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Articular system II

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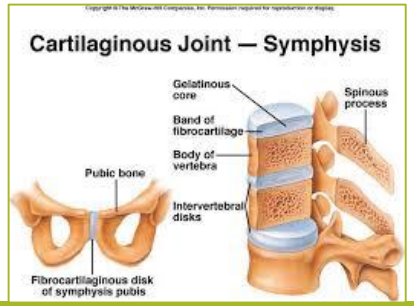
Cartilages

Hyaline

- Has an intercellular matrix rich in hyaluronic acid and mucopolysaccharides, which are natural lubricants
- Forms the articular cartilage in most joints
- Provides the anlage for long bone development

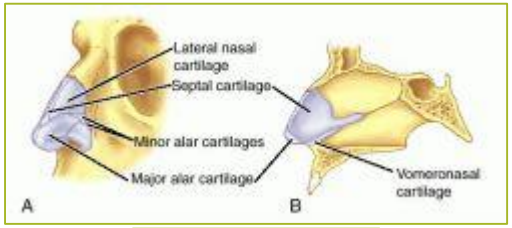
Fibrous

- Has an intercellular matrix rich in mucopolysaccharides and bundles of collagenous fibers
- Mucopolysaccharides provide high water content
- Especially resilient and durable form of cartilage
- Forms most symphyses and joint discs



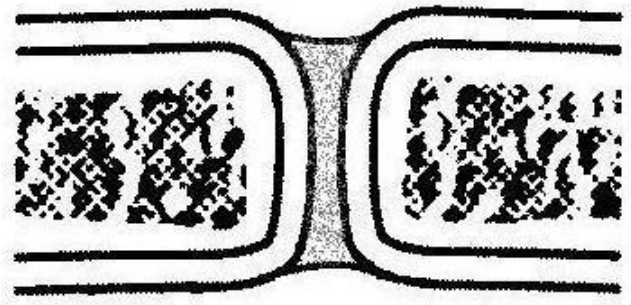
Elastic

- Has an intercellular matrix rich in mucopolysaccharides and bundles of elastic fibers, which provide a strong, yet flexible, support
- Forms the skeletal structure of external ear and the tip of the nose

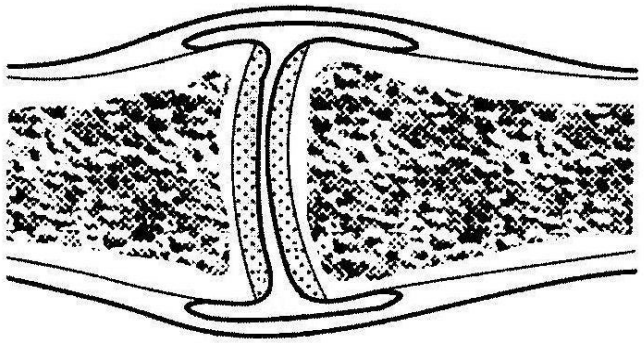


Classification of the joints

1.Synarthrosis
(immovable joint):
1)Syn*desmos*is
2)Syn*chondros*is
3)Syn*os*tosis



2. Diarthrosis
(synovial joint, joint)



Complexity of the joints

Simple joint

- two articular surfaces

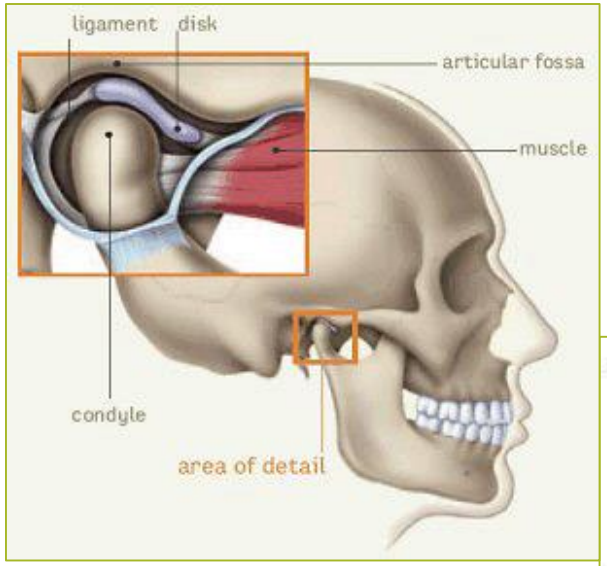
Complex joint

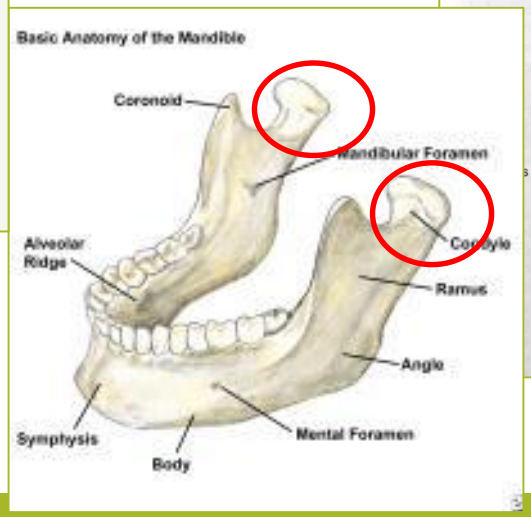
- more than two articular surfaces

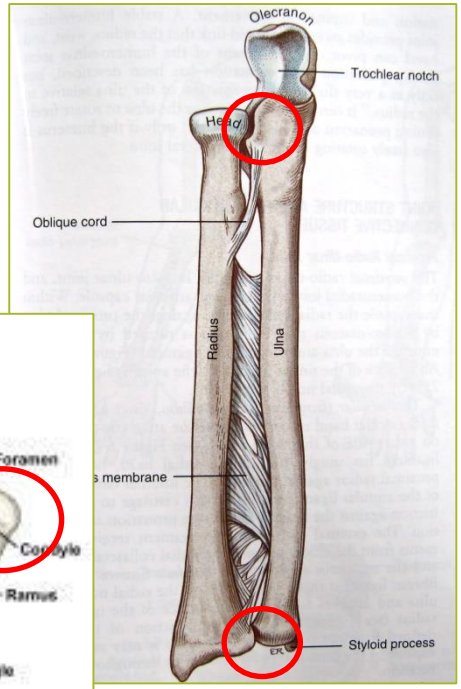
Synovial joints

Combined joint

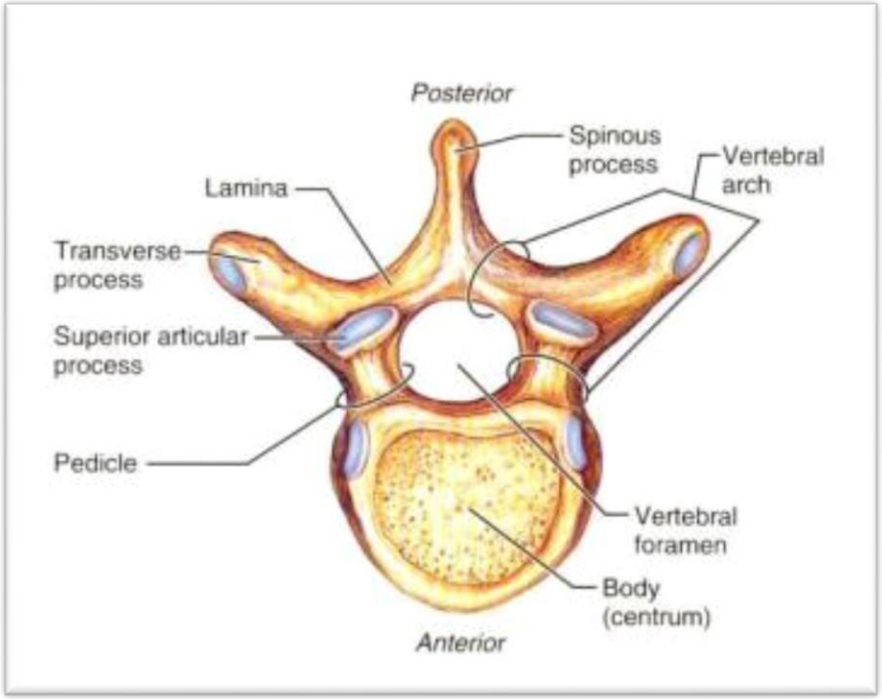
Two anatomically isolated joints move together at the same time

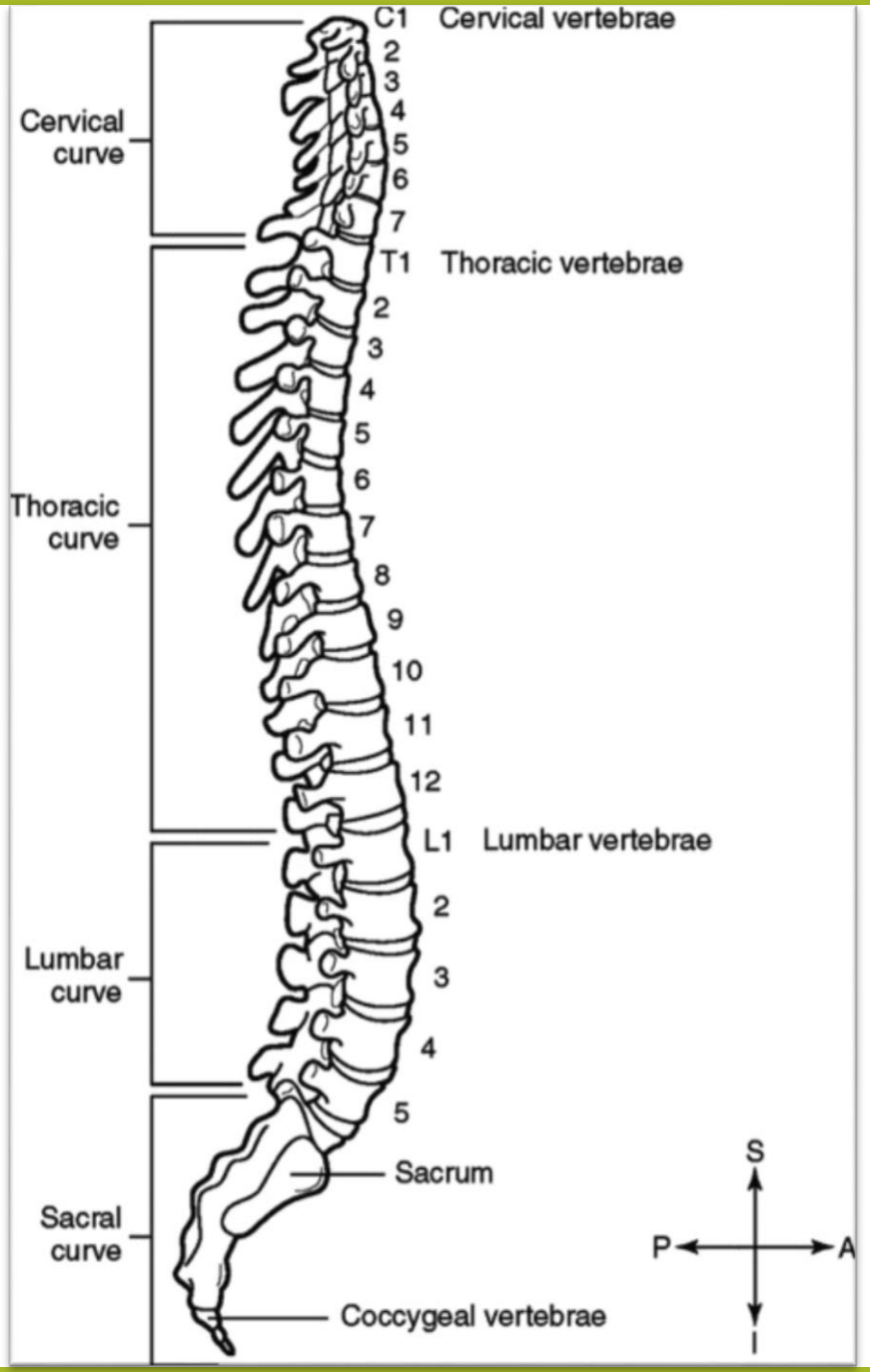




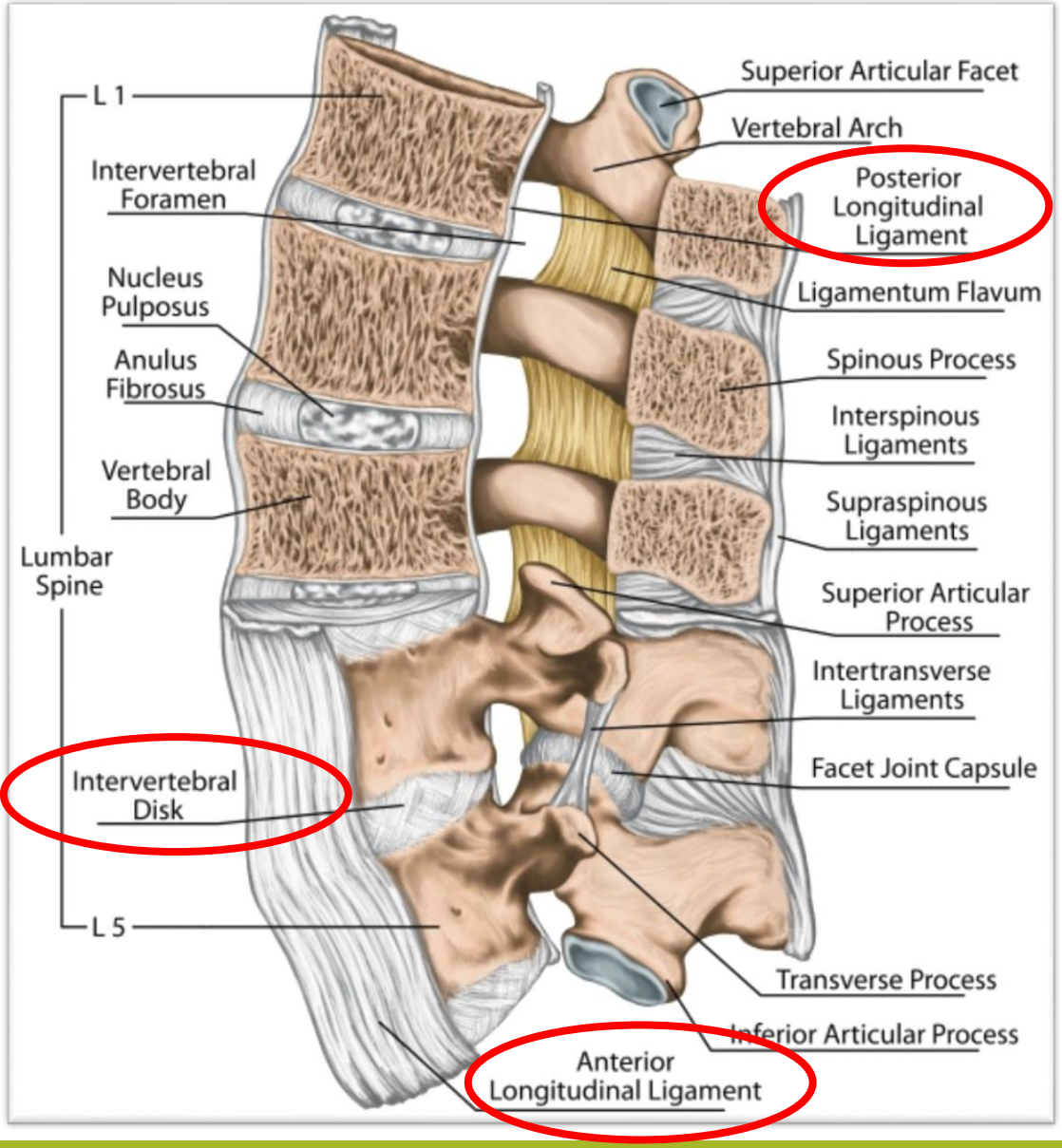


Vertebral column



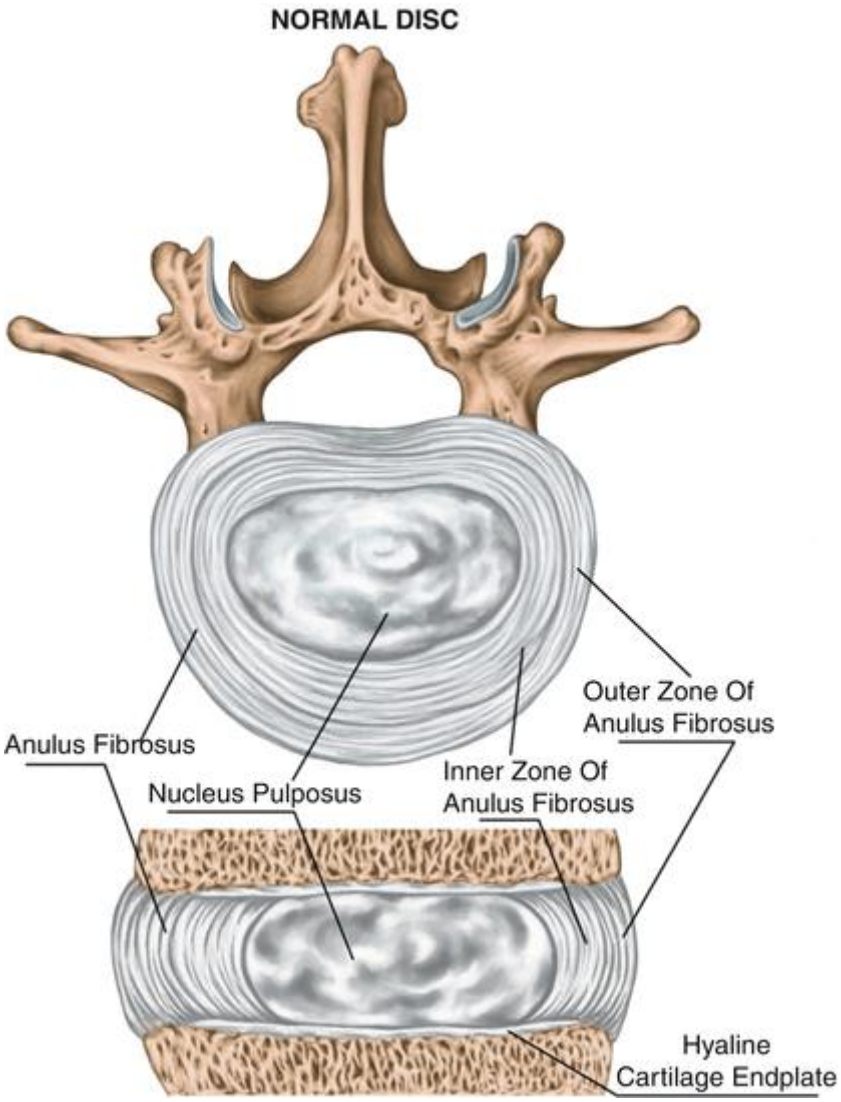


Joints of the vertebral bodies



- 1) ligaments – anterior and posterior longitudinal ligaments – *syndesmosis*
- 2) intervertebral disks - *synchondrosis or symphysis*

Intervertebral disc



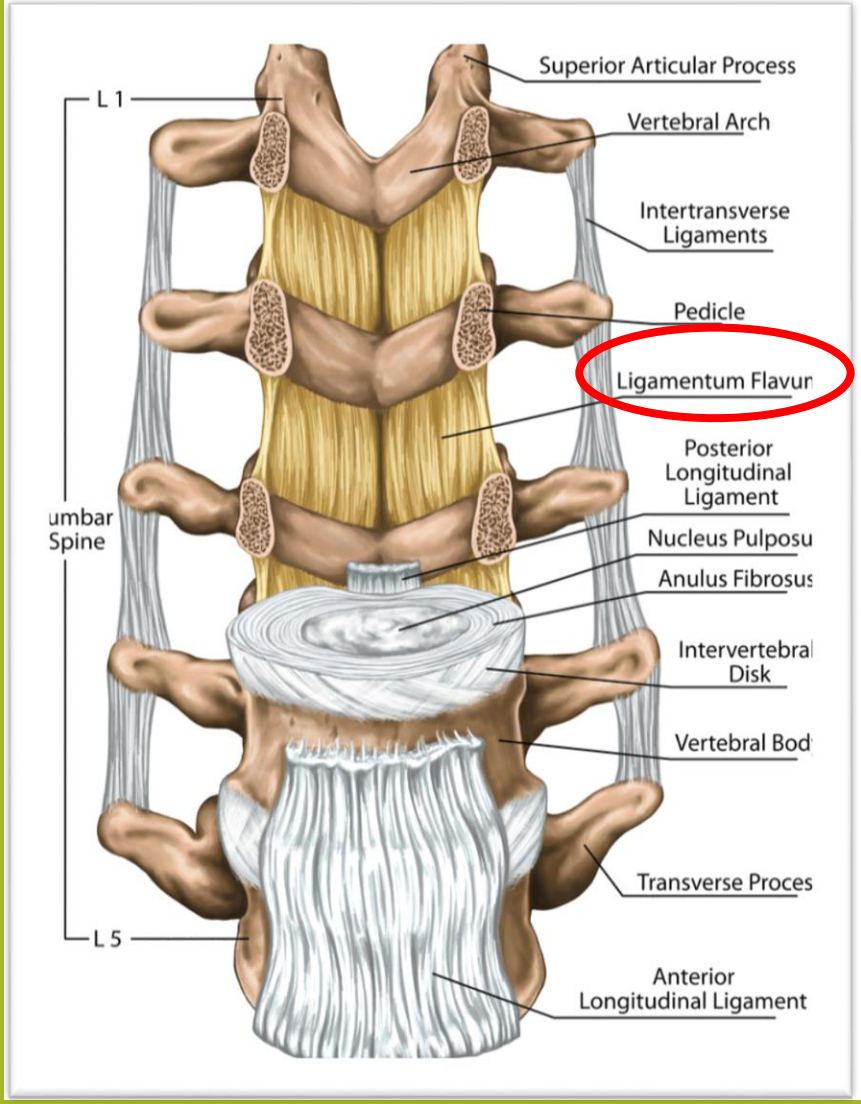
- Each disc composed of an outer fibrocartilaginous portion (*annulus fibrosus*) and an inner gelatinous central portion (*nucleus pulposus*)
- Nucleus pulposus – remnant of notochord

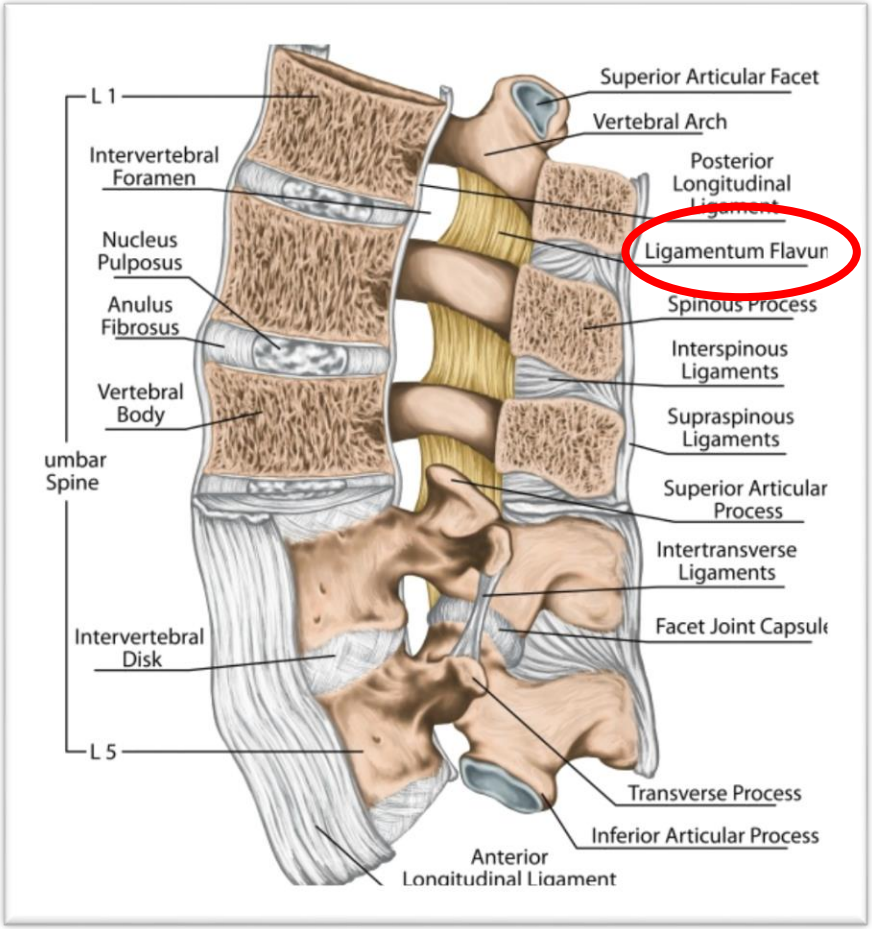
Functions of intervertebral disc:

- Permit limited movement between adjacent vertebrae
- Nucleus pulposus – compressible but deformable pad, that distribute forces over the entire surface of the vertebra

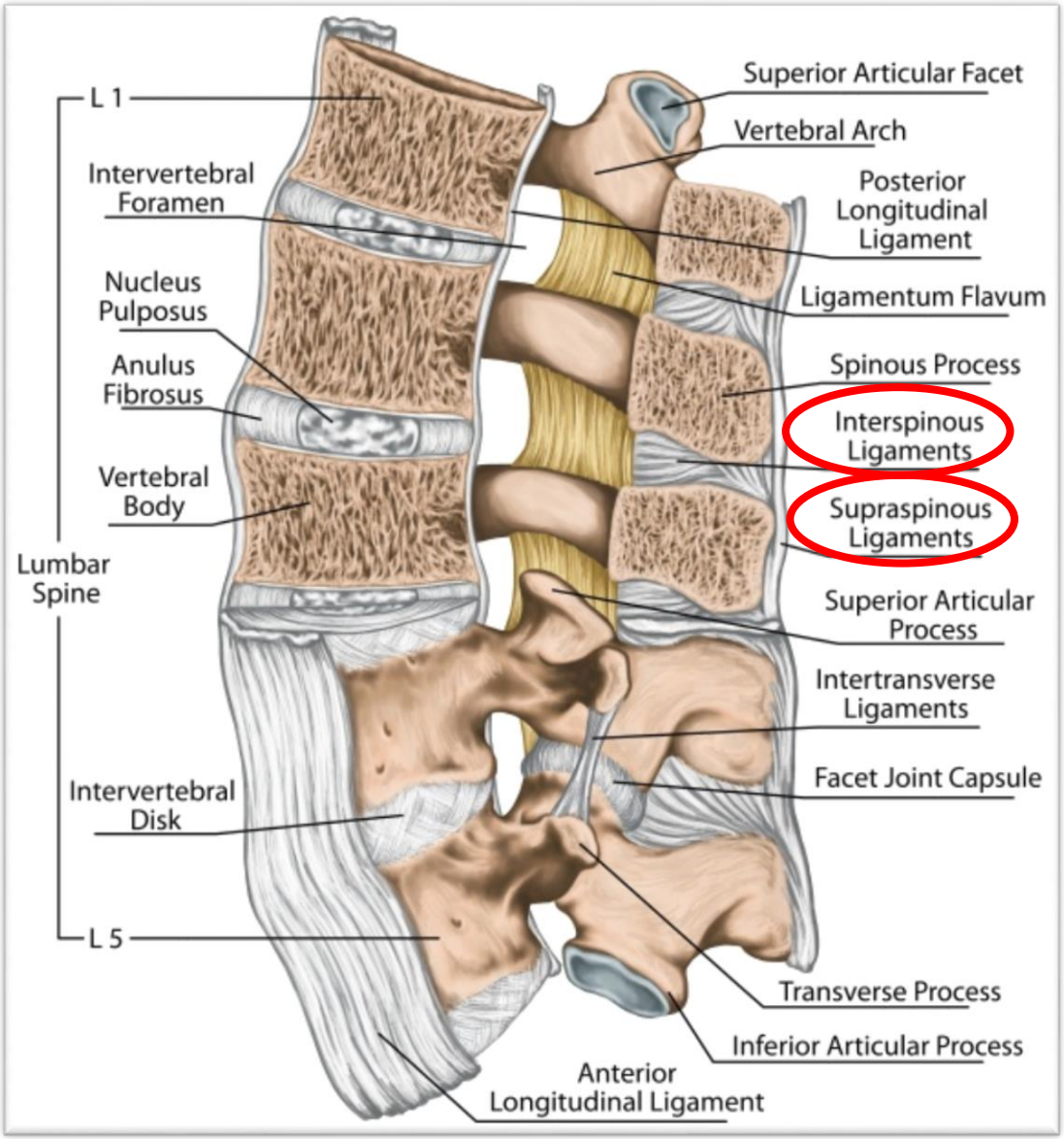
Joints of the vertebral arches

- the yellow ligaments (**ligg. flava**) – elastic fibers!

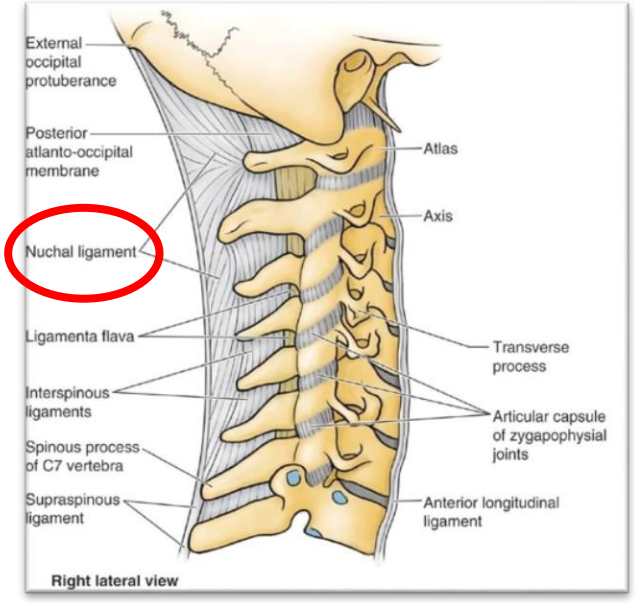




Joints of the vertebral spinous processes

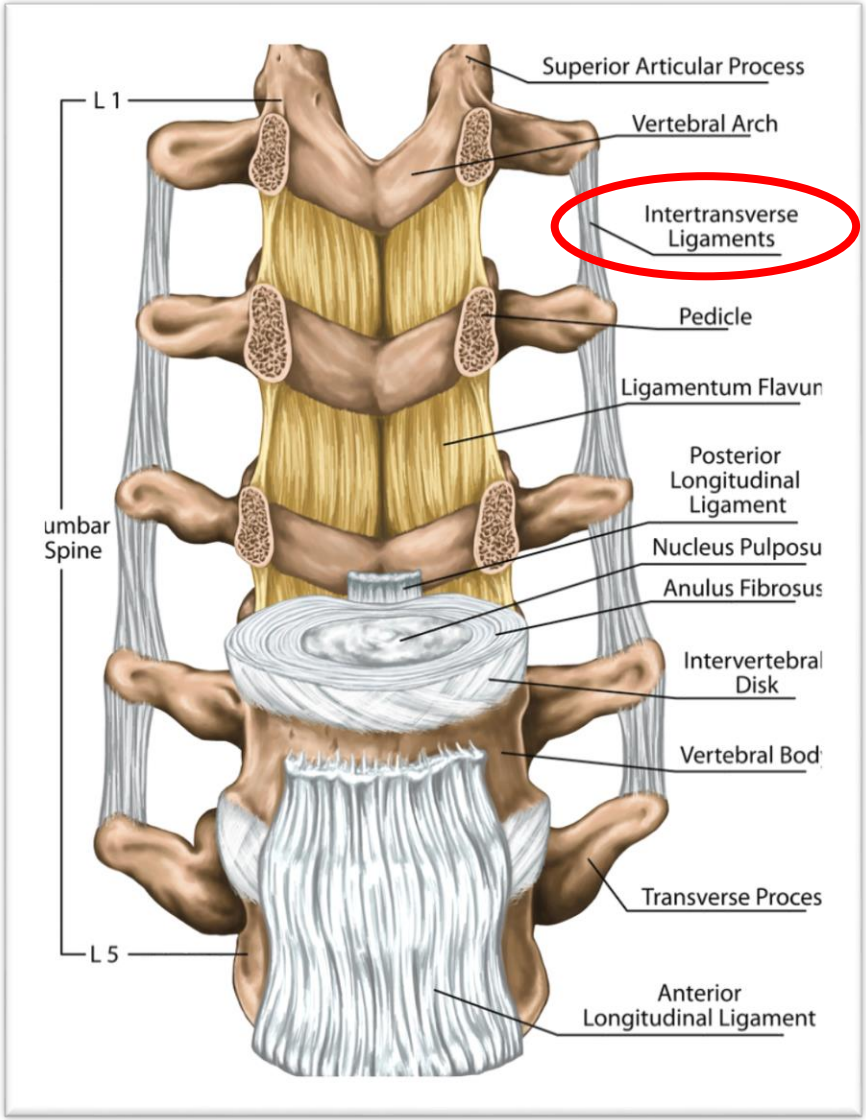


- 1) the interspinous ligaments (**ligg. interspinalia**) **–** between spinous processes
- 2) The supraspinous ligament (**lig. supraspinale**) – above all spinous processes – its continuation in suboccipital region – ***nuchal ligament***



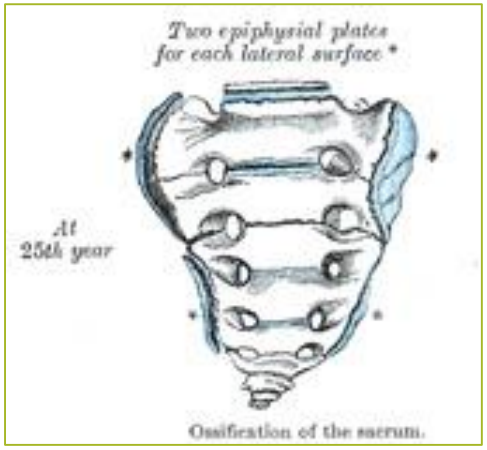
Joints of the vertebral transverse processes

❖ the intertransverse ligaments (**ligg. intertransversaria)**

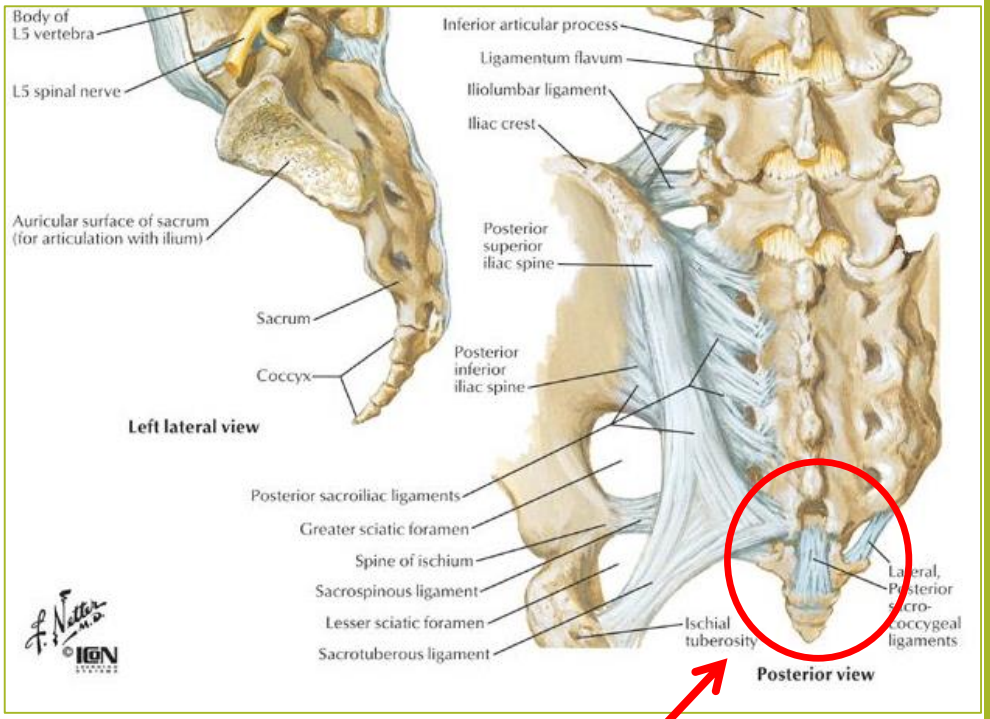


Joints of the sacral vertebrae

Temporary synchondrosis

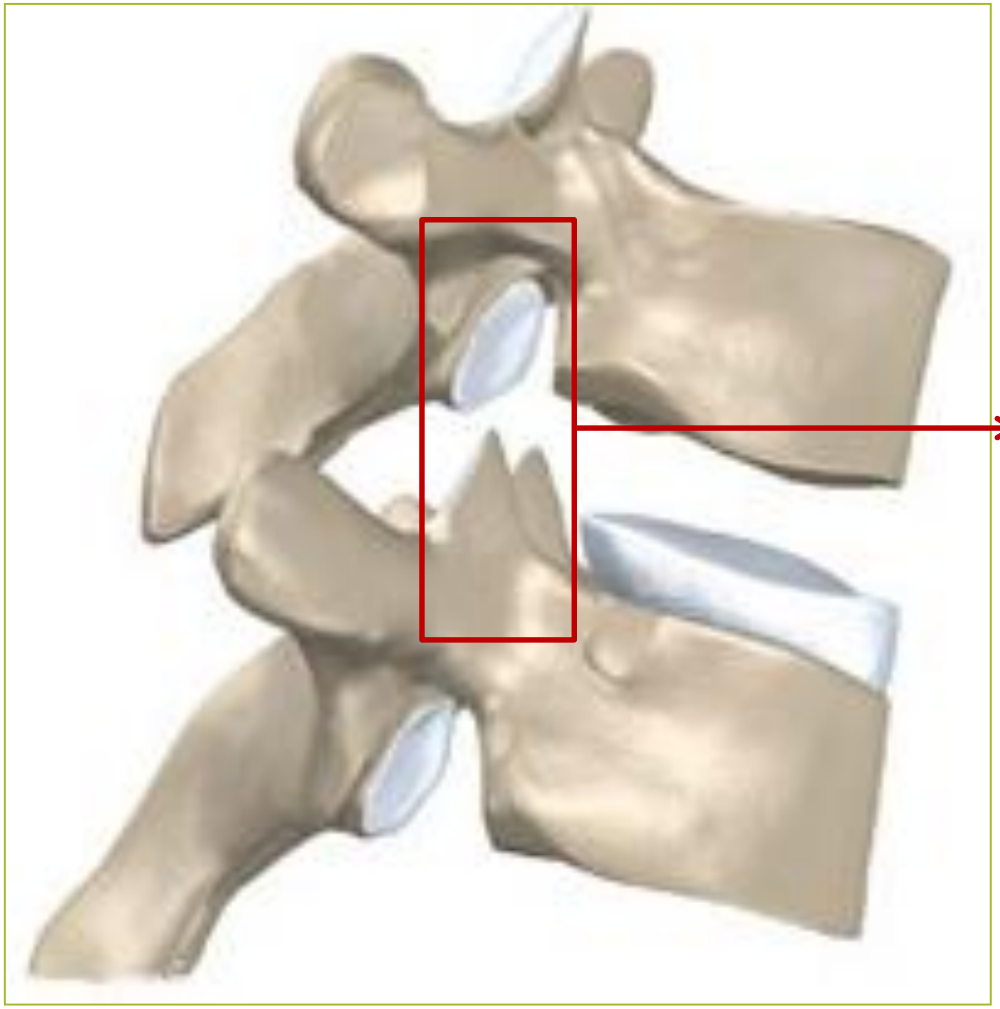


Synostosis



Sacrococcygeal joints:
– symphysis
– syndesmoses (ligaments)

Joints of the vertebral articular processes



Zygapophysial synovial joint (with all essential elements of the diarthroses) – provide mobility of the vertebral column

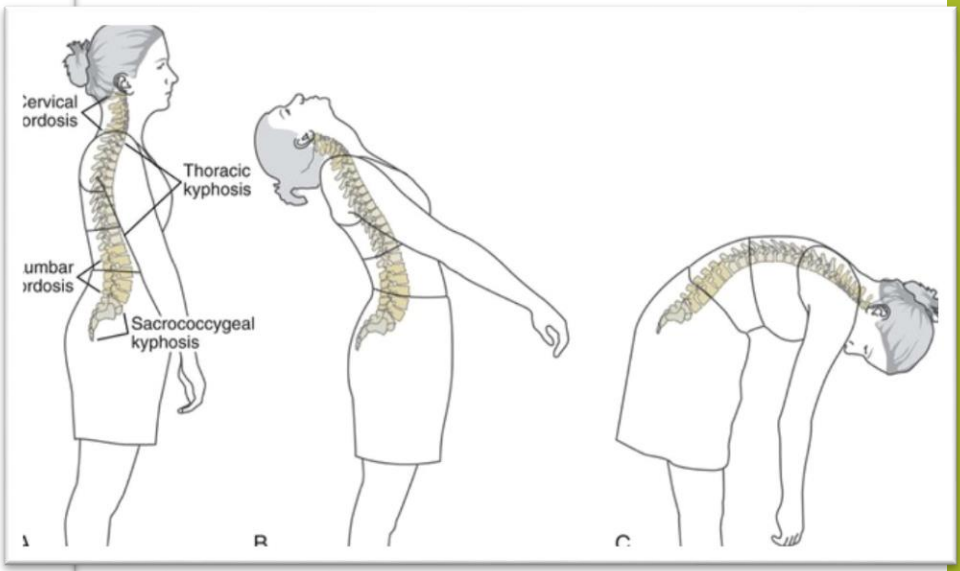
<u>Classification of this joint:</u>

- simple – 2 articular surfaces
- plane – shape of articular surfaces
- combined – left and write joints are anatomically separated and move simultaneously

NB! Plane joints – amphyarthrosis – multiaxial
- Volume of the movements in every single zygoapophysial joint is minimal

Volume of the movements in the vertebral column depends on position of:

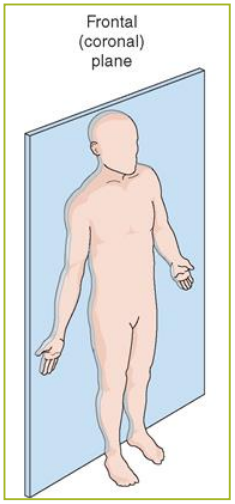
1) Articular surfaces
2) Spinous processes angle

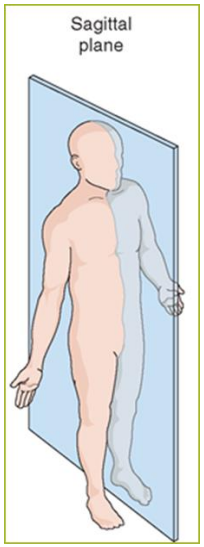


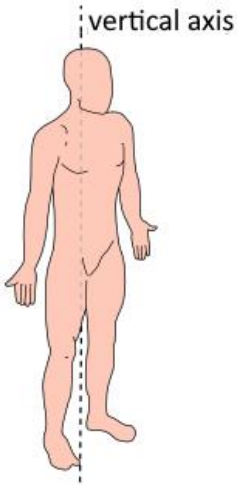
Cervical and lumbar regions are mobile.

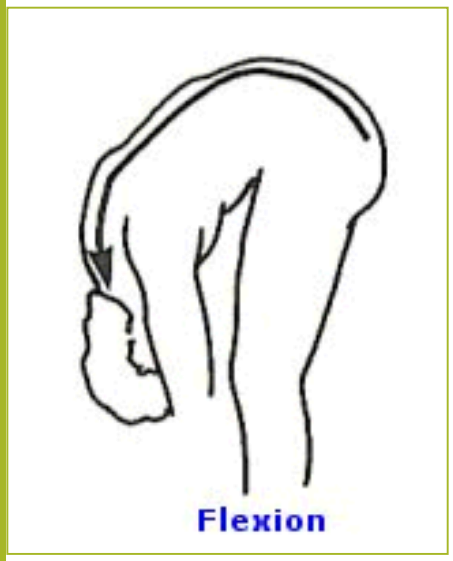
Thoracic region is less mobile.

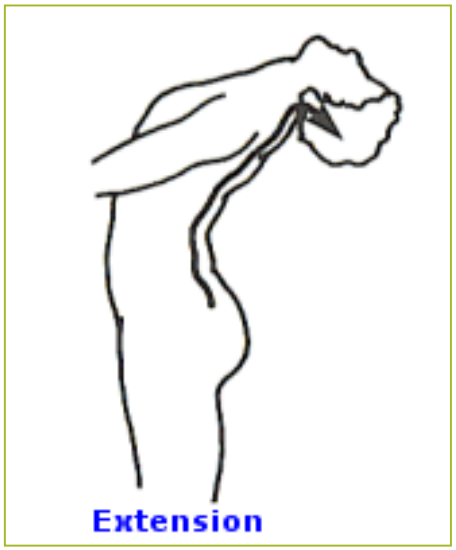
Movements of Spinal Column



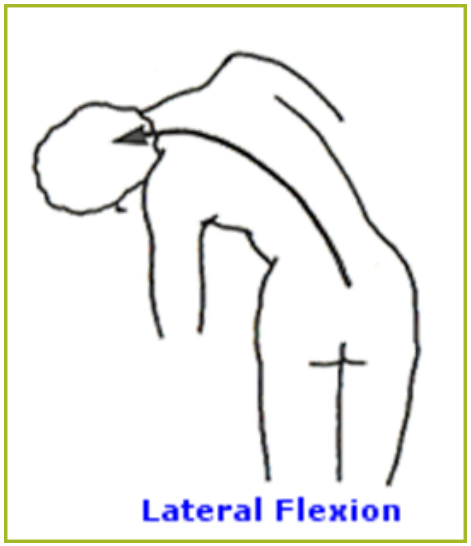








Flexion and extension along frontal axis

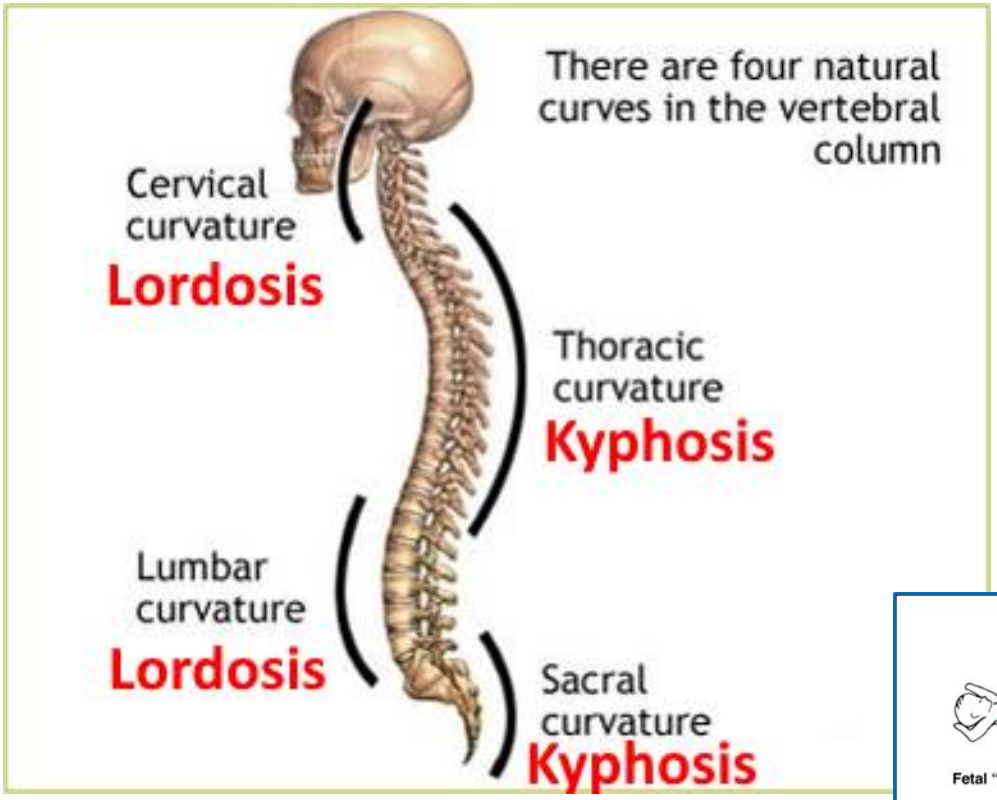


Lateral flexion
along sagittal axis

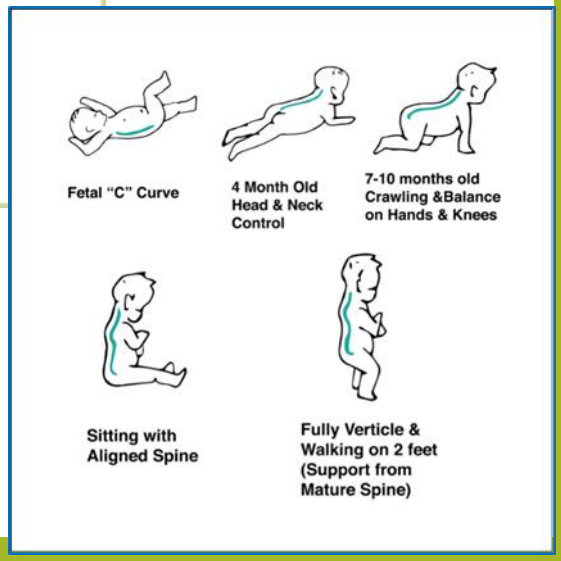
Rotation along
vertical axis

The vertebral column is curved in sagittal plane

Lordoses are convex ventrally

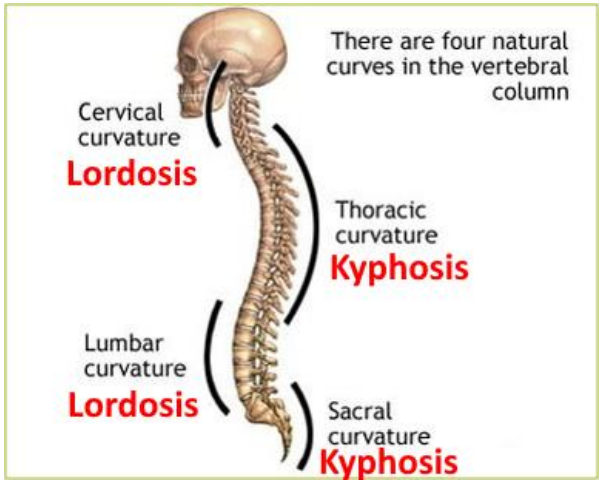


Kyphoses are convex dorsally

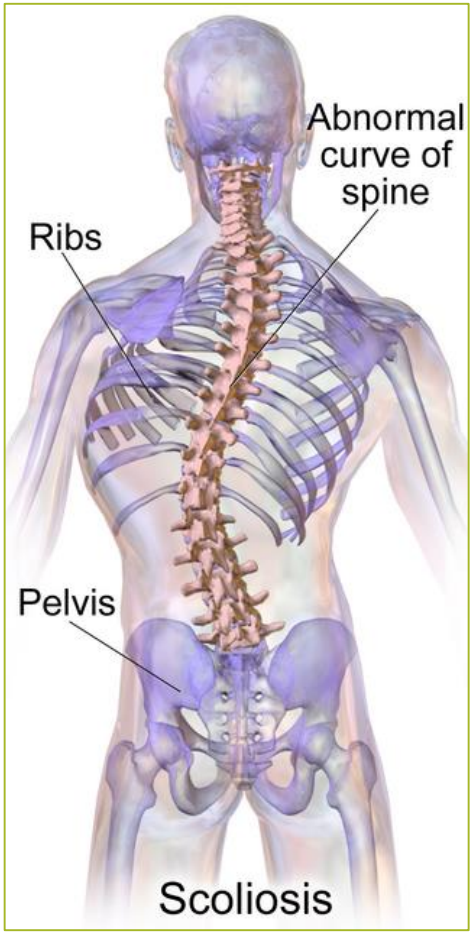


Cervical and Lumbar physiological Lordoses and Thoracic and Sacral physiological Kyphoses are distinguished.

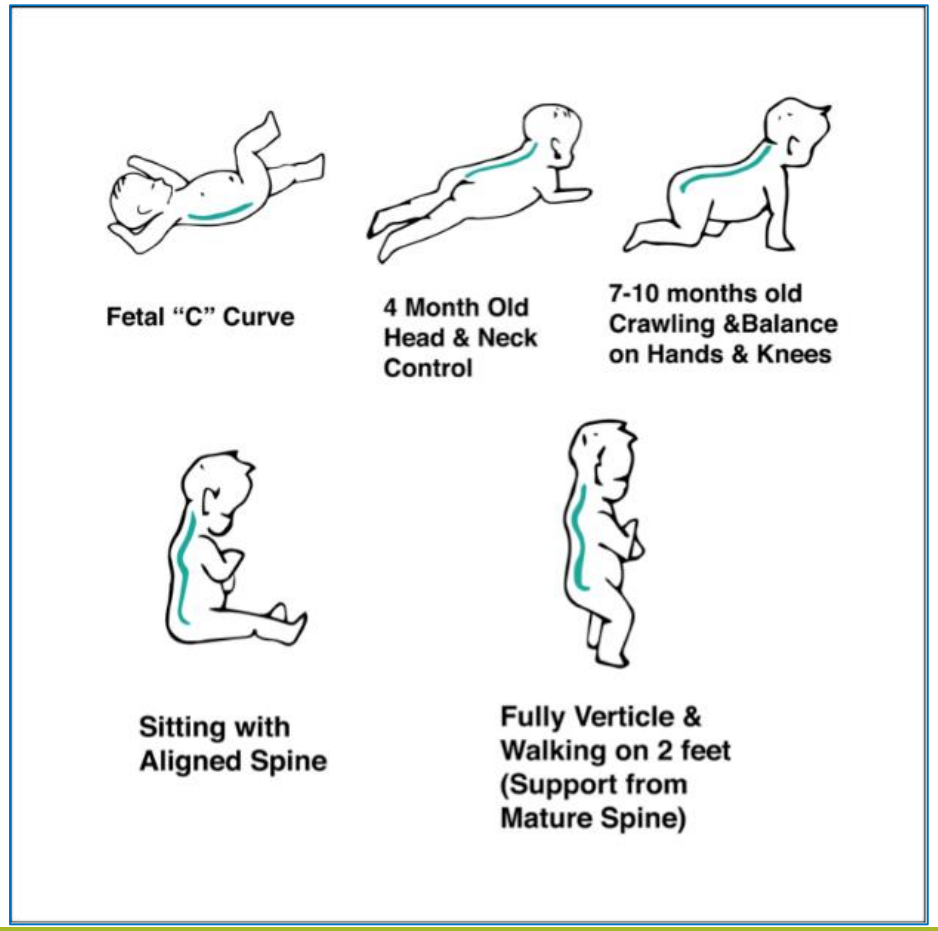
Physiological curves

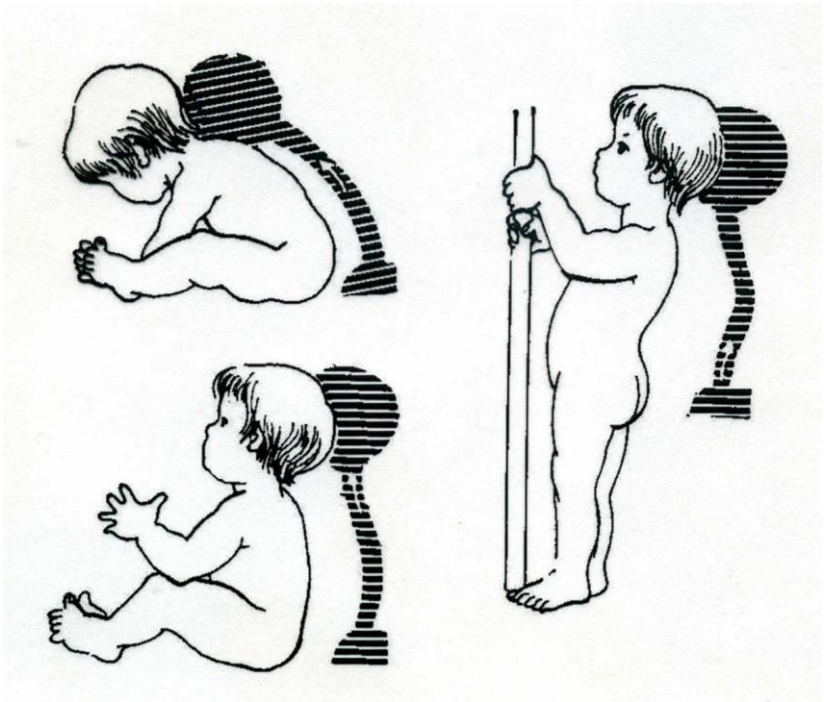


Skoliosis – deviation of the vertebral column from the median plane

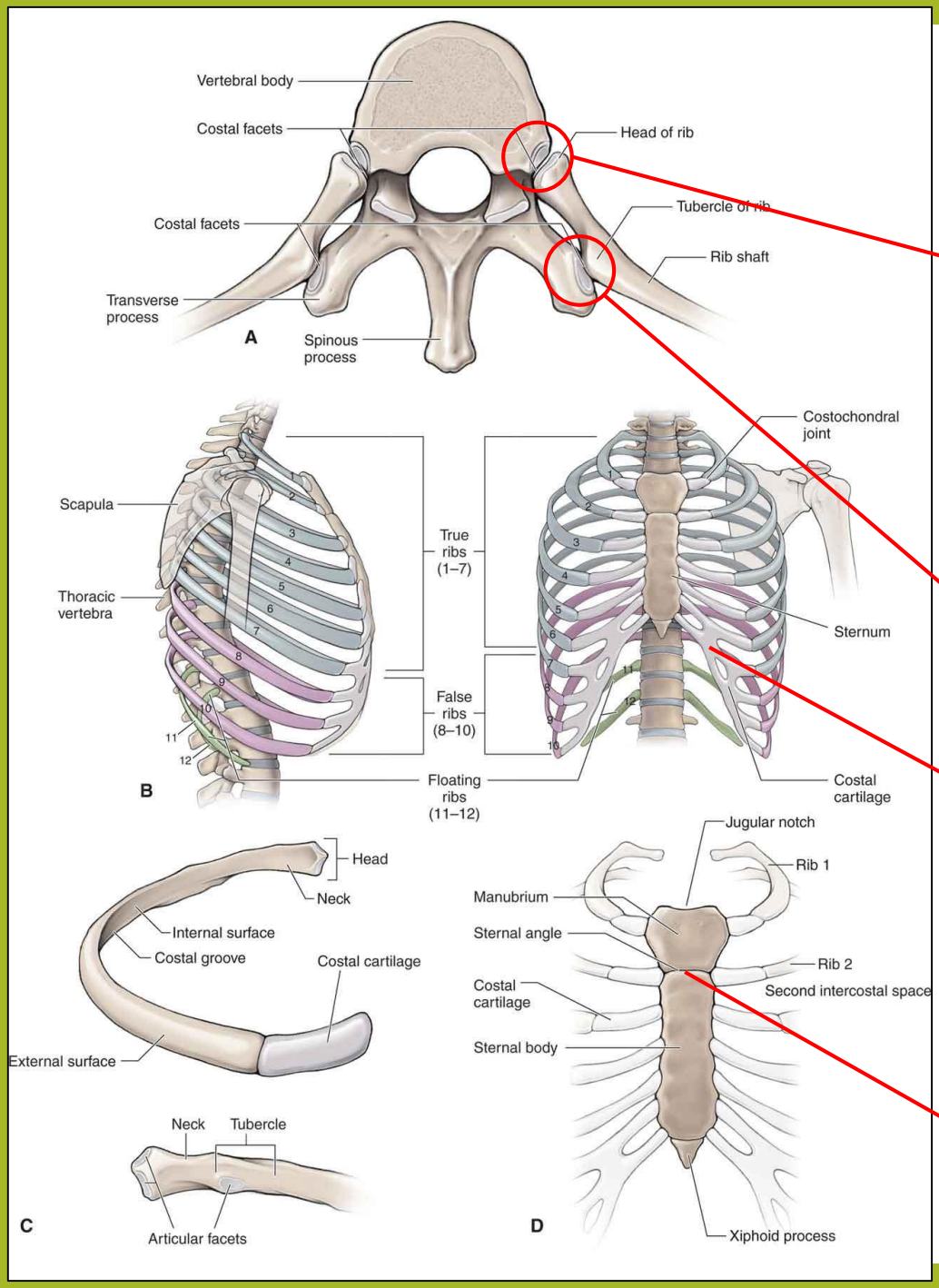


The curvatures of the vertebral column appear after birth





Joints of the thoracic cage



Articulatio capitis costae

- I, XI, XII ribs - simple (1 rib+1 vertebral articular facet), spheroidal multiaxial, joint
- II-X ribs - complex (1 rib+2 adjacent vertebral articular demifacets), saddle, biaxial joints.

Articulatio costotransversaria

- simple, cylindrical joints.

Articulationes sternocostales

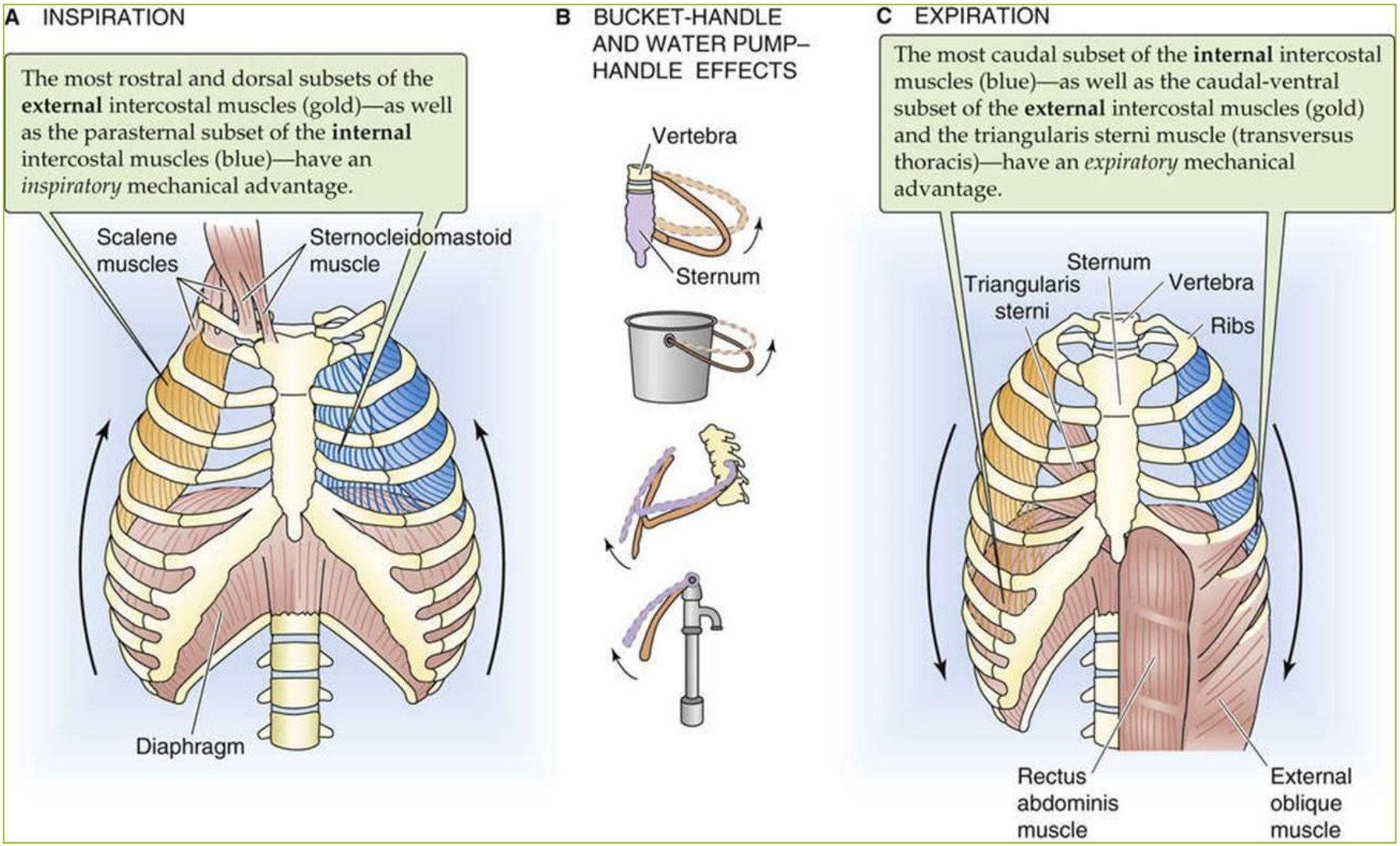
- permanent synchondrosis
- simple saddle joints

Combined joints

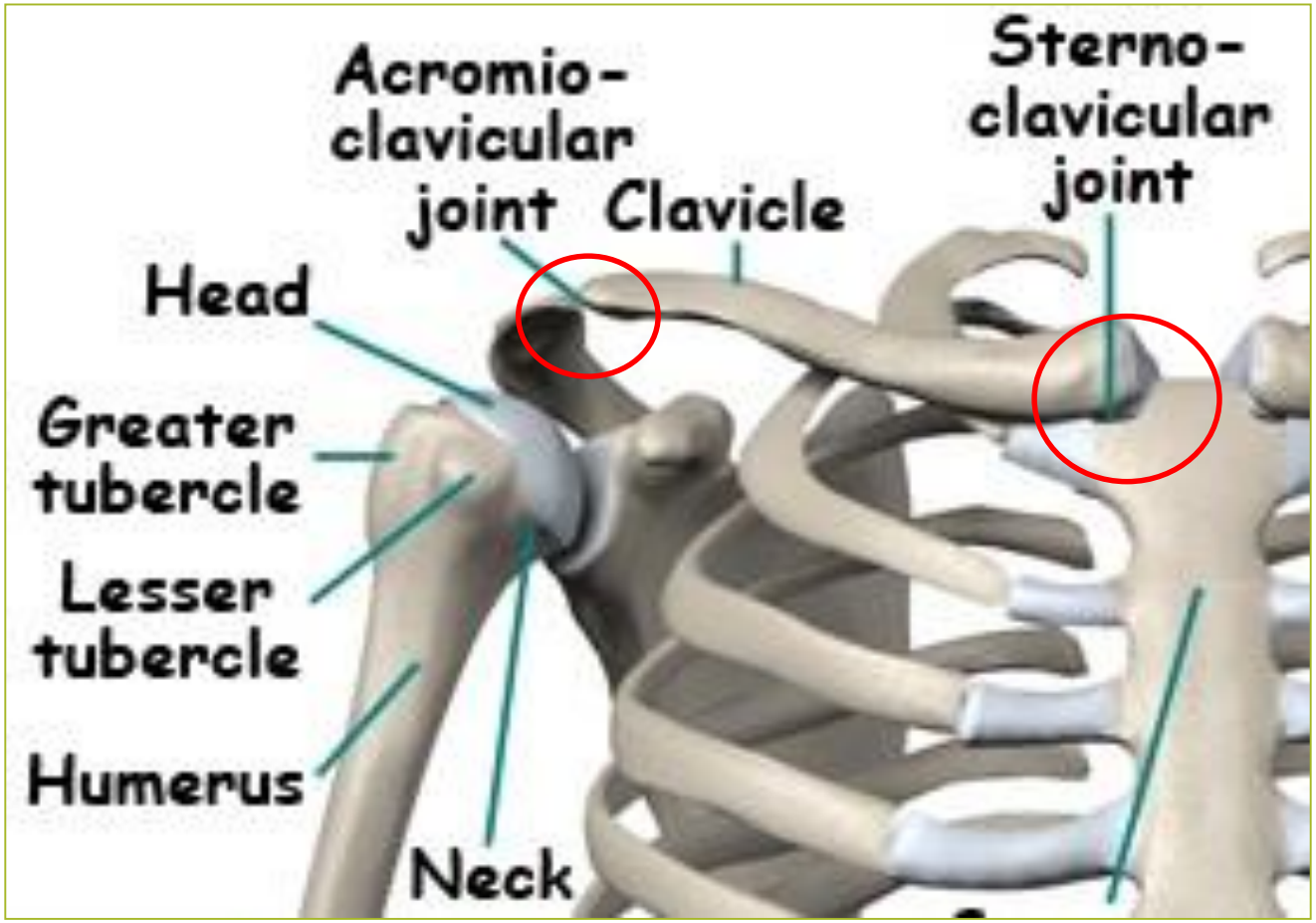
Junction between manubrium and body of the sternum

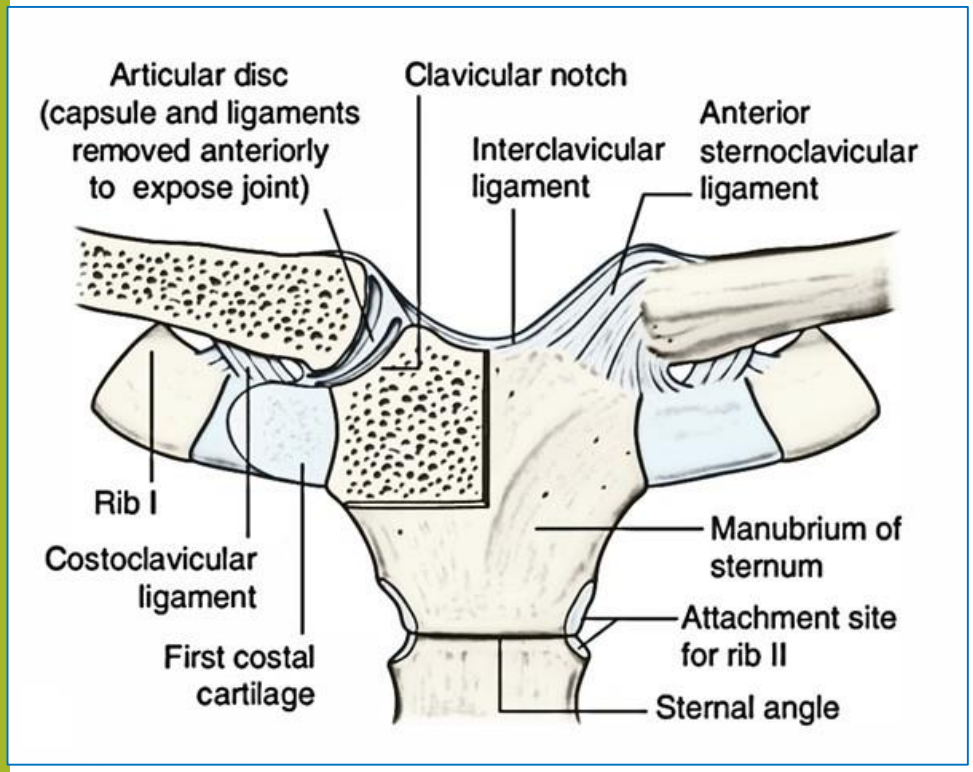
- temporary synchondrosis that later becomes synostosis
- sometimes can be symphysis

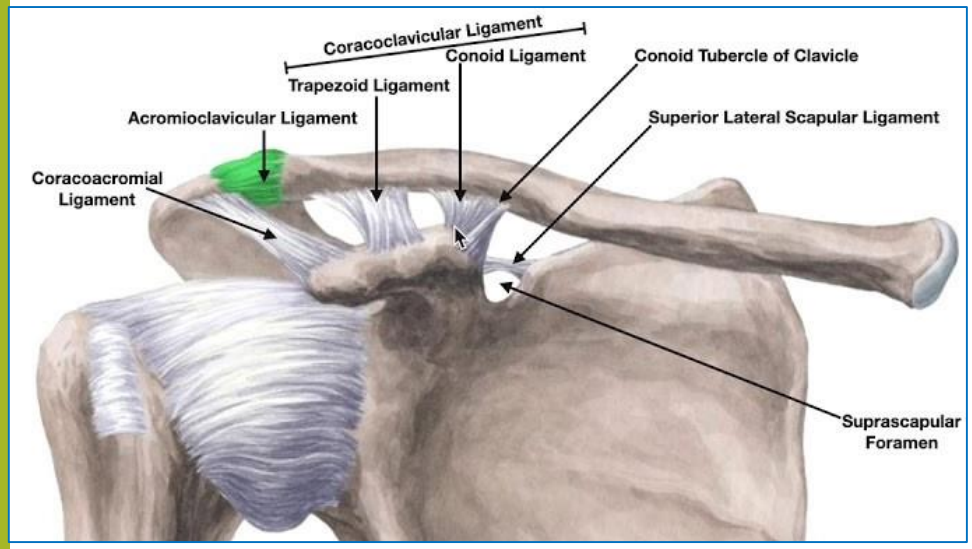
Movements in the thoracic cage



Shoulder Girdle







*Sternoclavicular joint

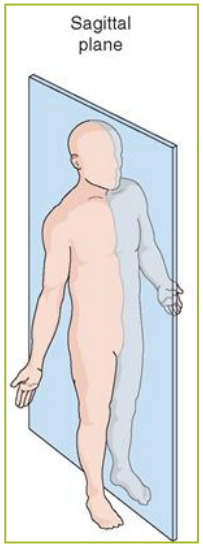
- simple (if there is no intraarticular disk)
- complex(in 30% there is intraarticular disk – complex)
- saddle - biaxial

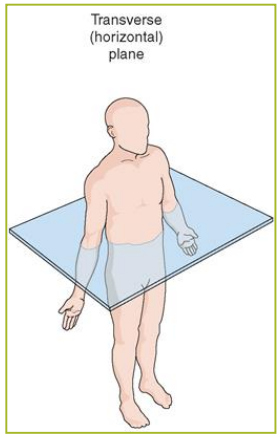
Combined joints

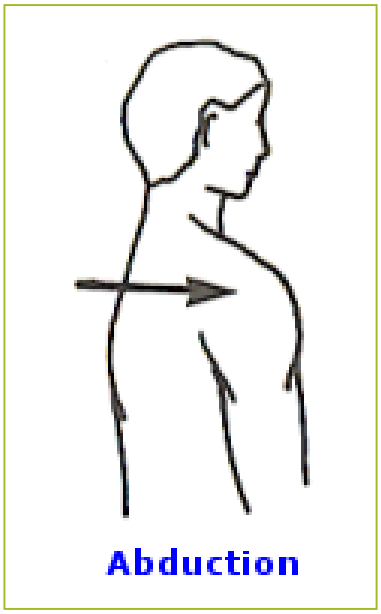
*Acromioclavicular joint

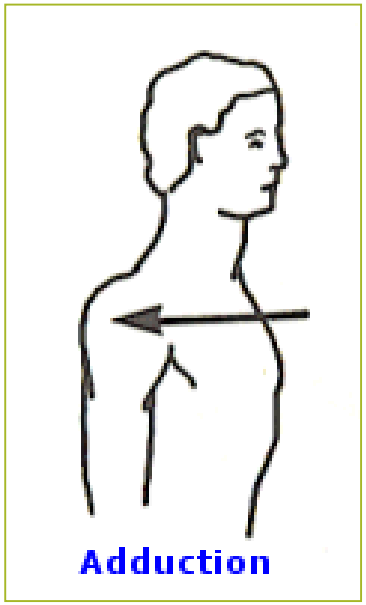
- simple
- plane - multiaxial

Shoulder Girdle

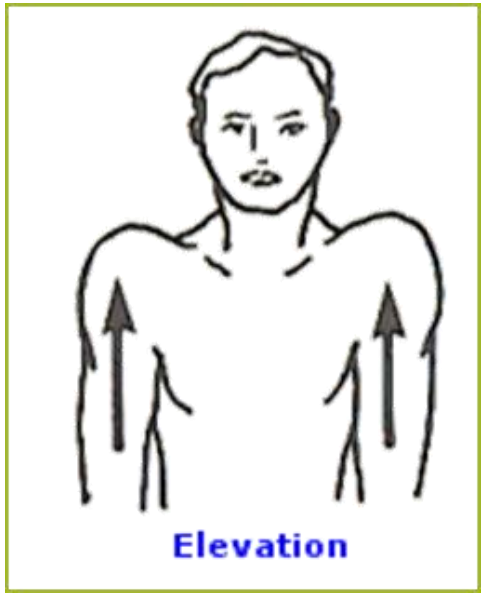


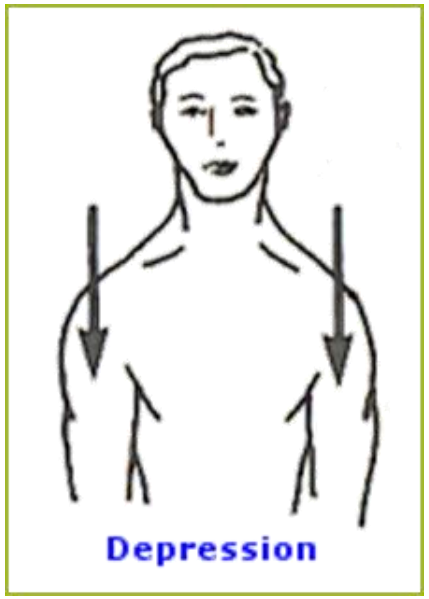






Adduction and abduction
along sagittal axis



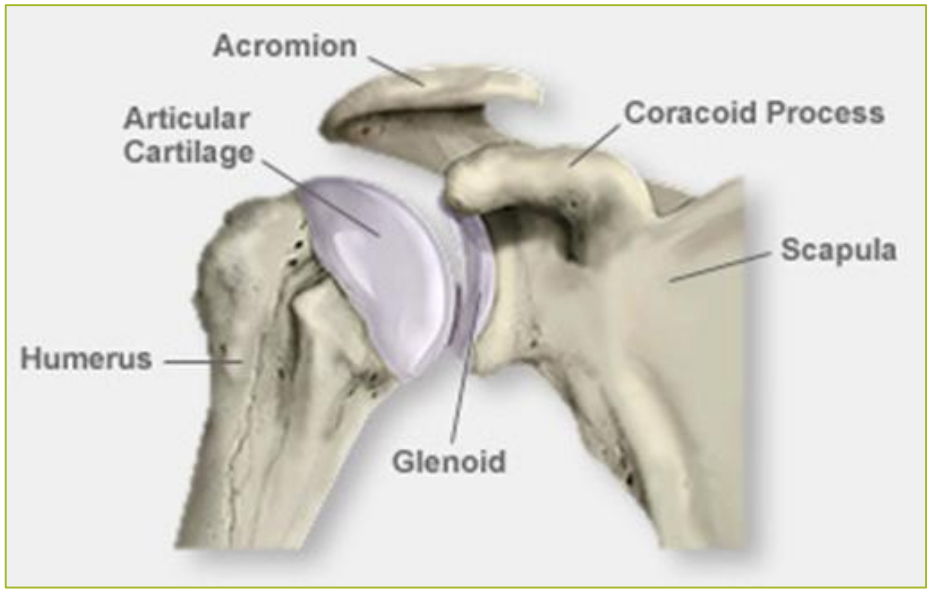


Elevation and depression
along transverse axis

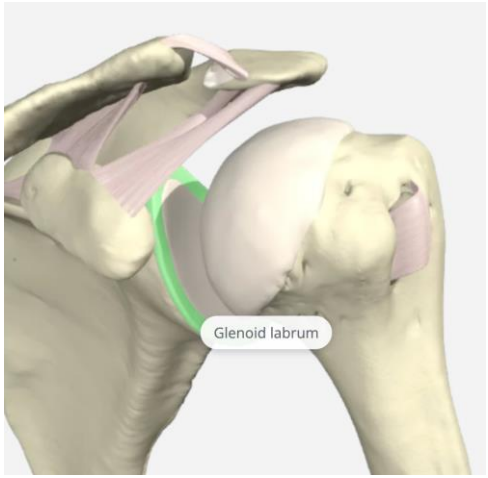
Shoulder joint (*articulatio humeri*)

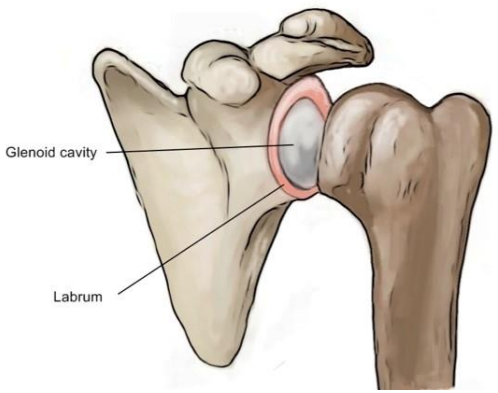
Articular surfaces:

- the head of the humerus,
- the glenoid cavity of the scapula.

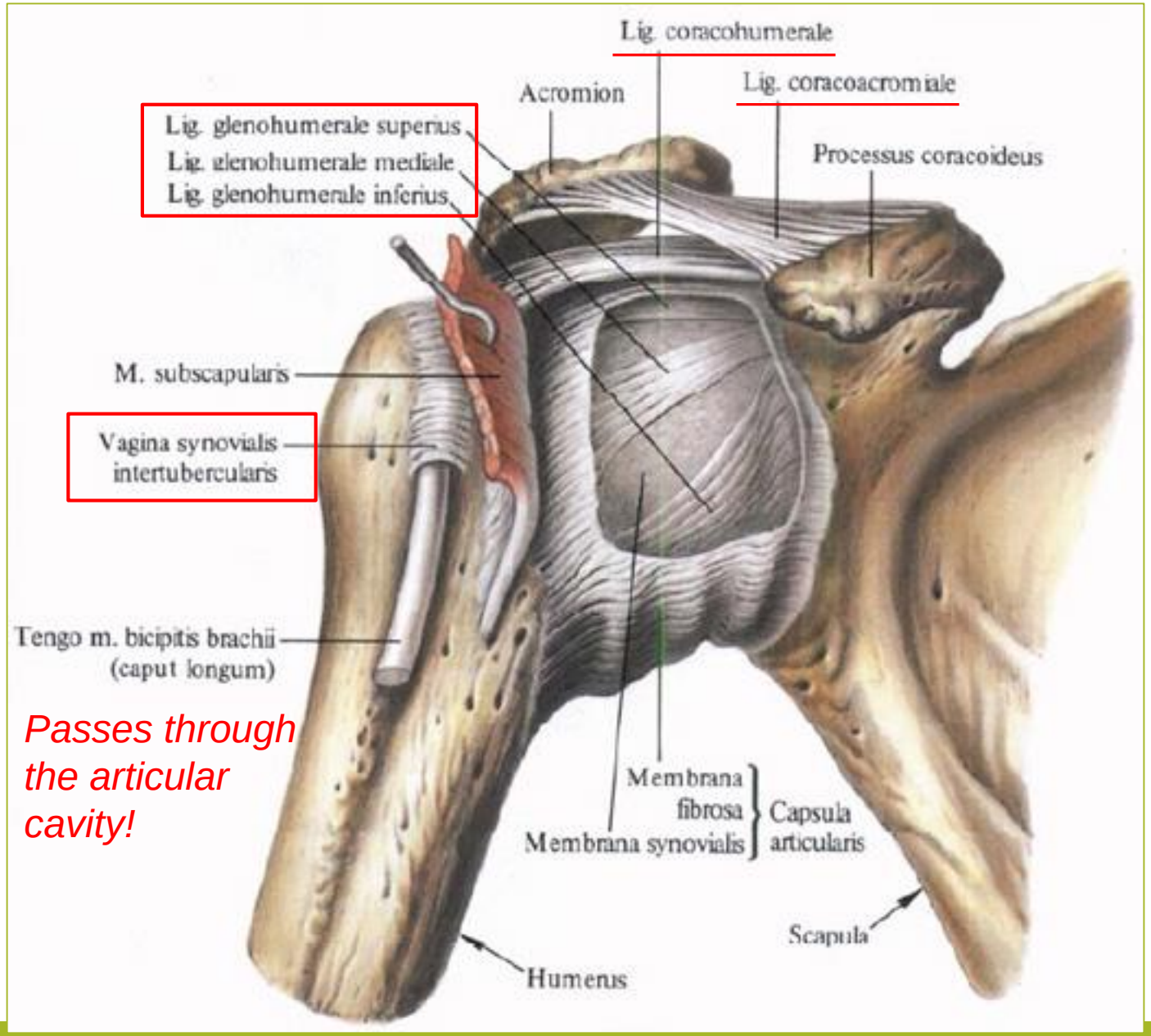


- *The glenoid labrum* (**labrum glenoidale**) is on the circumference of the glenoid cavity. It increases its depth (increase congruence).





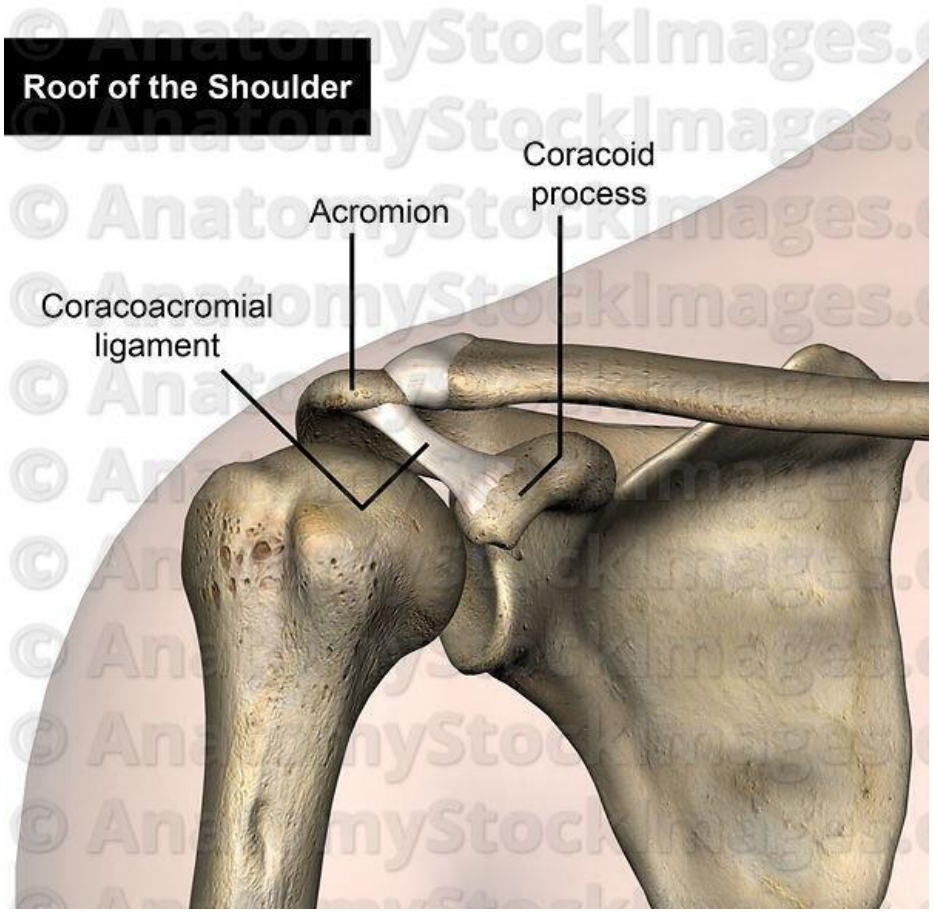
Shoulder joint (*articulatio humeri*)



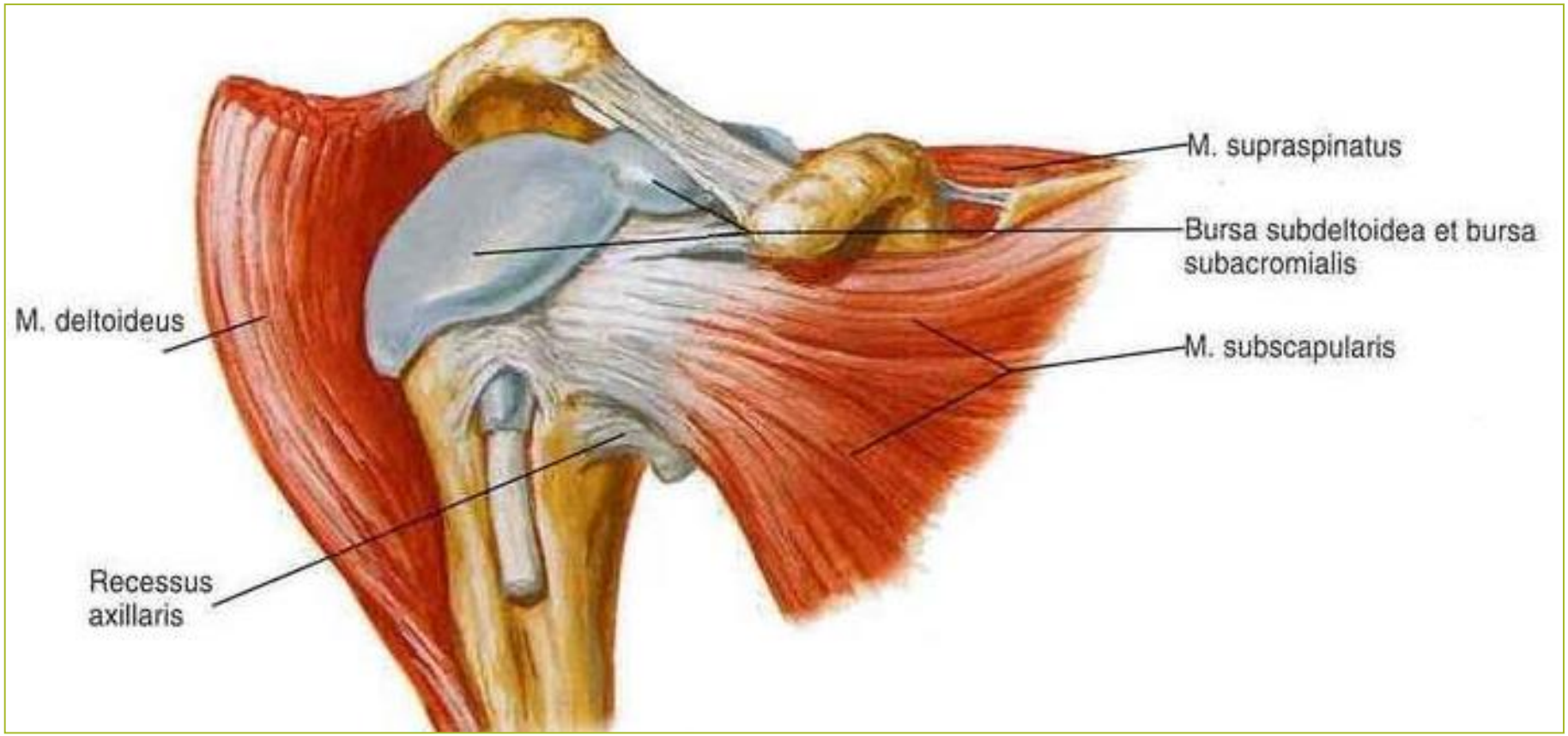
Passes through the articular cavity!

Coracoacromial ligament

prevents over abduction in this joint, limits the movements of the humerus upwards

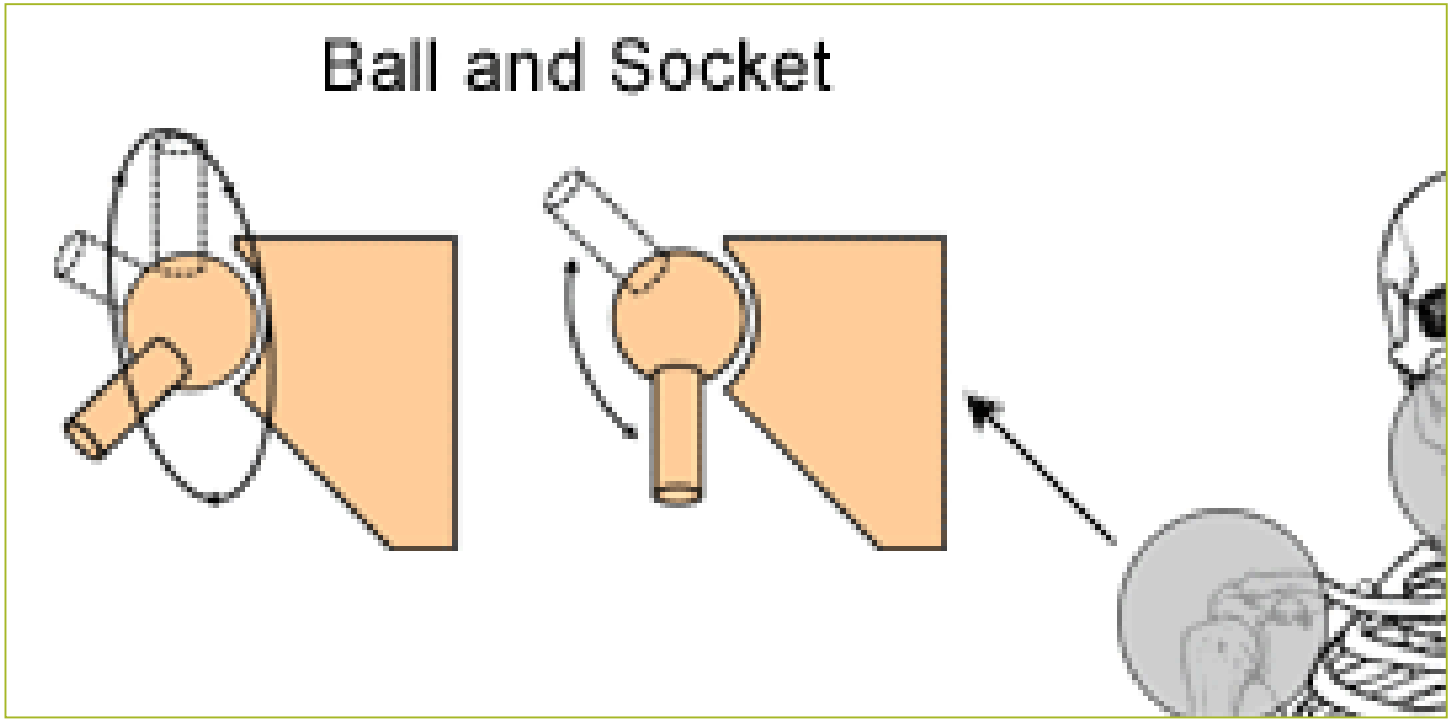


Shoulder joint (*articulatio humeri*)

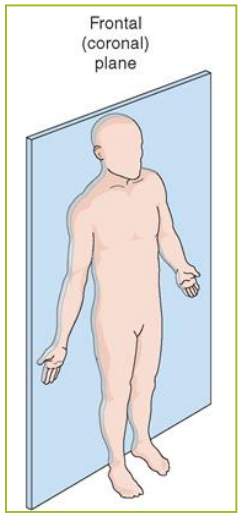


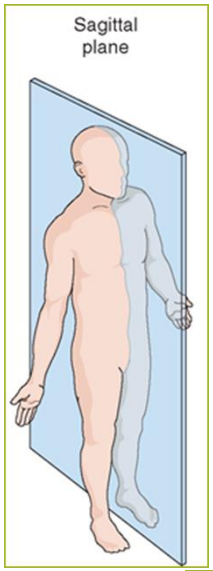
Shoulder joint (*articulatio humeri*)

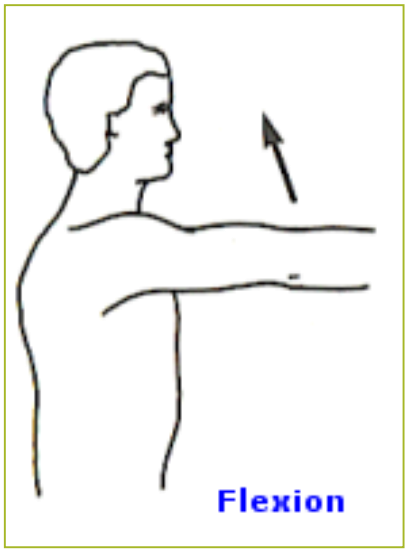
- Simple spheroidal joint.

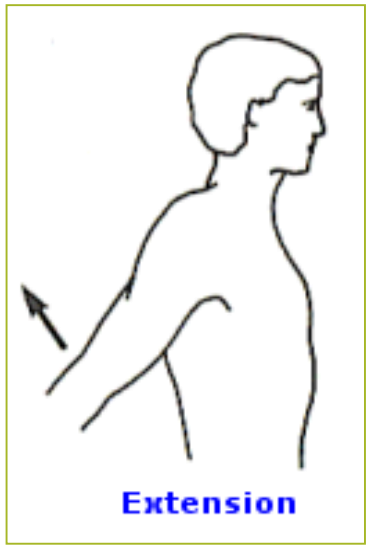


Shoulder Joint

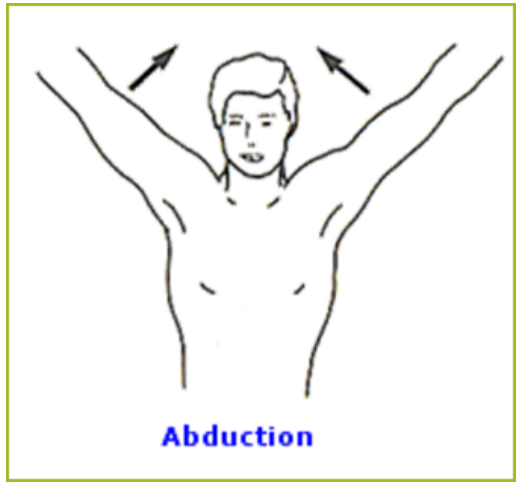


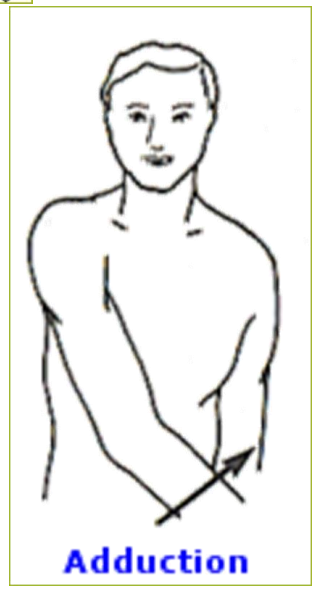






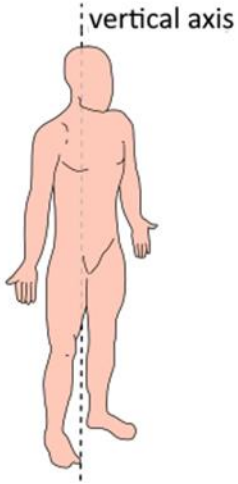
Flexion and extension
along frontal axis





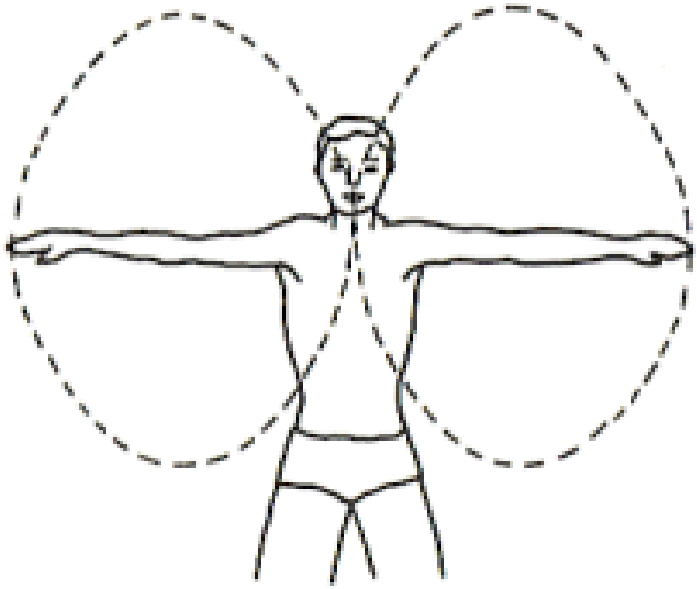
Adduction and abduction
along sagittal axis

Shoulder Joint



Outward Medial Rotation

Inward Medial Rotation



Circumduction

- Rotation and circumduction along vertical axis

The elbow joint (*articulatio cubiti*)

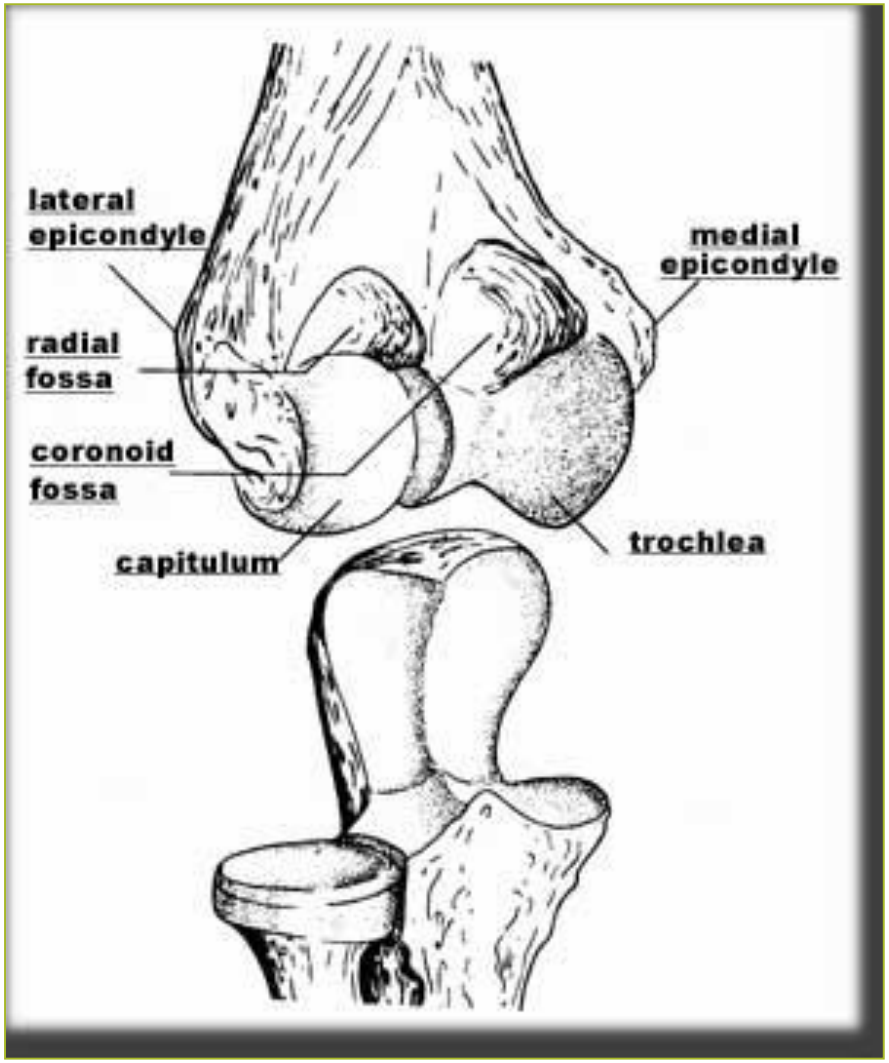
Three articulating bones form three joints invested in a common capsule:

1) humero-ulnar joint (hinge joint)

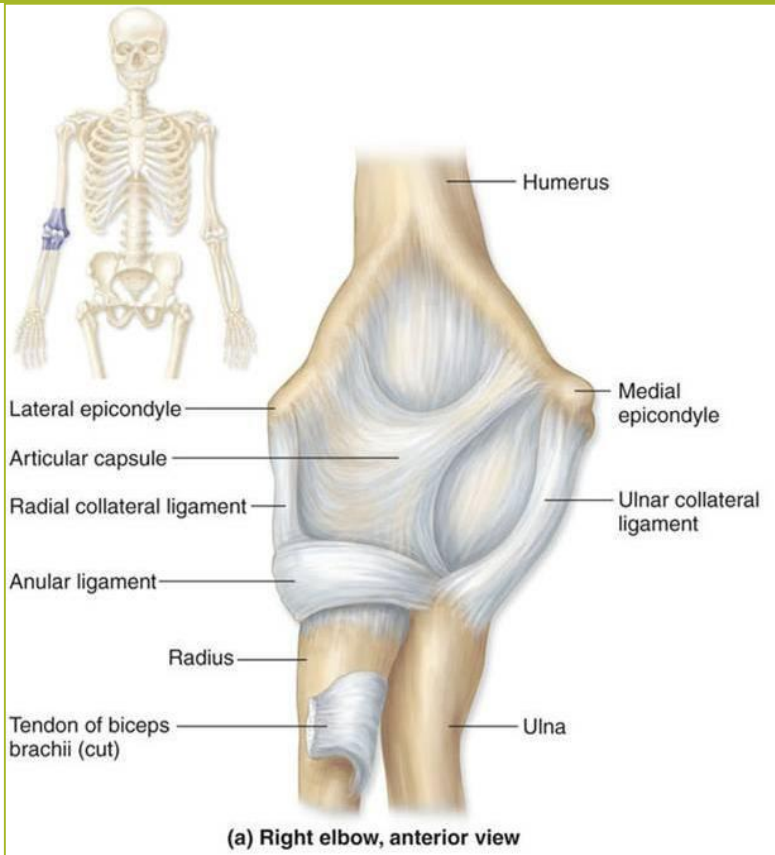
2) humeroradial joint (spheroidal joint)

3) proximal radio-ulnar joint (cylindrical=pivot joint)

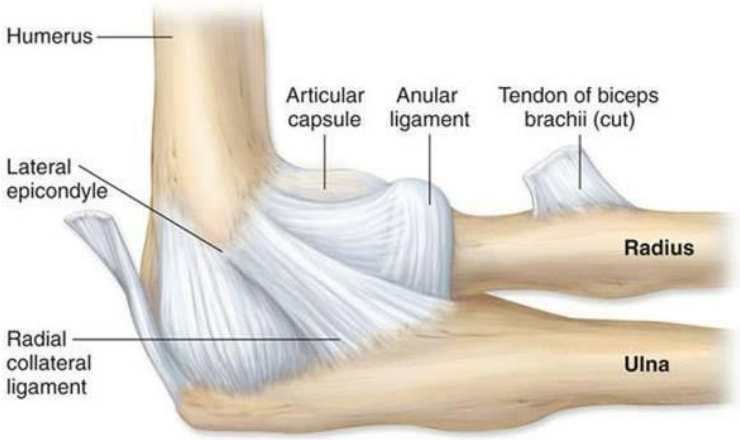
Articular capsule embraces the olecranon, radial and coronoid fossae but leaves the epicondyles free.



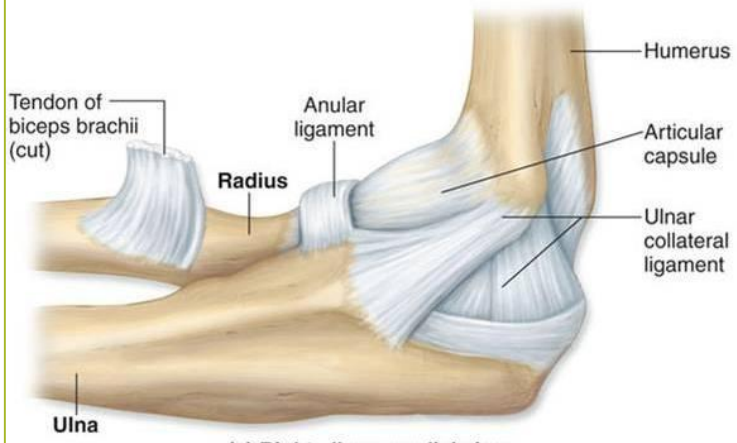
Elbow joint



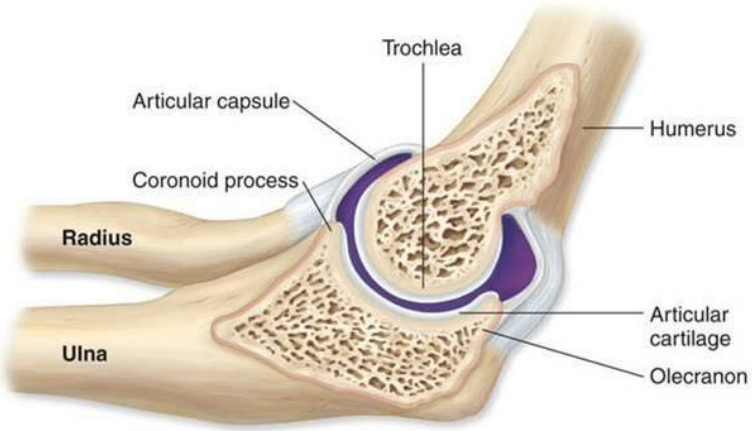
(a) Right elbow, anterior view



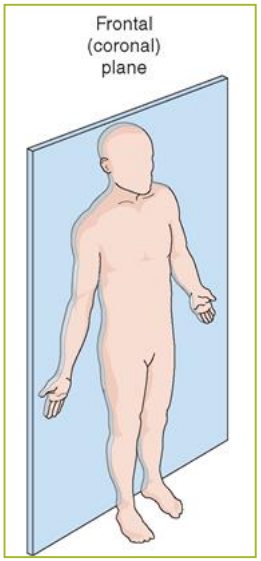
(b) Right elbow, lateral view



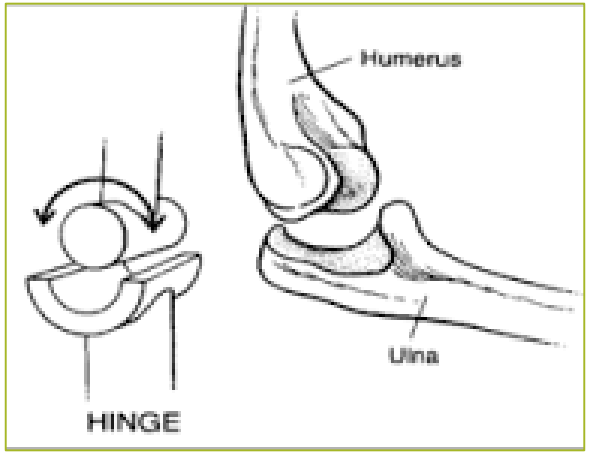
(c) Right elbow, medial view

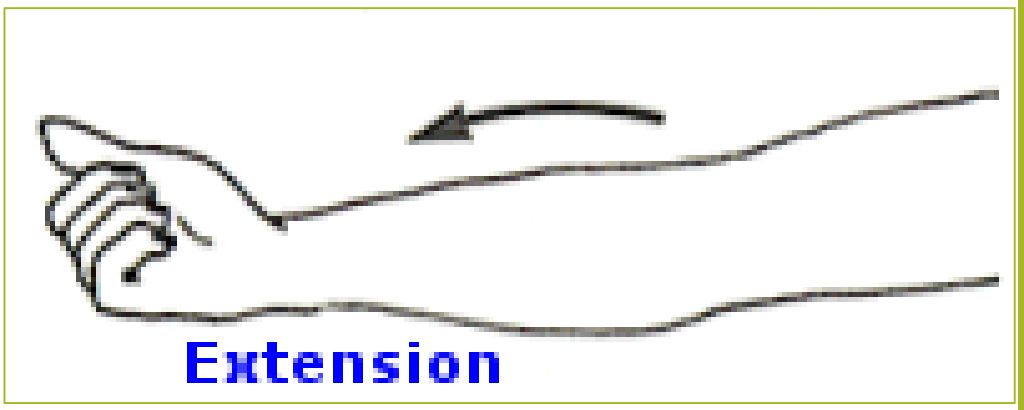


(d) Right elbow, sagittal section



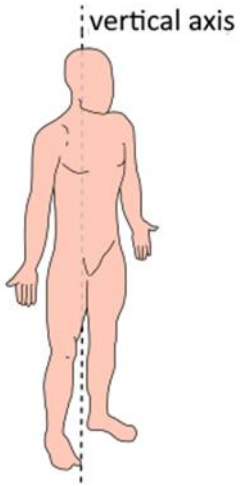
Elbow Joint

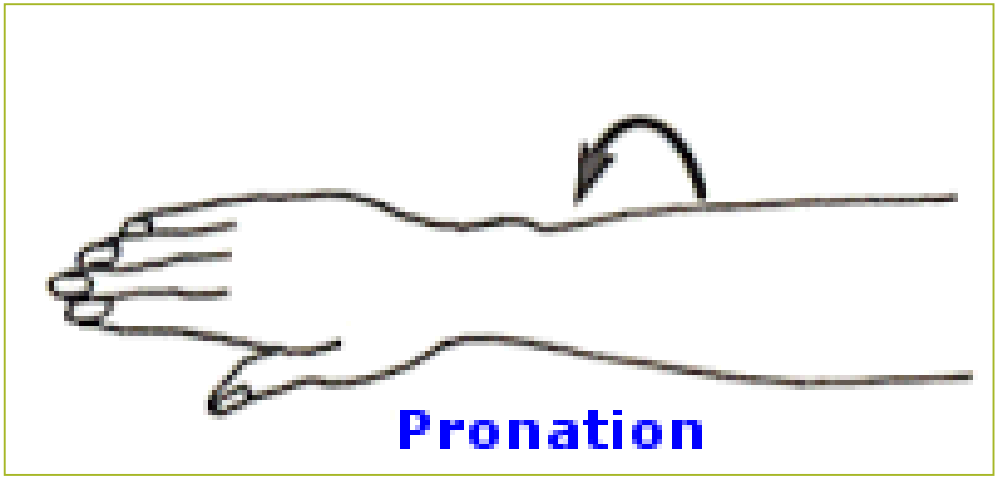


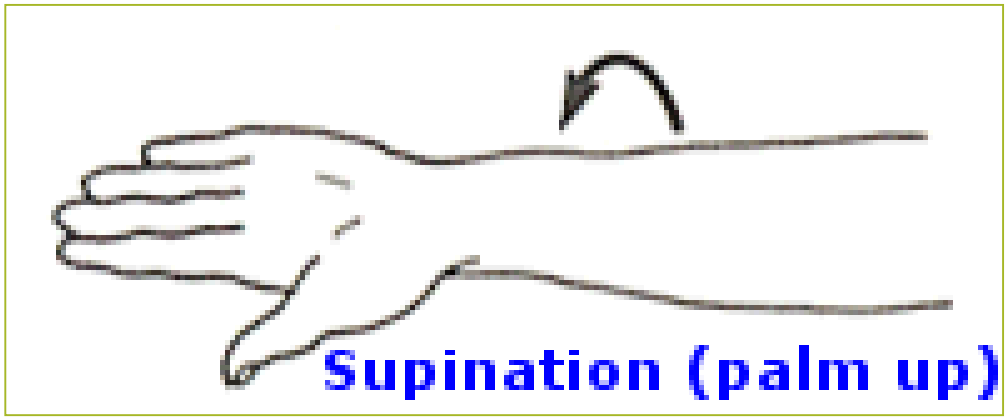


Flexion and extension along frontal axis

Elbow Joint

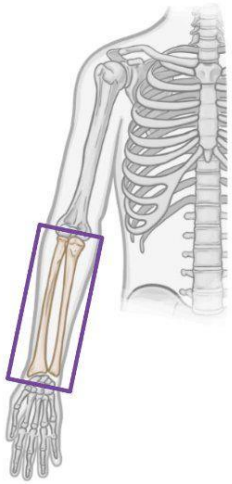


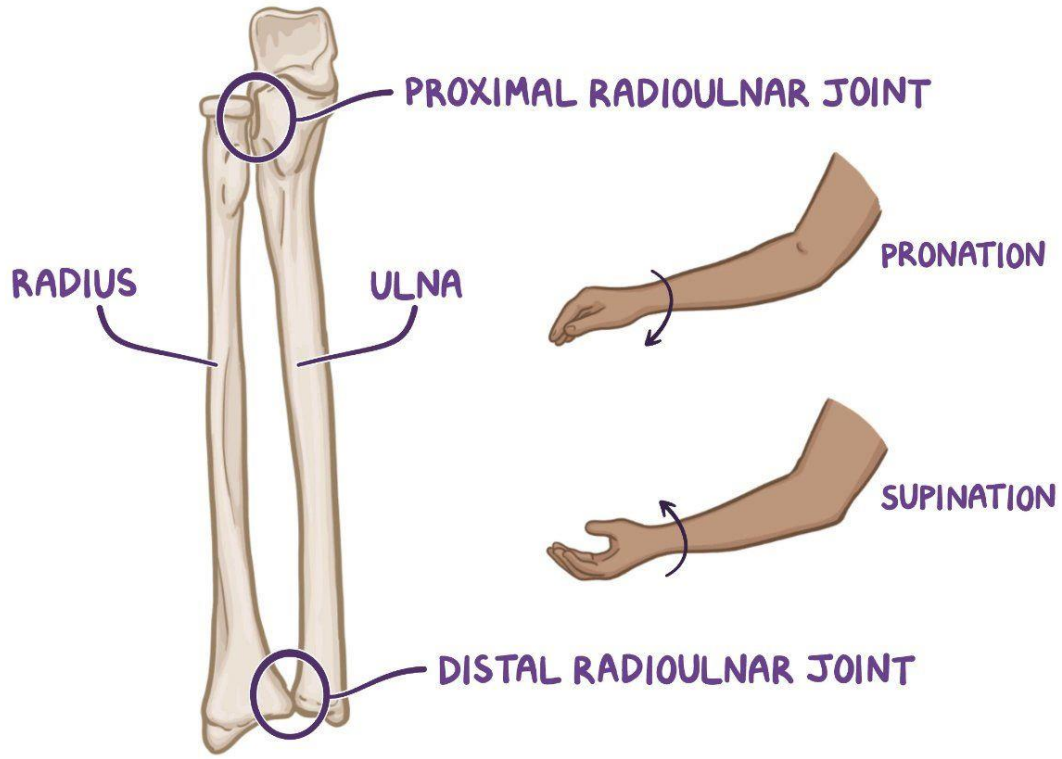




Pronation and supination along vertical axis

Combined movement in proximal and distal radio-ulnar joint



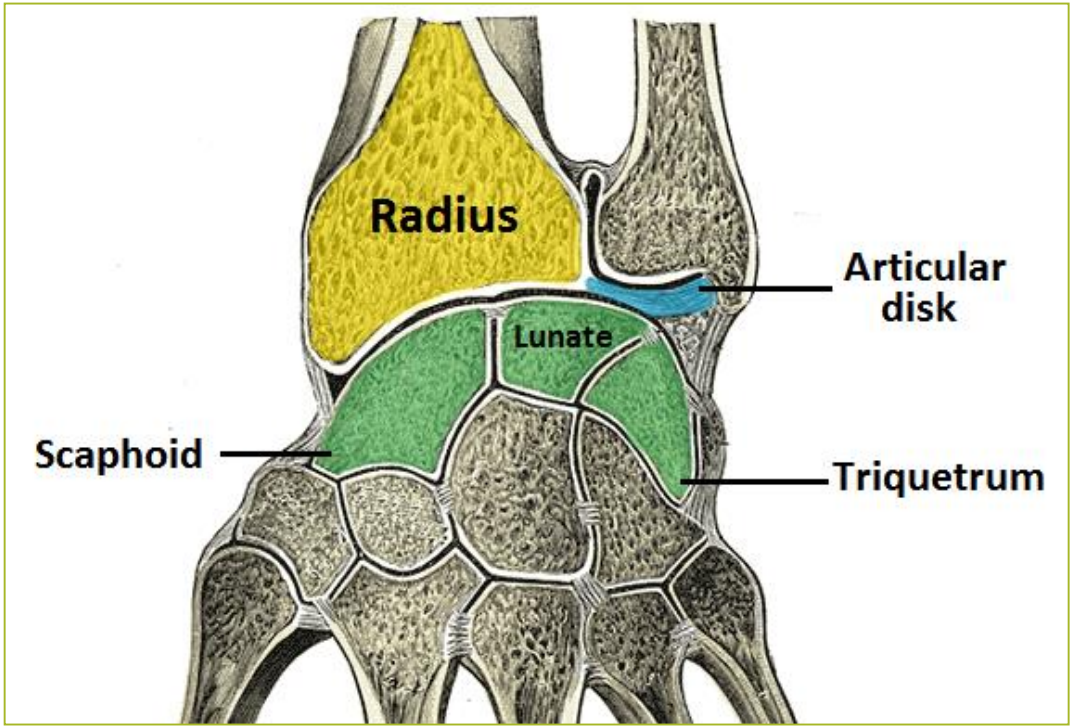


Combined movement in proximal and distal radio-ulnar joint

The wrist joint (*articulatio radiocarpalis*)

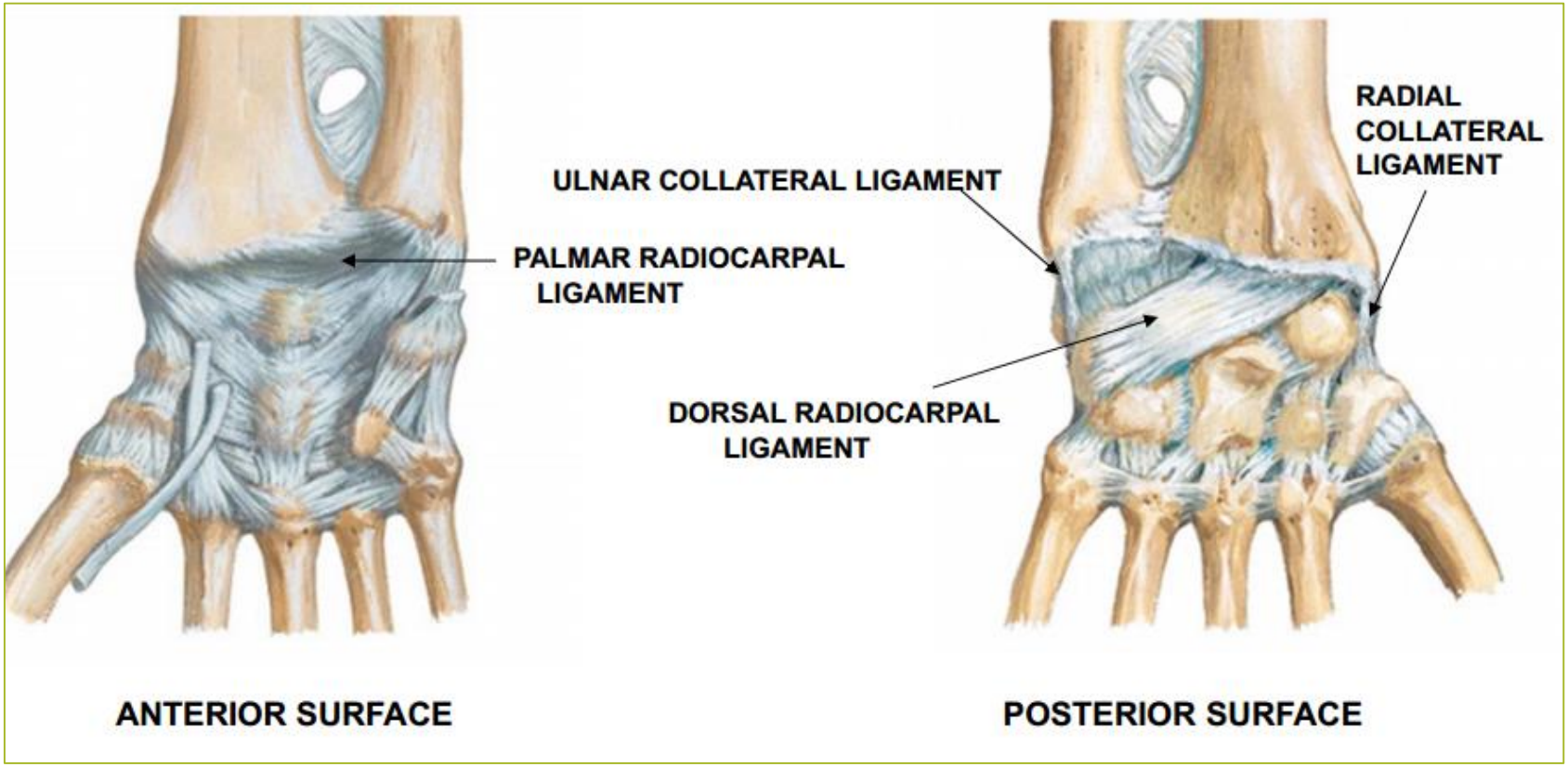
Articular surfaces:

- the carpal articular surface of the radius
- the articular disc (the distal radio-ulnar joint)
- scaphoid, lunate and triquetral bones.

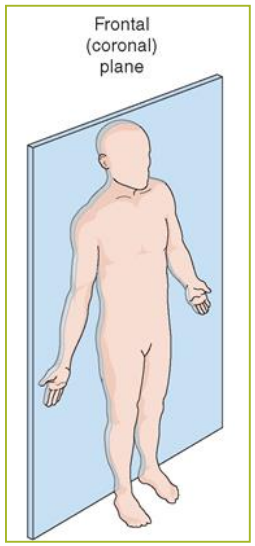


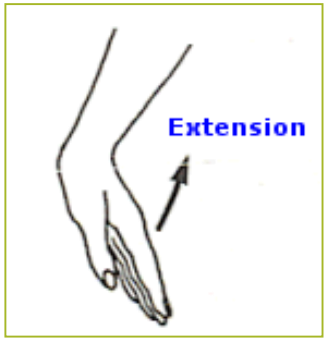
➢Complex ellipsoid joint.

The wrist joint

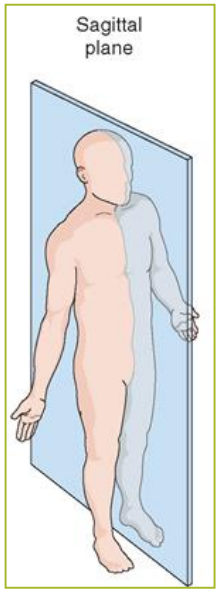


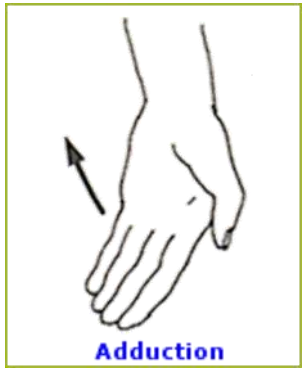
Wrist Joint



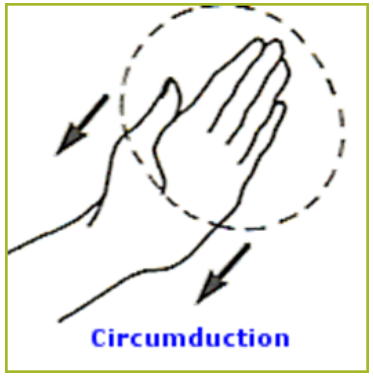


Flexion and extension along frontal axis



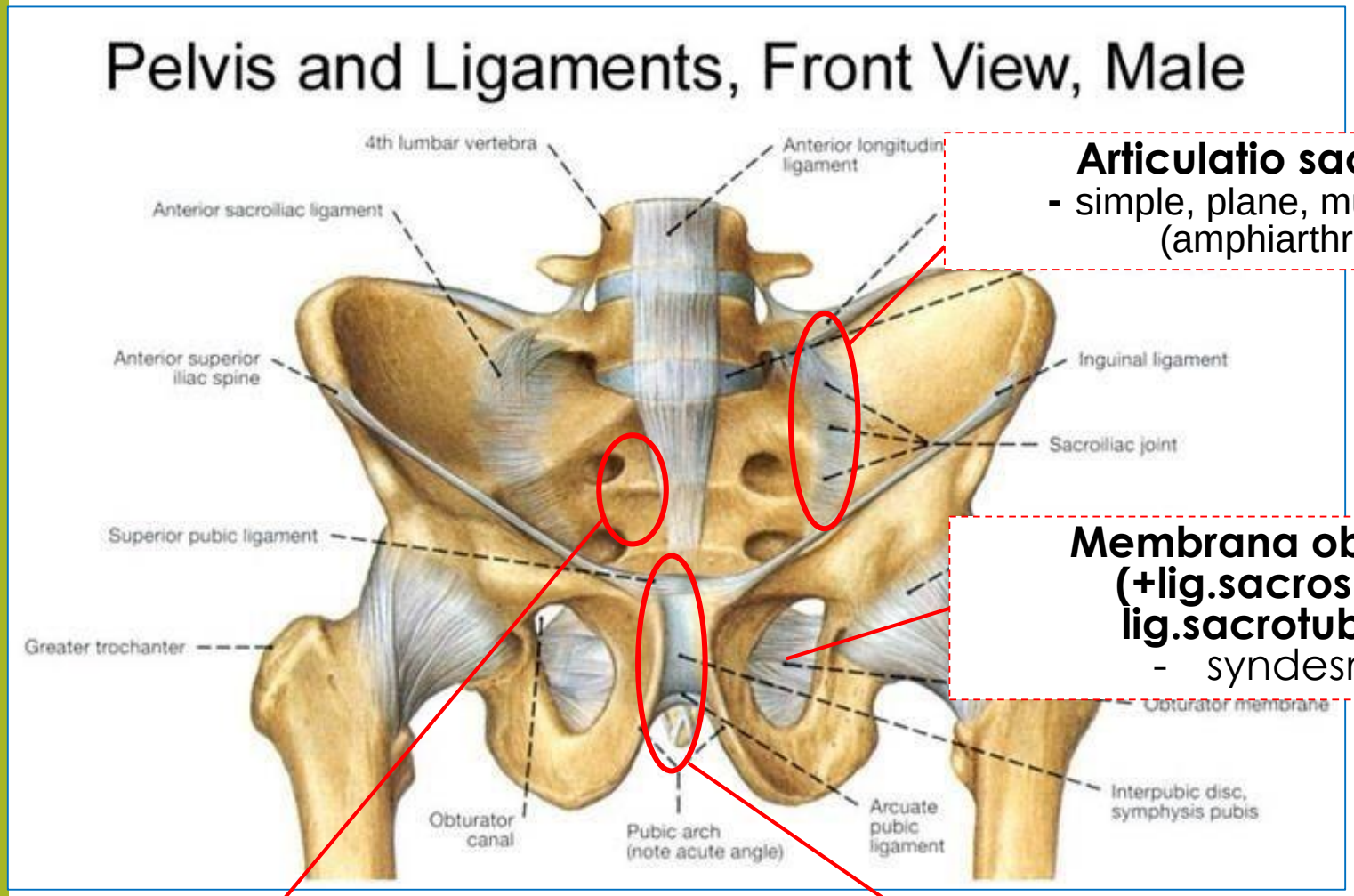


Adduction and abduction along sagittal axis



Circumduction the consequential movements along both axis

Joints of the pelvis



Articulatio sacroiliaca
- simple, plane, multiaxial joint (amphiarthrosis).

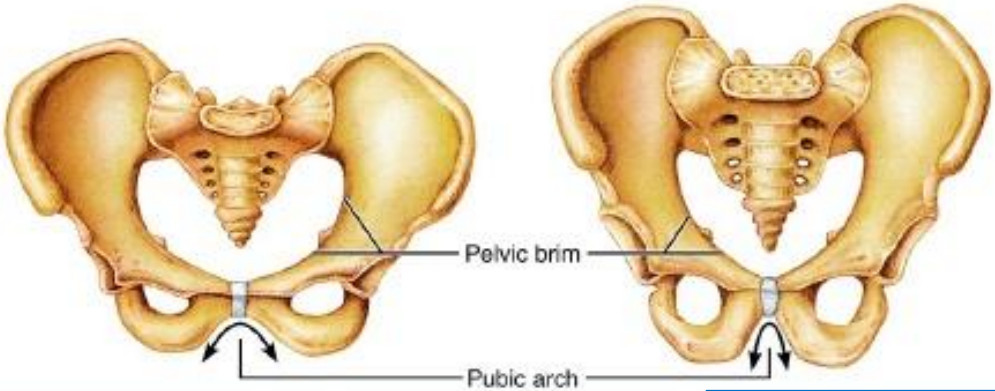
Membrana obturatoria (+lig.sacrospinale, lig.sacrotuberale)
- syndesmosis

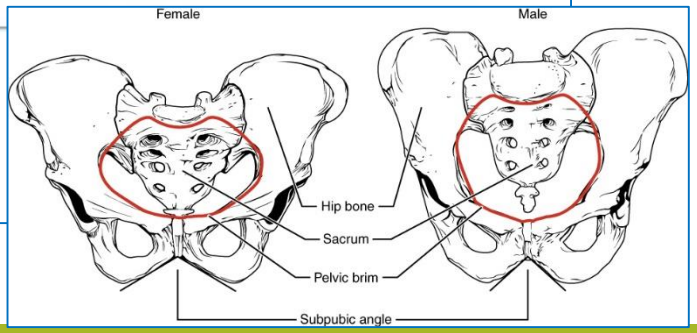
Sacrum (and os coxae)
- temporary synchondrosis that later become synostosis

Symphysis pubicum
- special type of synchondrosis
- interpubic disk with slit-like space

Comparison of Male and Female Pelves

TABLE 7.4 Comparison of the Male and Female Pelves

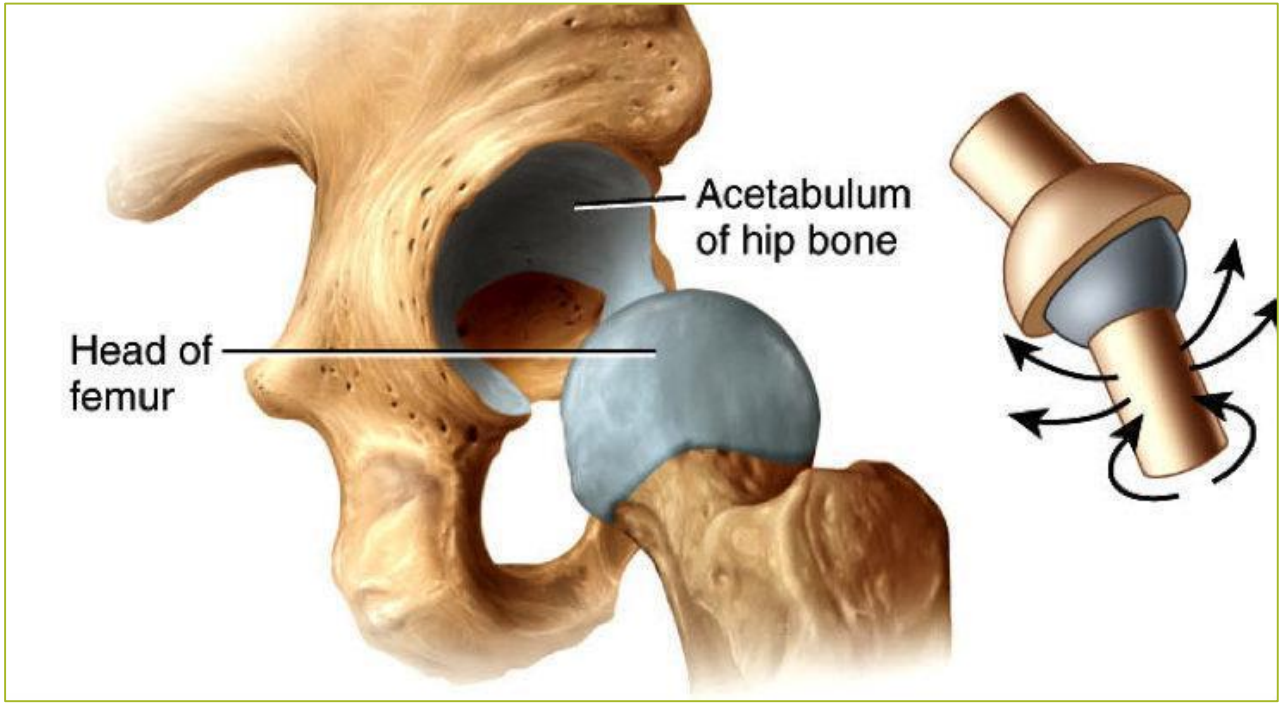
CHARACTERISTIC	FEMALE	MALE
General structure and functional modifications	Tilted forward; adapted for childbearing; true pelvis defines the birth canal; cavity of the true pelvis is broad, shallow, and has a greater capacity	Tilted less far forward; adapted for support of a male's heavier build and stronger muscles; cavity of the true pelvis is narrow and deep
Bone thickness	Less; bones lighter, thinner, and smoother	Greater; bones heavier and thicker, and markings are more prominent
Acetabula	Smaller; farther apart	Larger; closer
Pubic arch/angle	Broader (80–90°); more rounded	More acute (50–60°)
Anterior view		



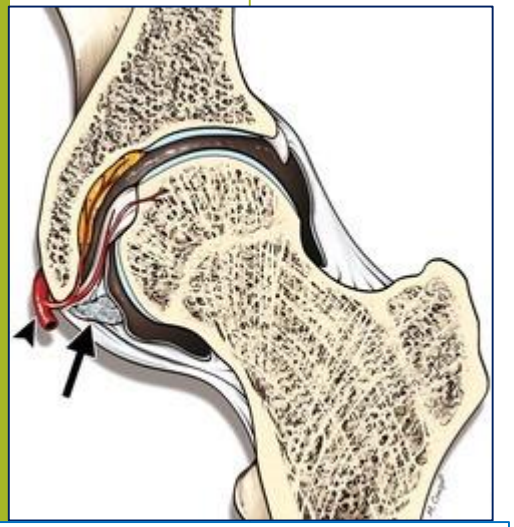
The hip joint (*articulatio coxae*)

Articular surfaces:

- Lunate surface of acetabulum of the hip bone
- Head of the femur

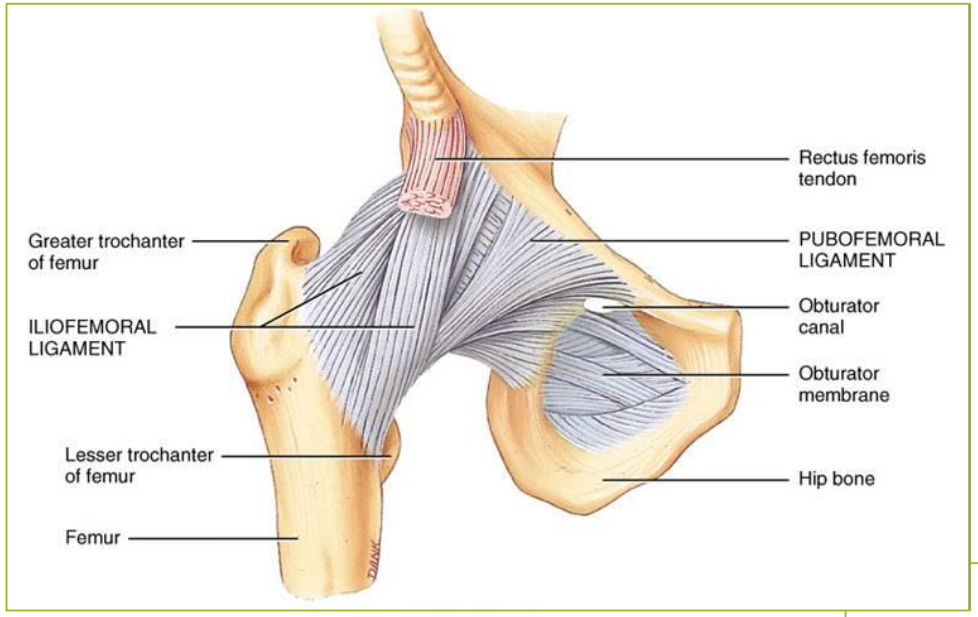


The hip joint (*articulatio coxae*)



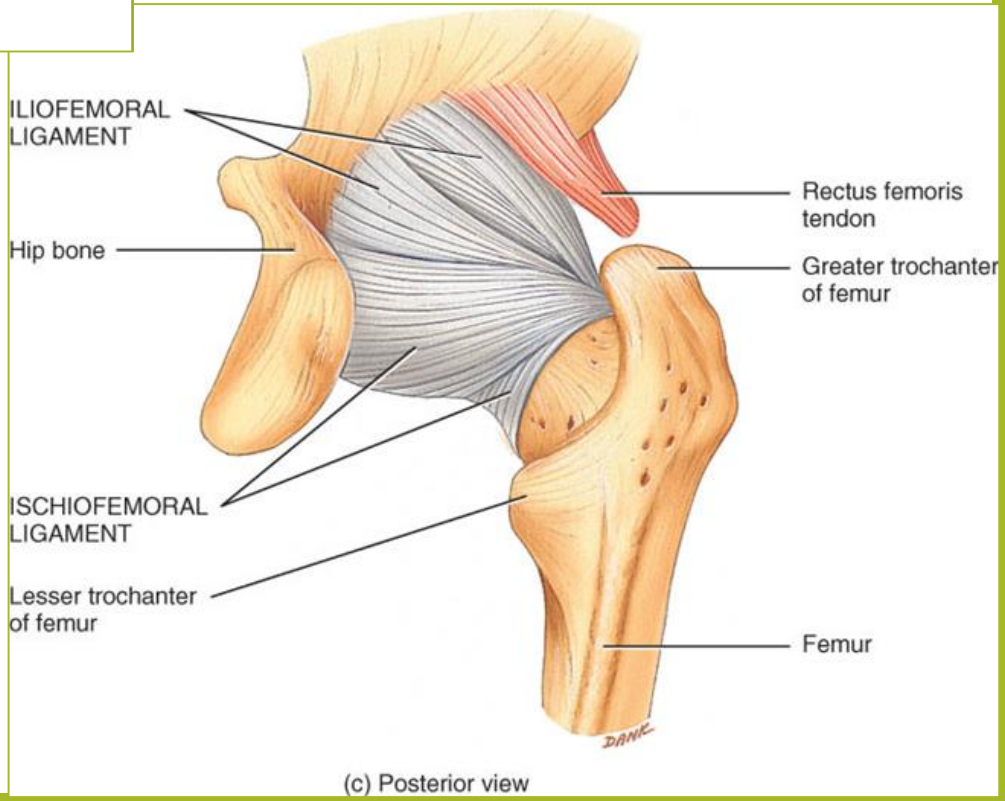
The single blood supply source of the femoral head passes within the lig. capitis femoris!

The hip joint

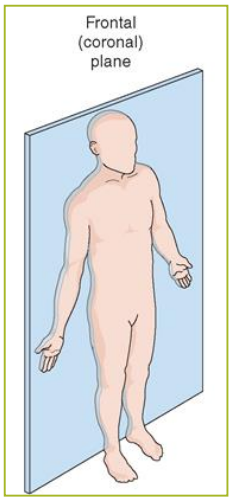


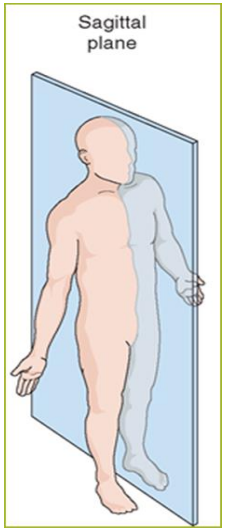
Ligaments:

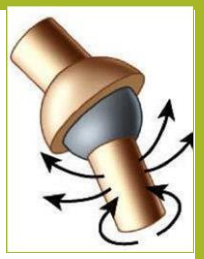
1) Lig. iliofemorale
2) Lig. ischiofemorale
3) Lig. pubofemorale
4) Zona orbicularis
5) Lig. capitis femoris



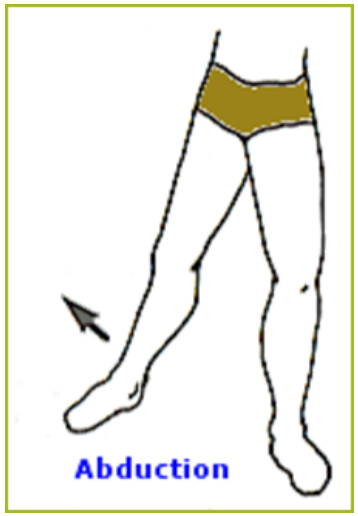
The hip joint

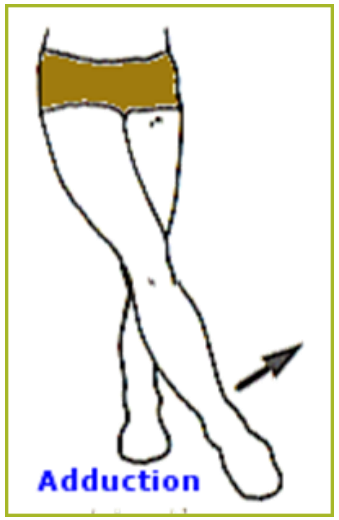




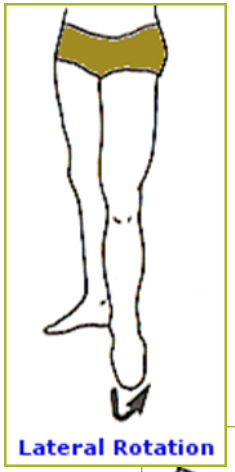


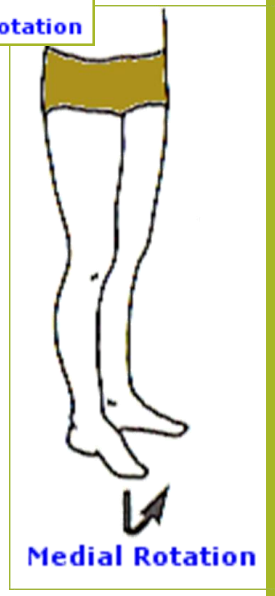
Flexion and extension along frontal axis





Adduction and abduction along sagittal axis



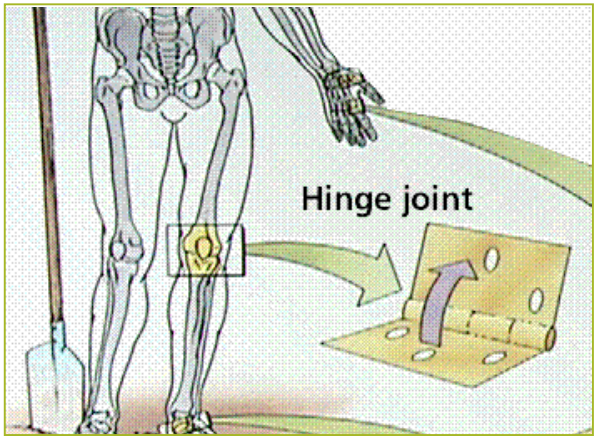


Rotation along vertical axis

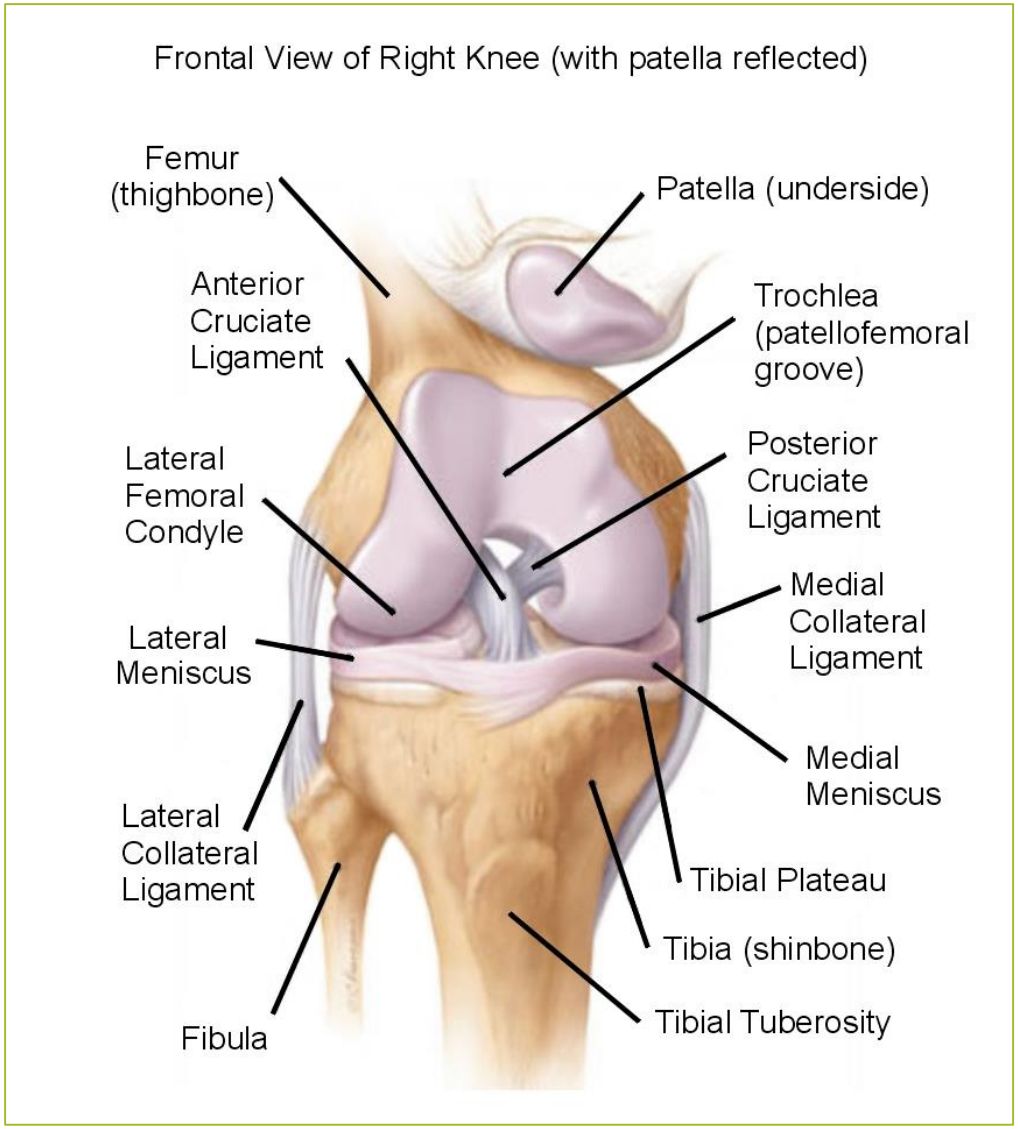
The knee joint (*articulatio genus*)

Articular surfaces:

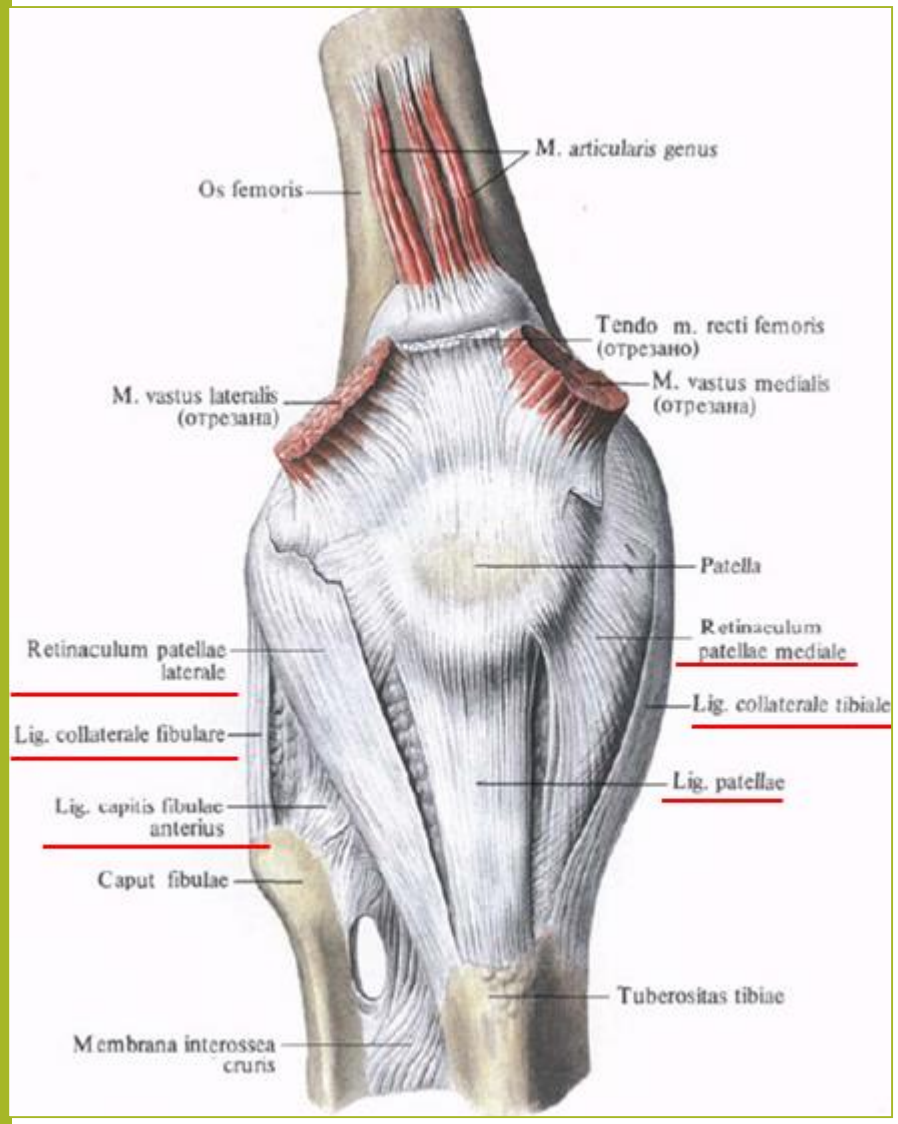
- Articular surface of medial and lateral condyle of femur
- Superior articular surface of tibia
- Articular surface of patella
- Patellar surface of femur

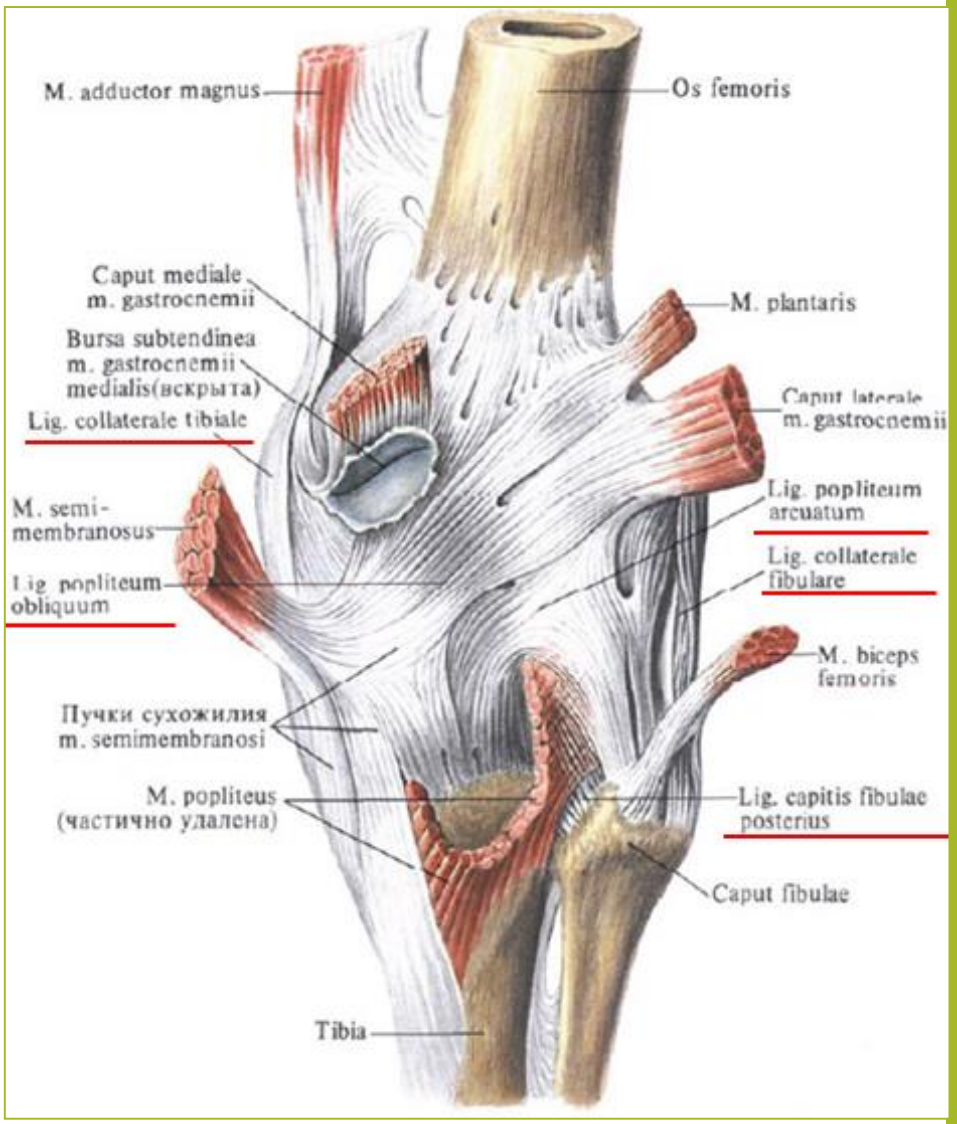


Complex bicondylar joint



The knee joint (*articulatio genus*)





Extra-articular ligaments

Anterolateral ligament of the knee joint

Journal of Anatomy

J. Anat. (2013) 223, pp321-328 doi: 10.1111/joa.12087

Anatomy of the anterolateral ligament of the knee

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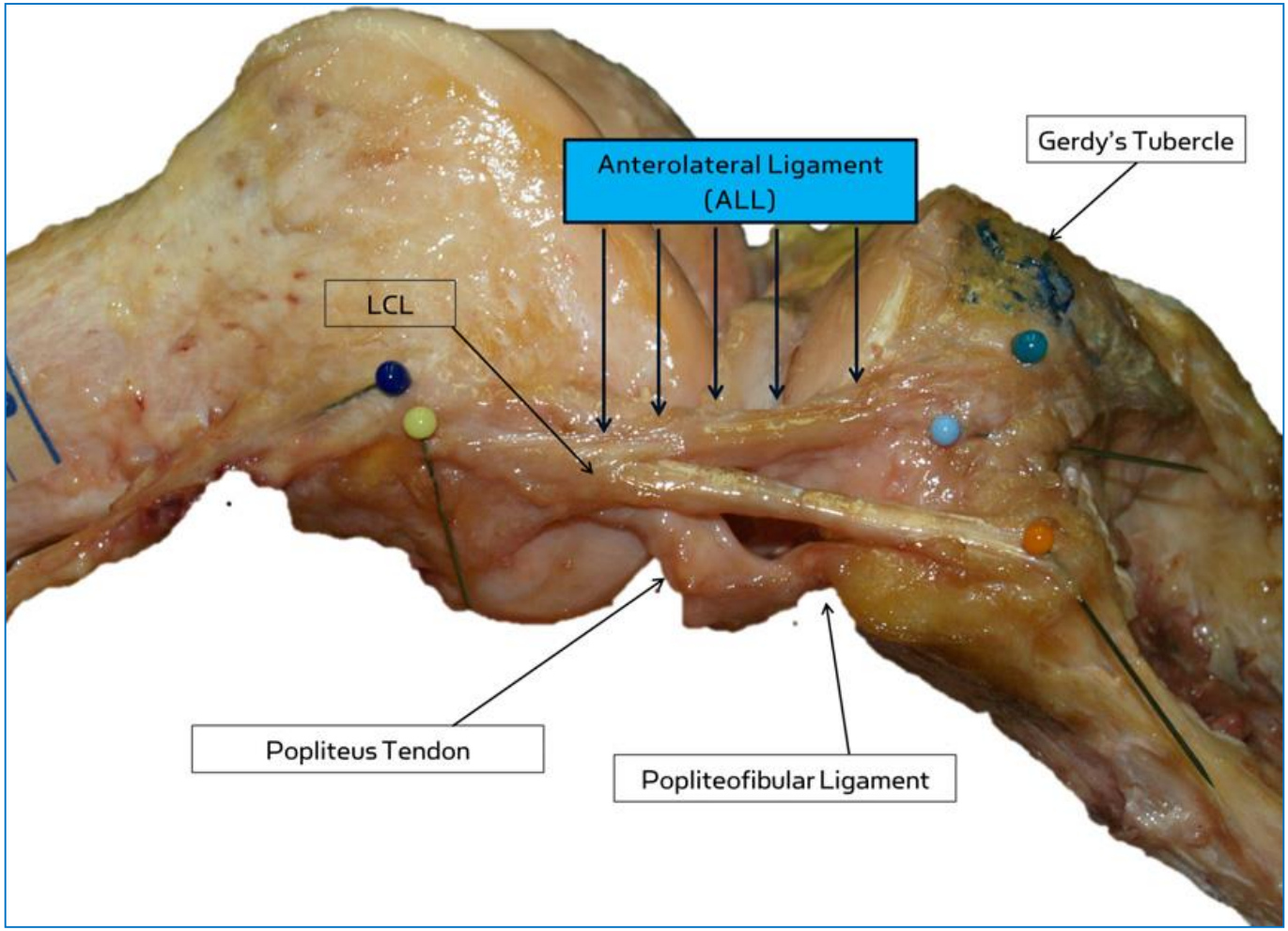
[2]*Department of Development and Regeneration, Faculty of Medicine@Kulak, Catholic University Leuven, Kortrijk, Belgium*
[3]*Department of Orthopedic Surgery & Traumatology, University Hospital Gent, Ghent, Belgium*
[4]*Antwerp Orthopedic Center, Monica Hospitals, Antwerp, Belgium*

Hypothesized function - control internal tibial rotation, stabilize internal rotation



Origin – on the prominence of the lateral femoral epicondyle
Insertion - the body of the ALL ran an oblique course to the anterolateral side of the proximal tibia.

Anatomy of the ALL, S. Claes et al. J. Anat. (2013) 223, pp321--328

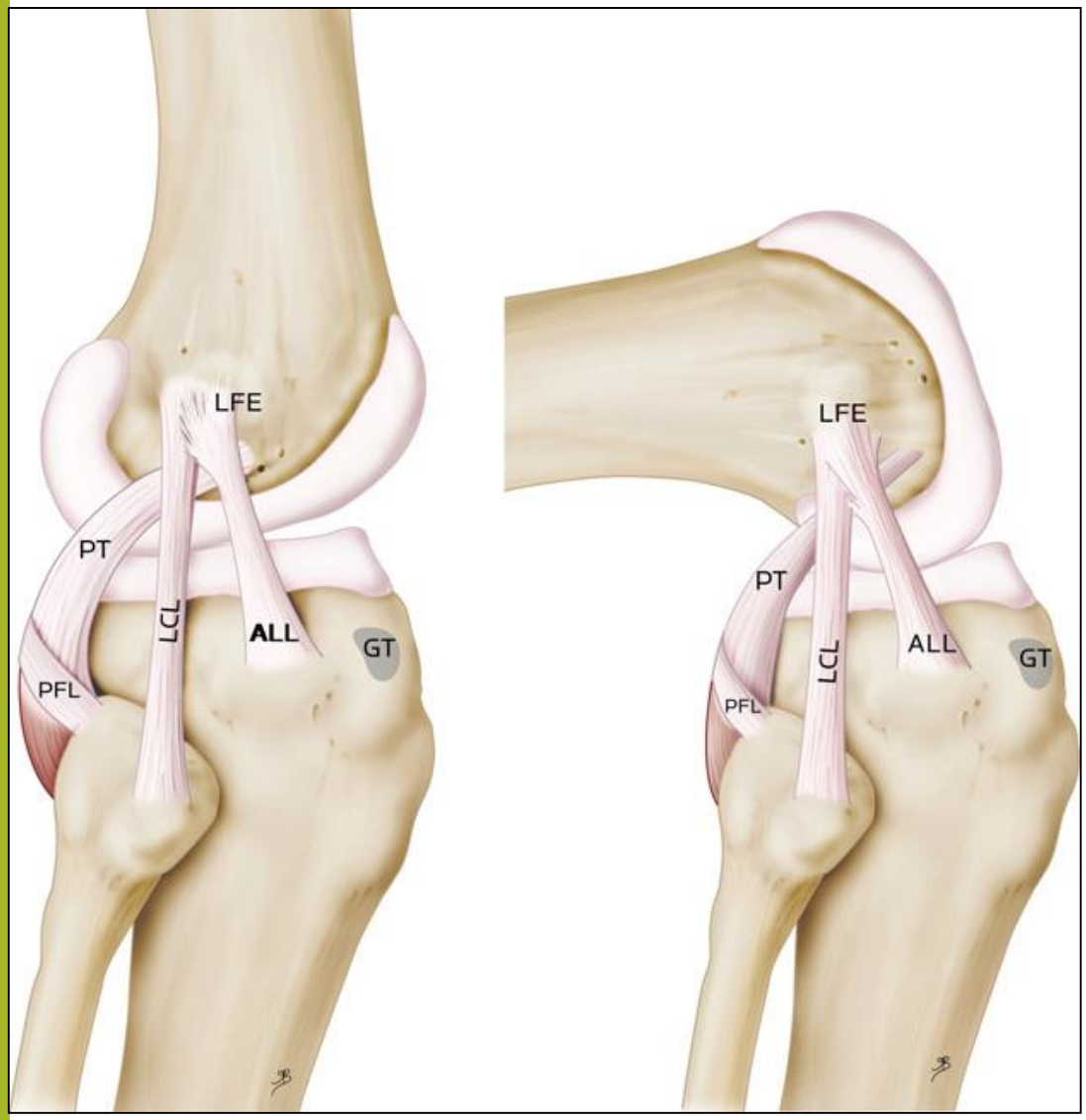


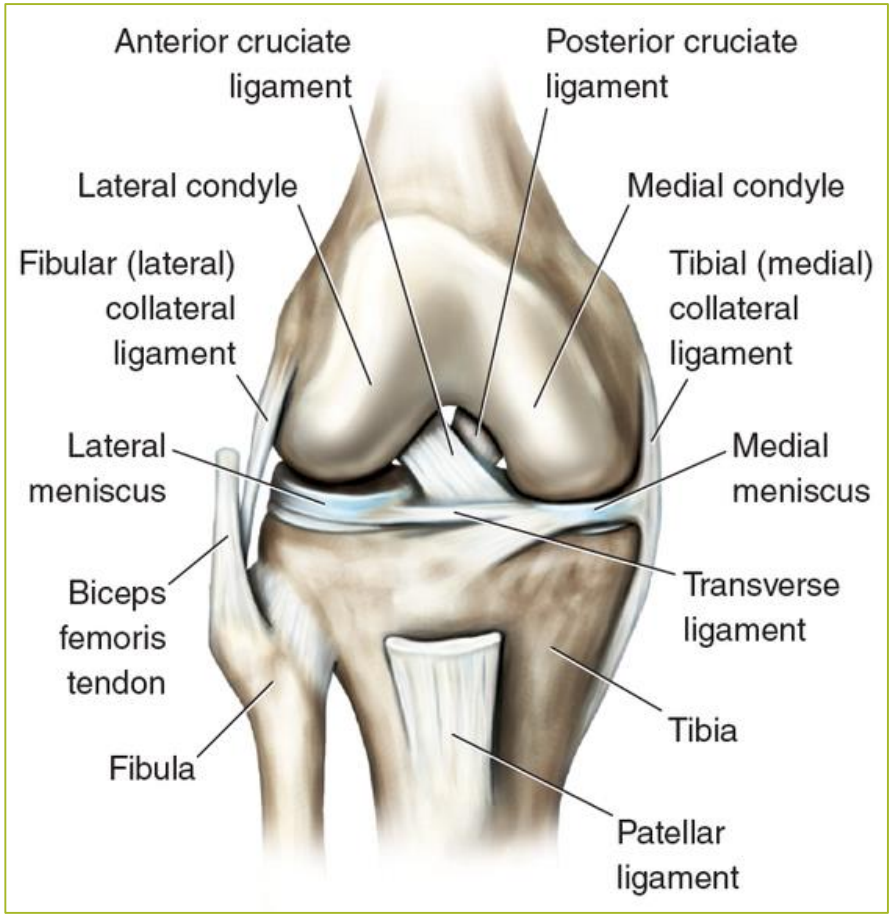
Fig. 4 Anatomic drawing considering the ALL and its relationship with well-known anatomical landmarks on the lateral aspect of the human knee.
(A) Knee in full extension.
(B) Knee in 90° of flexion.

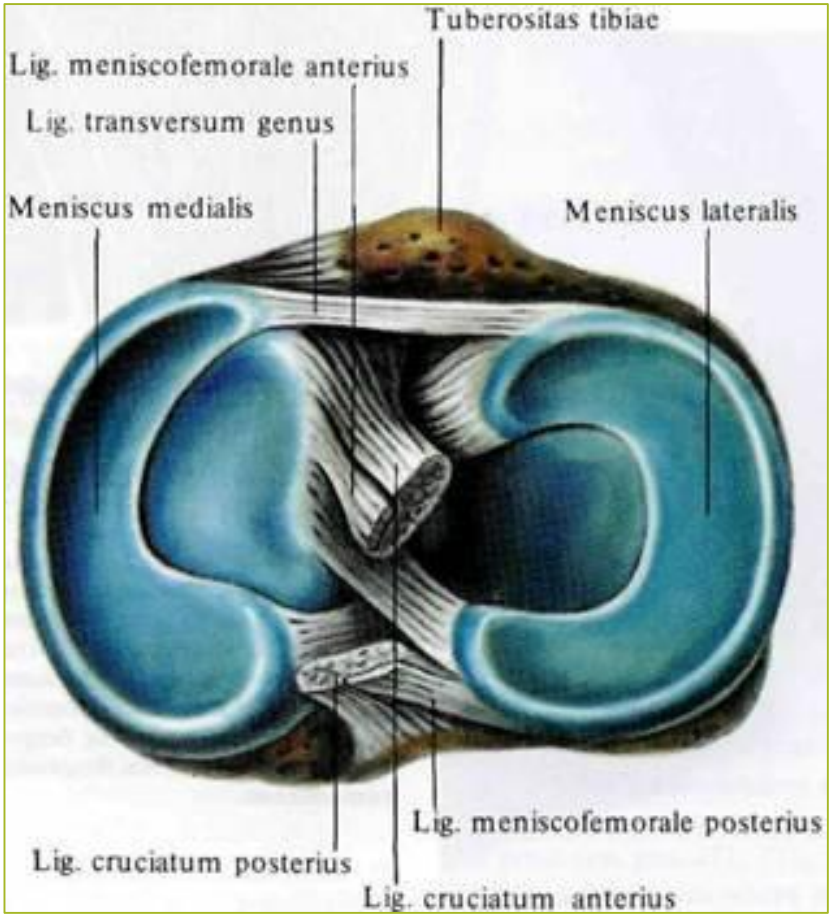
ALL, anterolateral ligament;
LCL, lateral collateral ligament;
GT, Gerdy's tubercle;
LFE, lateral femoral epicondyle;
PT, popliteus tendon;
PFL, popliteo-fibular ligament.

Anatomy of the ALL, S. Claes et al. J. Anat. (2013) 223, pp321--328

1879, years before the discovery of X-rays, **Dr. Paul Segond** described a remarkably constant avulsion fracture pattern at the anterolateral proximal tibia as a result of forced internal rotation at the knee (**Segond fracture**)

The knee joint (*articulatio genus*)

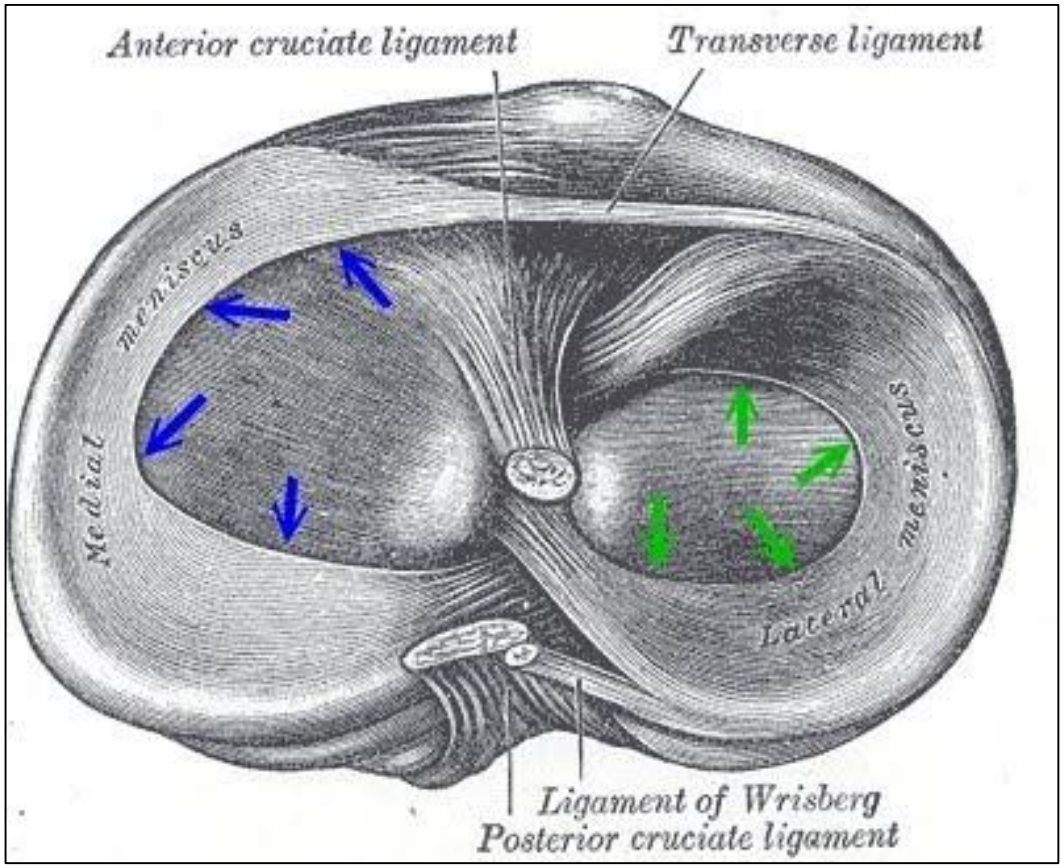




Intra-articular ligaments

Lateral and medial menisci of the knee joint

(viscoelastic soft tissue)



Functions of the menisci:

- adapt articular surfaces of femur and tibia, increase their congruence, hence the stresses on tibial cartilage are reduced
- to distribute loads and therefore reduce the stresses on the tibia,
- joint stabilisation;
- shock absorption;
- joint lubrication;
- cartilage protection and prevention of osteoarthrosis

Human meniscus

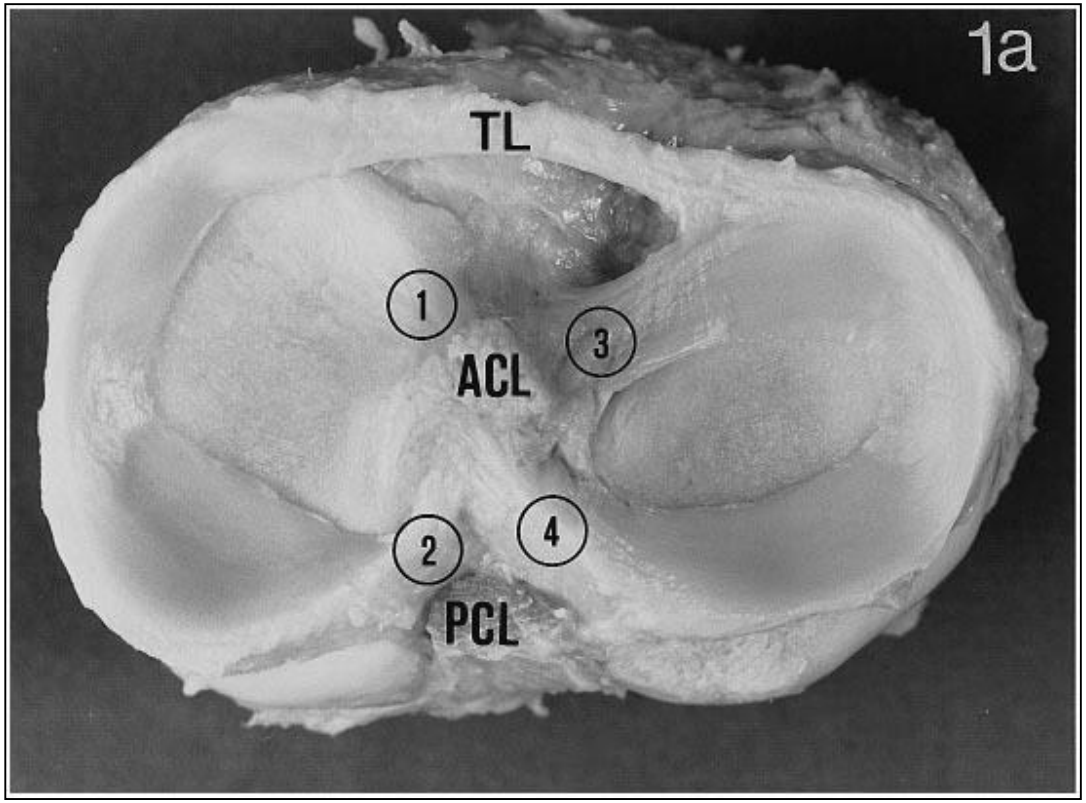
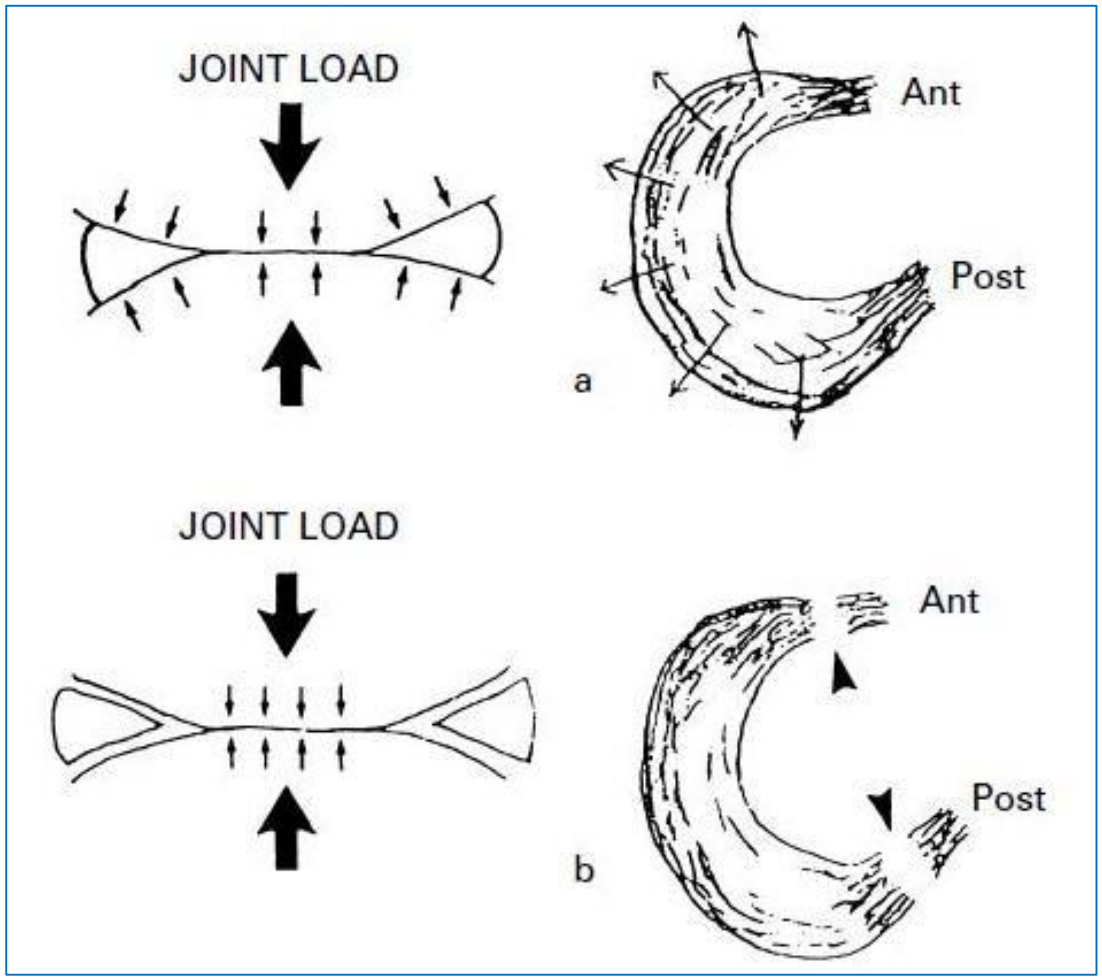


Fig. 1. Human meniscus. (*a*) Right human knee joint viewed from above (the femur has been removed); the tibial tuberosity is on top. The medial and lateral menisci are connected by a transverse ligament (TL).
1 - anterior insertional ligament of the medial meniscus;
2 - posterior insertional ligament of the medial meniscus;
3 - anterior insertional ligament of the lateral meniscus;
4 - posterior insertional ligament of the lateral meniscus;
ACL - cross section of the anterior cruciate ligament;
PCL – cross section of the posterior cruciate ligament.

Karola Messner and Jizong Gao. The menisci of the knee joint. Anatomical and functional characteristics, and a rationale for clinical treatment. Review. J. Anat. (1998) 193, pp. 161±178



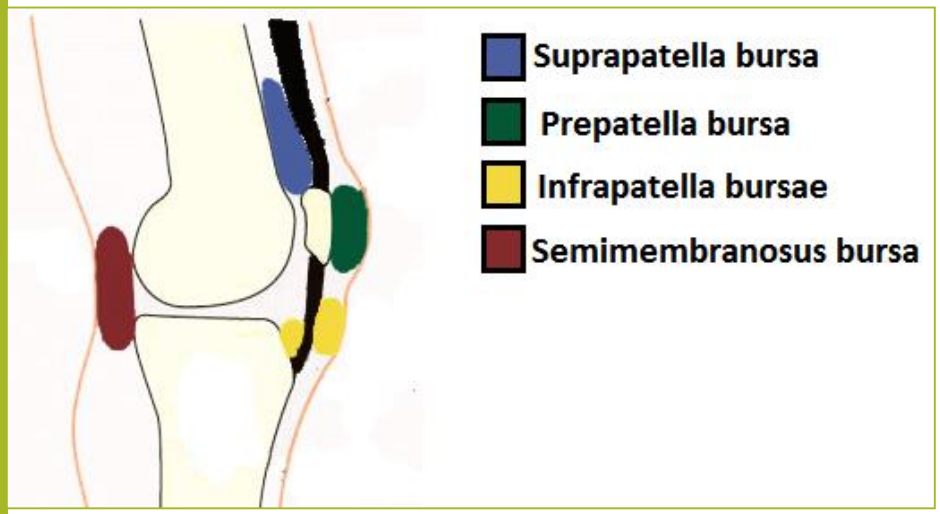
Karola Messner and Jizong Gao. The menisci of the knee joint. Anatomical and functional characteristics, and a rationale for clinical treatment. Review. J. Anat. (1998) 193, pp. 161±178

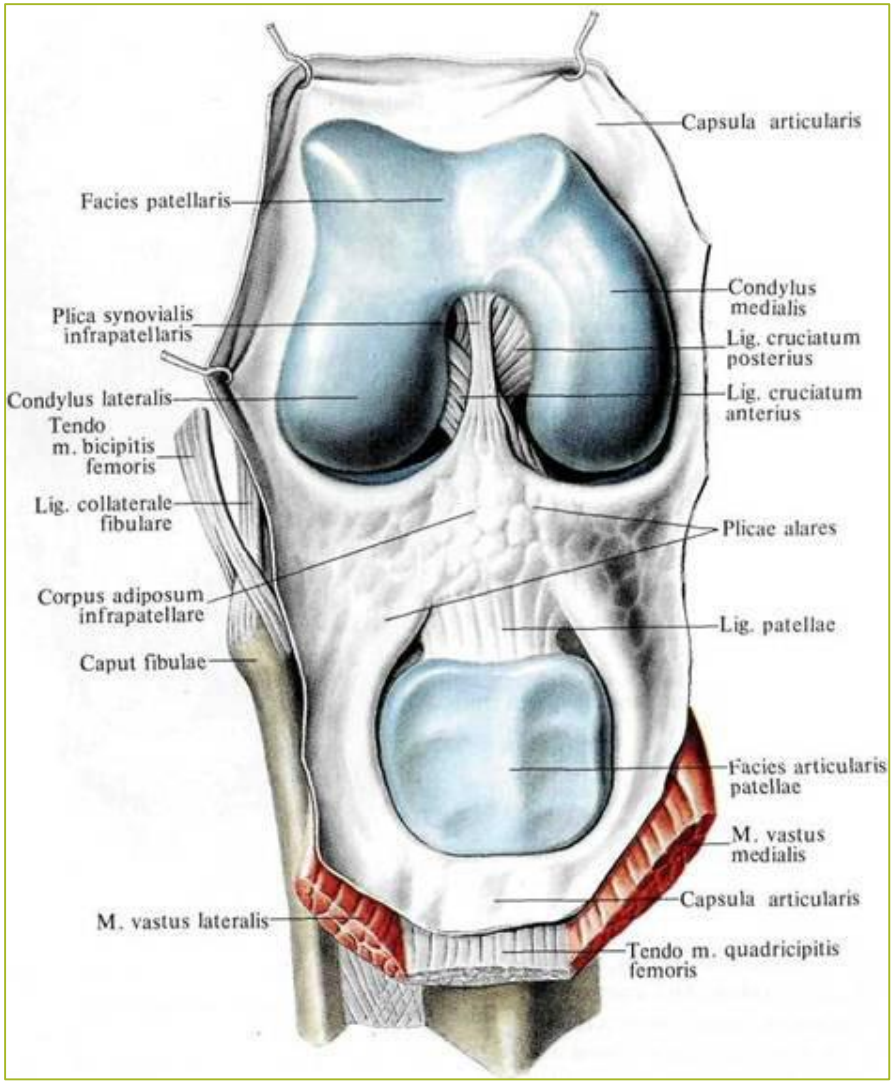
Fig. 2. Diagram demonstrating the importance of intact meniscal entheses for the load distribution function of the meniscus. (*a*) With intact entheses the load (thick arrows) is transmitted via the menisci and articular cartilage through a large contact area (left hand side of figure; small arrows). Part of the load is transformed to hoop stresses (right hand side of figure; long arrows).
(*b*) When the insertional ligaments are transected (right hand side of figure; arrowheads), the meniscus will extrude from the knee joint during loading, and the load (left hand side of figure; thick arrows) is mainly transmitted via articular cartilage through a reduced contact area (small arrows).

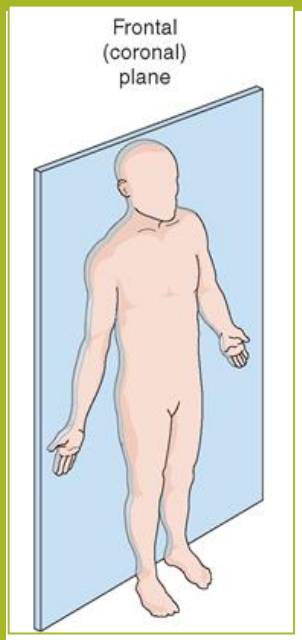

AON


AON

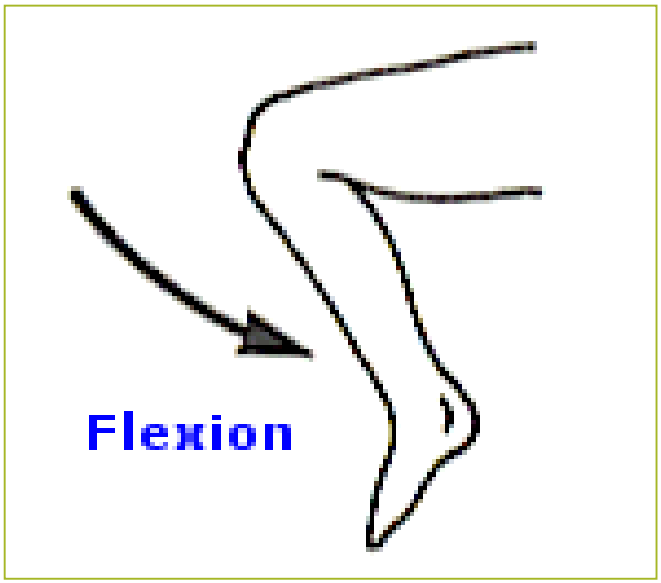
The knee joint (*articulatio genus*)

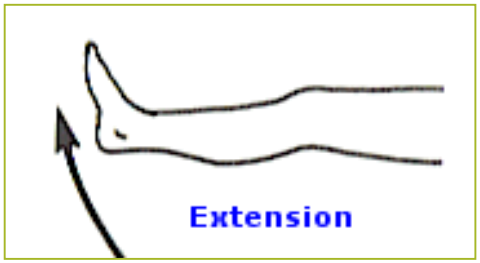






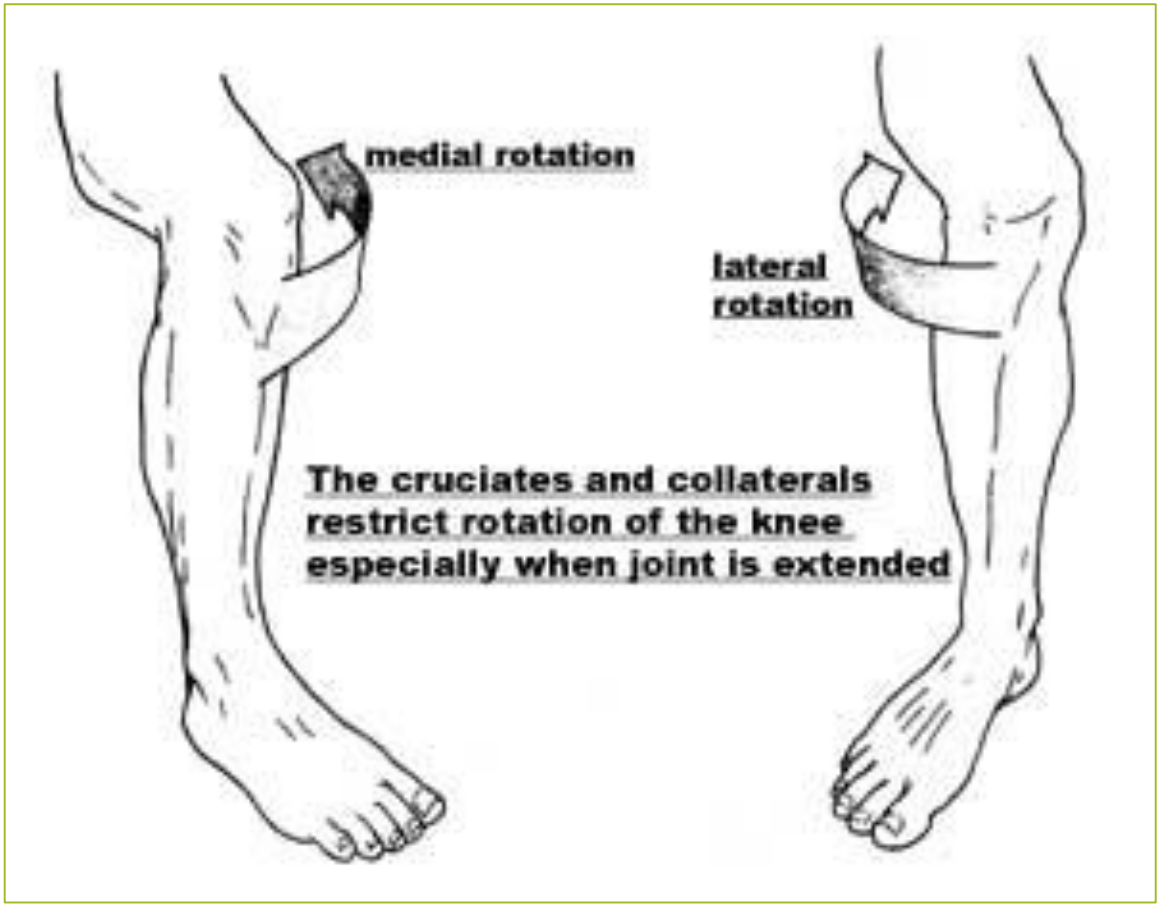
The knee joint





Flexion and extension along frontal axis

The knee joint

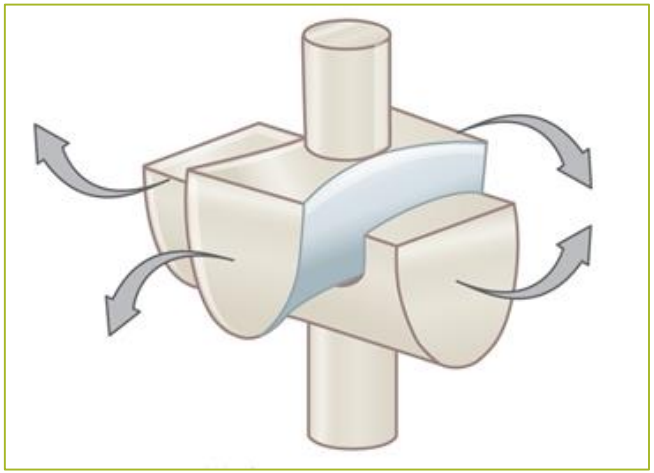


Rotation becomes possible when the knee is flexed!

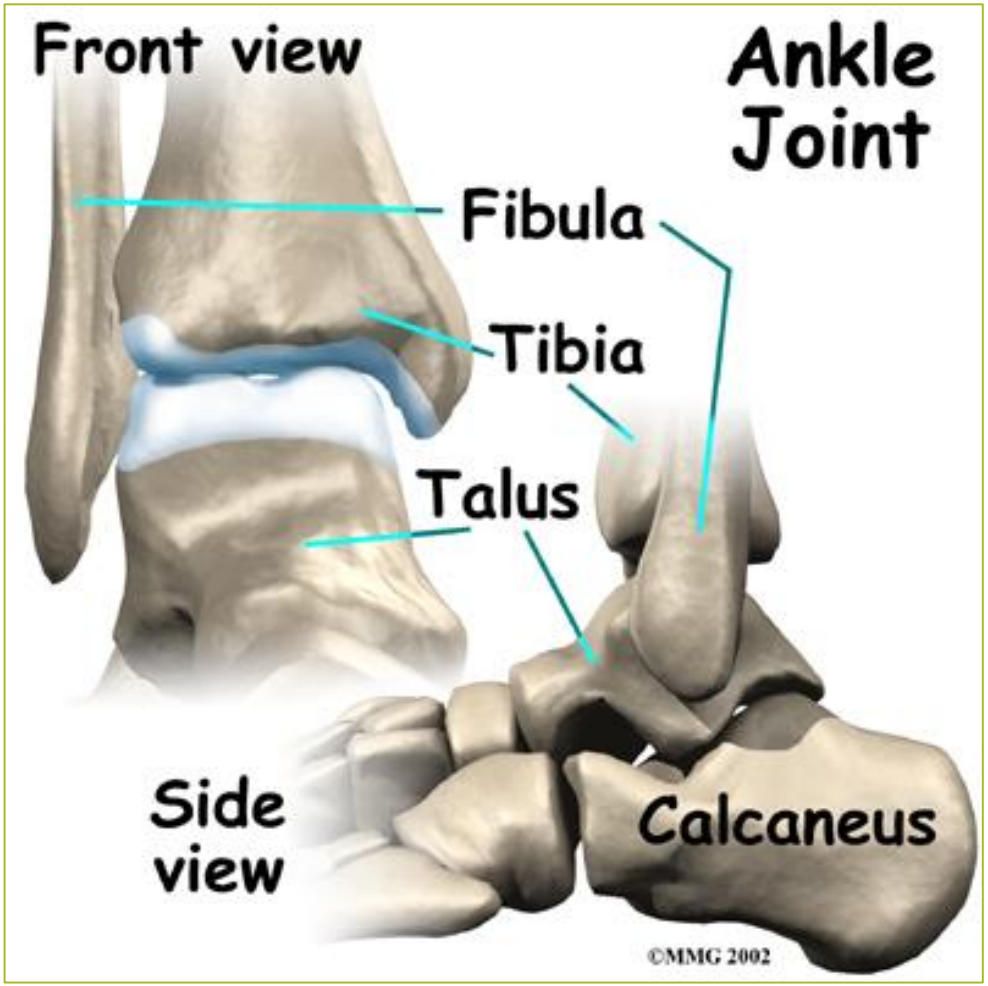
Ankle joint (articulation talocruralis)

Articular surfaces:

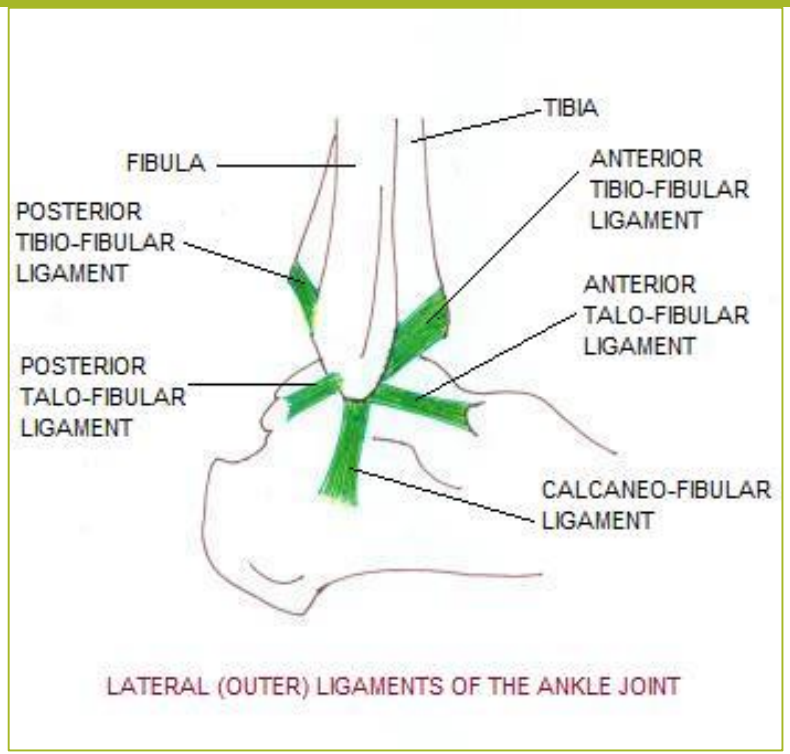
- Inferior articular surface of tibia
- Articular surface of medial malleoli (tibia)
- Articular surface of lateral malleoli (fibula)

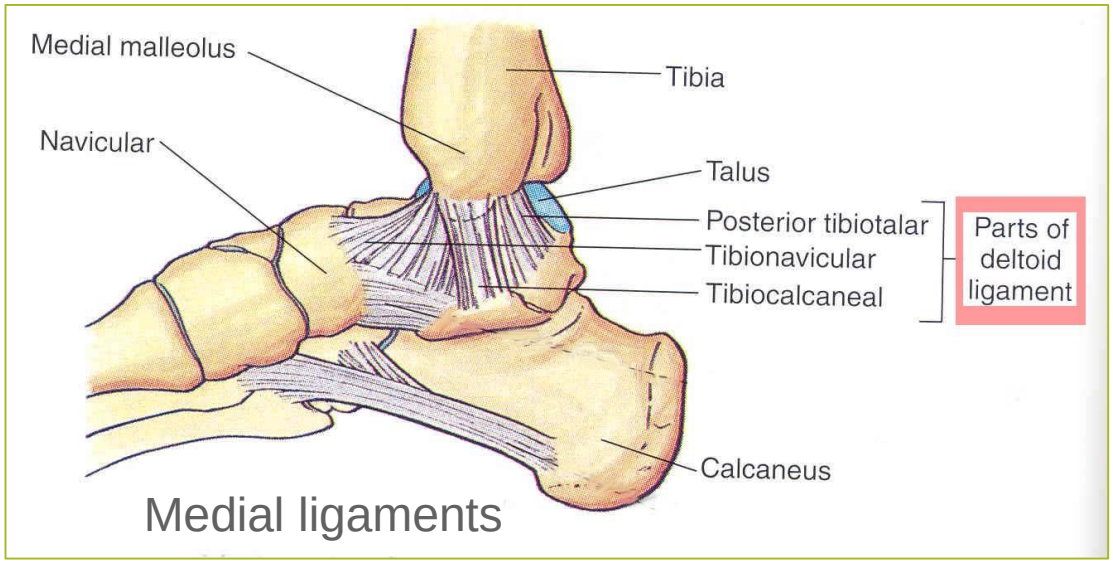


Complex saddle joint

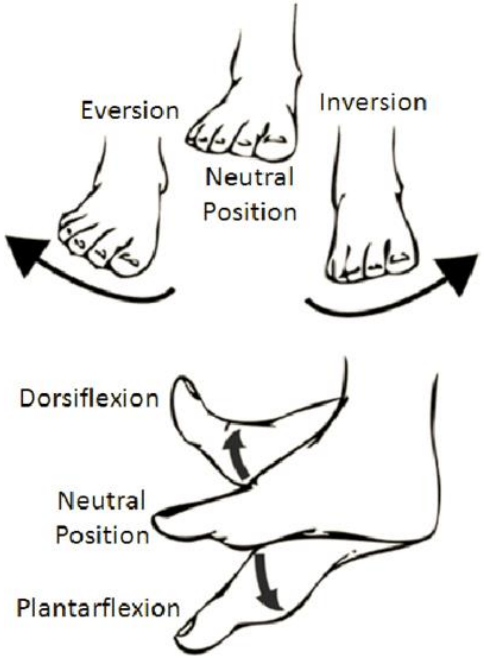


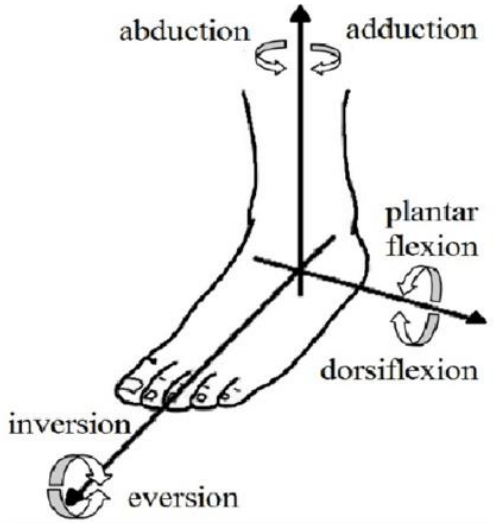
Ankle joint ligaments

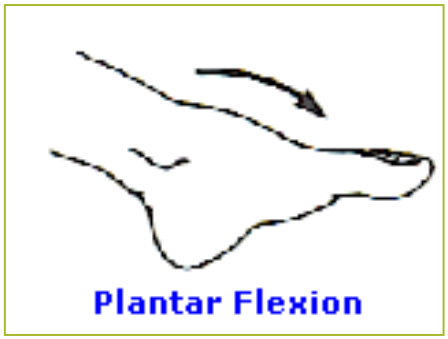




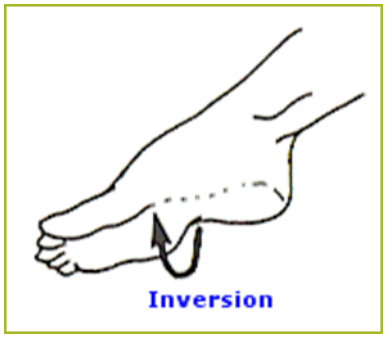
Ankle Joint







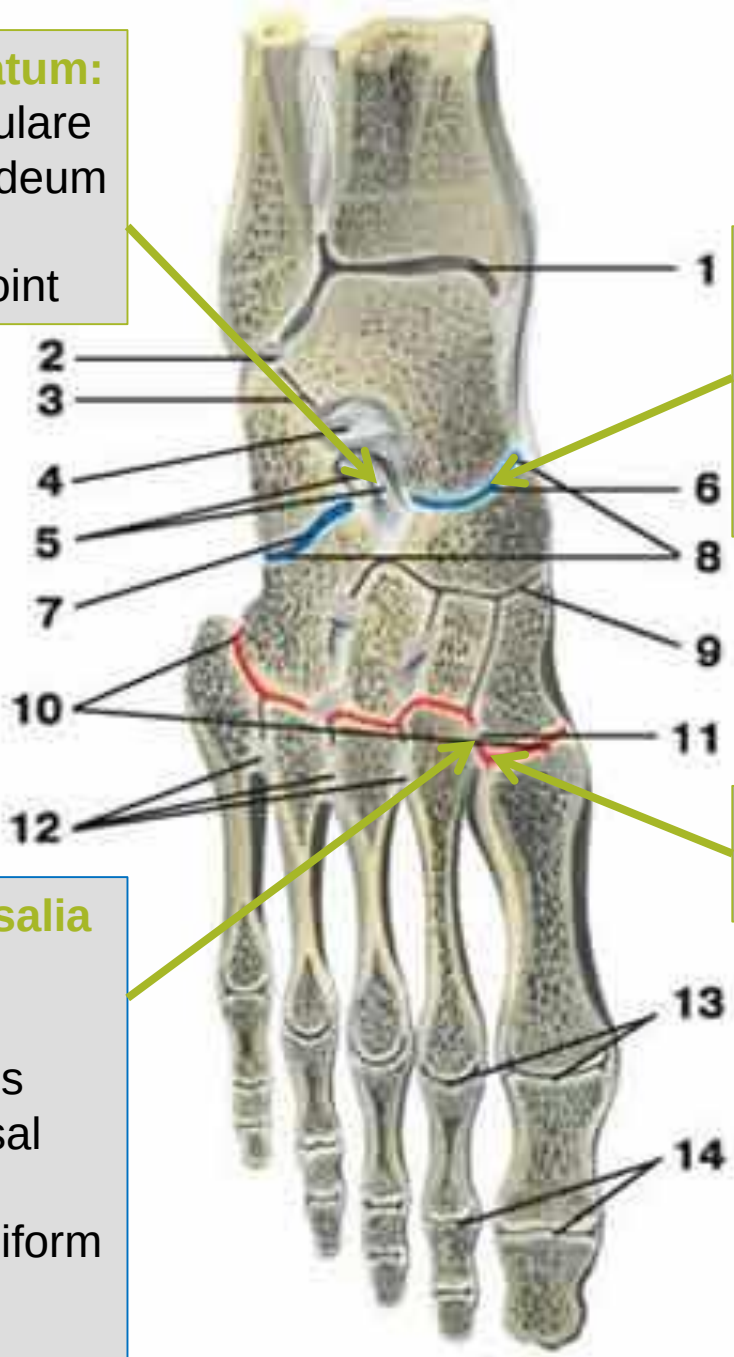
Plantar flexion and dorsi flexion along frontal axis



Inversion and eversion along vertical axis

Ligamentum bifurcatum:
- lig. calcaneonaviculare
- lig. calcaneocuboideum

- “key” of Chopart`s joint



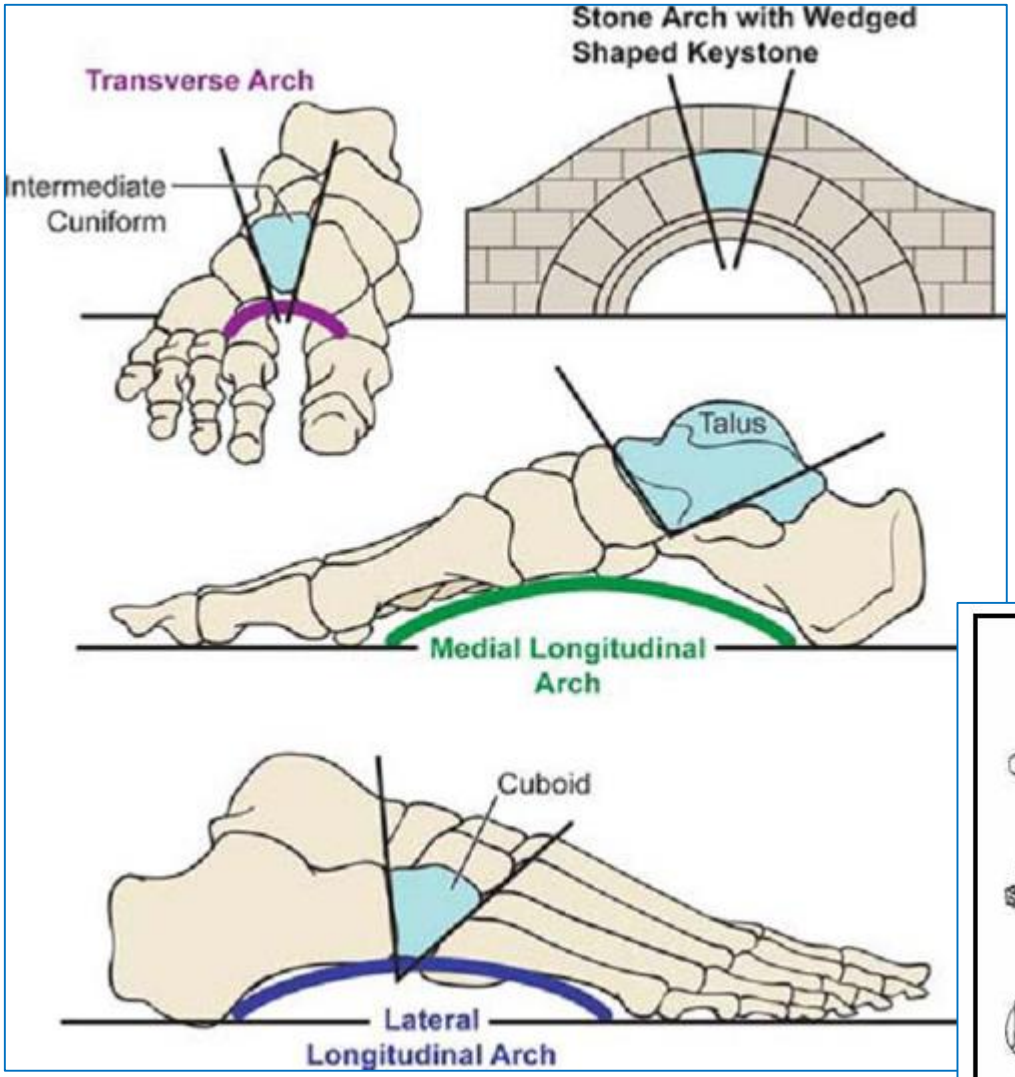
Articulatio tarsi transversa (Chopart`s joint) combines two joints:
- Calcaneocuboid joint
- Talonavicular joint

Articulatio tarsimetatarsales (Lisfrank`s joint)

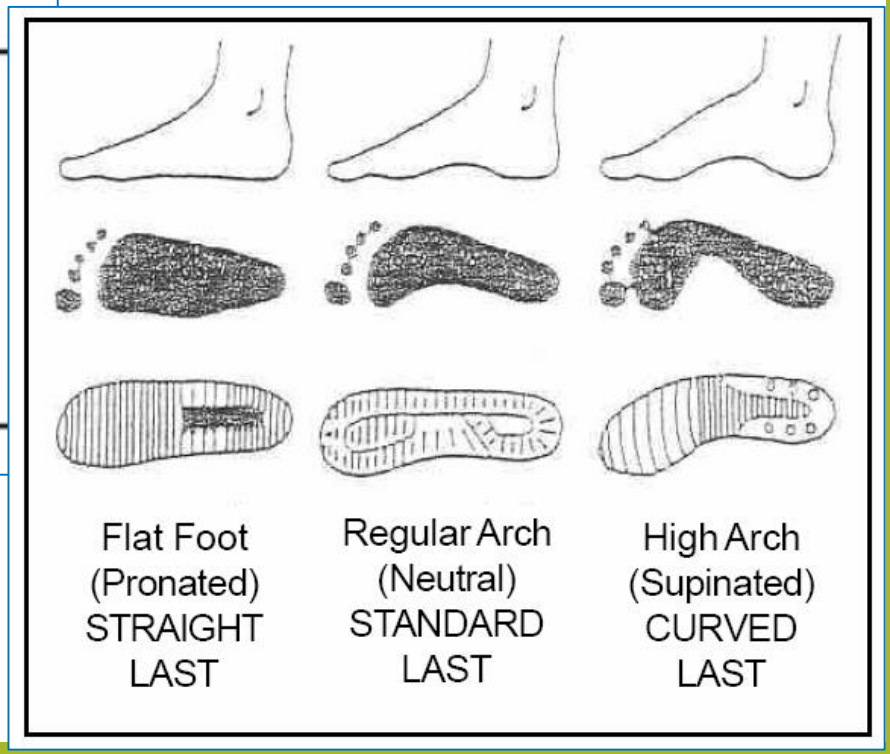
Ligg. cuneometatarsalia interossea:

The “key” of Lisfrank`s joint – cuneometatarsal interosseus ligament between medial cuneiform bone and second metatarsal bone

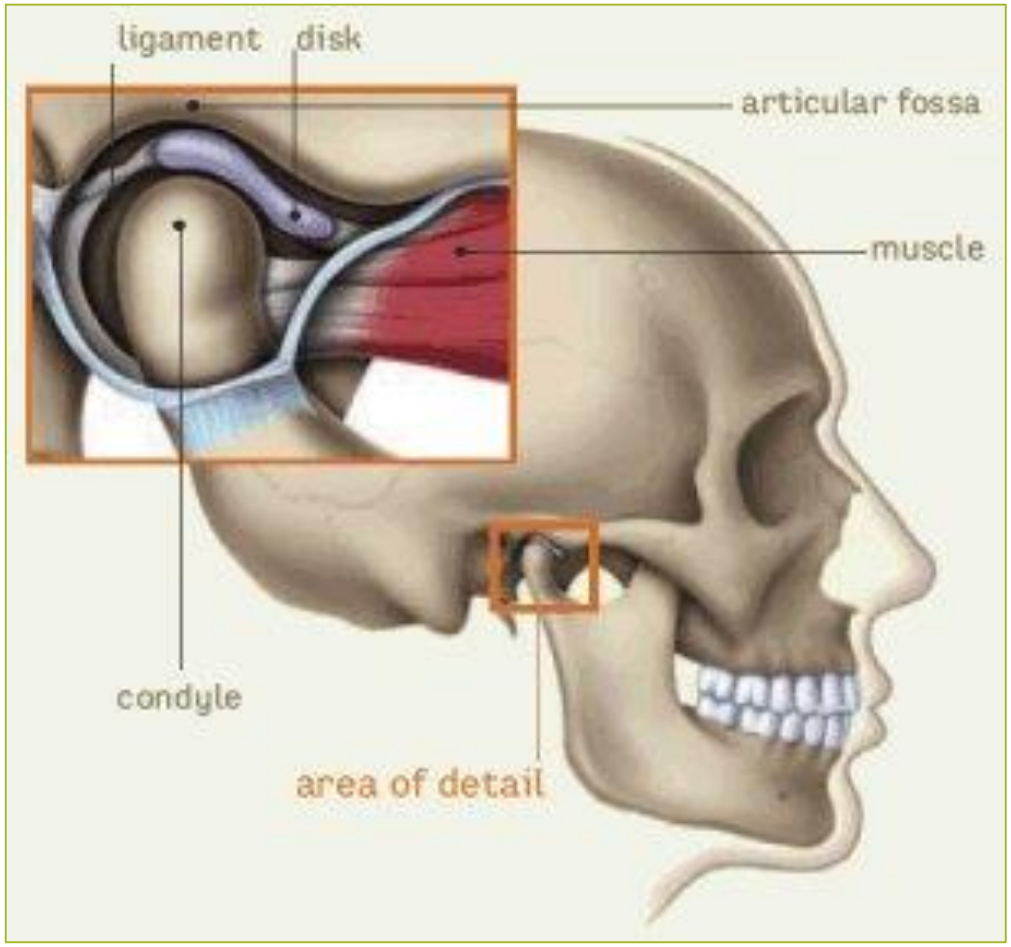
The Arches of Foot



- Weight distribution, amortization
- Adequate blood supply of foot

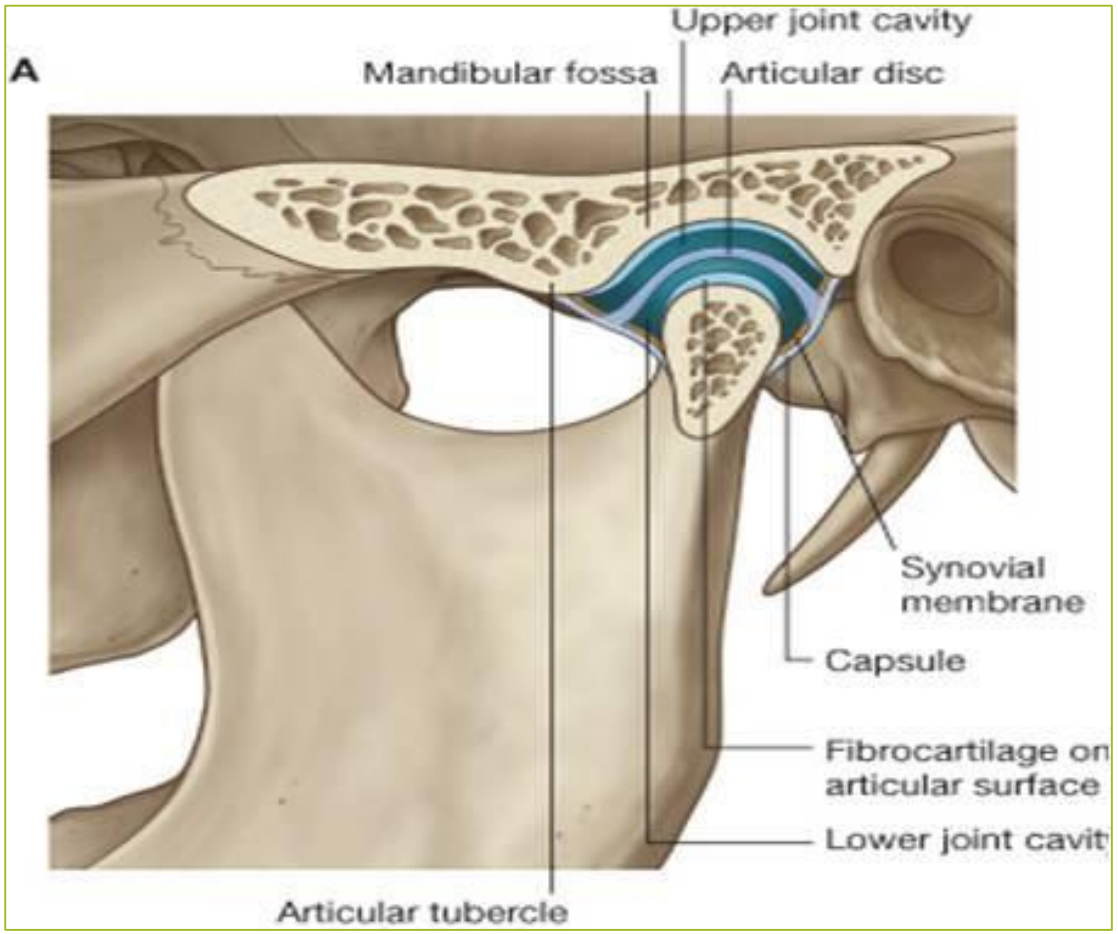


The temporomandibular joint (*articulatio temporomandibularis, TMJ*)



- Complex (+articular facets of the the disk) bicondylar combined joint

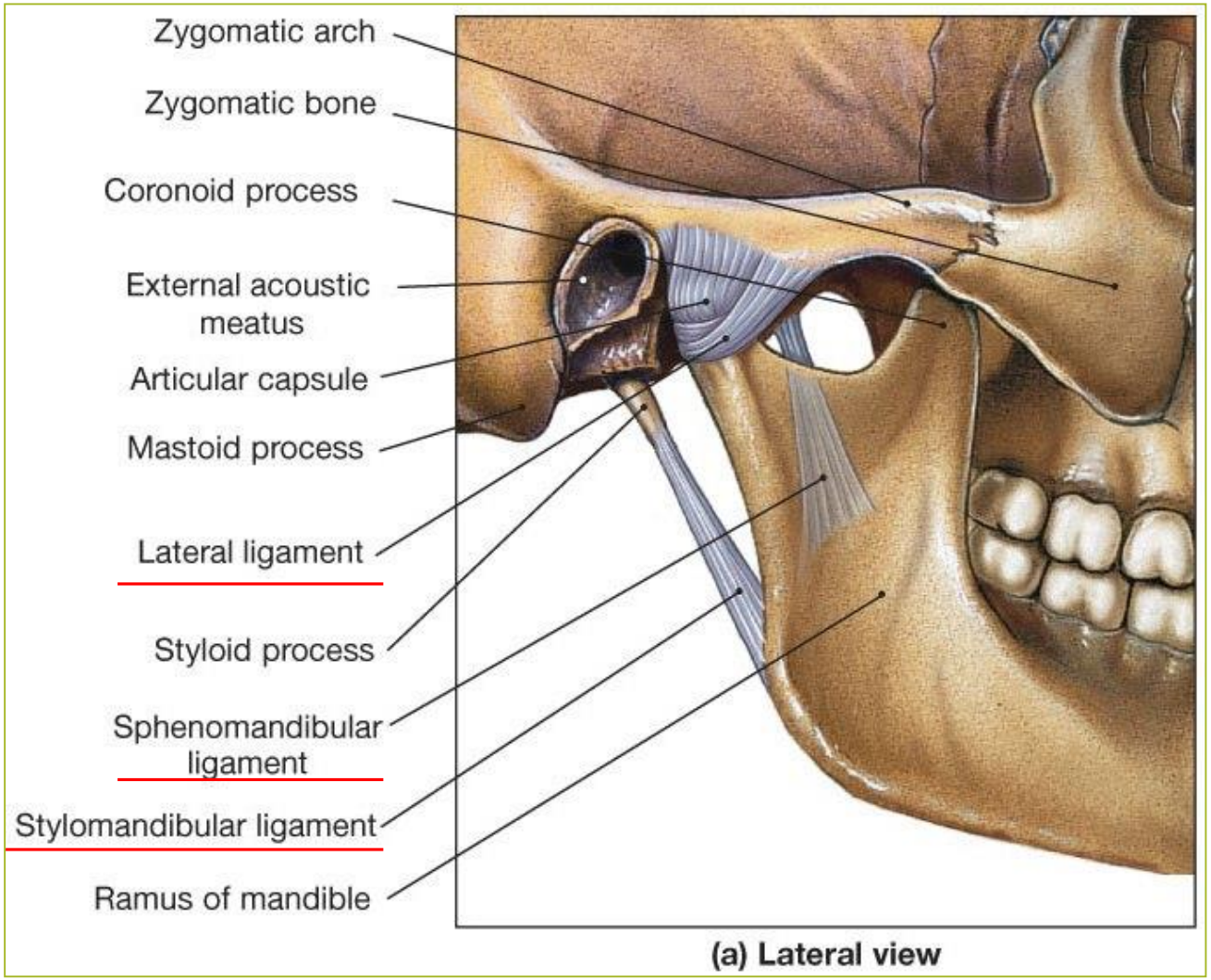
The temporomandibular joint



Disc is made out of fibrocartilage with markedly anteroposterior alignment.

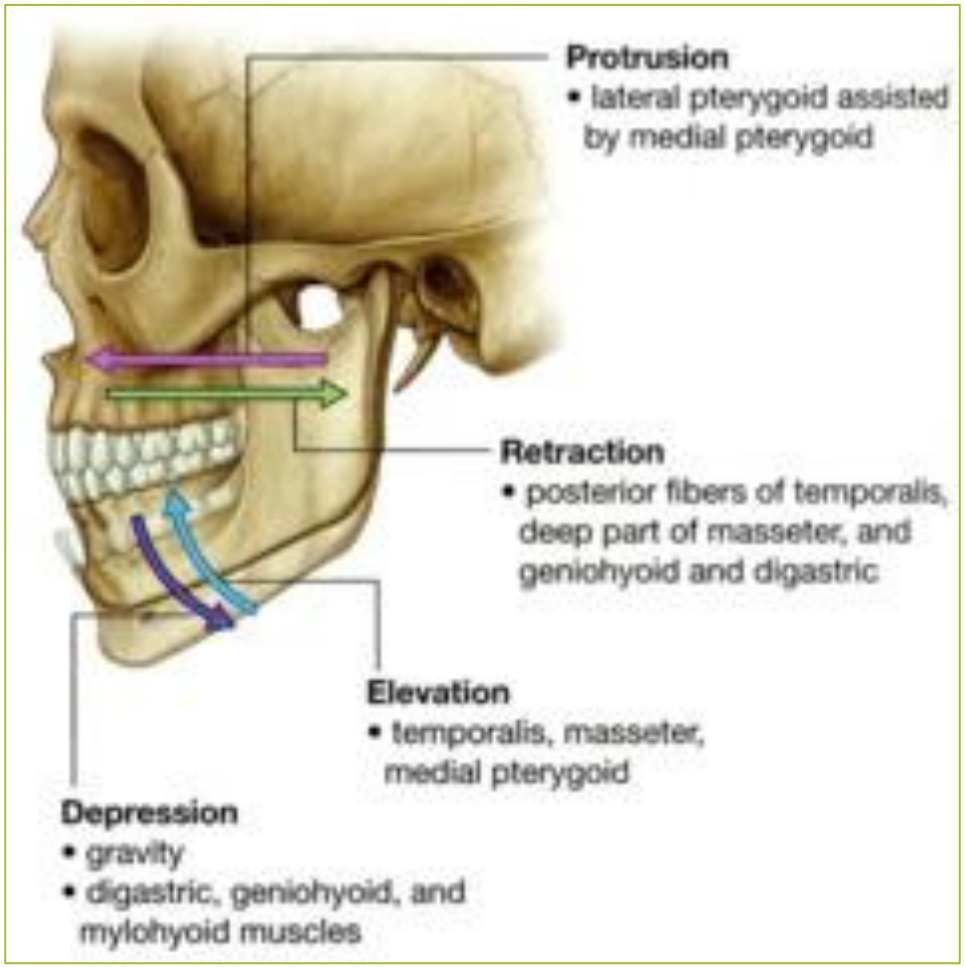
Functions:
1) to diminish the effects of incongruence between the articular surfaces.
2) the disc acts as a shock absorber when the joint is subjected to impact loading.

- The surfaces are complemented by *a fibrous articular disc* (**discus articularis)** located between them. The edges of the disc are joined to the articular capsule as a result of which the articular cavity is separated into two isolated compartments.

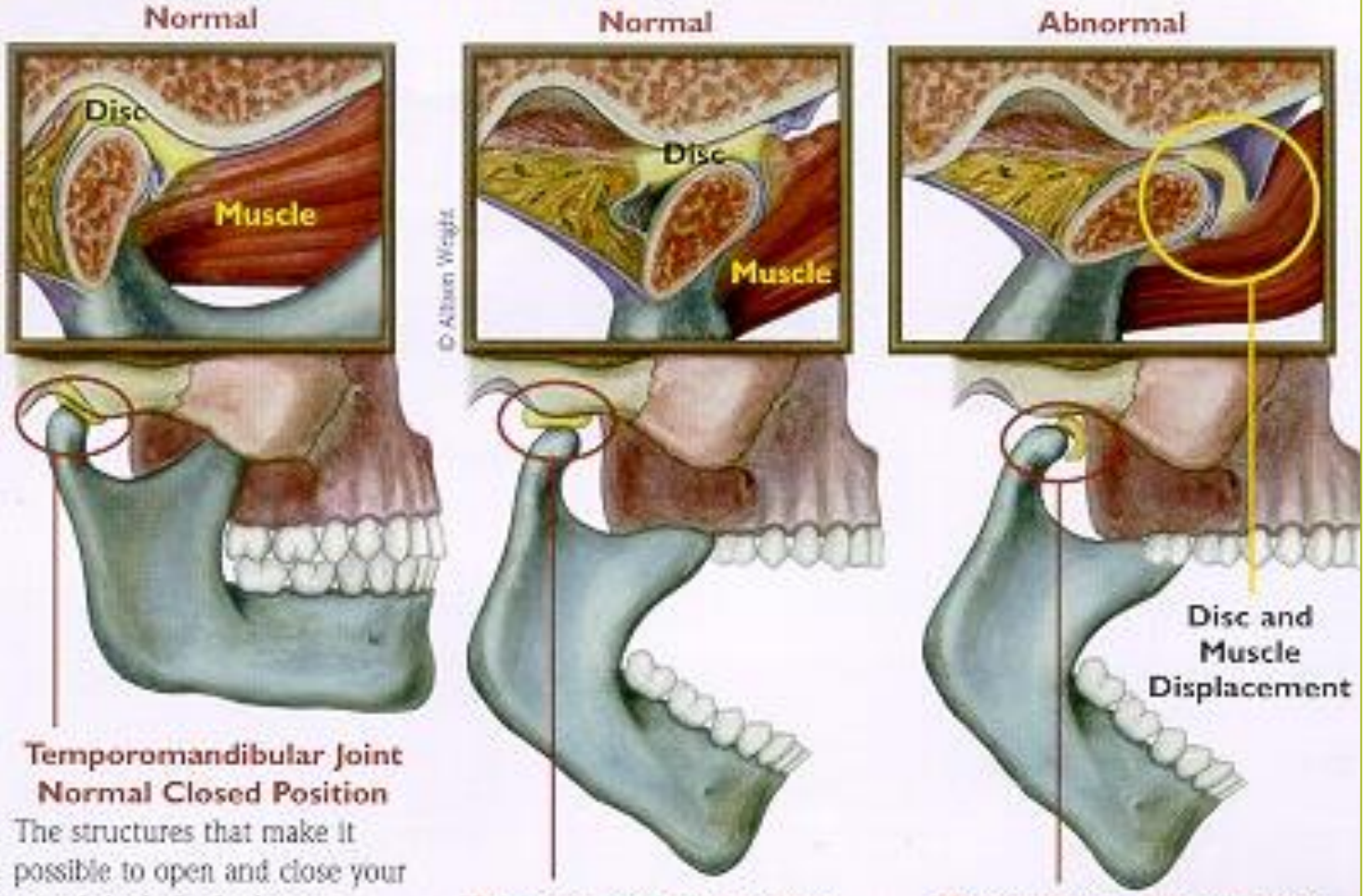


- ***Articular*** **capsule** is attached along the borders of articular surfaces. The mandibular neck is within the articular cavity.

Movements of the temporomandibular joint



Function of the Temporomandibular Joint



Temporomandibular Joint
Normal Closed Position

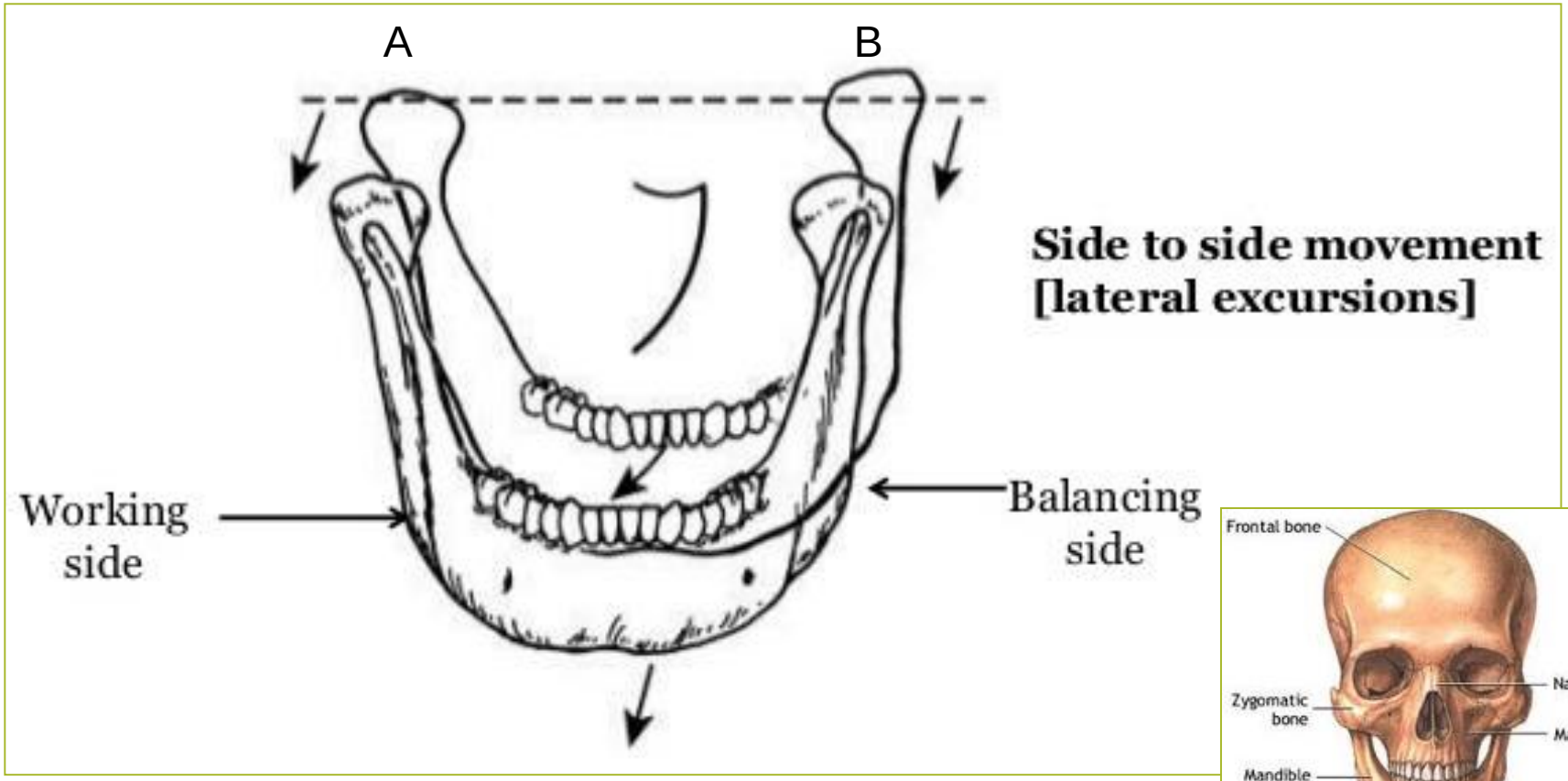
The structures that make it possible to open and close your mouth include the bones, joints, and muscles. When functioning correctly, your jaw-bone is separated from your skull by a soft disc that acts as a cushion when you chew, speak or swallow.

Temporomandibular Joint
Normal Open Position

When the joint is functioning properly, the disc stays in place when the jaw is in use, preventing the bony structures from coming in contact.

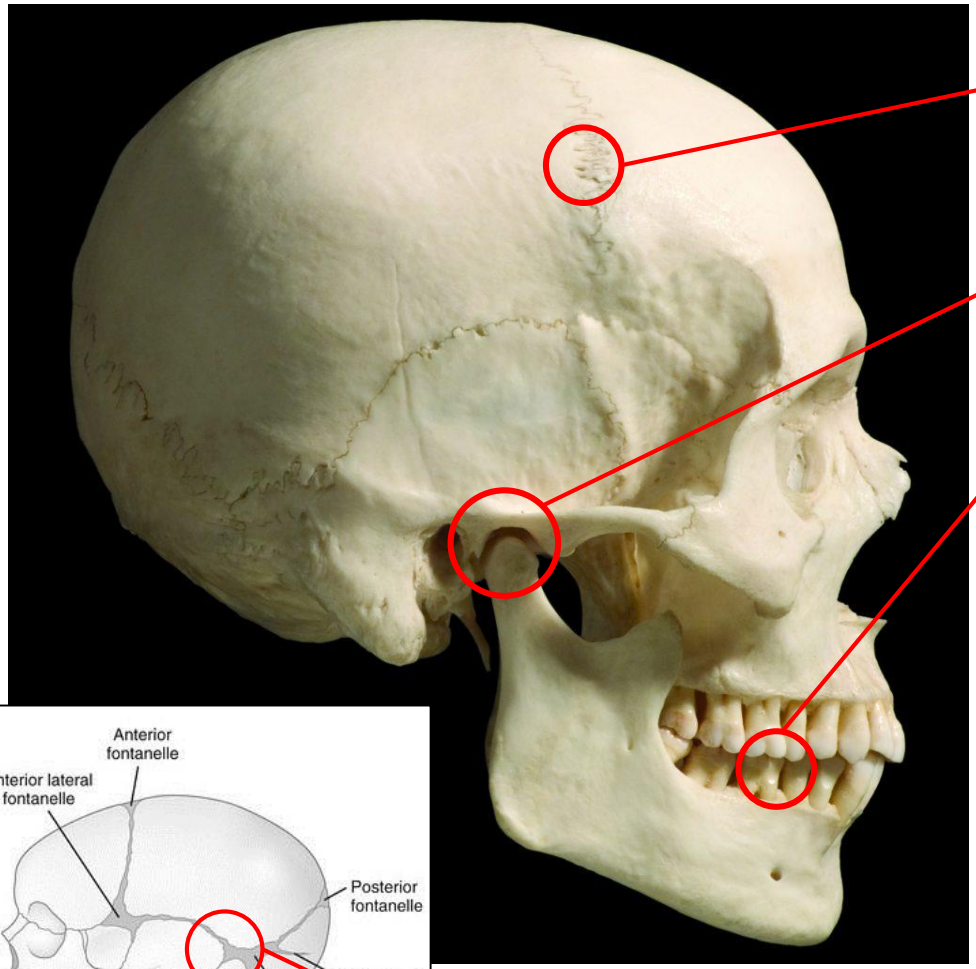
Temporomandibular Joint
Dysfunctioning Open Position

When the joint is not functioning properly, the disc is commonly pulled forward when the jaw is in use, causing the bones of the skull and jaw to grind together.



* When the mandible moves laterally, one condyle (B) moves forward (first two steps of opening) and a bit inward, while the other condyle (A) will shift slightly in a lateroposterior (or rotate in vertical axis) direction

* Cranium as a whole

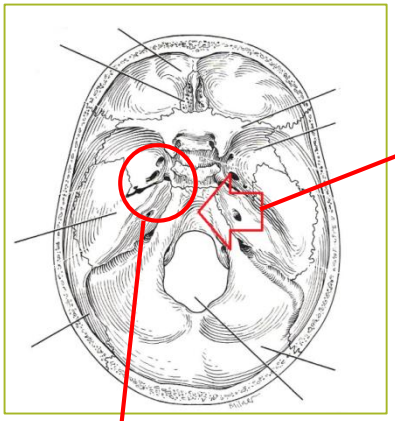


Sutures (syndesmosis):
- plane, serrate and squamos sutures.

Diarthrosis:
- Temporomandibular joint (complex, condylar, biaxial, combined joint).

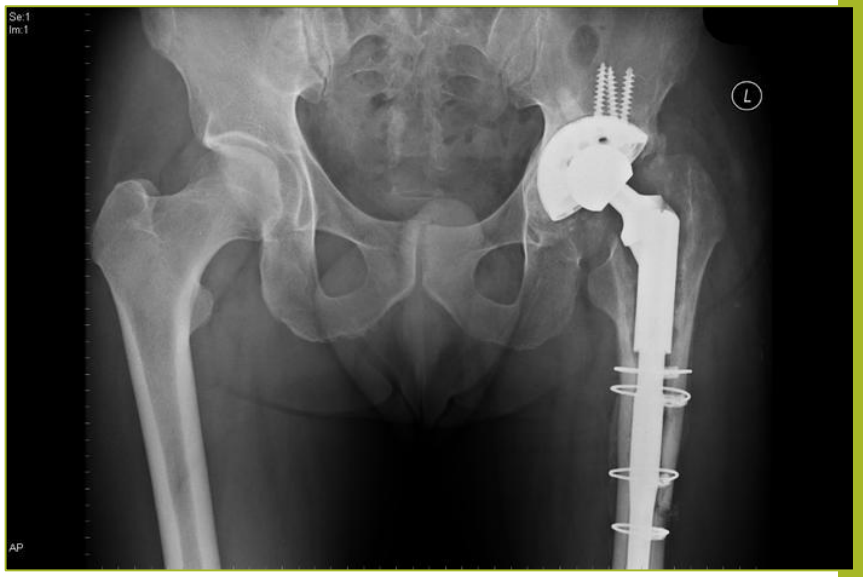
Gomphosis (syndesmosis):
-dentoalveolar junction.

Fontanells (syndesmosis):
-newborn baby cranium.



Clivus:
- temporary sphenooccipital synchondrosis becomes *clivus*
- synostosis

Permanent synchondroses:
-synchondrosis petrooccipitalis
-synchondrosis sphenopetrosa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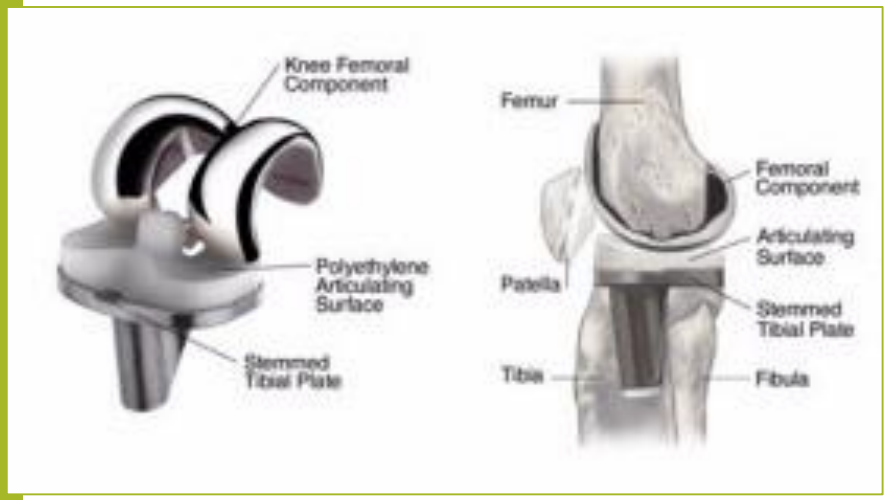
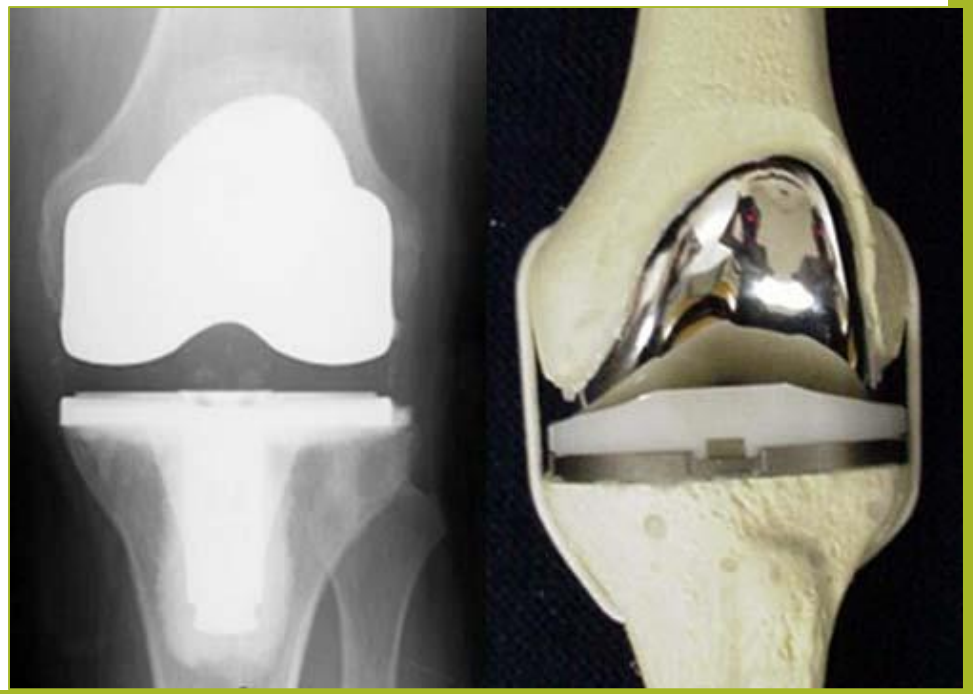

Knee Femoral Component
Polyethylene Articulating Surface
Stemmed Tibial Plate
Femur
Femoral Component
Articulating Surface
Patella
Stemmed Tibial Plate
Tibia
Fibula



Subsequence of the answer:

1. Name of the joint (English and Latin)
2. Classification of the joint (simple, combined, complex)
3. Description of the essential elements of the joint (articular surface, type of cartilage, cavity and capsule)
4. Description of the ligaments.
5. Special features (bursa)
6. Movements