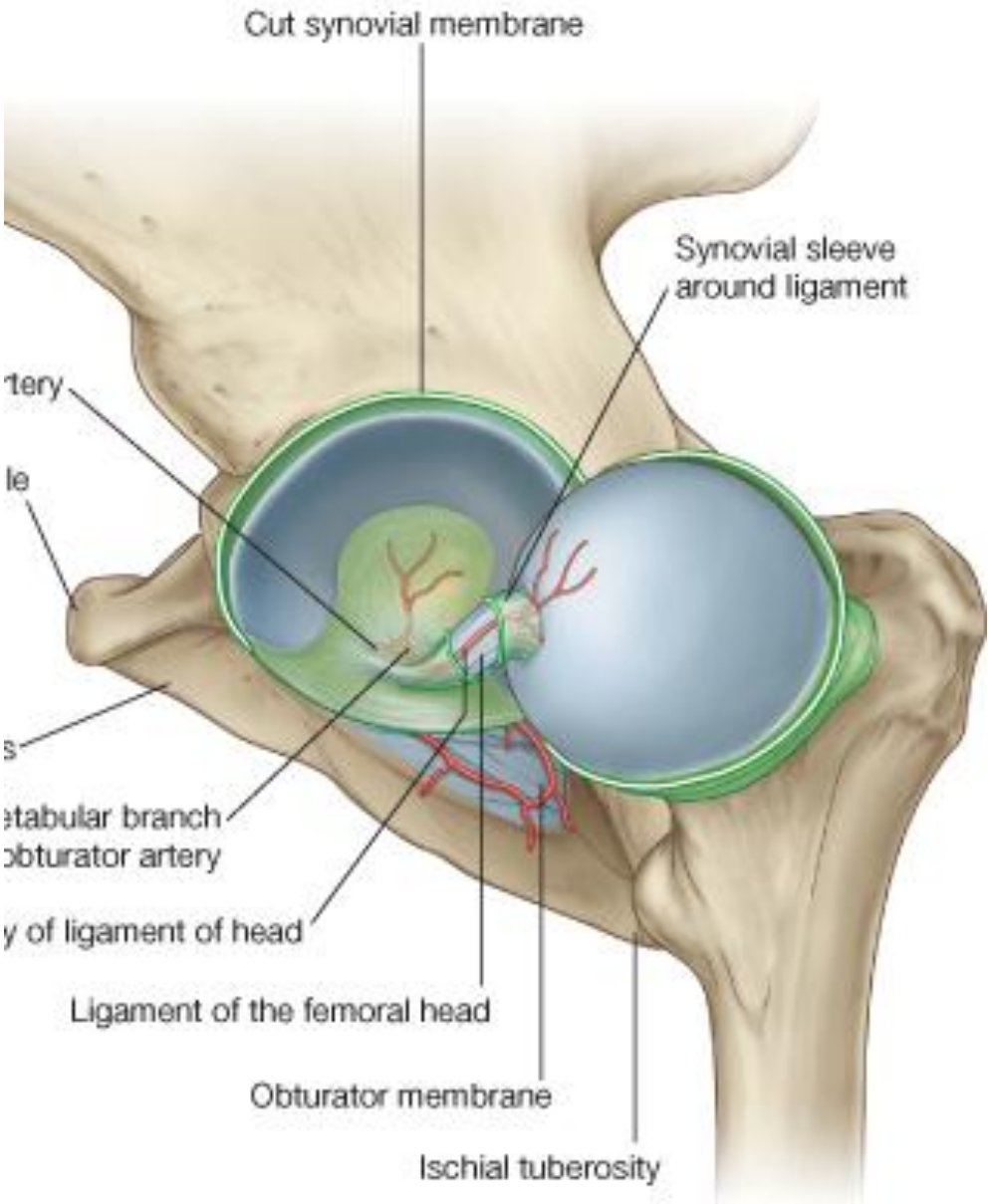
The ball & socket property:

- Complete typical ball-and-socket design of the hip is the major factor which predispose to its stability
- To increase this property, a rim of the acetabulum is raised slightly by an acetabular labrum
- Acetabular notch is bridged by the labrum & transverse acetabular ligament



Articular surfaces:

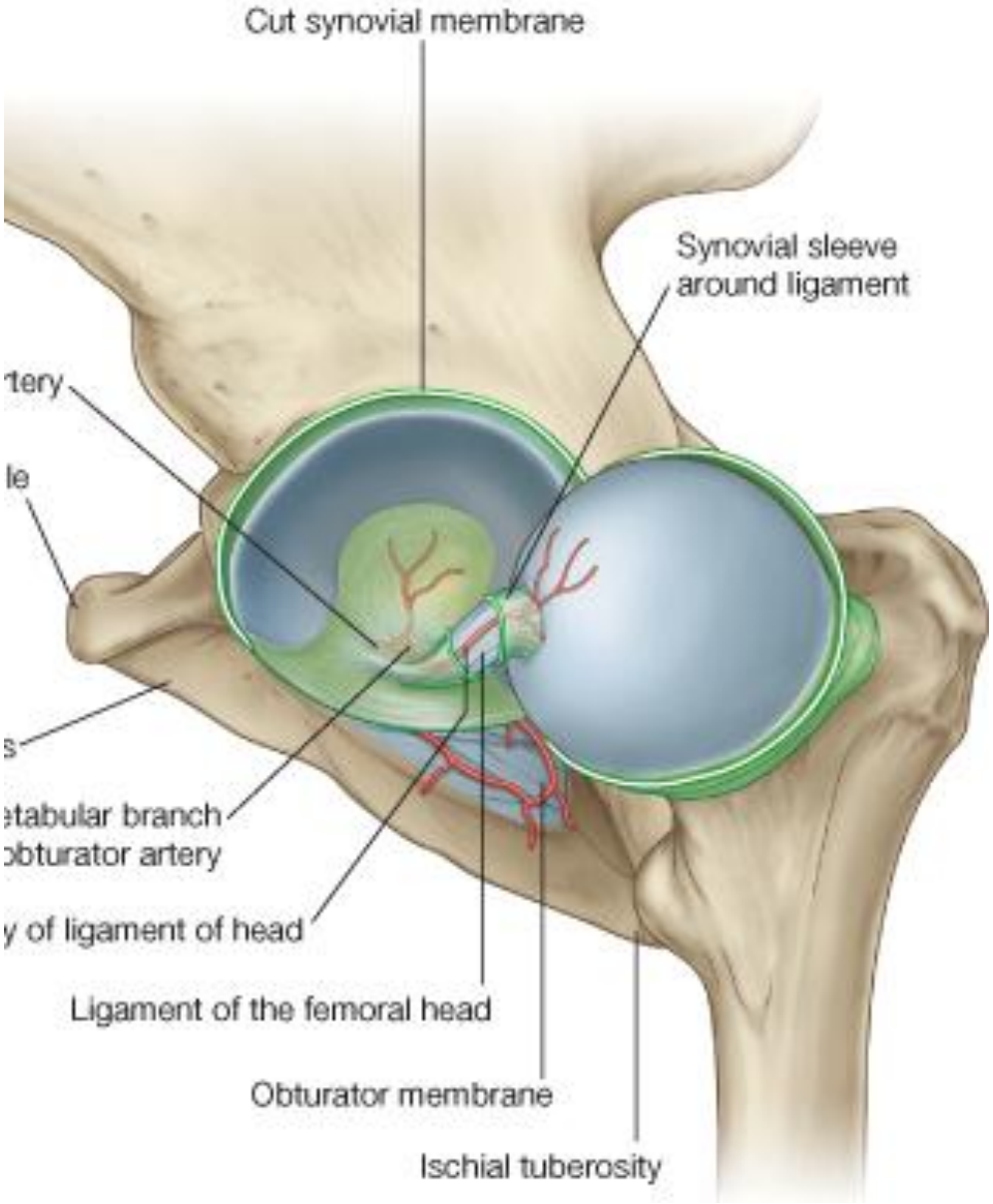
- **Except for the fovea, the head of the femur is covered by hyaline cartilage as well as the lunate surface of the acetabulum**
- **The non articular acetabular fossa contains loose connective tissue.**
- **Ligament of head of femur extends between these two non articular surfaces**



The synovium:

-The synovial membrane attaches to the margins of the articular surfaces of the femur and acetabulum

-From its attachment to the margin of the femoral head, the membrane covers the neck of the femur before reflecting onto the fibrous capsule

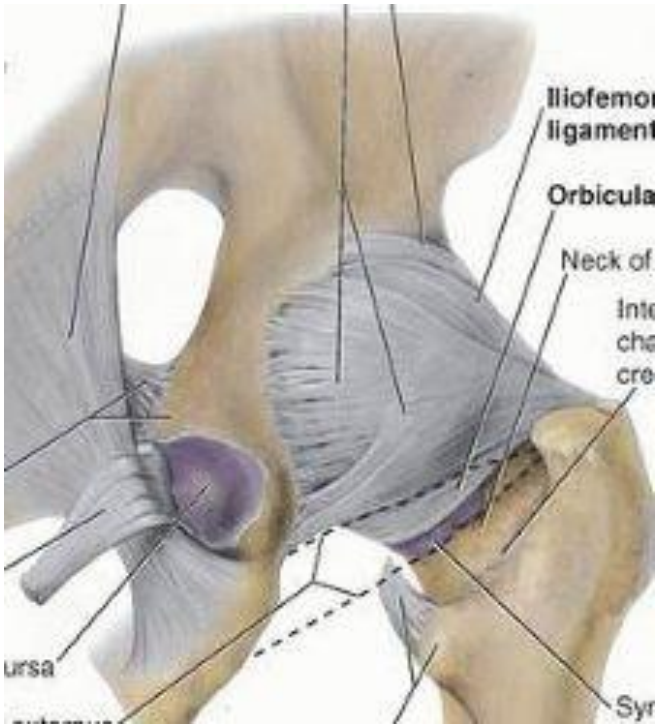


The capsule:

-Medially, it is attached to the margin of the acetabulum, the transverse acetabular ligament

- Laterally, it is attached to the intertrochanteric line anteriorly & to the neck posteriorly

-From the distal attachment, some of the capsule fibers return back on the neck of femur binding arterial branches to the femoral head (retinacular fibers)



Fracture neck of femur

Damage to retinacular fibers

Avascular necrosis of the head

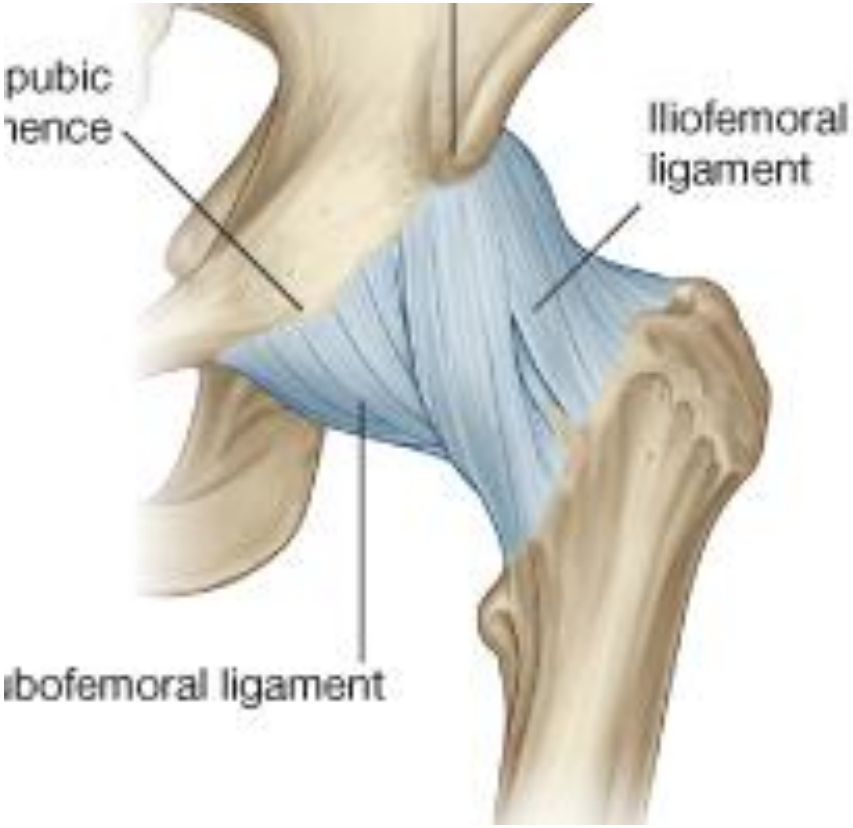
Often needs surgery

Ligaments:

The iliofemoral ligament:

-**Y- shaped ligament, lies anterior to the hip joint**

-**The stem is attached between the anterior inferior iliac spine & acetabulum while its base is attached between the ends of the intertrochanteric line.**

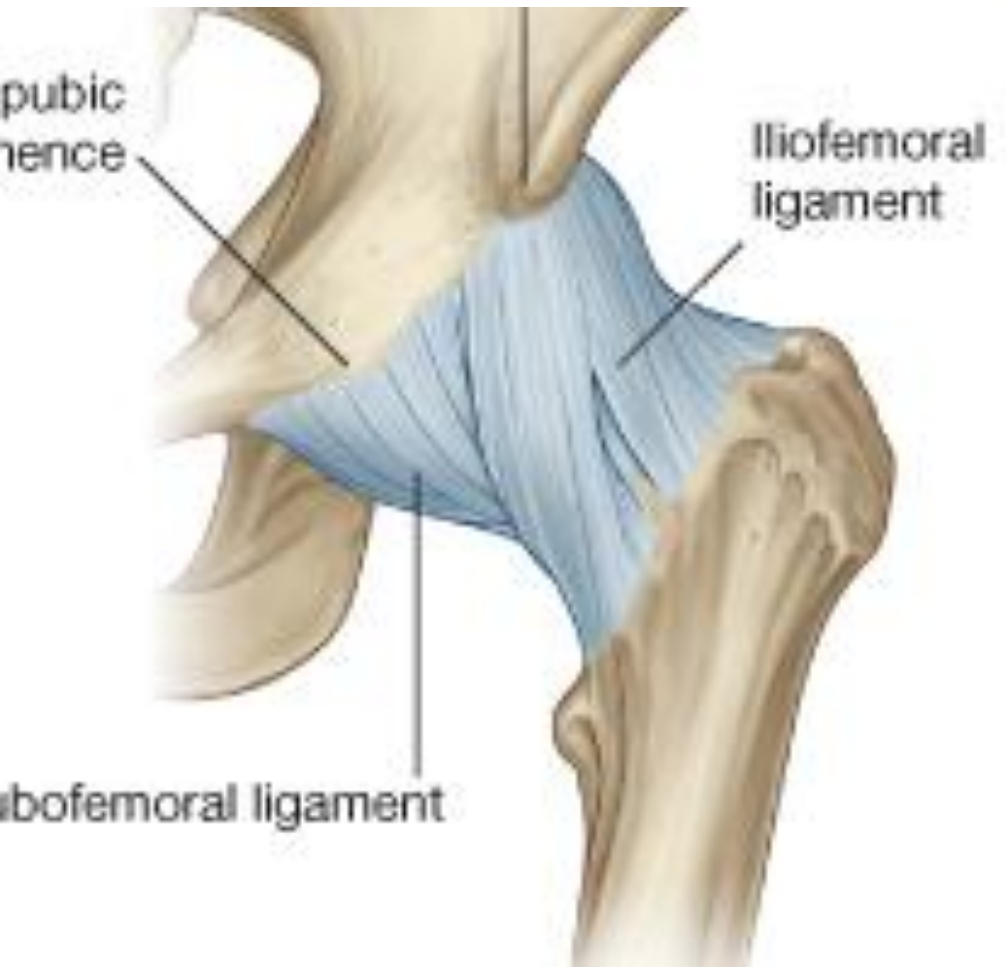


The pubofemoral ligament:

Lies on the anterior surface of the joint deep to the iliofemoral one

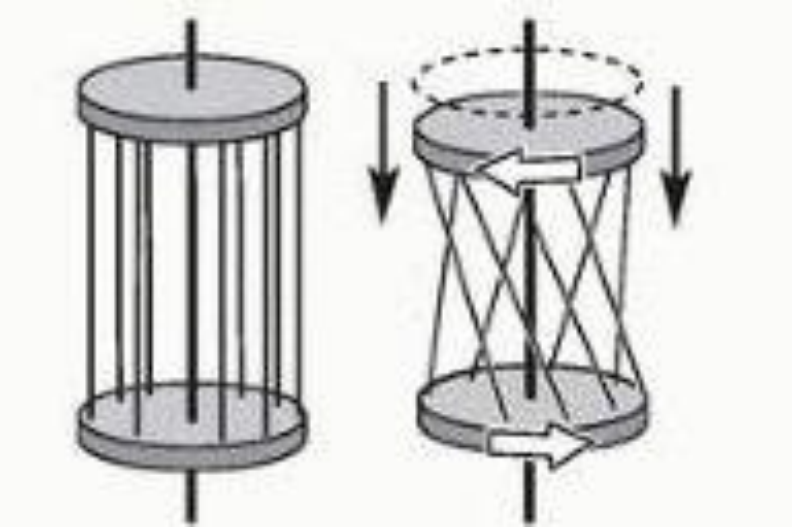
The ischiofemoral ligament:

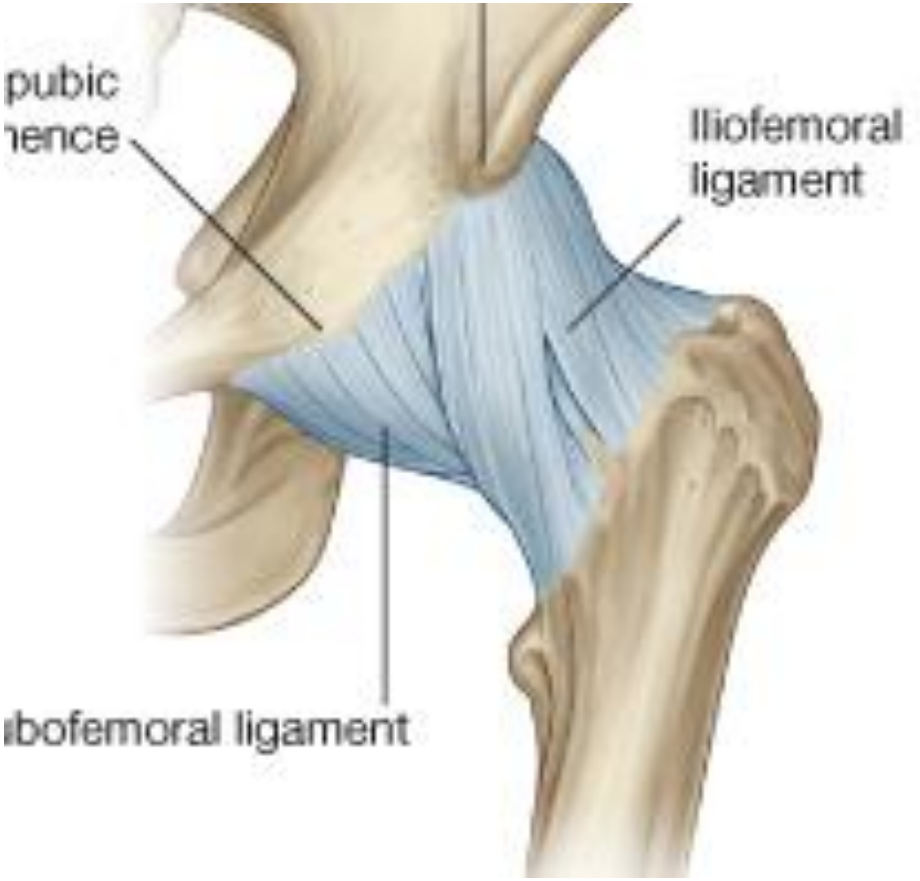
Reinforces the posterior aspect of the fibrous membrane



The fibers of all three ligaments are oriented in a spiral fashion around the hip joint so that they become taut when the joint is extended.

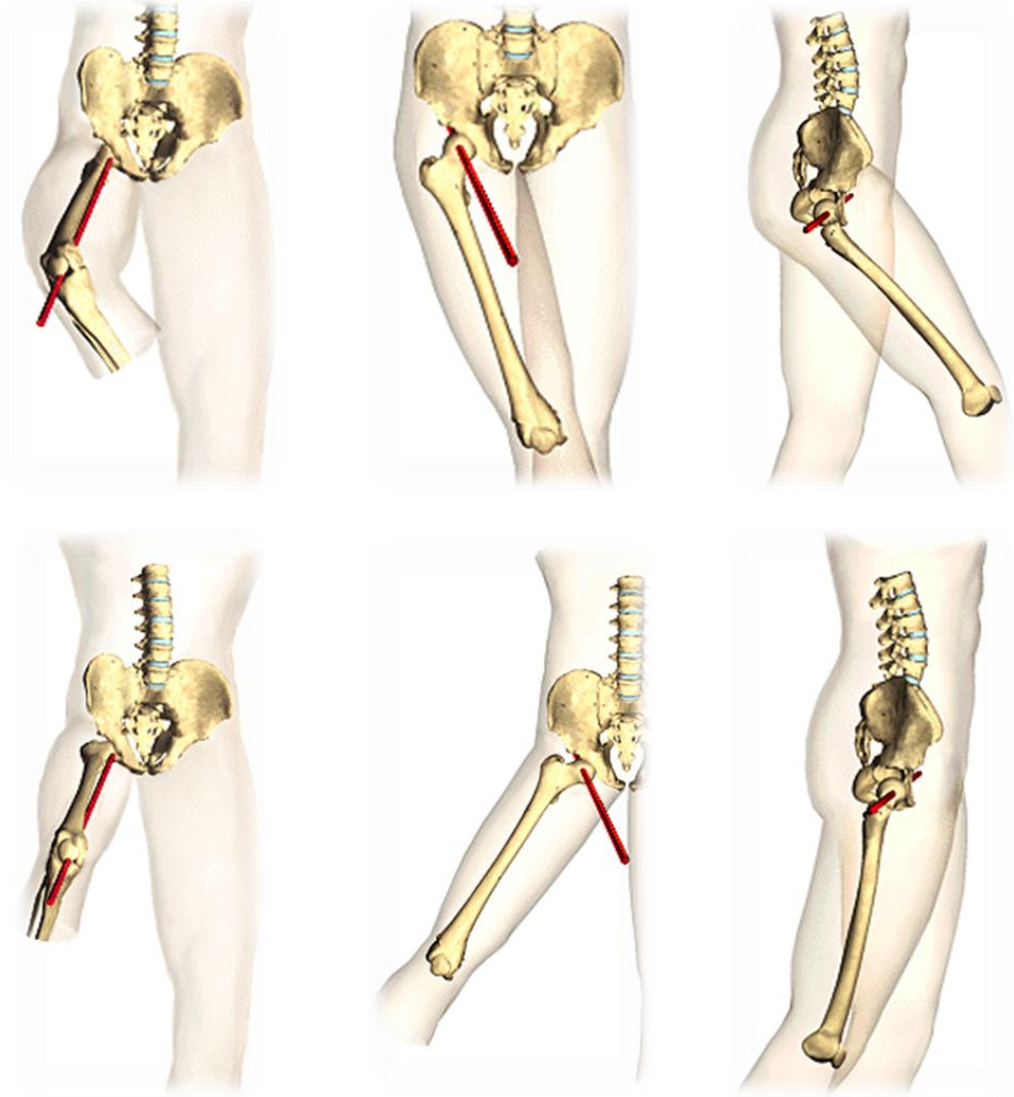
This stabilizes the joint and reduces the amount of muscle energy required to maintain a standing position.





Hip movements:

- Movements of the trunk at the hip joints are also important, such as those occurring when a person lifts the trunk from the supine position
- The degree of flexion and extension possible at the hip joint depends on the position of the knee. Flexed knee with relaxed hamstrings permits active flexion
- Iliofemoral ligament limits hip extension
- Abduction & lateral rotation have more range of movement than adduction & medial rotation because of the shape of joint & contact of lower limbs with each other



Vascular supply:

1- Head of femur; trochanteric anastomosis via retinacular fibers passing across the neck, the artery of head of femur is insufficient for the supply.

Fracture of femoral neck leads to death of femoral head!

2- The obturator, circumflex, gluteal & the first perforating branch of the deep artery of the thigh form a vascular network which supplies the joint.

Innervation:

The hip joint is innervated by articular branches from the femoral, obturator, superior gluteal nerves and nerve to the quadratus femoris (Hilton's law).