Connection of the lower limb bones

(juncturae ossium extremitatis inferioris)
includes connection of pelvic girdle and free part of lower limb

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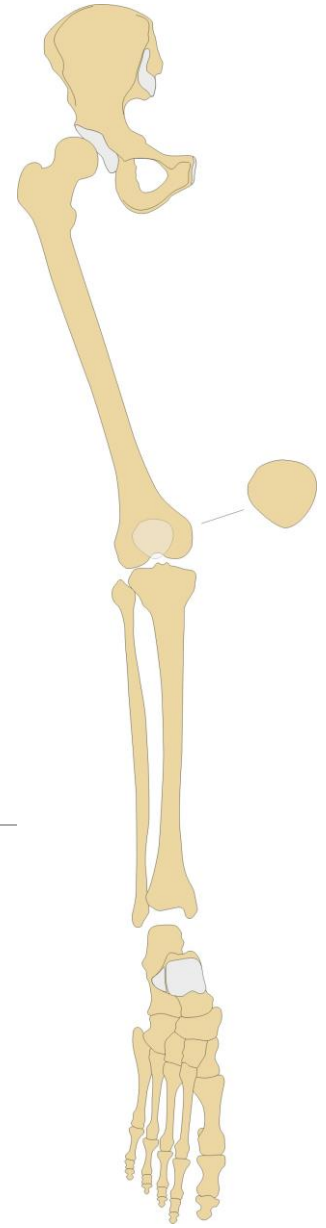


Connection of pelvic girdle *(juncturae ossium cinguli extremitatis inferioris)*

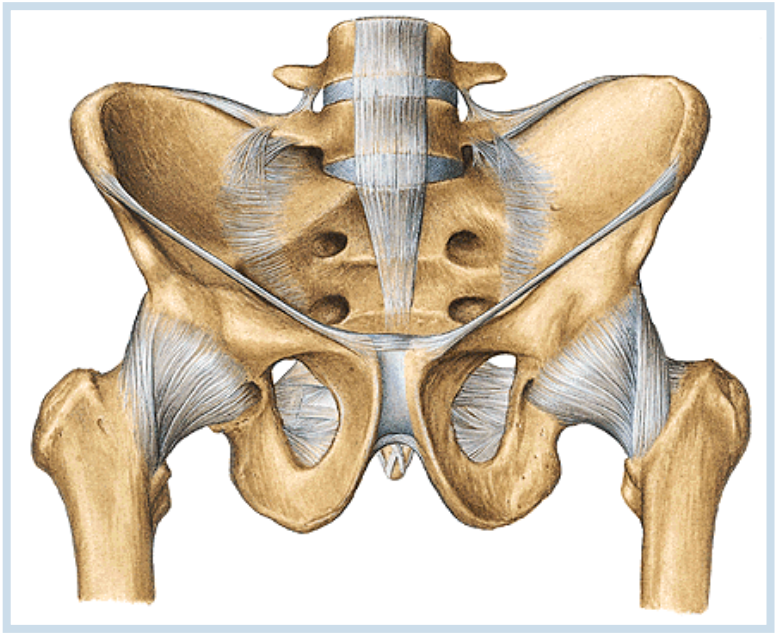
1. Sacroiliac joint *(Articulatio sacroiliaca)*

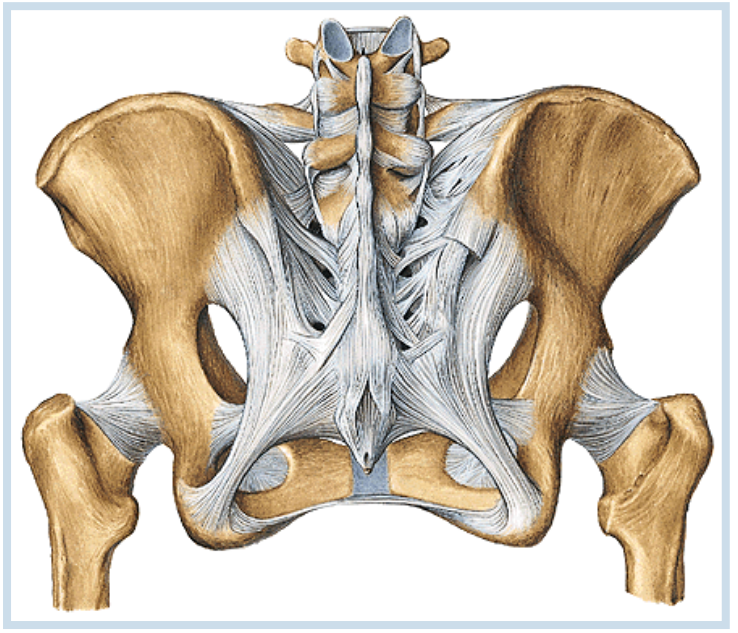
Articular surfaces: facies auriculares ossis sacri et illii

Articular capsule: tight and is attached to margins of AS

Auxiliary facilities: capsule is strengthened by ligg. sacroiliaca ventralia and dorsalia (ventral and dorsal sacroiliac ligaments), ligg.sacroiliaca interossea (interosseal sacroiliac ligaments)

Type of joint: amphiartrosis





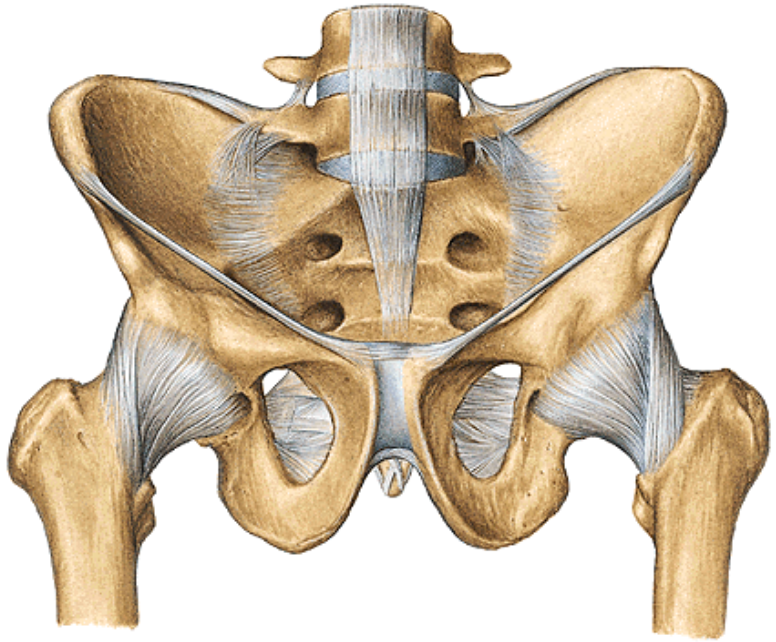
2. *Symphysis pubica*

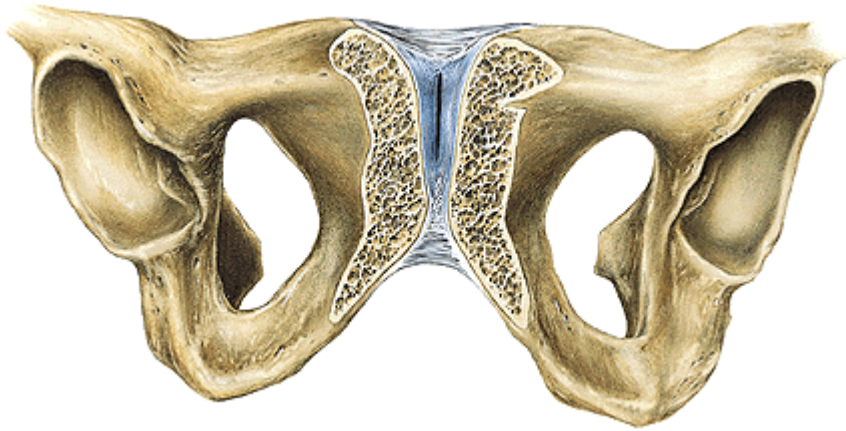
Is formed by cartilagenous *discus interpubicus* which connects both pubic bones. Symphysis pubica is 4,5 – 5 cm in hight.
lig. pubicum superius and stronger *lig. arcuatum pubis*

3. *Syndesmoses of pelvis*

Membrana obturatoria

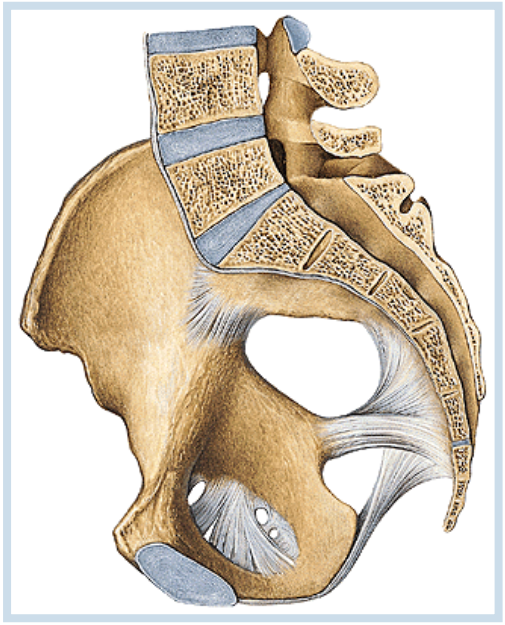
a stiff membrane which closes *foramen obturatum (canalis obturatorius)*

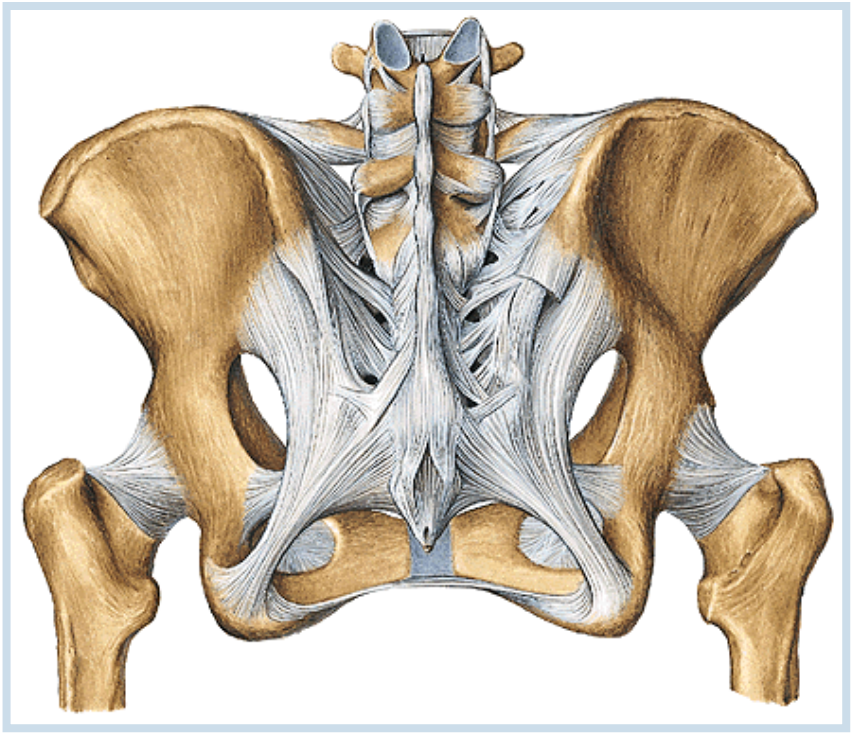




Ligaments in the pelvic region

Lig. sacrospinale (Sacrospinal ligament)
Lig. sacrotuberale (Sacrotuberal ligament)
Foramen ischiadicum majus (Greater sciatic foramen)
Foramen suprapiriforme and foramen infrapiriforme (Supra- and infrapiriform foramen)
Foramen ischiadicum minus (Lesser sciatic foramen)

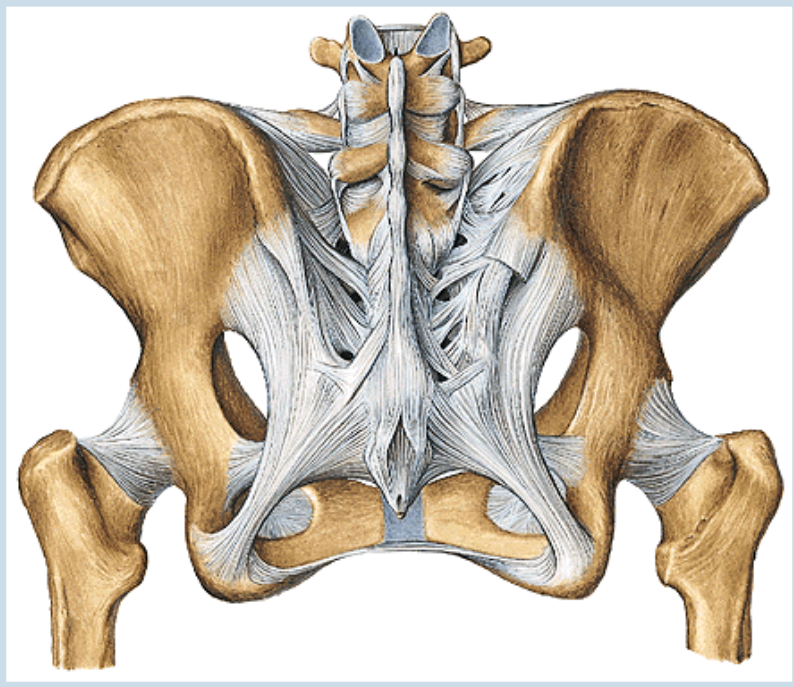


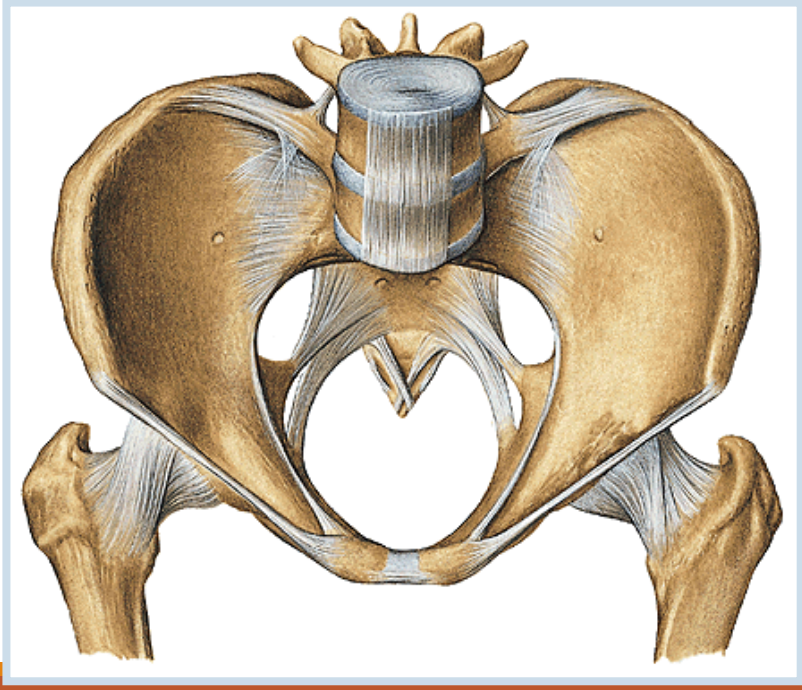


5. Pelvis

Aditus pelvis (the pelvic inlet) is bordered by linea terminalis which separates pelvis major and pelvis minor.
Exitus pelvis (the pelvic outlet) is the region between the subpubic angle, tubera ischiadica and os coccygis.

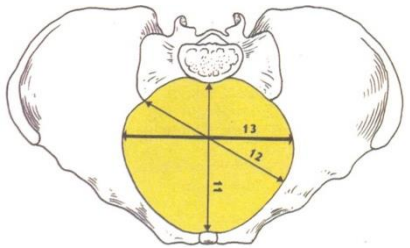
Pelvis minor (lesser pelvis) is „true pelvis“ (genital organs, a part of urinary system), an important childbirth way in female and it has great intersexual differences.

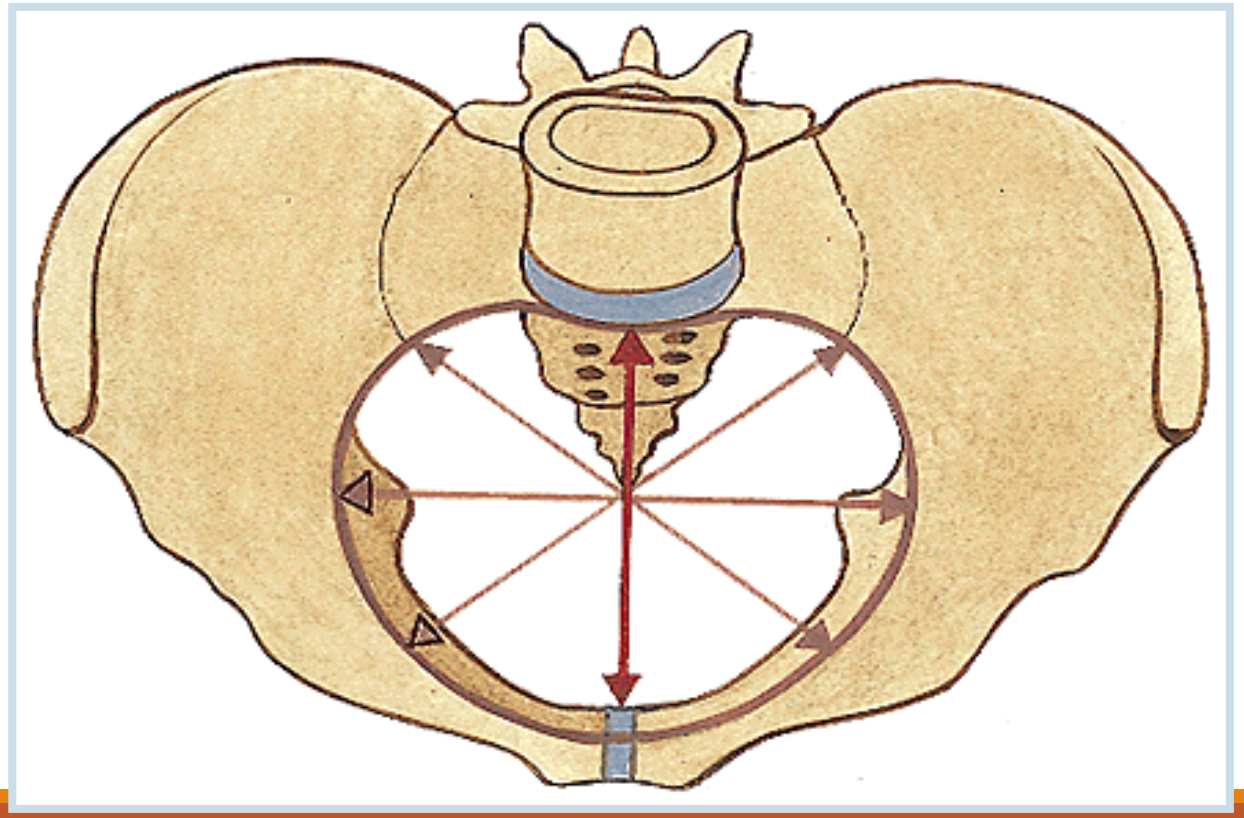


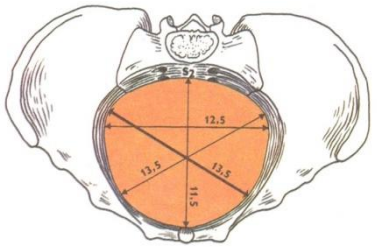


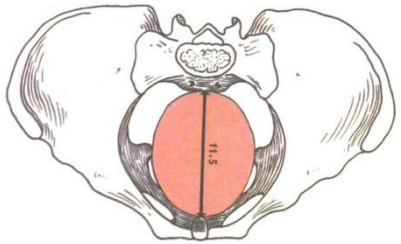
Internal diameters of pelvis (female)

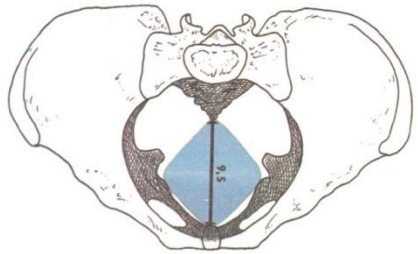
1. **Aditus pelvis = apertura pelvis superior (inlet)** transverse diameter about 13 cm
2. **Amplitudo pelvis (width of pelvis)** about 12 cm
3. **Angustia pelvis (narrow part of bone pelvis)** about 10 cm
4. **Exitus pelvis = apertura pelvis inferior (outlet)** about 9 cm
5. **Conjugata diagonalis 12.5 – 13 cm (per vaginam)**







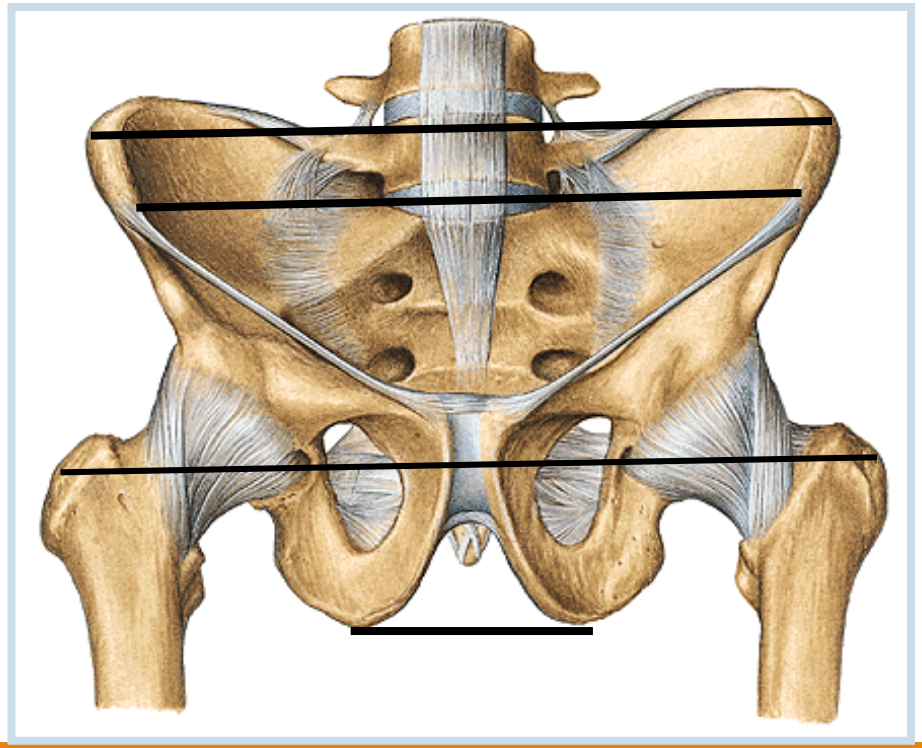


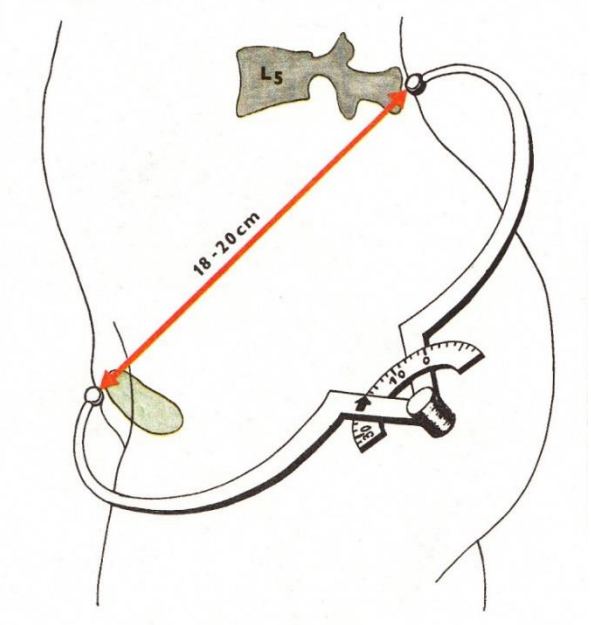


B. External diameters of pelvis (female)

Distantia bispinalis (bispinal diameter) (about 26 cm)
Distantia bicristalis (bicristal diameter) (about 29 cm)
Distantia bitrochanterica (bitrochanteric diameter) (about 31 cm)
Distantia bituberalis (bituberal diameter) (about 12 cm)

Conjugata externa (min. 18 cm)



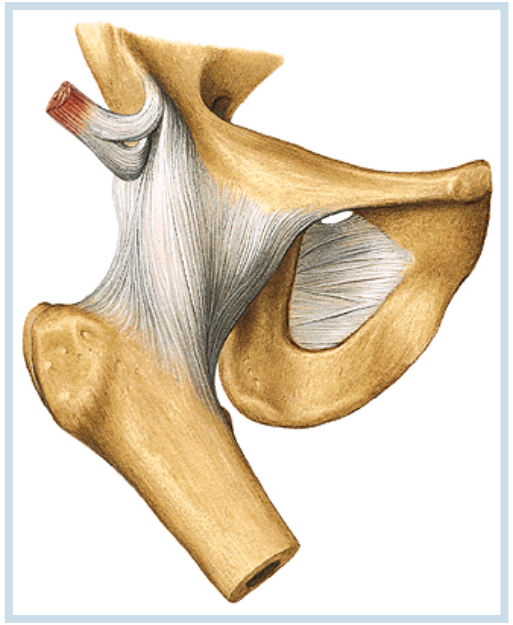


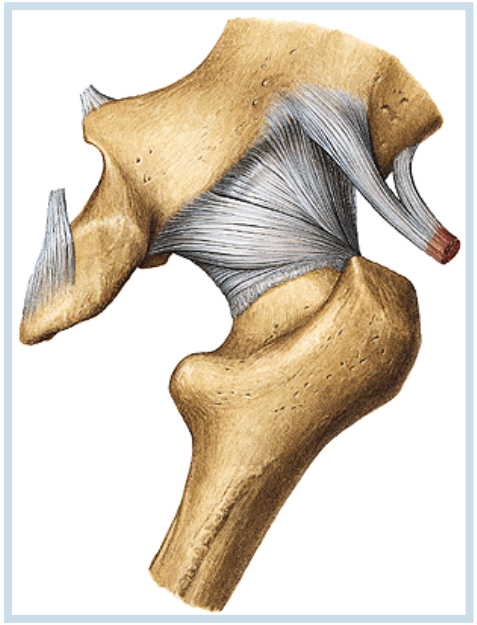
Connection of free part of lower limb

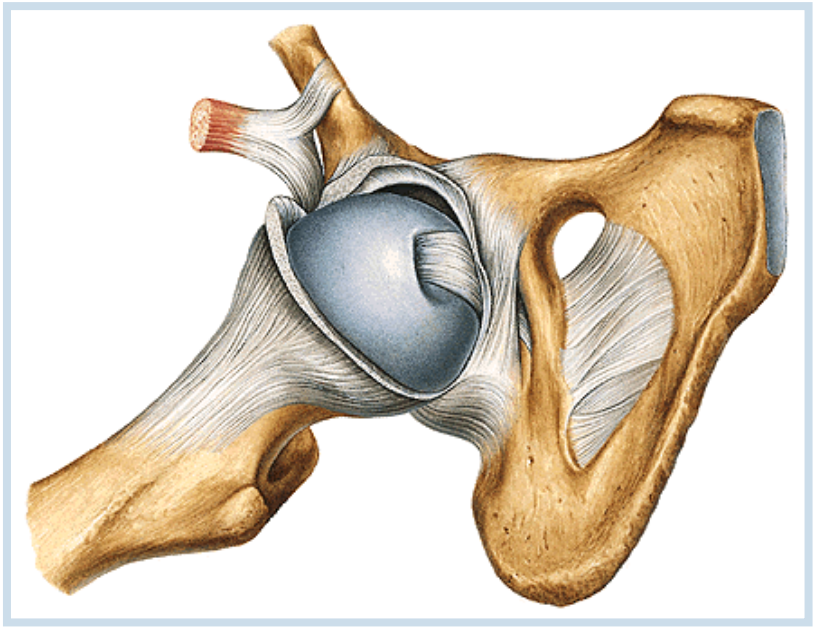
(juncturae ossium extremitatis liberae inferioris)

1. Articulatio coxae (hip joint)

Articular surfaces: *facies lunata* of an acetabulum !!!!! + head of the femur
Articular capsule: is attached to the margins of acetabulum. It reaches ventrally linea intertrochanterica of femur, dorsally is attached to the collum femoris (neck of femur) medially away from fossa trochanterica.
Auxiliary facilities :
a) *Labrum acetabulare* formed by cartilage.
b) *Lig. transversum acetabuli* runs through *incisura acetabuli.*
c) *Lig. iliofemorale*
d) *Lig. pubofemorale*
e) *Lig. ischiofemorale*
f) *Zona orbicularis*
g) *Lig. capitis femoris*
Type of joint: typical spheroid joint (ball-and-socket) with limited movements *(enarthrosis).*
Movements – flexion, extension, abduction, adduction and internal and external rotation.





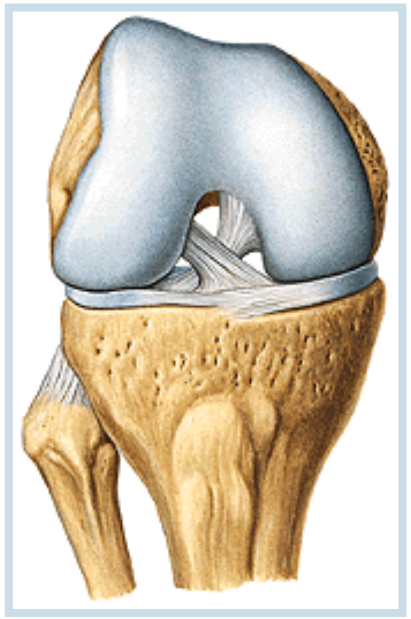


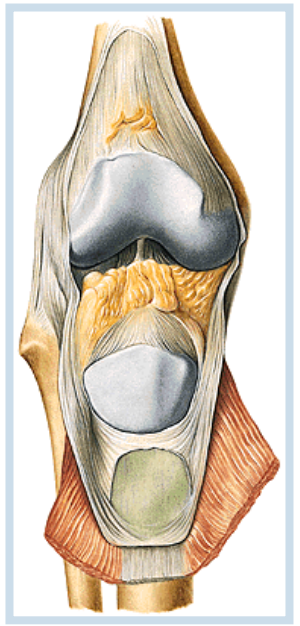
2. Articulatio genus (knee joint)

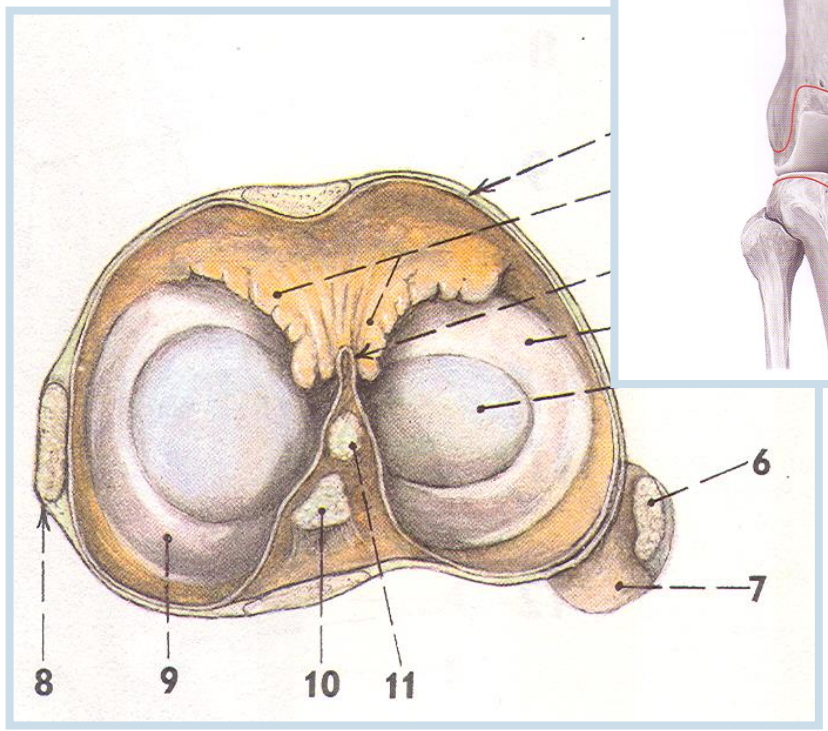
Articular surfaces: Condylus med. et lat. femoris, fac.art.med. et lat. on the proximal tibial end; fa patellae + fa patellaris femoris

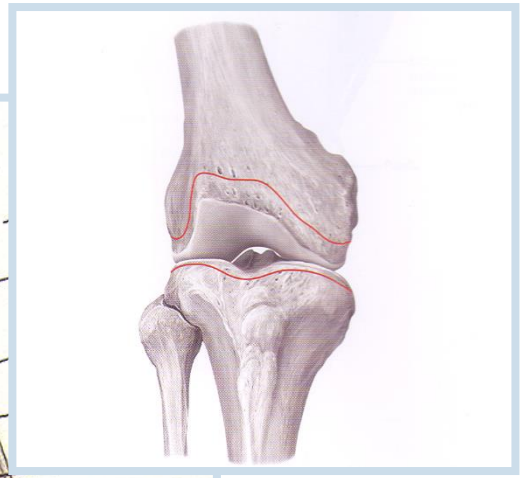
Articular capsule: is strong, attached proximally a little above articular surface of the femur.

Capsula synovialis lines all articular cavity and runs from the sides to intraarticular ligaments and continues ventrally as a plica synovialis patellaris (synovial patellar plica), ventraly is divided into two plicae alares (alar plicae).







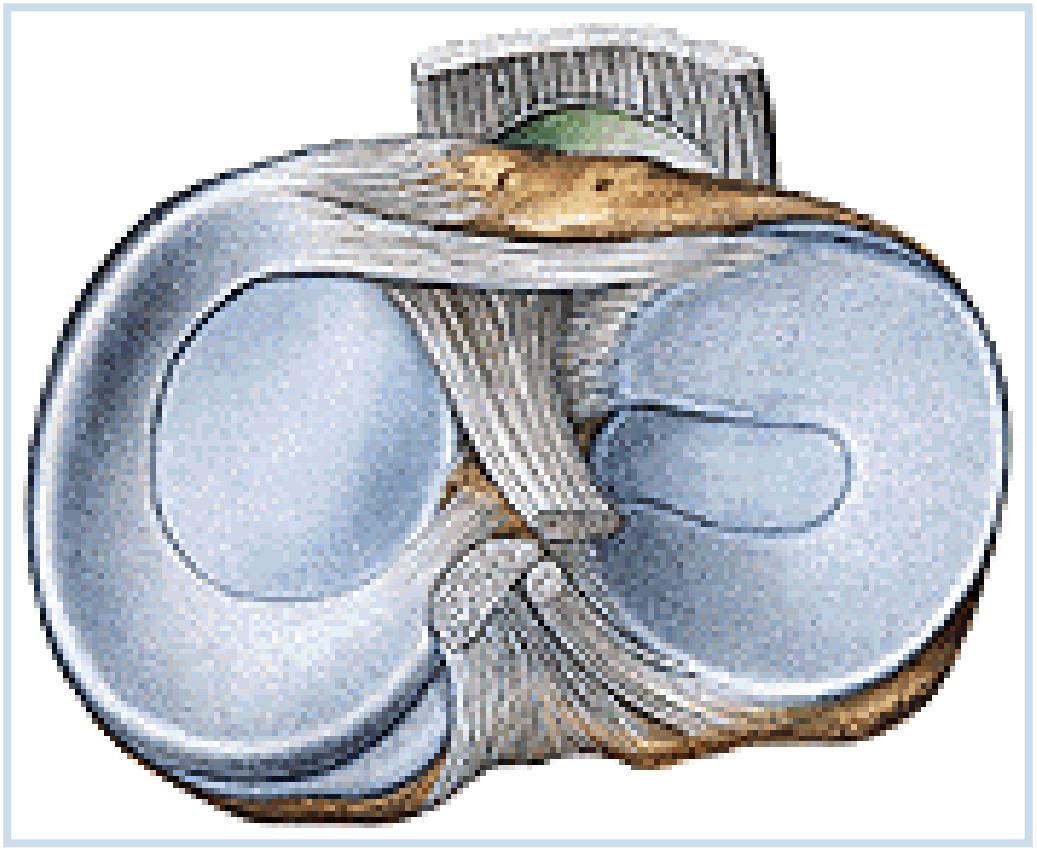


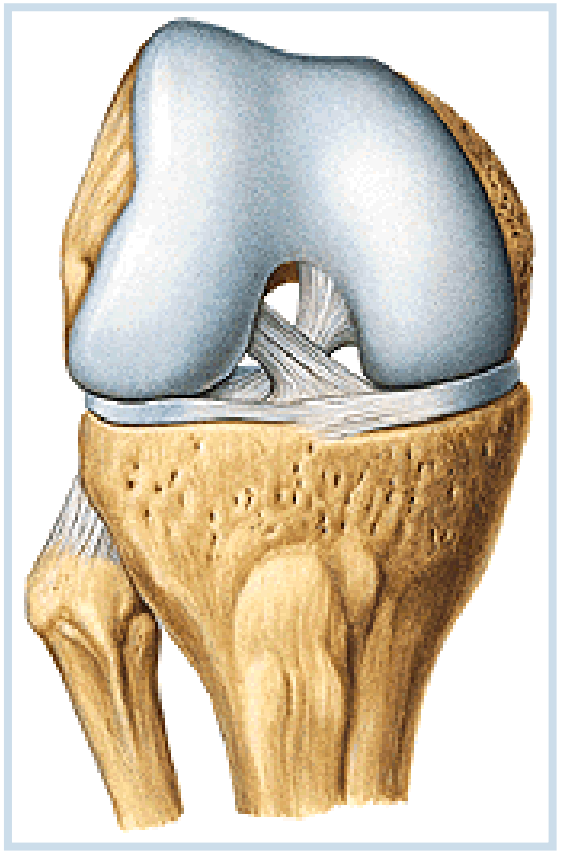
Intraarticular auxiliary facilities of an *articulatio genus* (knee joint):

1. Meniscus – Medial © and lateral (circular)

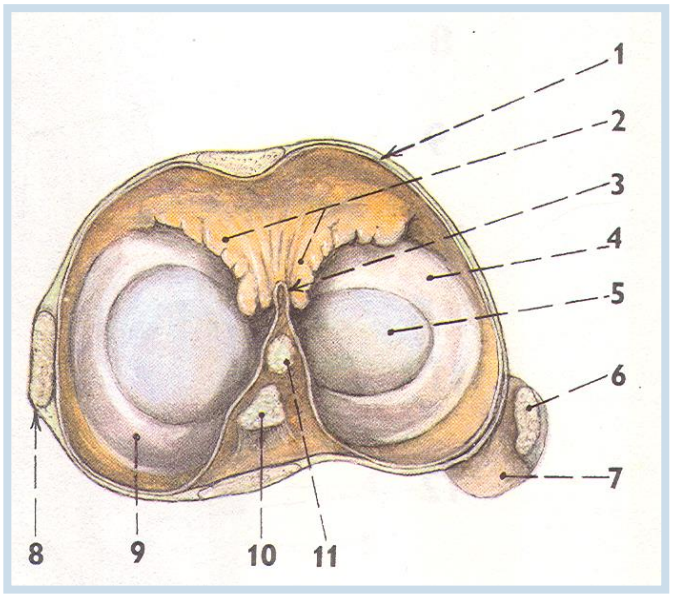
2. Ligamenta cruciata genus – ***anterius* -** limits extension and medial rotation

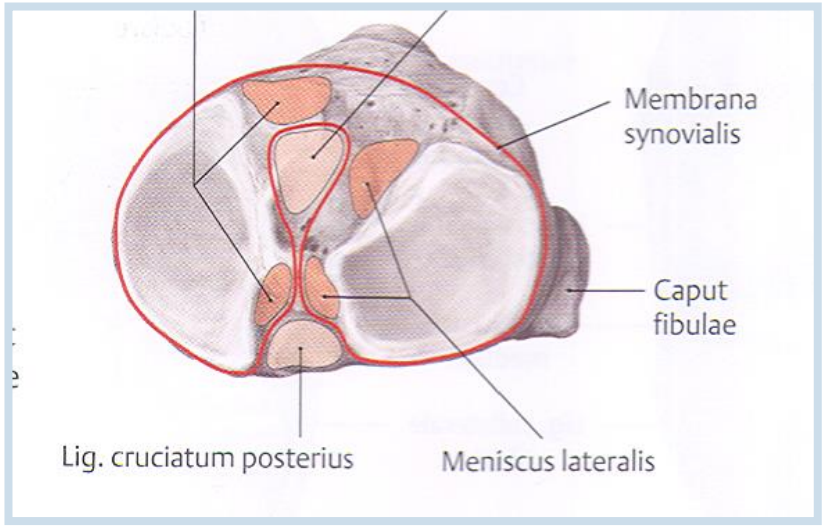
***posterius* -** limits extension and keeps stability of the joint

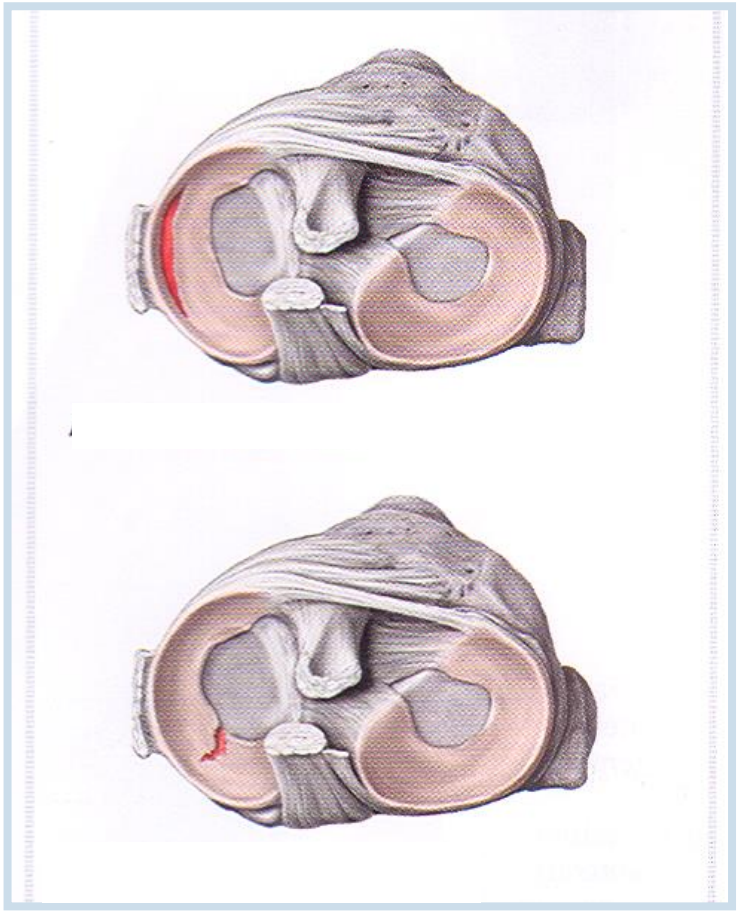




Synovial membrane and position of corpus adiposum genus

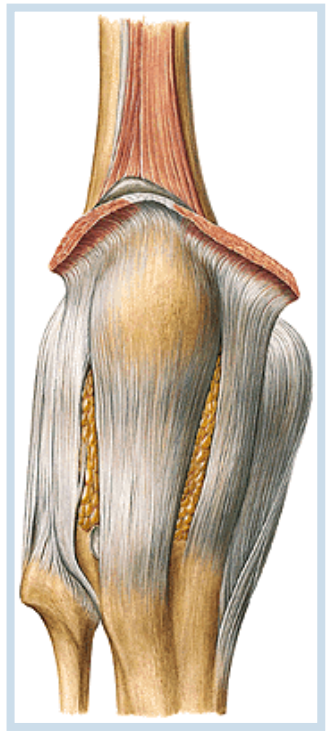


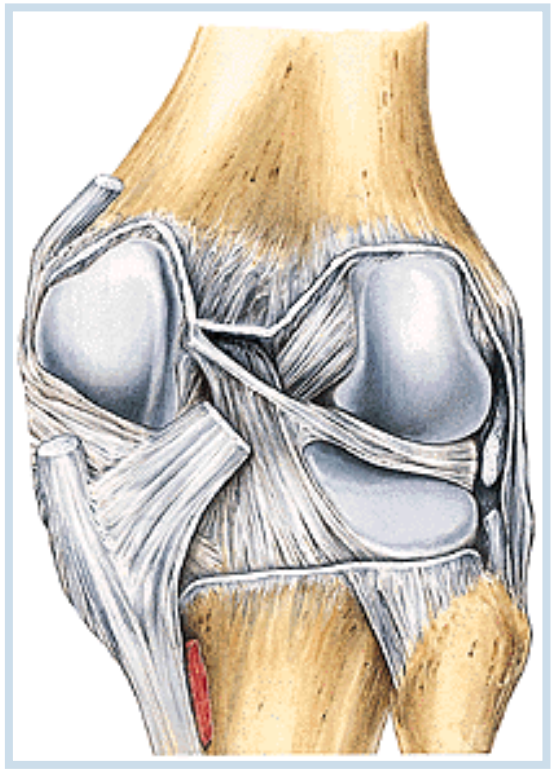


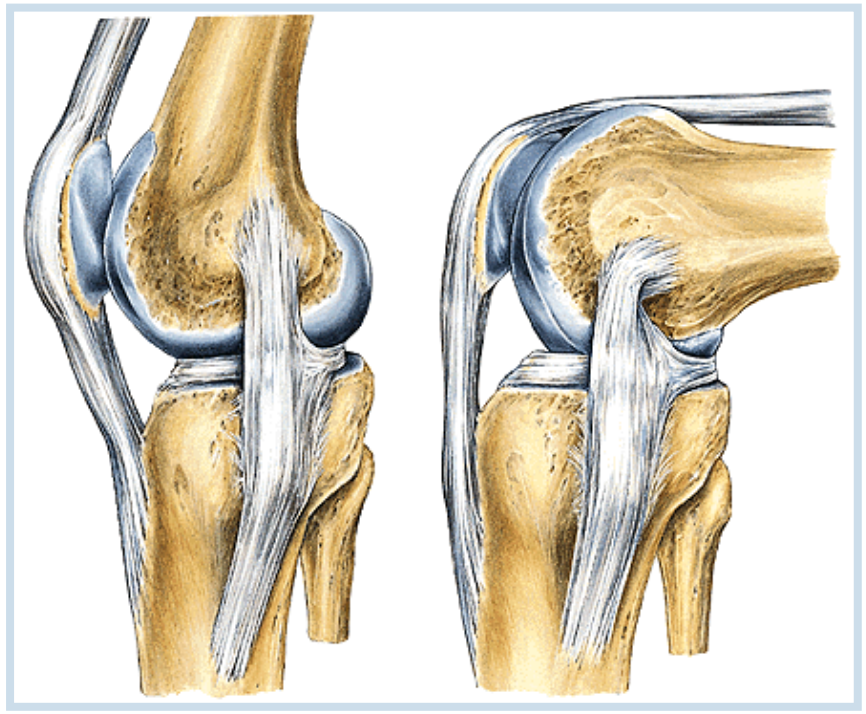


2.Extraarticular auxiliary facilities (articulatio genus)

a) lig. patellae - tendon of m. quadriceps femoris
b) retinacula patellae mediale and laterale
c) lig. collaterale tibiale (collateral tibial ligament)
d) lig. collaterale fibulare (collateral fibular ligament)
e) lig. popliteum obliquum (oblique popliteal ligament)

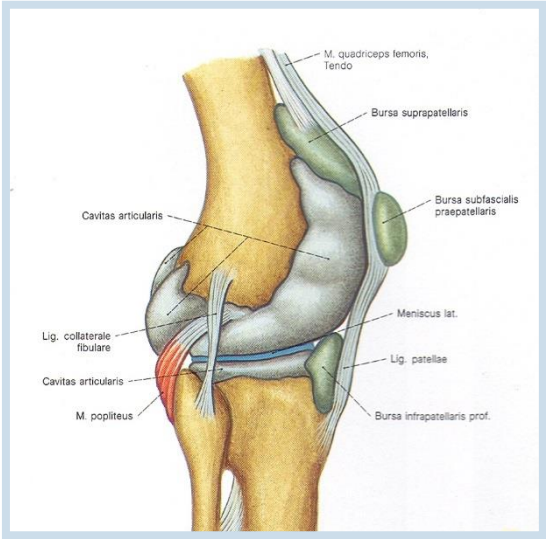




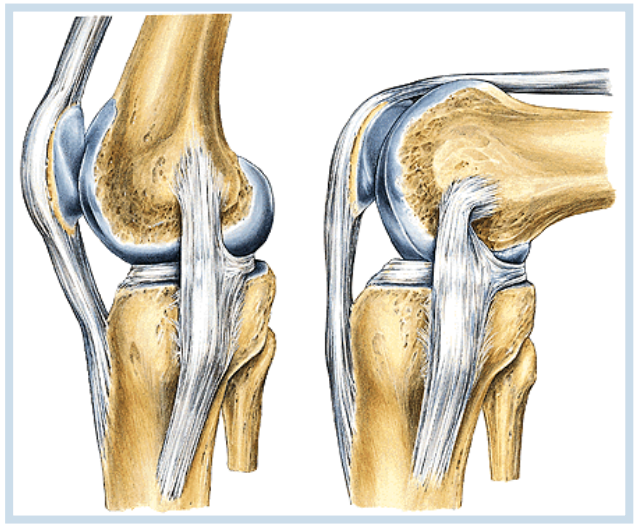


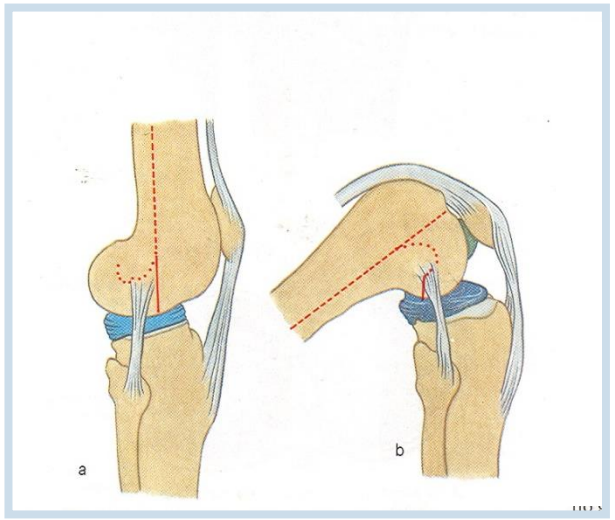
Bursae synoviales

Suprapatellaris, praepatellaris (subcutanea)



Type of joint: hinge joint (trochlear)
Movements: flexion and extension.
During a mild flexion is possible slight external and internal rotation.
Middle position of the joint – mild flexion





3. Juncturae tibiofibulares (Tibiofibular connections)

Consist of *articulatio tibiofibularis*, *membrana interossea cruris* and *syndesmosis tibiofibularis*.

A. Articulatio tibiofibularis (tibiofibular joint)

Articular surfaces:
Articular capsule: is short, stiff and attached to FAM
Auxiliary facilities : lig. capitis fibulae anterius and posterius
Type of joint kloubu: plane, slight movements ahead and back.

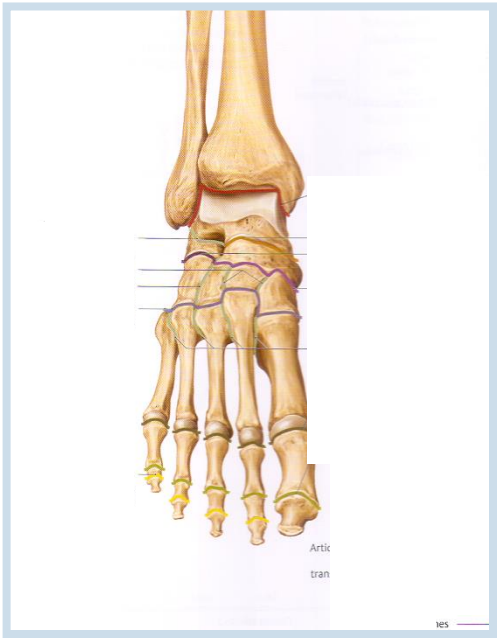
B. Membrana interossea cruris

stiff membrane. Serves as a place of attachment for some muscles.

C. Syndesmosis tibiofibularis = *fibrous joint* between distal ends of tibia and fibula

In incisura fibularis tibiae is placed distal end of fibula. Syndesmosis is reinforced by lig. tibiofibulare anterius and lig. tibiofibulare posterius (tibiofibular anterior and posterior ligaments).

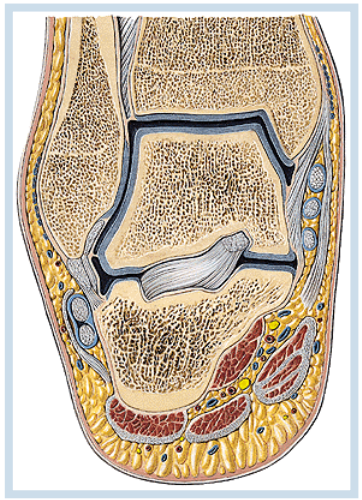
Articulationes pedis (Joints of foot)

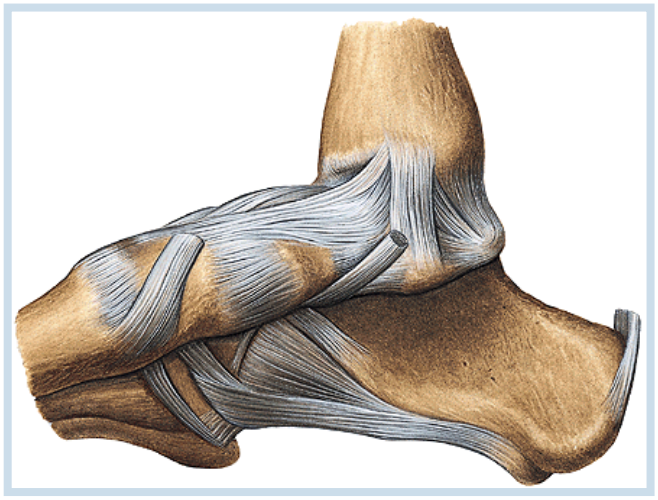


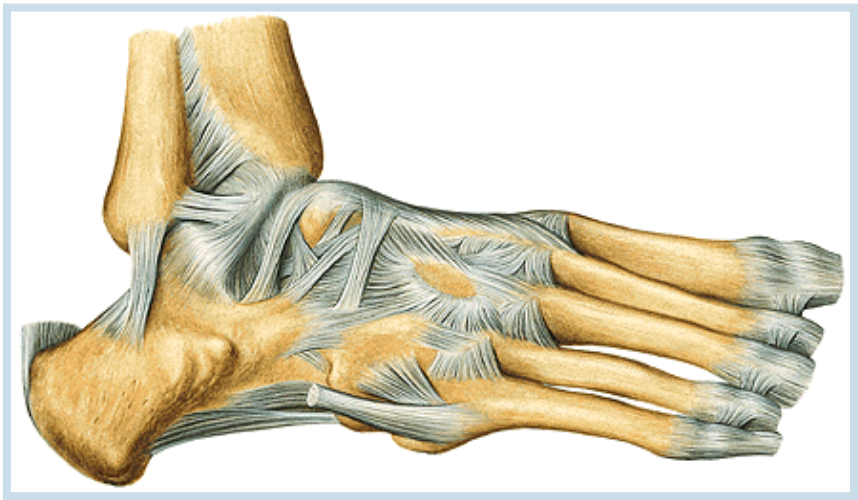
1. Articulatio talocruralis (Talocrural joint)
2. Articulationes intertarseae (Intertarsal joints)
   - Articulatio subtalaris (subtalar joint)
   - Art. talocalcaneonavicularis (talocalcanear joint)
   - Art. calcaneocuboidea (calcaneocuboid joint)
   - „Articulatio tarsi transversa“ (Chopart´s joint)
   - Articulatio cuneonavicularis (Cuneonavicular joint)
   - Articulatio cuneocuboidea (Cuneocuboid joint)
3. Articulationes tarsometatarseae (Tarsometatarsal joints) – Lisfranck´s joint)
4. Articulationes metatarsophalangeae (Metatarsophalangeal joints)
5. Articulationes interphalangeae pedis (Interphalangeal joints)

A. Articulatio talocruralis (talocrural joint)

Articular surfaces:
Articular capsule:
Auxiliary facilities: **Lig. collaterale mediale** consists of four parts running from medial ankle to adjacent bones (pars tibionavicularis, tibiotalaris anterior, tibiotalaris posterior and pars tibiocalcanearis).
From the lateral ankle run three ligaments: lig. talofibulare anterius, lig. talofibulare posterius and lig. calcaneofibulare.
Type of the joint: hinge joint, movements – plantar and dorsal flexion, slight side-to-side movements

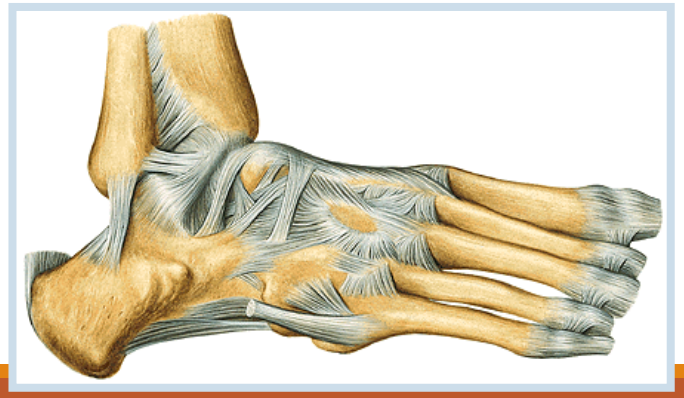


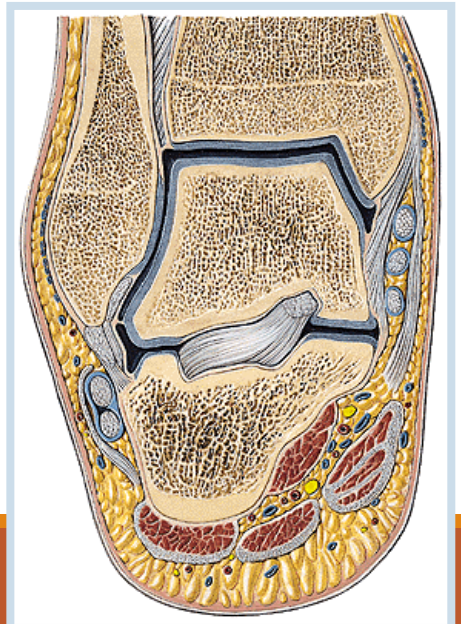




B. Articulationes intertarseae (Intertarsal joints)
a) Articulatio subtalaris (Lower ankle joints)

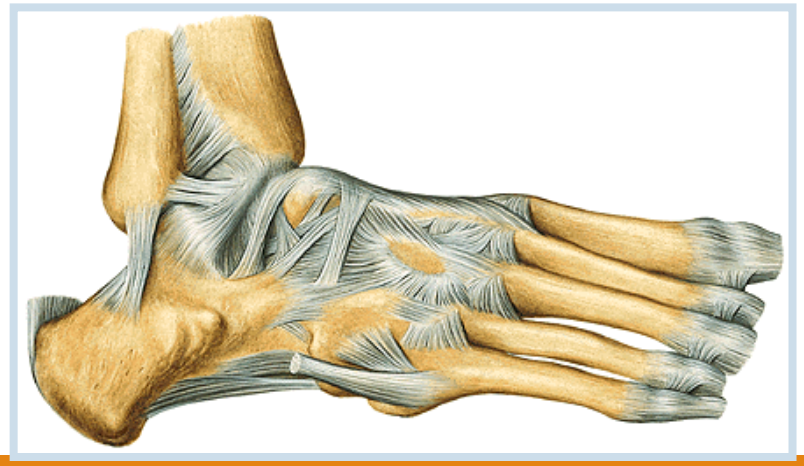
Articular surfaces: facies articularis calcanea posterior and facies articularis talaris posterior.
Articular capsule: is short and is attached to…
Auxiliary facilities: lig. talocalcaneum laterale, mediale and inside of sinus tarsi is located lig. talocalcaneum interosseum.
Type of joint: together with art. talocalcaneonavicularis and calcaneocuboidea - functional unit.
Axis of **movements** - through sinus tarsi, inner rotation (pronation) and external rotation (supination).





b) Articulatio talocalcaneonavicularis (Talocalcaneonavicular joint)

Articular surfaces: facies articularis calcanea anterior and media of talus and facies articularis talaris anterior and media of calcaneus, caput tali and articular surface of os naviculare.
Articular capsule: very thin
Auxiliary features: lig. calcaneonaviculare plantare. Dorsally forms lig. calcaneonaviculare dorsale a part of lig. bifurcatum. Small dorsal, plantar and interosseal ligaments join talus, calcaneus and os naviculare.
Type of joint: together with art. subtalaris and calcaneocuboidea form a functional unit.
The axis of **movements** - through sinus tarsi, inner rotation (pronation) and external rotation (supination).

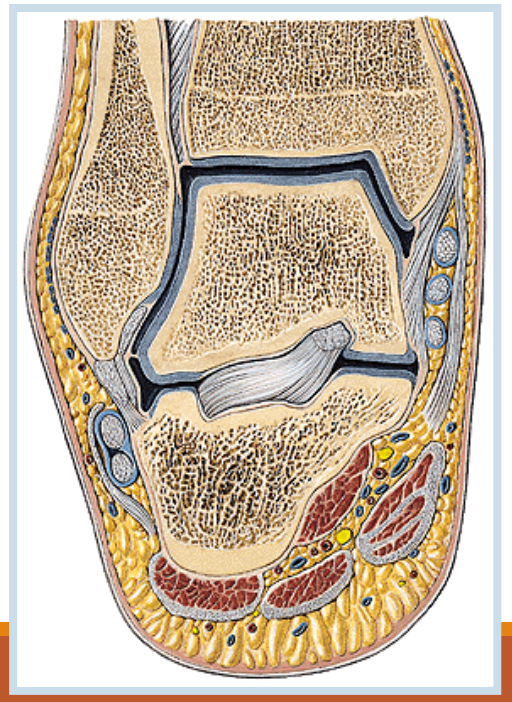


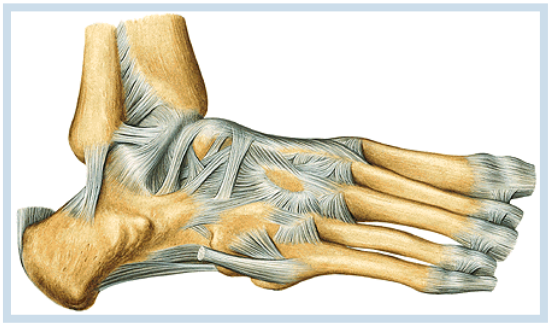
c) Articulatio calcaneocuboidea (Calcaneocuboid joint)

Articular surfaces:
Articular capsule: thin

Auxiliary features: *lig. calcaneocuboideum dorsale* (a part of *lig. bifurcatum*), *lig. plantare longum* and small ligaments between bones.

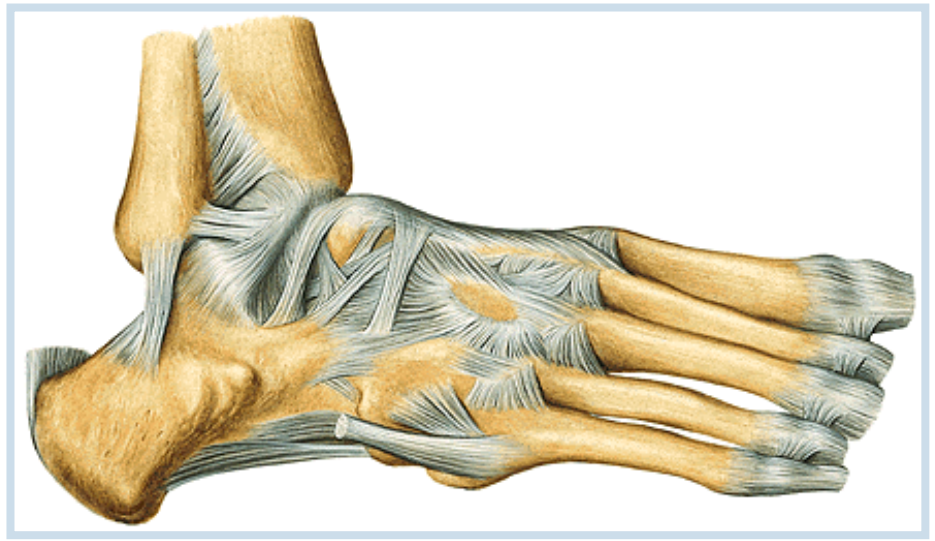
Type of joint: amphiarthrosis.





d) Chopart´s joint – *articulatio tarsi transversa* – it is a fissure between *talus* and *os naviculare* medially and between *calcaneus* and *os cuboideum* laterally. Opening of this fissure - by cut of *lig. bifurcatum* (*lig. calcaneonaviculare* and *lig. calcaneocuboideum*).

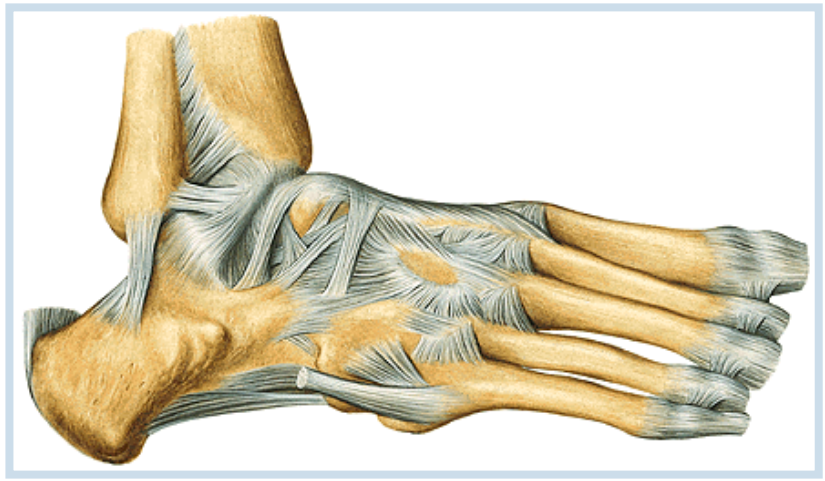
e) Articulationes cuneonavicularis, cuneocuboidea and intercuneiformia are joints between adjacent tarsal bones; dorsal, plantar and interosseous ligaments.



C. Articulationes tarsometatarseae (Lisfranc´s joint)

Joint consists of three separated joints:
Articular surfaces:
Articular capsule: is thin
Auxiliary facilities: *lig. tarsometatarsea dorsalia, plantaria* and *interossea.*
Type of joint: amphiarthrosis, slight movements, specially during loading of plantar arch.
Between bases of metatarsal bones - *(articulationes intermetatarseae)*
– *lig. metatarsea dorsalia, plantaria* and *interossea.*

In the fissure of Lisfranc´s joint could be exarticulated toes of the foot.



D. *Articulationes metatarsophalangeae*

Articular surfaces: metatarsal heads +basis of proximal phalanges
Articular capsule: is attached to the margins
Auxiliary facilities: *fibrocartilagines plantares*, in the joint of the big toe are two *ossa sesamoidea.* Collateral ligaments and *lig. metatarseum transverum profundum.*
Type of joint: art. spheroidea (ball-and-socket joint), their mobility is restricted by collateral ligaments – flexion, extension, abduction and adduction.

E. *Articulationes interphalangeae pedis*

Articular surfaces:

Articular capsule: are attached to …. dorsally fuse with tendons of extensor muscles.

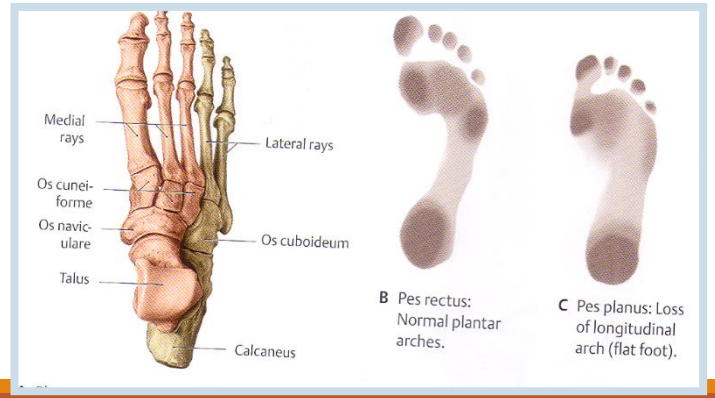
Auxiliary facilities: collateral ligaments, *fibrocartilagines plantares*

Type of joint: art. trochlearis (hinge joint) - flexion and extension of phalanges.

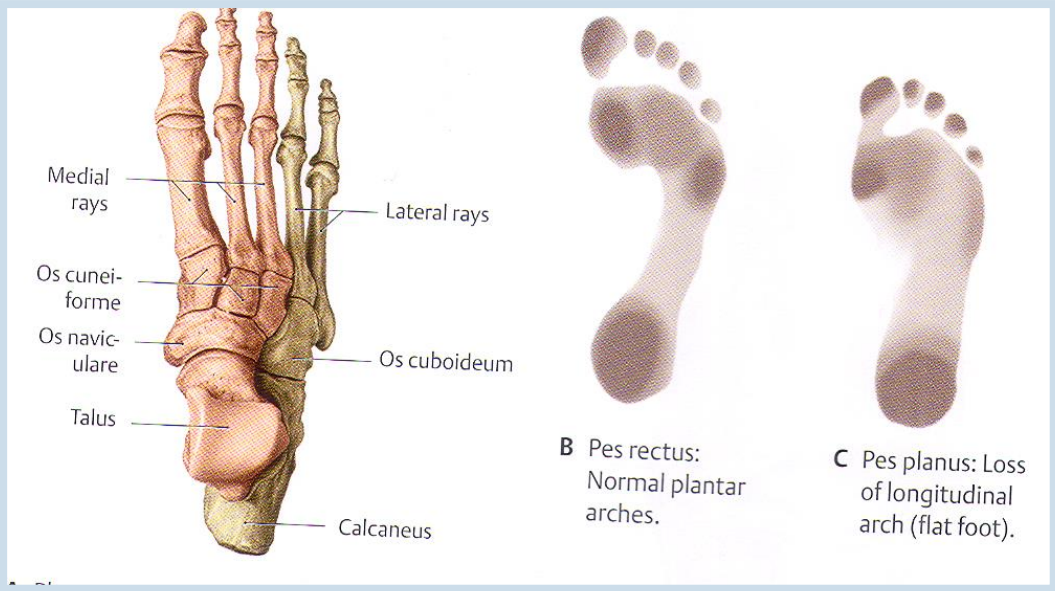
F. Plantar arch protects (vessels, nerves) before press, especially during long standing. Weight-bearing points are *tuber calcanei* and caput of the I. and V. metatarsal bones.

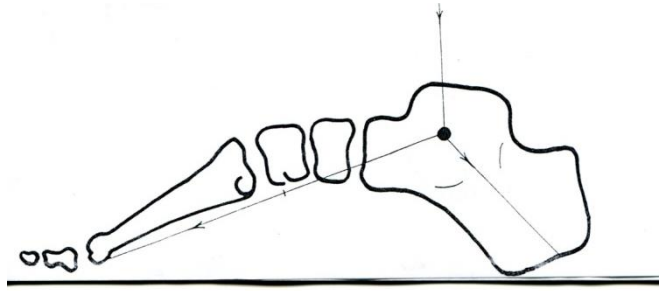
Two longitudinal plantar arches (medially *talus, os naviculare* and *ossa cuneiformia* and the I.–III. metatarsus, lateraly *calcaneus, os cuboideum* and the IV. – V. metatarsus) and one transverse arch *(ossa cuneiformia).*

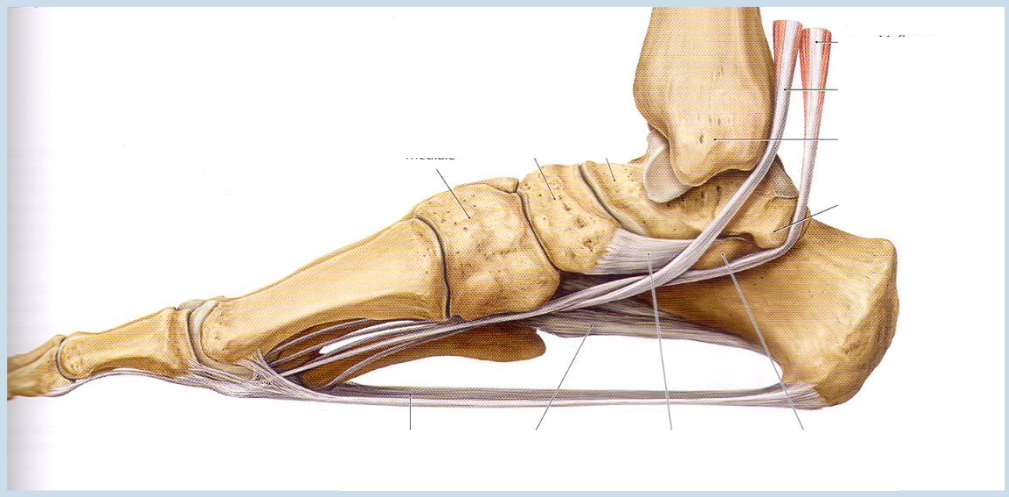
Medial plantar longitudinal arch is higher. Plantar arch is supported by ligaments and muscles of the foot.
Transverse plantar arch is done by the shape and position of the cuneiform bones ***(ossa cuneiformia)***, and it is carried by *m. fibularis longus* **mainly***.*

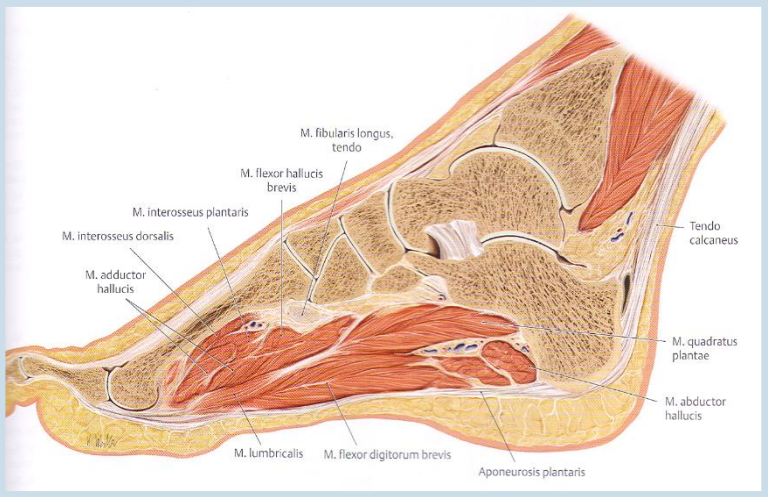


Longitudinal plantar arch



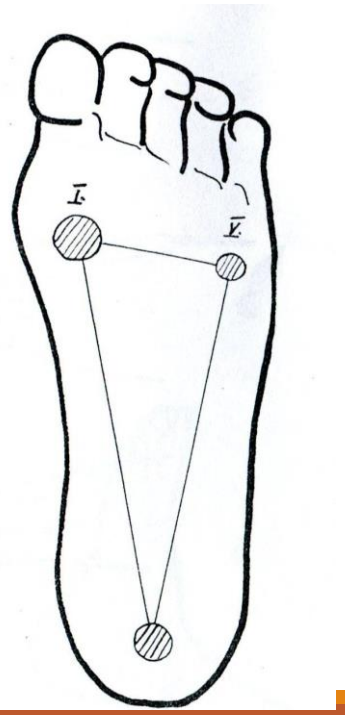


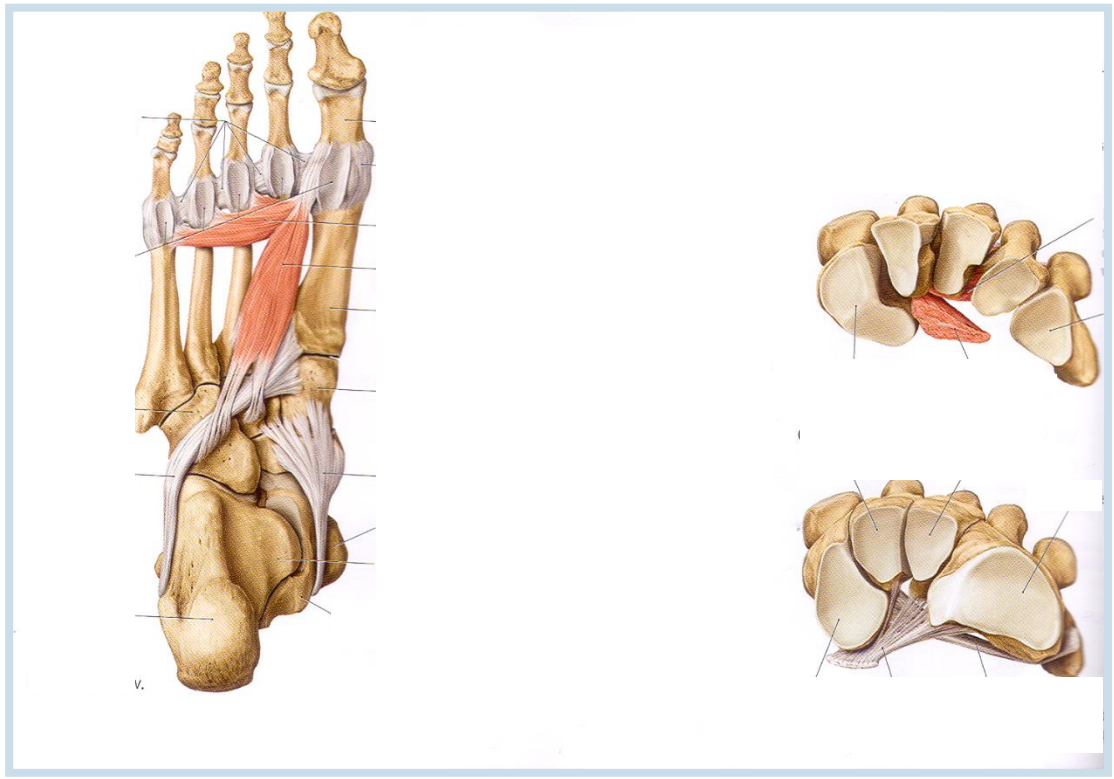




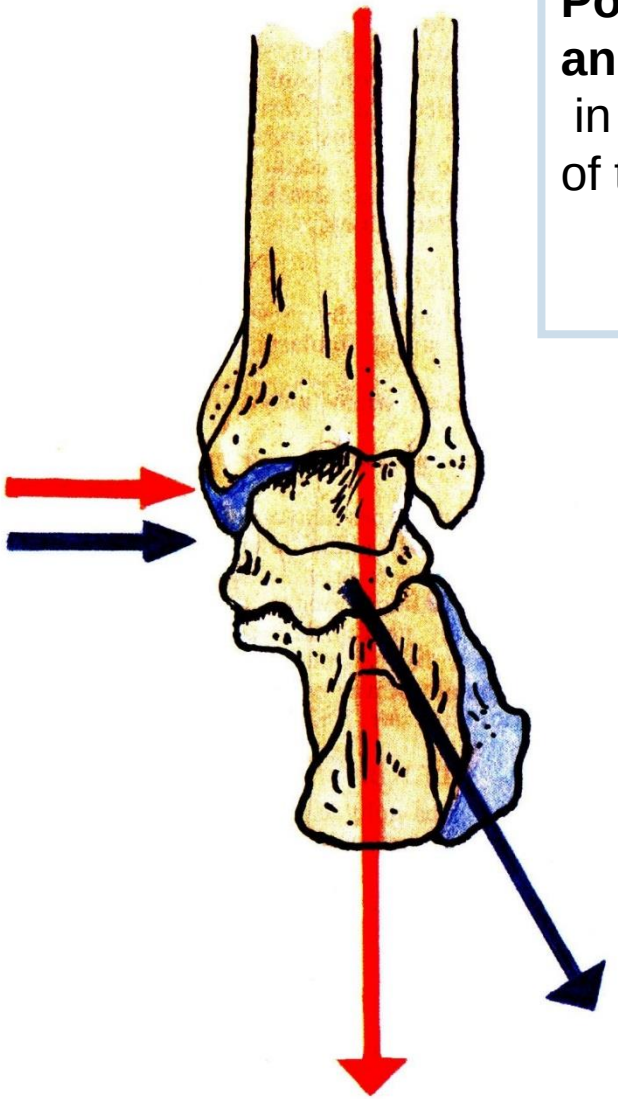
Lig. plantare longum, m. tibialis posterior et anterior, flexors of toes, aponeurosis plantaris

Transverse plantar arch





m. fibularis longus
m. tibialis ant.
transverse ligaments



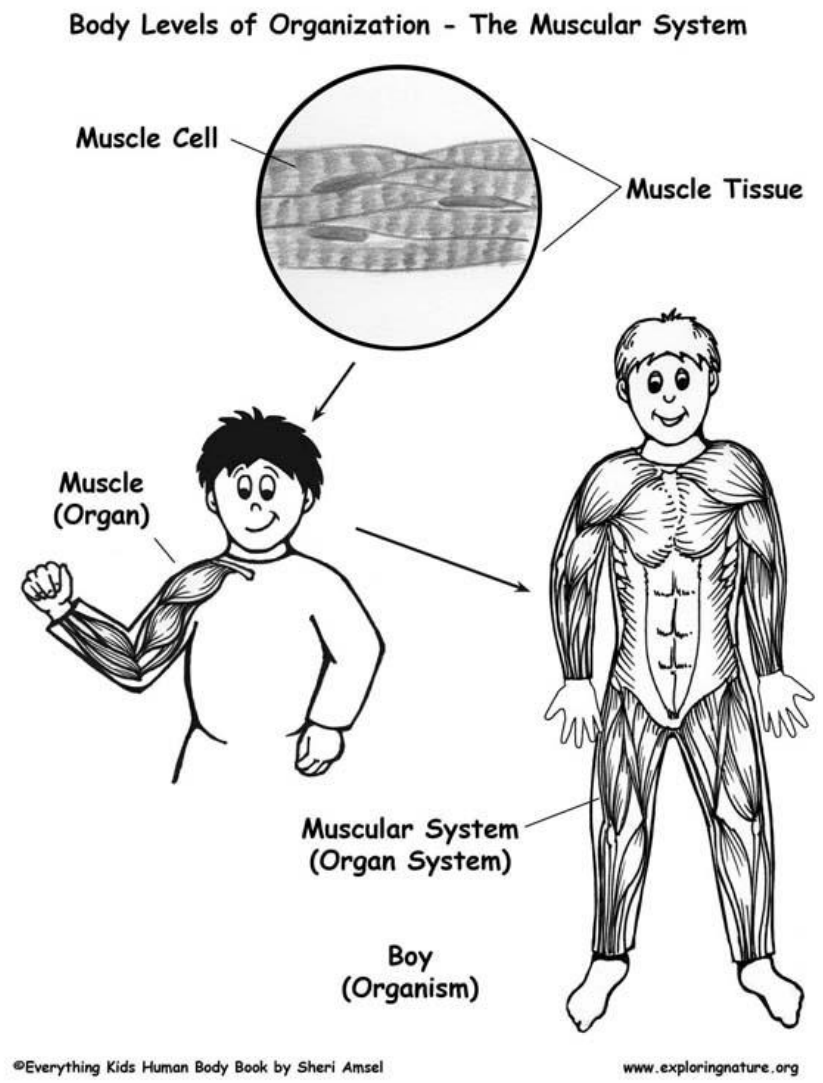
Position of calcaneus – normal foot and flatfoot („Flatfoot“ – *pes planus* – severe pain in the foot and leg occurs, due to overstretching of the long muscles and nerves and vessels of the sole.

Pes cavus

Pes planus

Pes planovalgus

Lecture 10. MYOLOGY



GENERAL MYOLOGY

Structure of skeletal muscle (origo, venter musculi, insertio)

Auxiliary muscular equipment (fascie, bursae synoviales, vaginae tendinum, trochleae musculares)

Vascularization, innervation

Classification of muscles according to:

number of heads (one-headed muscle, multi-headed muscle)

number of bellies (one-bellied muscle, multi-bellied muscle)

function (flexors, extensors, abductors, adductors, levators, sfincters...)

General function of muscle

*produces movement in sites of skeletal junctions

*changes shapes and dimensions of various body cavities and openings

*gives important information about the body position in three-dimensional space

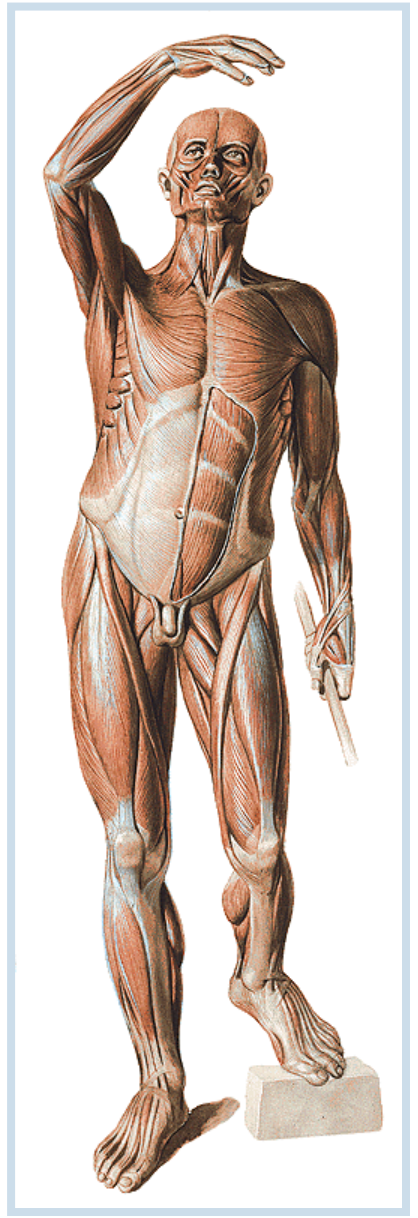
*important role during thermoregulation

*helps to blood and lymph circulation

* verbal and non verbal comunication

* about 600 muscles (♂ 35%, ♀ 32%)

* logistic system (supports respiration, digestion…)

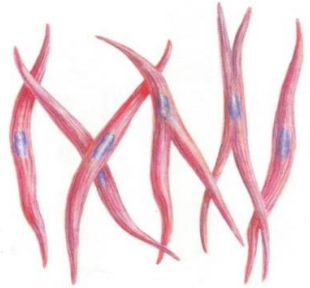
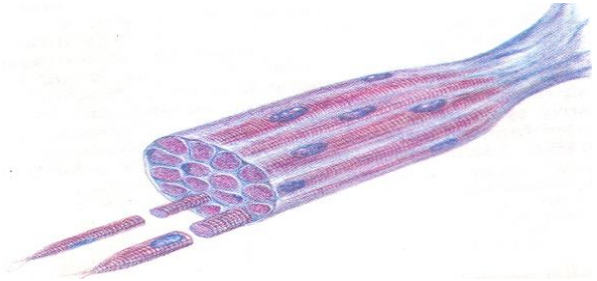


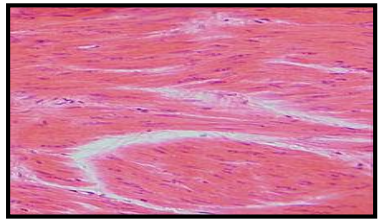
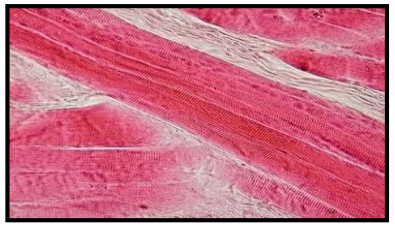
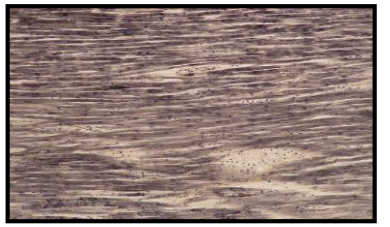
There are three different types of muscle:

1) **Skeletal:** striated muscle fibers that are attached to bone and are responsible for movements of the skeleton (sometimes simplistically referred to as *voluntary muscle* – work under control of our will, spent a lot of energy, produce heat (*musculi sceleti* + skin muscles *(musculi cutanei)*

2) **Cardiac:** striated muscle fibers that make up the walls of the heart and proximal portions of the great vessels (myocardium)

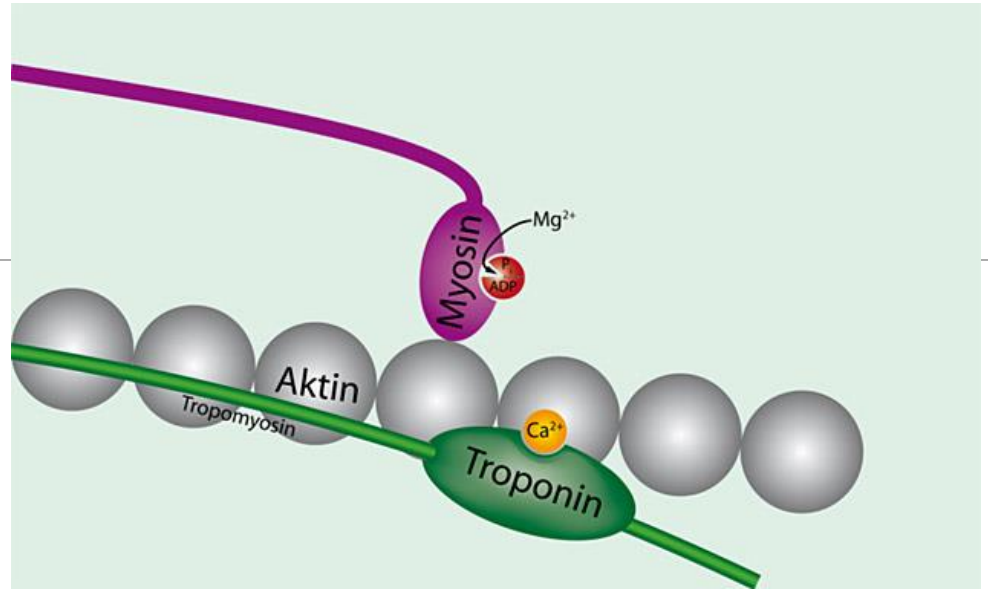
3) **Smooth (visceral):** nonstriated muscle fibers that line various organs, attach to hair follicles, and line the walls of most blood vessels (sometimes simplistically referred to as *involuntary muscle- work without our will, without fatigue*)

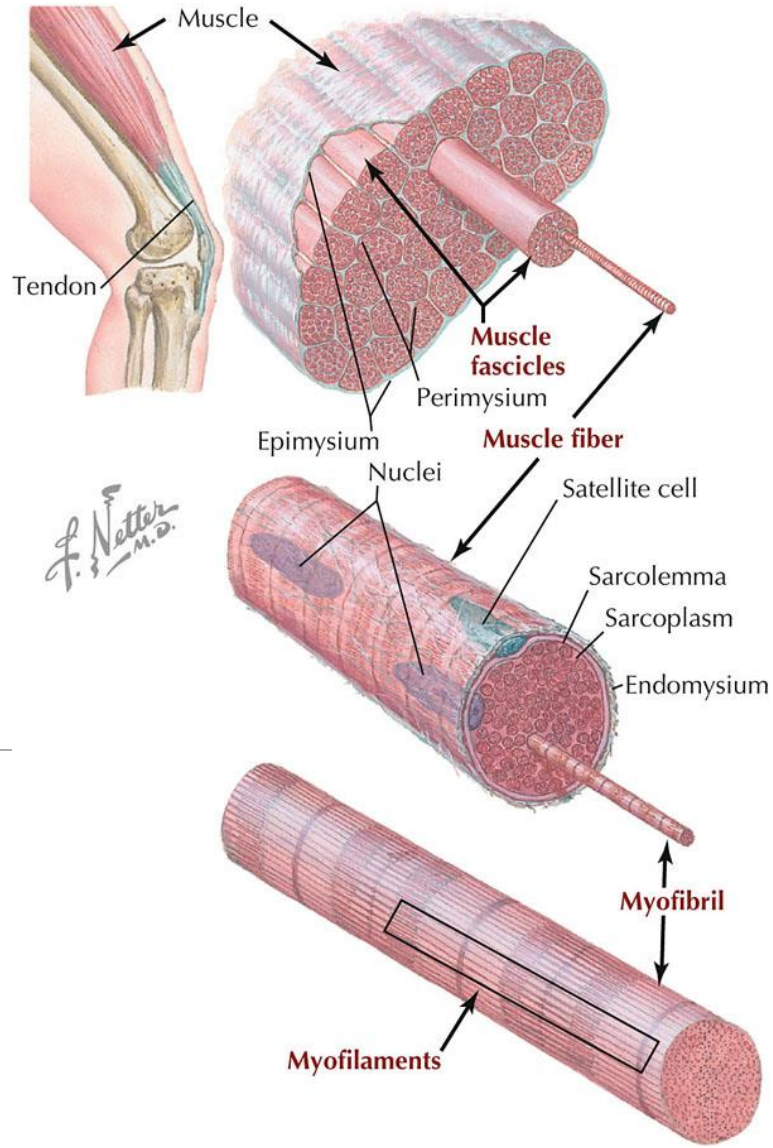



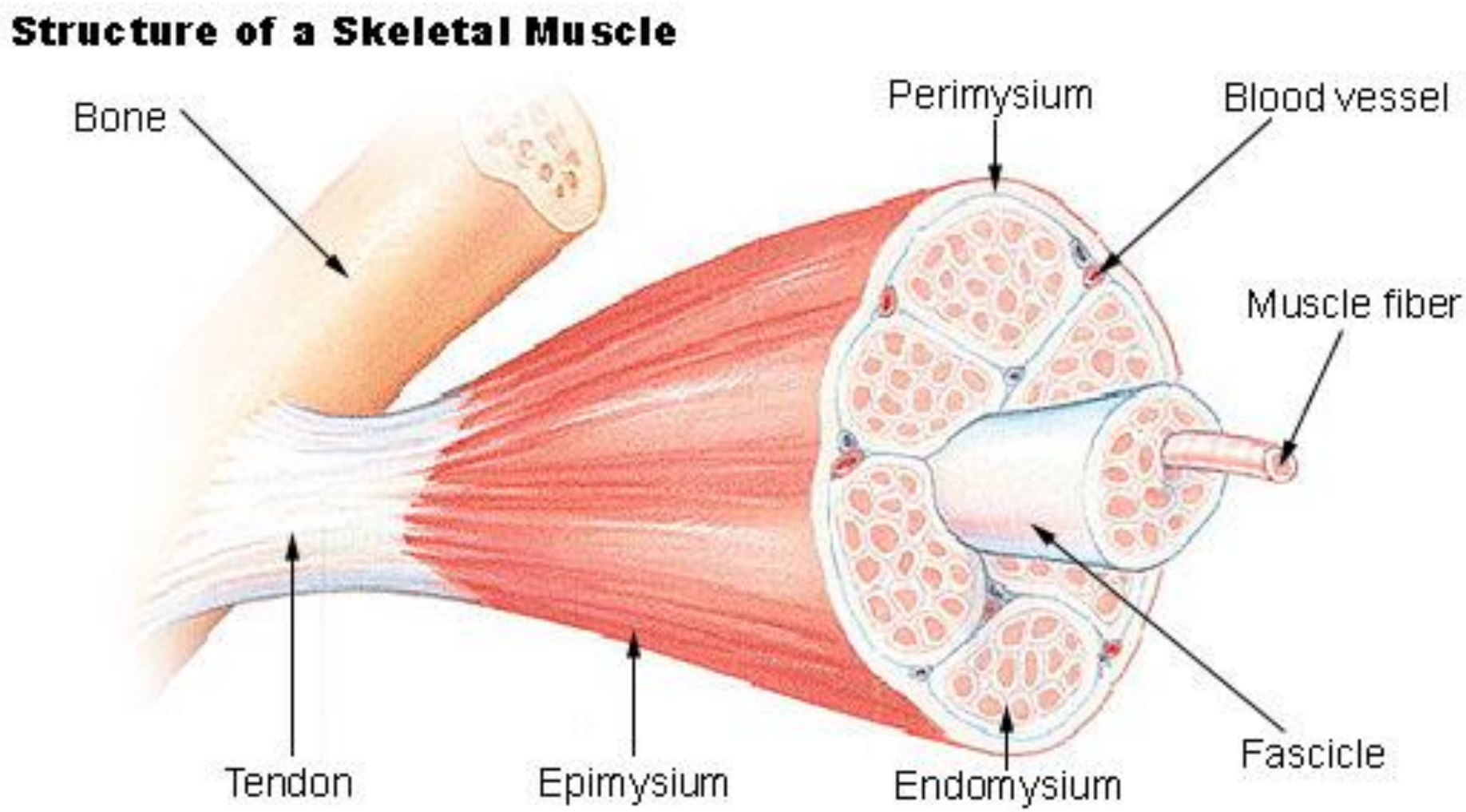




SKELETAL MUSCLES
(Muscles - an active part of the locomotor system)

Skeletal muscle is divided into **fascicles** (bundles), which are composed of muscle fibers (muscle cells). The muscle fiber cells contain longitudinally oriented **myofibrils** that run the full length of the cell. Each myofibril is composed of many **myofilaments,** which are composed of individual **myosin** (thick filaments) and **actin** (thin filaments) that slide over one another during muscle contraction.







Striated fibres – endomysium

Primary and secondary muscle bundles – perimysium internum

Surface of muscle perimysium externum – fascia propria musculi

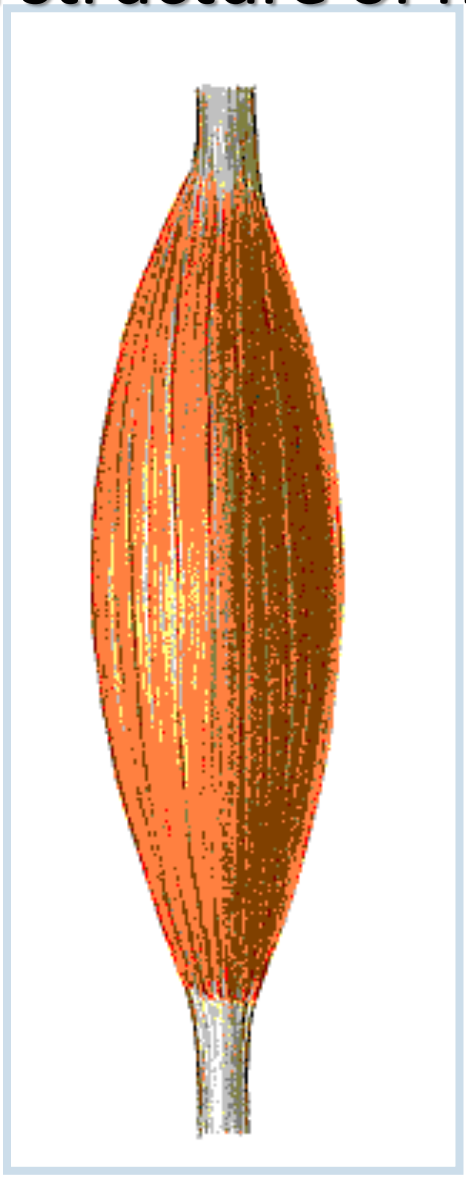
Common structure of muscle

Origo (origin)
Proximal part (more fixed)

Fascia

Tendo, aponeurosis

Insertio (insertion)
– distal part, more movable)

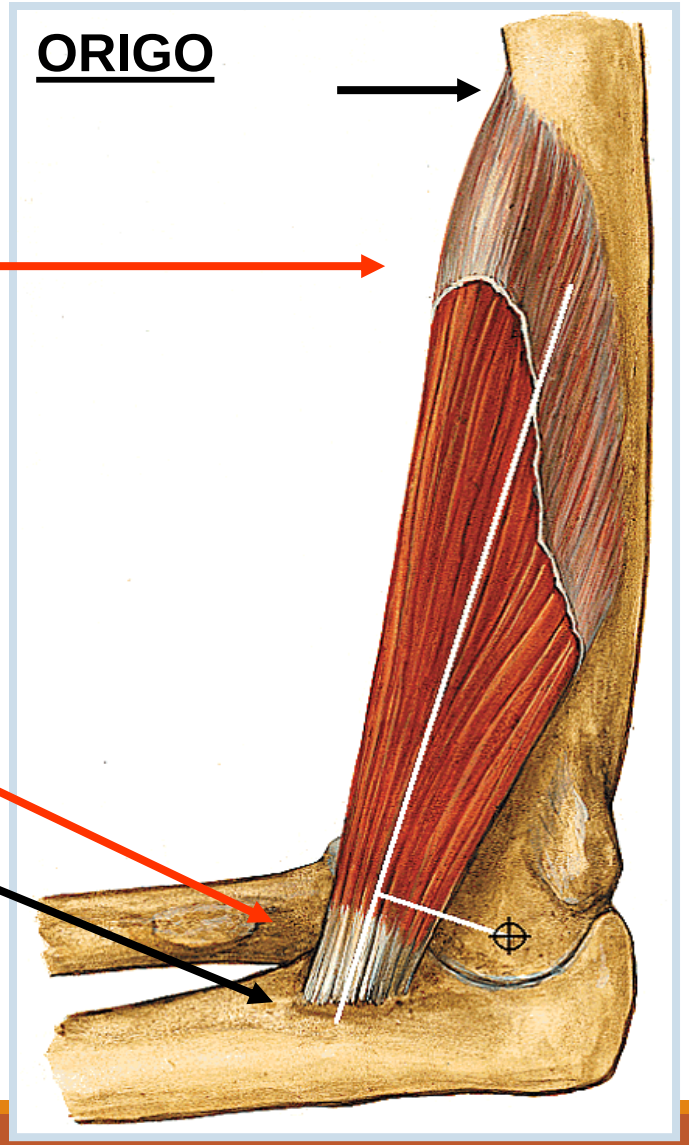


Caput (head)

Venter (belly)

Cauda (tail)

Structure of muscle



fibrous membrane – *fascia* – separates the muscles (or groups) from adjacent structures.

Vessels and nerves enter into muscle by its hilus (rich ramification)

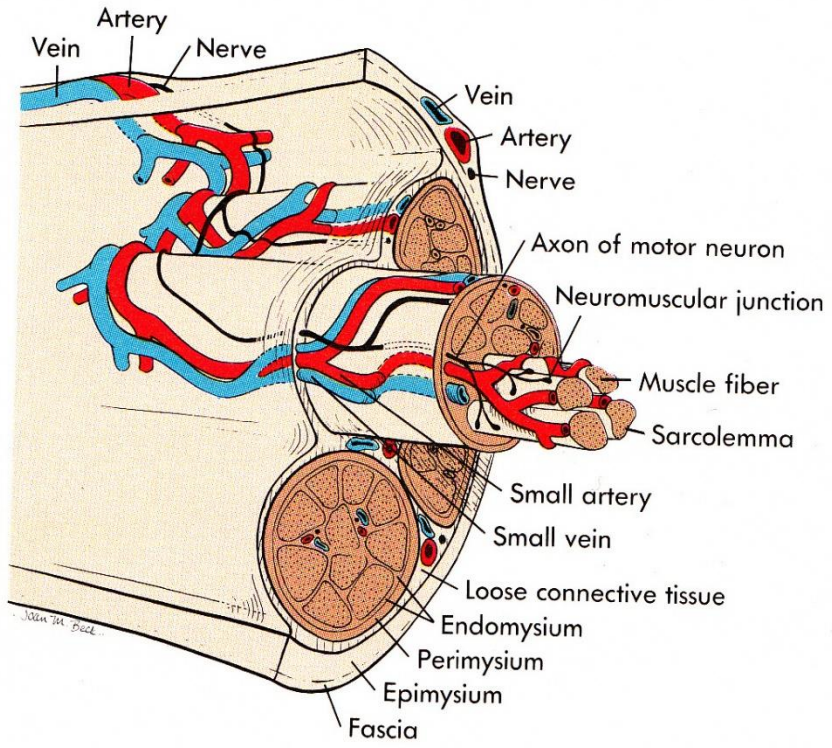
Tendons are attached to the bones by Sharpey´s fibres

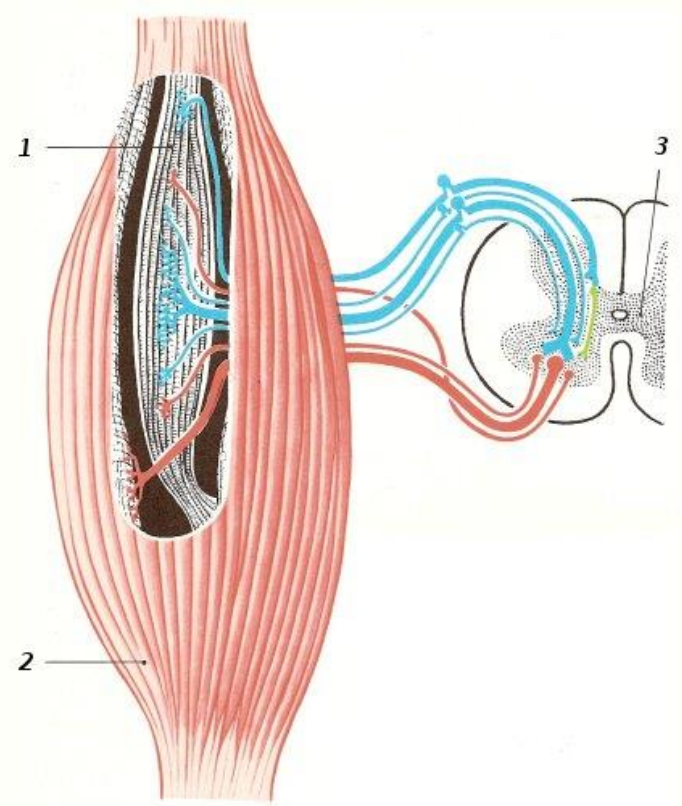
Vessels and nerves of the muscles

Hilus – vessels and nerves

Sensory innervation – muscle and tendon spindles

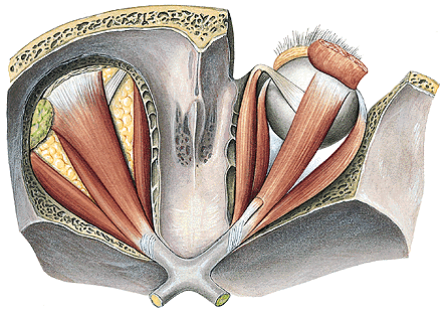
Motor innervation – motor plate

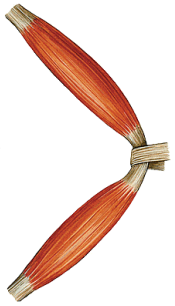


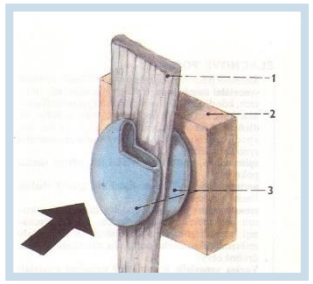


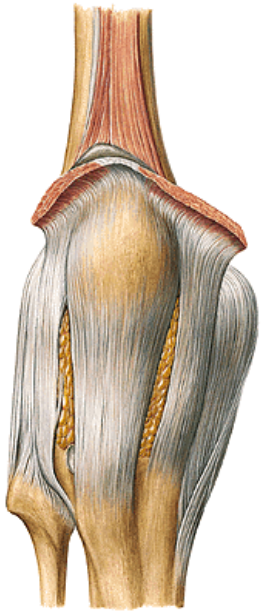
Auxiliary facilities of muscles

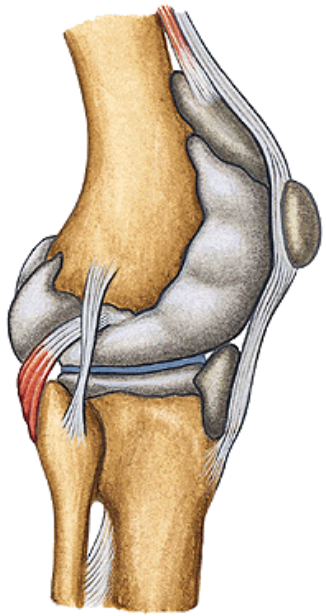
Fascias – allow to move one muscle against the other
Synovial bursae – protect muscle tendons against friction
Tendons, aponeurosis
Muscular trochleae – fibrous loops keeping tendon to bone, permit change of direction of muscle pulling
Sesamoid bones – at the places of pressure
Tendon sheats – vaginae tendinum







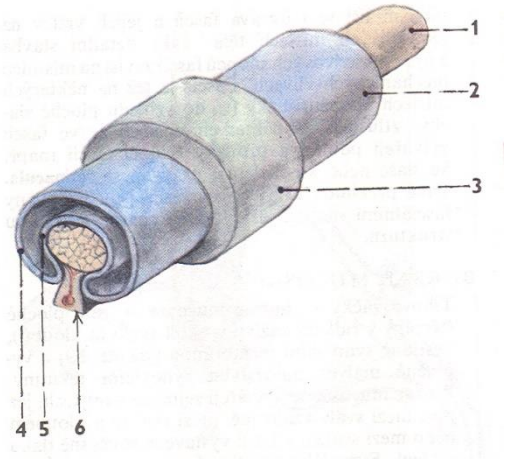


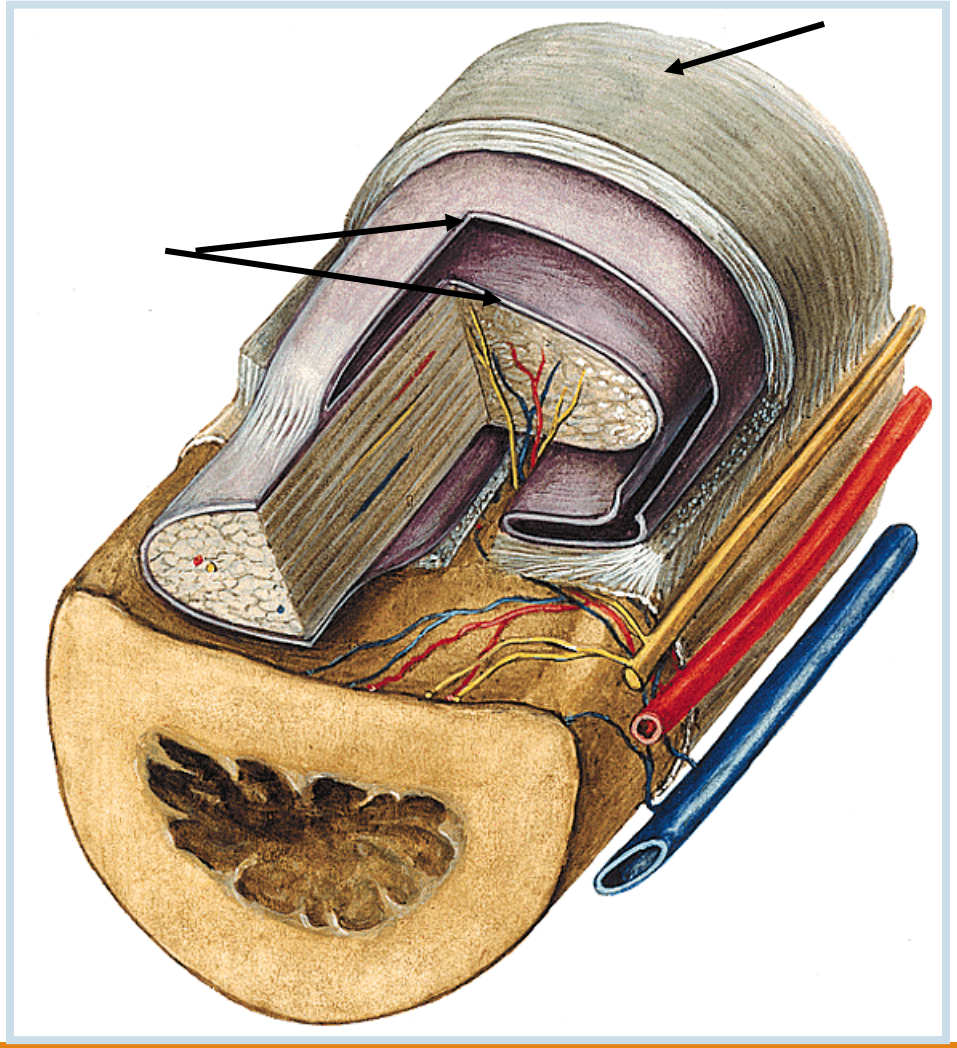


Auxiliary facilities – tendon sheaths = vaginae tendinum

Along the tendons, closed, increasing sliding capacity of tendons

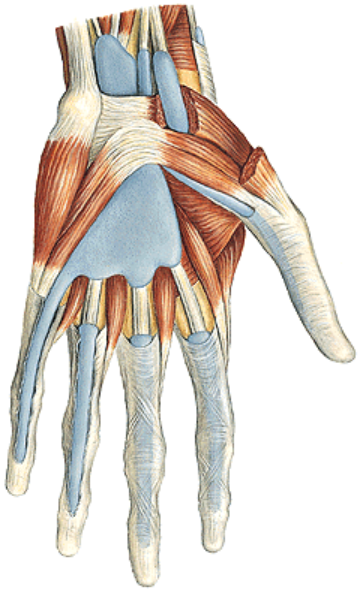
Synovial layer = *stratum synoviale* (ext. and int. layer with mesotenonium for penetration of vessels into tendon)





Fibrous layer = *stratum fibrosum*

(Osteofibrous canal)



Division of muscles according to the shape

- *long type* (predominantly limb muscles)
- *flat type of muscles* , paralel fibers, flat sheath, flat tendon – aponeurosis (abdominal wall muscles)
- *short type of muscles* (circumarticular muscles)
- Circular muscles (sphincters, around openings)
- Composed:
- *biceps*, begins with two heads (triceps, quadriceps)
- *digastric muscle – musculus digastricus (multi-bellied muscle)*
- *unipennate muscles* or *multipennate* muscles – feathered apereabce

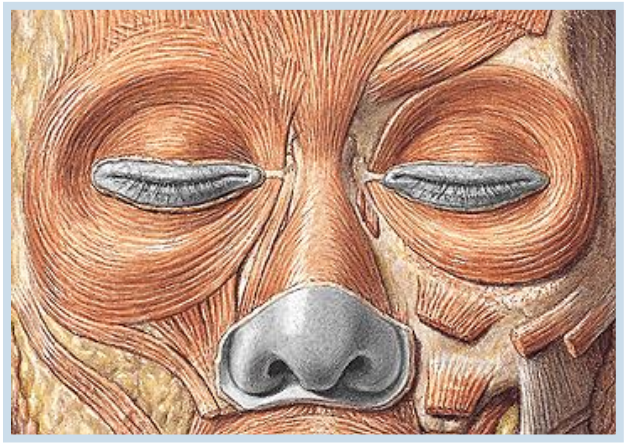
Division of muscles according to the function

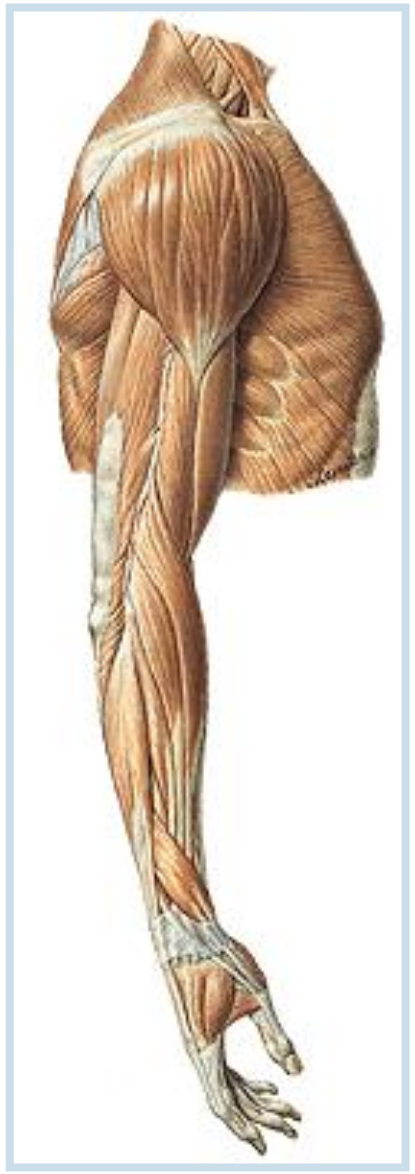
synergists x antagonists

flexors x extensors f. eg.
biceps of brachium x triceps of brachium

abductors x adductors f. eg. abductor pollicis brevis x adductor pollicis

dilatators x sphincters f. eg.
dilatator pupillae x sphincter pupillae





SPECIAL MYOLOGY

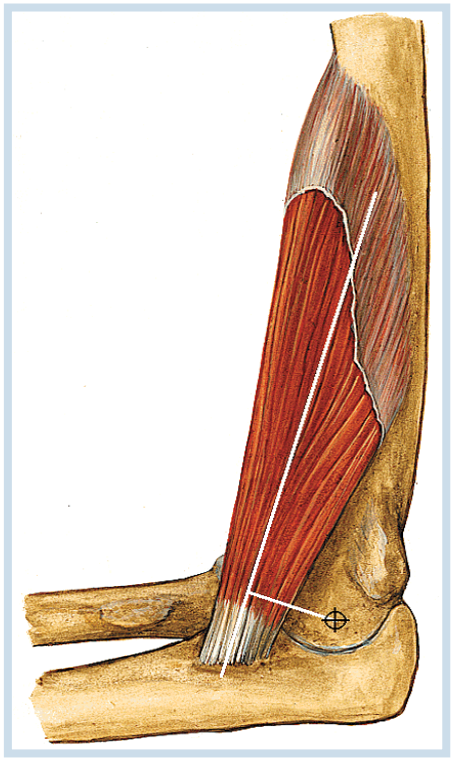
Description of the muscle (muscles group):

Origo - origin

Insertio - insertion

Functio – function/action

Inervatio - innervation



Fascias are part of the description of muscles. Simplified description of muscles or muscle groups is attached to the frame in form of tables.

The followings lectures we will have demonstations of the muscles group

Division of muscles according to topography

Muscles of head

Muscles of neck

Muscles of thorax

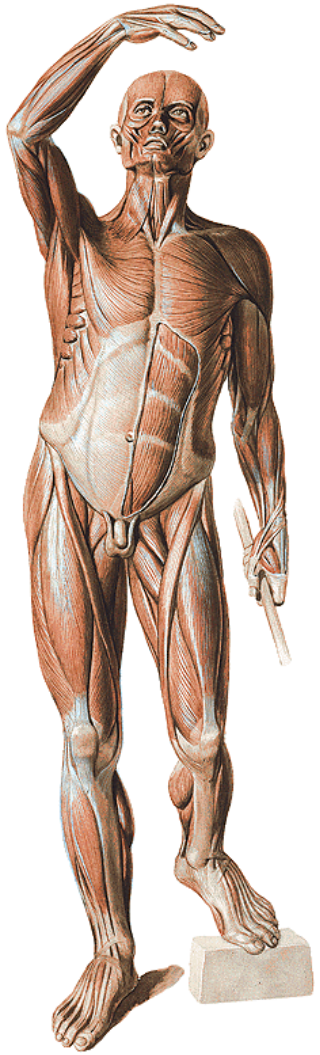
Muscles of abdomen

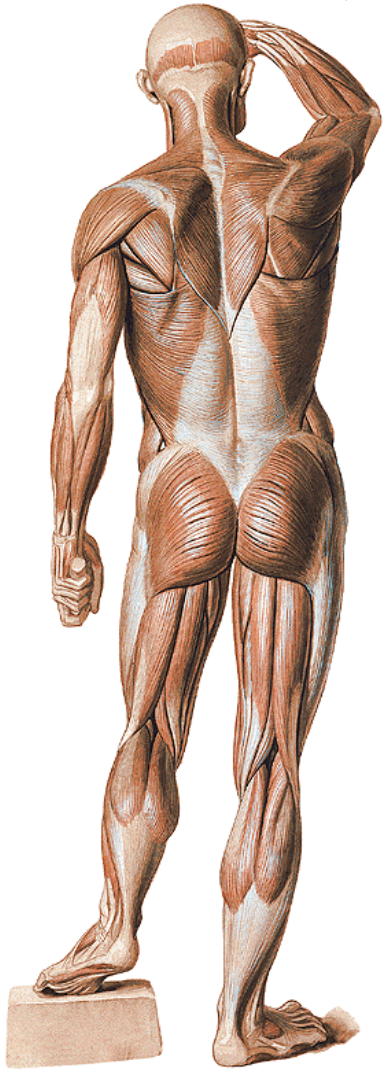
Muscles of diaphragma pelvis

Muscles of back

Muscles of the upper limb

Muscles of the lower limb





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