# Anatomy 3

# Movement system

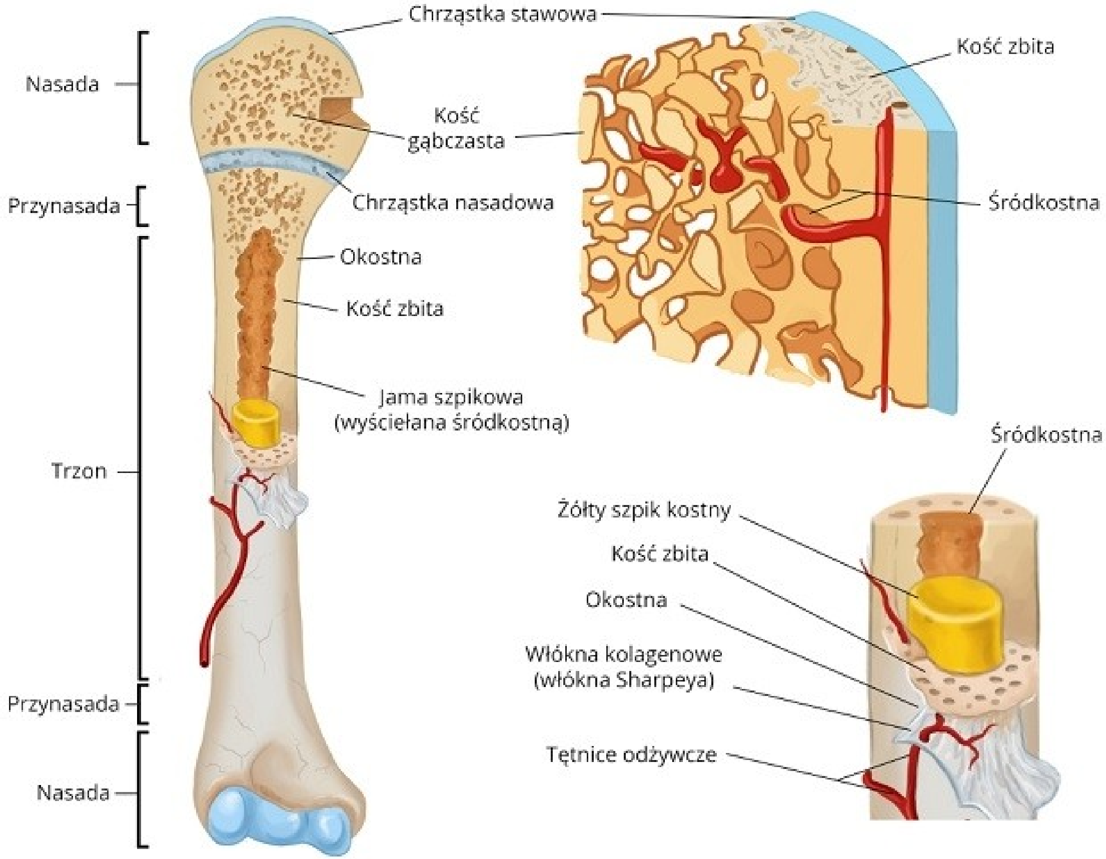
# Bone structure

https://www.mp.pl/patient/rheumatology/diseases/161264,necrotic-jal-bone

- We divide bone tissue into compact and spongy tissue (beads loosely arranged with spaces between them - it is not soft like a sponge!).
- In long bones we distinguish the shaft, appendages and epiphyses (proximal and distal).
- The shaft of the bone is made up of compact bone, in the center of which is the marrow cavity. The epiphyses and epiphyses are made of spongy tissue. Between the epiphysis and the epiphysis in children is the epiphyseal cartilage, which is the place where the bone grows in length (transparent on X-ray).
- The bone is covered with periosteum (well innervated and vascularized), from which nerves

# Tendons, tendons, ligaments and fascias

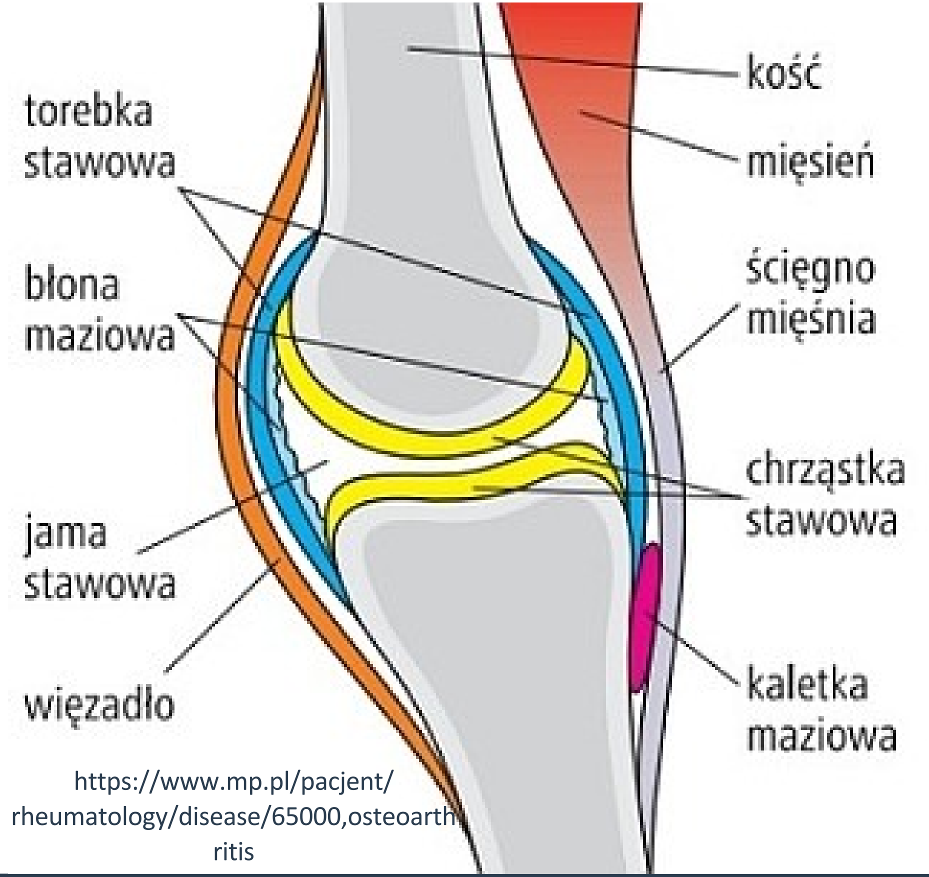




# Bone structure

- Tendon → the fibrous end of a muscle that transmits the force of contraction to the bone to which the tendon attaches.
- Tendon → the fibrous end of the muscle, which is flat and wide, resembling a membrane.
- Ligament → a band of fibrous compact connective tissue that strengthens the joints of the bones (often stiffens the joint capsule), connects at both ends to the bones.
- Fascia → membranous structure covering muscles or whole groups of muscles.

# Fracture, sprain, dislocation

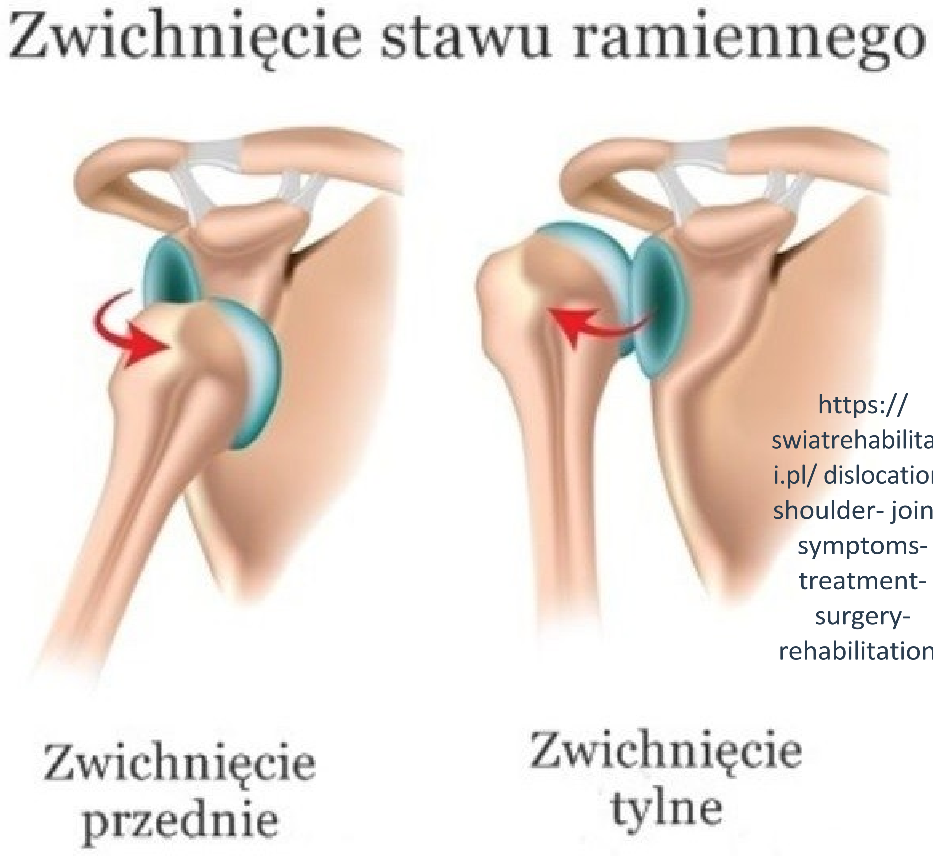



https://www.mp.pl/pacjent/rheumatology/disease/65000,osteoarthritis

- Joints → the connection of bones that allows their movement relative to each other (as opposed to ligamentous, bony, cranial sutures).
- The articular surfaces of at least 2 bones are surrounded by an articular capsule to form a joint cavity. The joint capsule is lined on the inside with synovium, which produces small amounts of fluid for smooth movement.
- The joint surfaces are covered with cartilage.
- Sometimes tendons are surrounded or separated from other structures by a synovial bursa (a fluid-producing sac) that facilitates their movement.

# Ponds

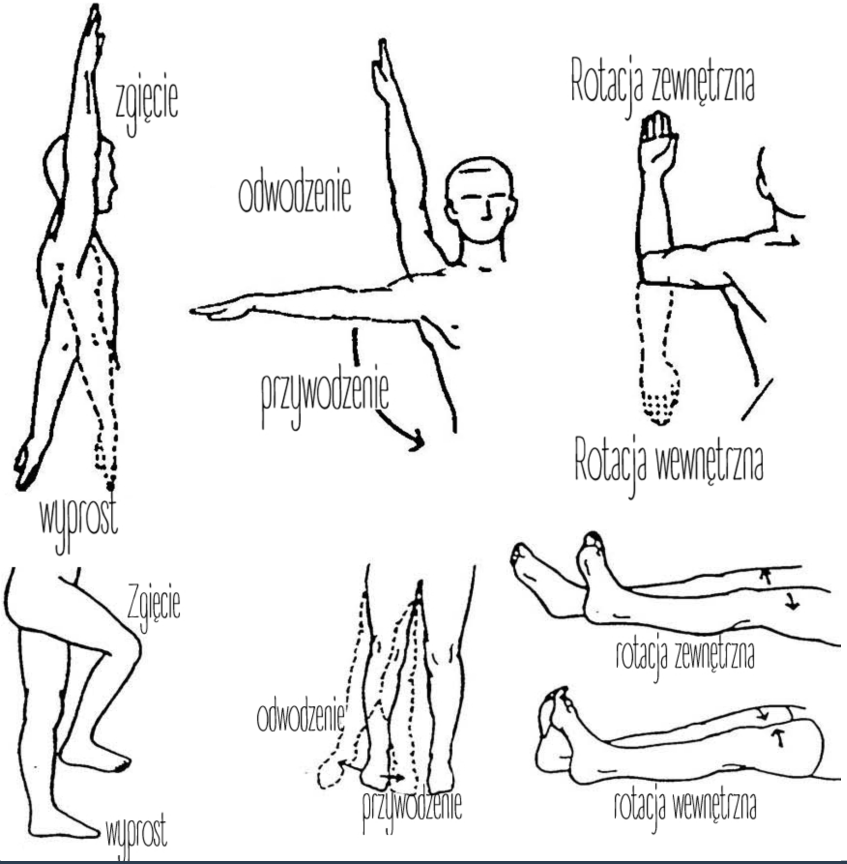
# Fracture, sprain, dislocation




https:// swiatrehabilitacji.pl/ dislocation- shoulder- joint- symptoms- treatment- surgery- rehabilitation/

- <u>Fracture</u> → interruption of bone continuity.
- <u>Torsion</u> → making an unnatural movement in a joint that causes stretching, tearing or rupture of ligaments or joint capsule, but the joint surfaces <u>are not permanently translocated</u>.
- <u>Dislocation</u> → <u>translocation</u> (displacement) relative to each other of joint surfaces.

# Limb movements




- **Movements in the sagittal plane are bending and straightening.**
- **Movements in the frontal plane are inversion and adduction.**
- **Movements in the horizontal plane are rotations (internal and external).**

https://www.polskieszafiarki.pl/wpis/s

# Limb muscles

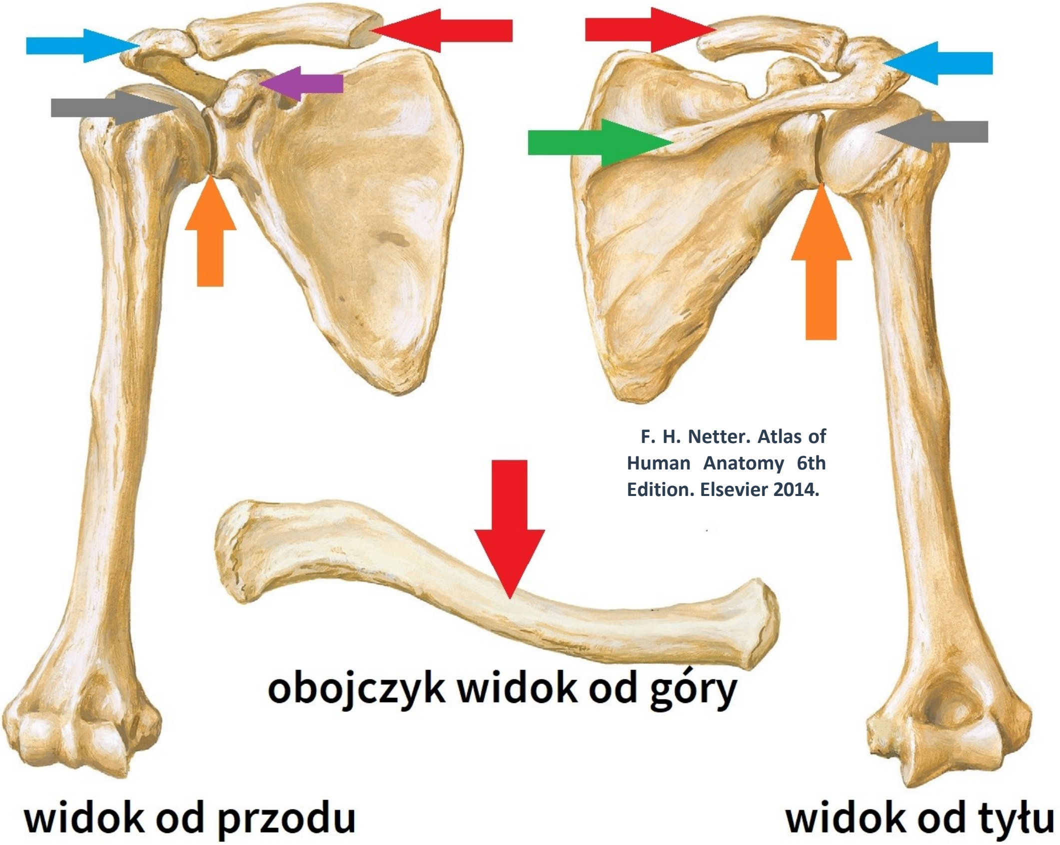
# Limb movements

- If a muscle or its tendon runs forward from the joint, its contraction causes flexion at the joint.
- If a muscle or its tendon runs backward from the joint, its contraction causes the joint to straighten.
- Knowing the location of the attachment of a particular muscle or its tendon, one can reason similarly in relation to the movements of adduction, inversion, internal and external rotation.

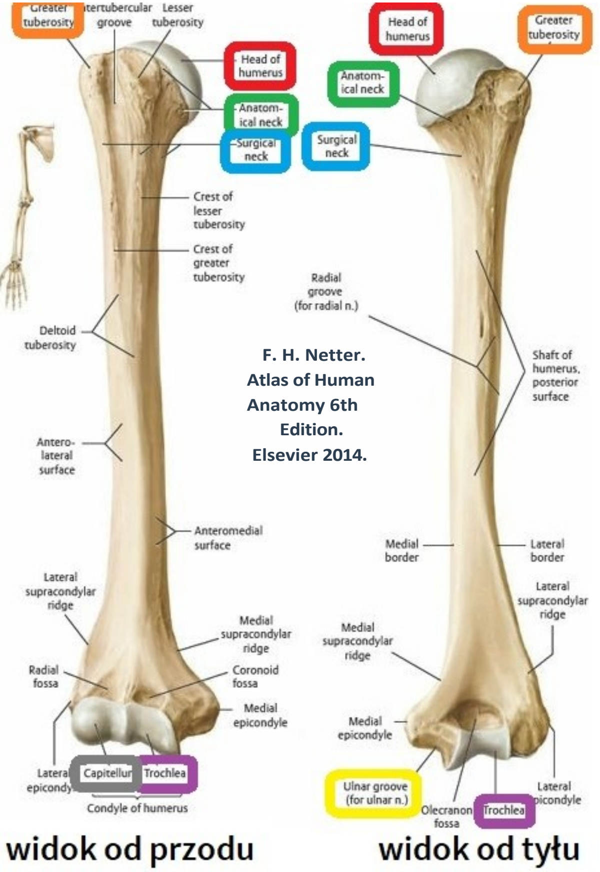
# Upper limb

- **In simple terms, the upper limb can be divided into: shoulder, arm, forearm, wrist and hand.**
- **The hollow between the chest wall and the proximal part of the arm is the axillary fossa.**
- **The term hand refers to the area distal from the wrist (and not, as in the common understanding, the entire upper limb).**
- **The front surface of the hand is called the palm (the palm cannot be called the whole hand, but only its front surface).**

# Bones of the shoulder girdle

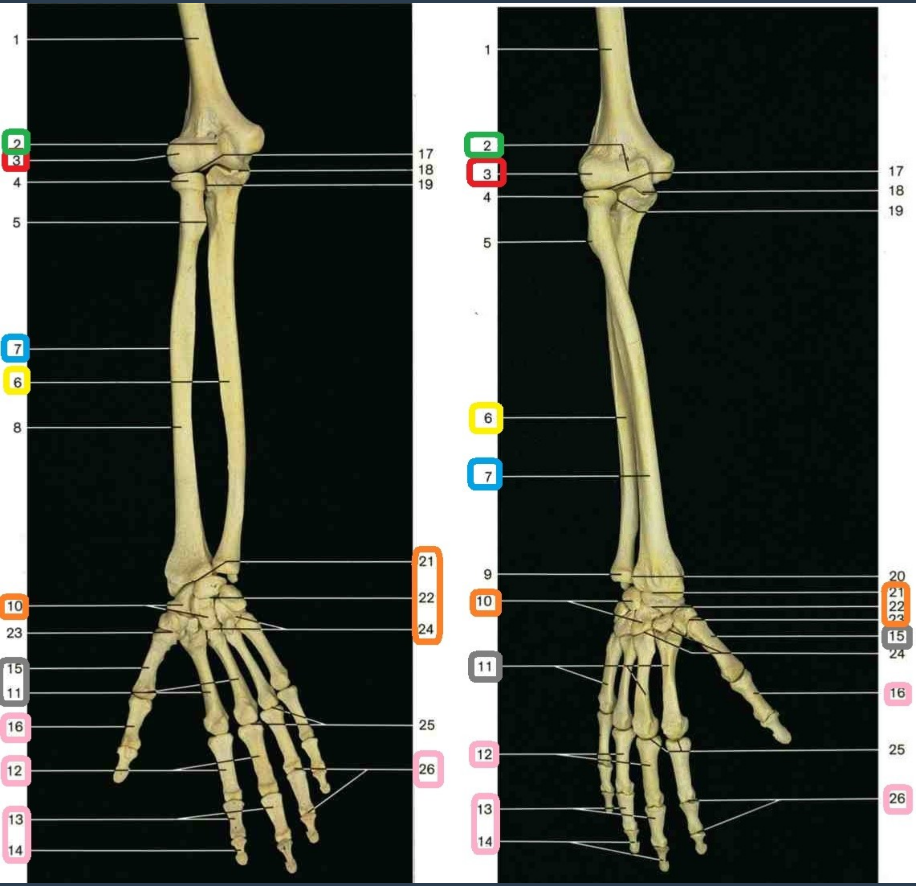



- Shoulder rim: scapula and clavicle. The clavicle (S-shaped) connects the sternum to the scapula (shoulder process).
- The scapula (triangular in shape) in its lateral angle has a hollow, which is the acetabulum for the shoulder joint (with the head of the humerus). Above the acetabulum of the shoulder joint are 2 processes (the coracoid and shoulder). The shoulder process is an extension of the scapular crest. The shoulder muscle attaches to the scapular crest, shoulder process and clavicle.




- **Directly below the head of the humerus is its anatomical neck, while the surgical neck (a site subject to frequent fractures) is located below. In addition, the humerus in the proximal part has 2 nodules (smaller and larger), which are the site of muscle attachment.**
- **The distal epiphysis of the humerus (through the pulley and head) joins the bones of the forearm: the ulna (medially, through the pulley, on the V-finger side) and the radius (laterally, through the head, on the thumb side) to form the elbow joint.**
- **Adjacent to the posterior aspect of the shaft of the humerus is the deep artery of the arm and the radial nerve. Medially from the block to the distal epiphysis is adjacent to the ulnar nerve (a fracture can damage these structures).**

# Bones of the forearm, wrist and hand

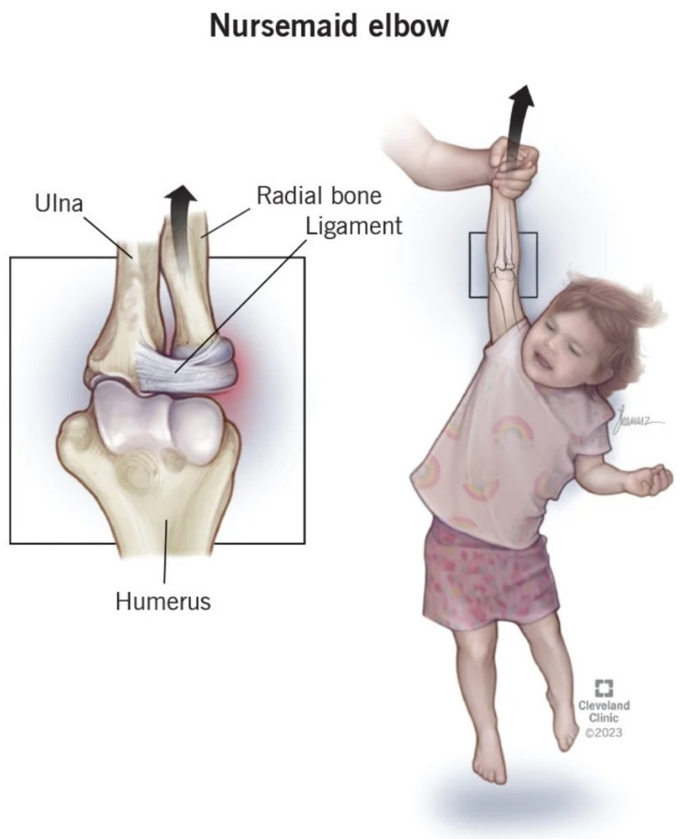



- The ulna bone connects to the humerus block, at the elbow joint this bone is wide and narrows towards the wrist (it does not connect directly to the carpal bones). The radius bone is narrower in the proximal part (it connects to the head of the humerus) and widens distally until it reaches the wide distal epiphysis that connects to the carpal bones.
- The carpal bones connect to the metacarpal bones (carpometacarpal joints), these to the proximal phalanges (metacarpophalangeal joints), these in turn to the middle phalanges (proximal interphalangeal joints) and these in turn to the distal phalanges (distal interphalangeal joints).
- Exception - 1st finger (thumb): the middle phalanx is missing.

Rohen et al. Color Atlas of Anatomy

A Photographic Study of The Human Body. Seventh Edition, 2011 by Schattauer GmbH.

# Huber's elbow




- The proximal epiphysis of the radius bone is surrounded by the <u>annular ligament.</u>
- If the child pulls hard on the limb (for example, protecting the child from a fall), dislocation can occur by slipping the radius bone out of the annular ligament.

# Shoulder girdle muscles

F. H. Netter. Atlas of Human Anatomy 6th Edition. Elsevier 2014.

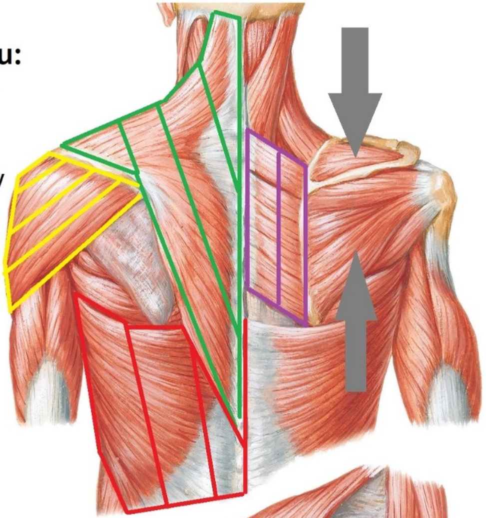
- Attached to the shoulder girdle and the proximal epiphysis of the humerus are numerous muscles whose initial attachments are located on the spine and chest wall. These include the parallelogram, quadriceps, dorsal widest, anterior dentate, pectoral (lesser and greater), among others.
- The muscles that span between the bones of the shoulder girdle and the proximal epicondyle of the humerus are the shoulder muscle and the cone (cuff) rotators (a group of muscles that is mainly responsible for rotation at the shoulder joint).

# Huber's elbow

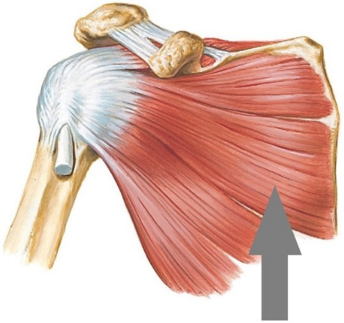


**widok od tyłu:**

(po stronie prawej usunięto mięsień naramienny i czworoboczny, aby uwidocznić równoległoboczne i mankiet rotatorów)



**mięśnie stożka rotatorów:**



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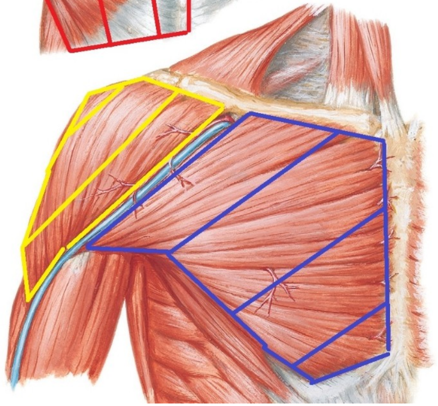
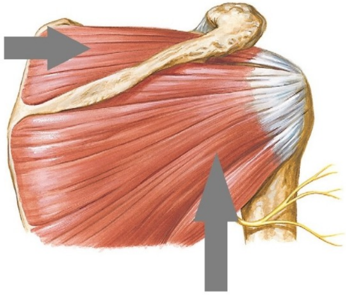
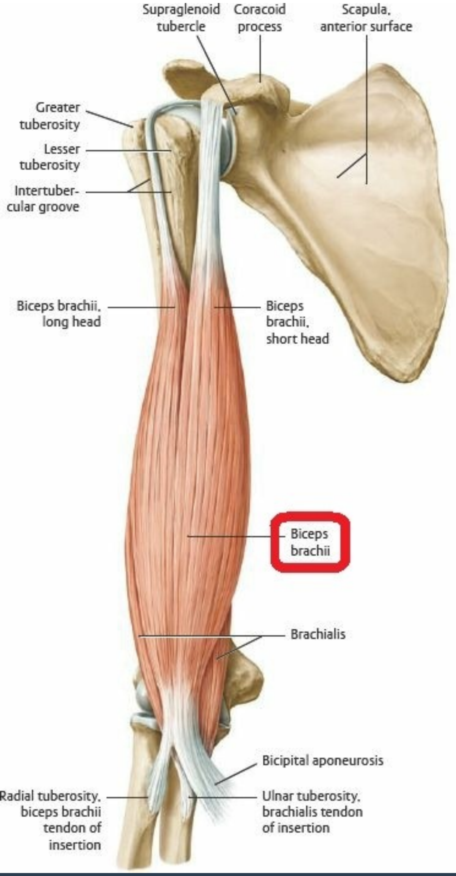




# Muscles of the forearm and hand

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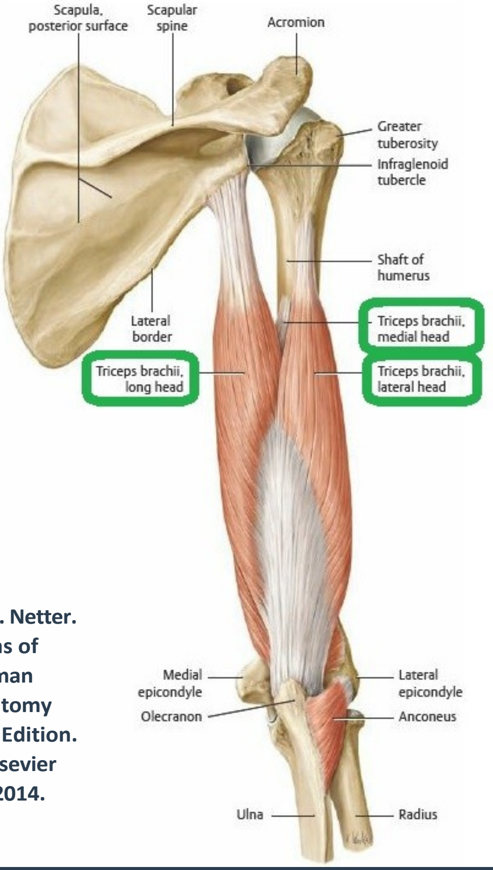


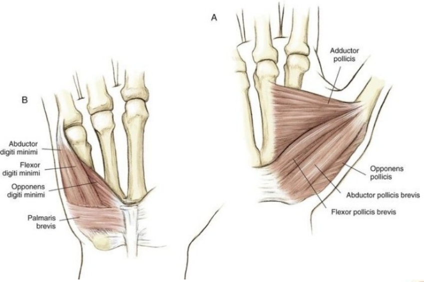

- Muscles of the anterior group (which includes <u>the biceps brachii muscle</u>) - flexion at the shoulder and elbow joints.
- The muscles of the posterior group (which include <u>the triceps brachii muscle</u>) - straightening at the shoulder and elbow joints.

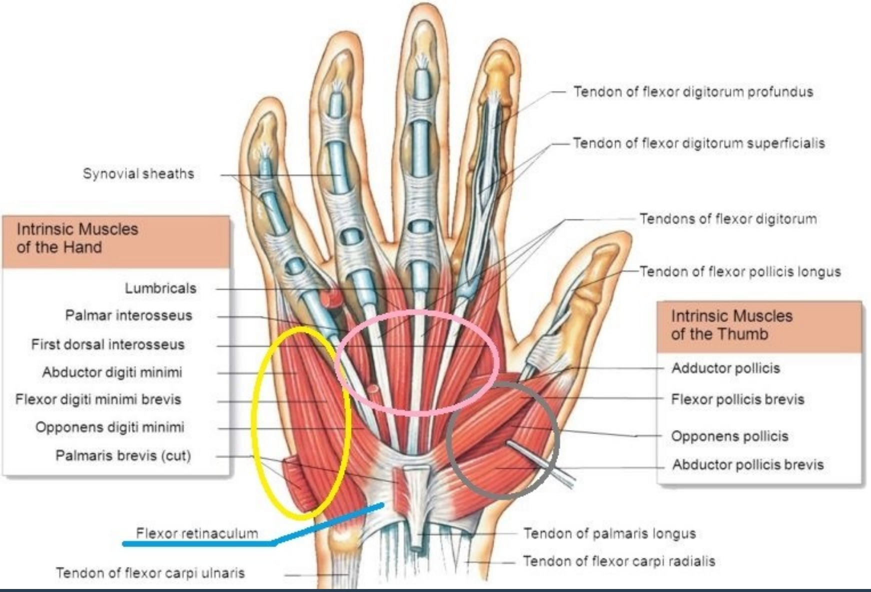
# Arm muscles

https://anatomyinfo.com/hand-muscles/

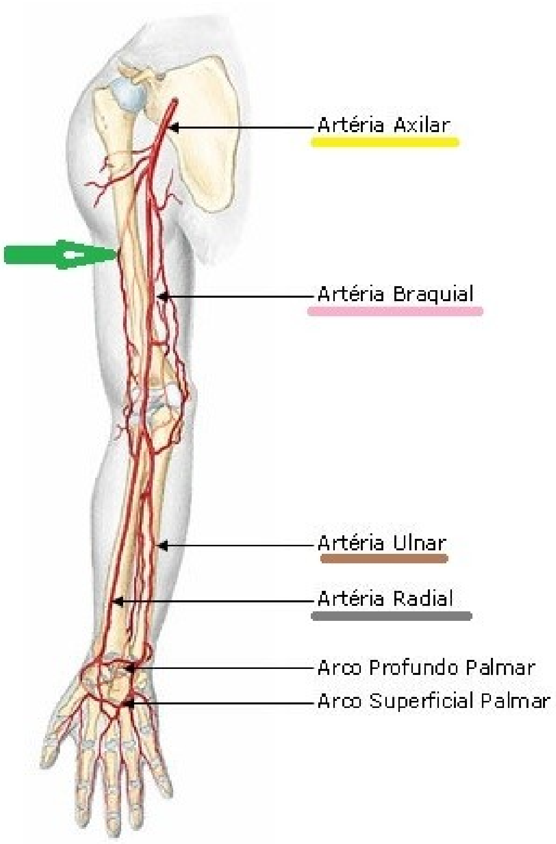
- **The muscles of the forearm are arranged in an anterior (flexors) and posterior (extensors) group. Their tendons reach the hand and are responsible for movement at the wrist and fingers. The flexor tendons pass under the flexor trochlea in the carpal canal, and the extensors in 6 sheaths on the dorsum of the wrist.**
- **The muscles of the hand are divided into 3 groups: the knuckle of the thumb (A), the knuckle of the little finger (B) and the middle finger.**
- **Between the metacarpal bones are small muscles (of the medial group): the intercostals and the glabellae.**
- **There are no longer muscle fibers in the fingers, tendons are responsible for their movement, which are connected to the muscles of the forearm and metacarpus.**

# Muscles of the forearm and hand



# Arterial vessels of the upper limb

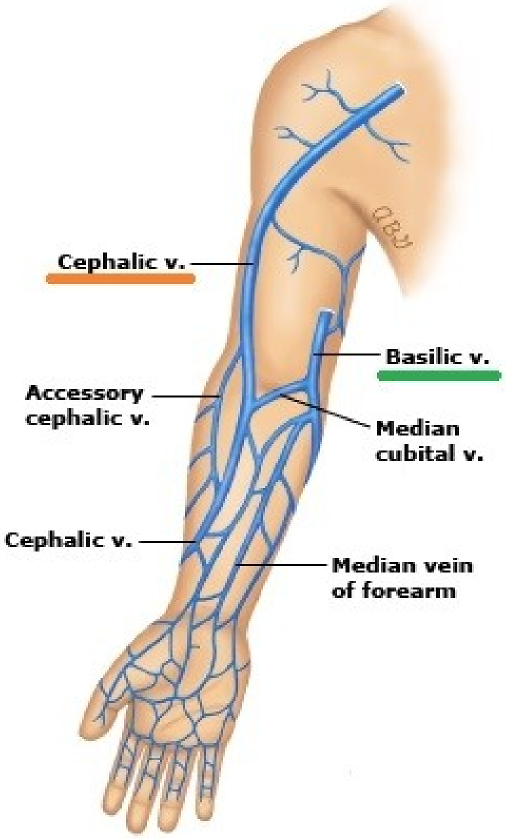



- **The upper limb is supplied with blood by the subclavian artery, which, passing the 1st rib, "changes its name" to the axillary t. and then the brachial t.**
- **From the brachial artery comes the deep artery of the arm passing on the posterior surface of the humerus (along with the radial nerve).**
- **The brachial artery divides into the radial artery and the ulnar artery, which reach the hand to form 2 arterial arches (designed to create collateral circulation in case of circulation disorders in 1 of**

# Venous vessels of the upper limb

the vessels).

# Arterial vessels of the upper limb

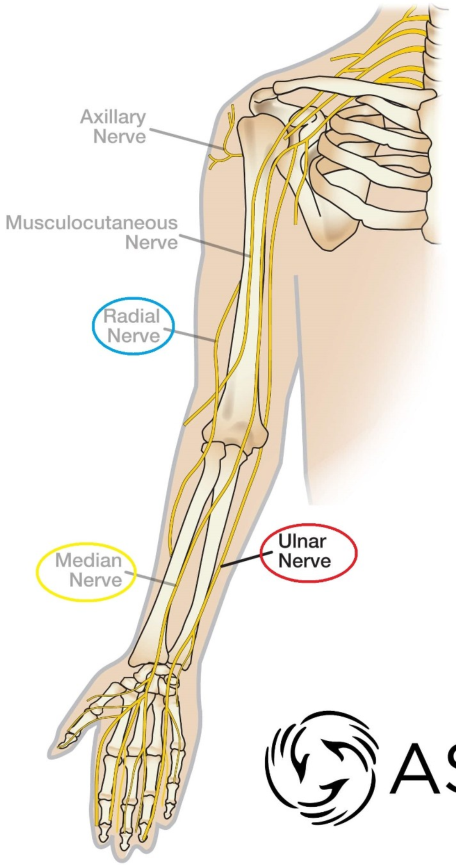


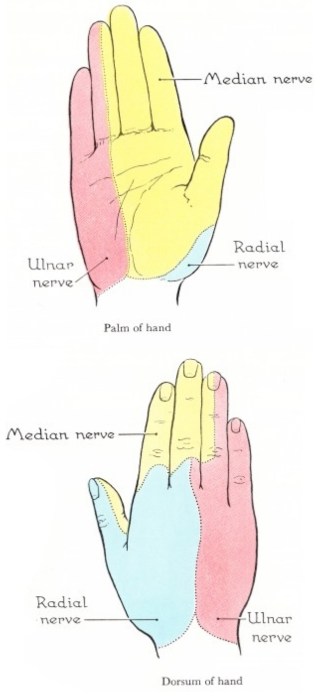

- Venous flow from the extremities runs through 2 systems (deep and superficial).
- The deep vein system accompanies the arteries, the names of these vessels are the same.
- The superficial venous system consists of numerous, individually variable veins of subcutaneous tissue that flow into 2 large vessels: the ulnar vein and the saphenous vein.
- The ulnar vein drains into the brachiocephalic vein, and the radial vein

# Venous vessels of the upper limb

drains into the axillary vein.

# Upper limb innervation




- The brachial plexus receives its innervation from the spinal nerves C5 - Th1. It then runs between the vagus muscles and continues in company with the axillary artery.
- The plexus gives off numerous short branches innervating the muscles of the shoulder girdle, and ends with 5 definitive nerves: axillary, median, ulnar, radial and musculocutaneous. Only 3 of the above nerves reach with their innervation all the way to the hand.
- The radial nerve is responsible for innervating the extensors and sensory dorsal (back) side of the forearm and fingers 1 - 3 of the hand. It runs along the posterior surface of the humerus (where it is prone to damage from fractures). Its damage leads to a "drooping hand."
- The median nerve innervates part of the flexors and sensory anterolateral part of the forearm and palmar surface of fingers 1 - 3. Its damage leads to "blessing hand".
- The ulnar nerve innervates the medial part of the flexors and sensory fingers 4 - 5 (on both sides). It runs close to the humerus medially from the humeral block. Damage to this nerve leads to "clawed hand."

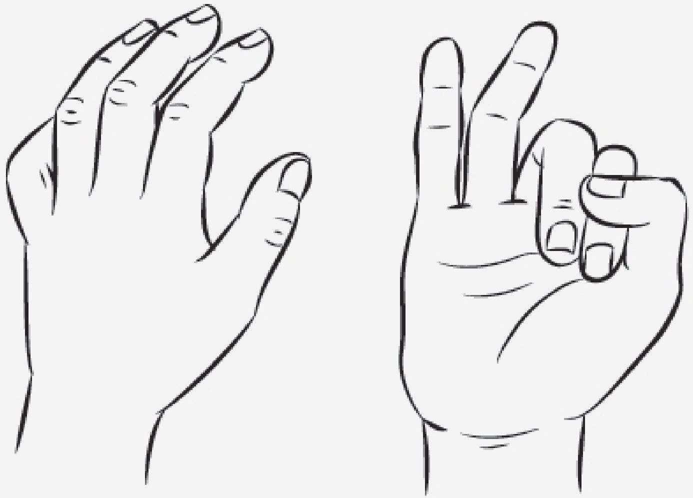


https://medovita.pl/co-to-jest-zespol-kanalu-de-guyona-objawy-przyczyny-i-sposoby-leczenia-2/

# Upper limb innervation

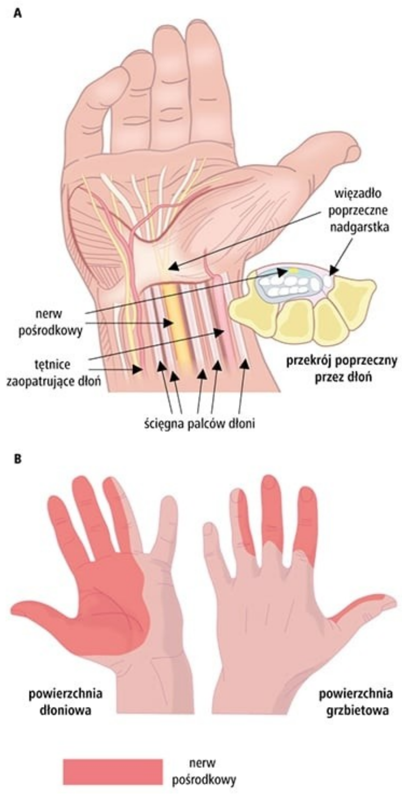
1 Uszkodzenie nerwu pośrodkowego

2 Uszkodzenie nerwu promieniowego



3 Uszkodzenie nerwu łokciowego

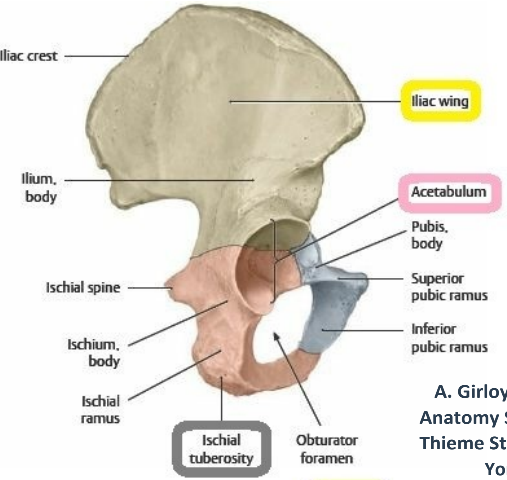
# Carpal tunnel syndrome



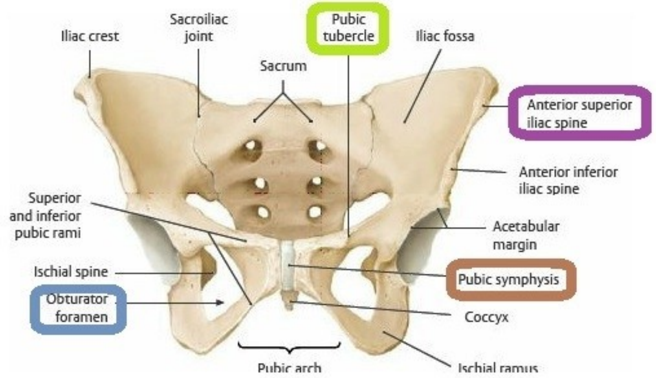

- <u>The median nerve </u>runs under the flexor trochlea (in the carpal tunnel). This is a closed space, so if there is inflammation, swelling of the flexor tendons, for example, this nerve is compressed.
- The characteristic symptom is <u>pain radiating to the fingers 1 - 3 of the hand (especially on the palm side).</u>
- Treatment includes extinguishing the inflammation, but when that doesn't work, the flexor trochlea is incised to decompress the nerve.

# Lower limb

# Bones that build the pelvis




A. Girloy et al. Atlas of Anatomy Second Edition. Thieme Stuttgart, New York 2012.




- **The pelvic rim consists of the sacrum and the paired pelvic bones, which are the fused bones of the hip, ischium and pubis.**
- **The sacroiliac joints are where the sacrum and pelvic bones are connected, and the two pelvic bones join together anteriorly at the pubic symphysis.**
- **From the side of the pelvic bone there is a cavity in it - the acetabulum of the hip joint.**
- **The sciatic nodules are the lowest (we sit on them).**
- **The upper part of the hip bone - the hip plate. On the front of the hip plates are the anterior hip spines (upper and lower). The upper anterior iliac spines are connected to the pubic tubercle by the inguinal ligament.**
- **The ischium and pubic bones have branches that join together surrounding the obturator opening.**

# Femur and shank bones

Rohen et al. Color Atlas of Anatomy.
A Photographic Study of The Human Body. Seventh Edition, 2011 by Schattauer GmbH.

- The hip joint is formed by the acetabulum of the pelvic bone and the head of the femur, which connects to the distal elements with the neck. The proximal femoral epiphysis also has a lesser vertebra and a greater vertebra.
- The knee joint is formed by the condyles of the femur, the plateau of the tibia and the patella. Below the knee joint on the anterior surface of the tibia is the tuberosity, which is the site of attachment of the patellar ligament.
- The arrow in the proximal epiphysis begins with a head that is not part of the knee joint.
- The bones of the lower leg in the distal part end in ankles: the fibula with a lateral ankle, the

# Bones that build the pelvis

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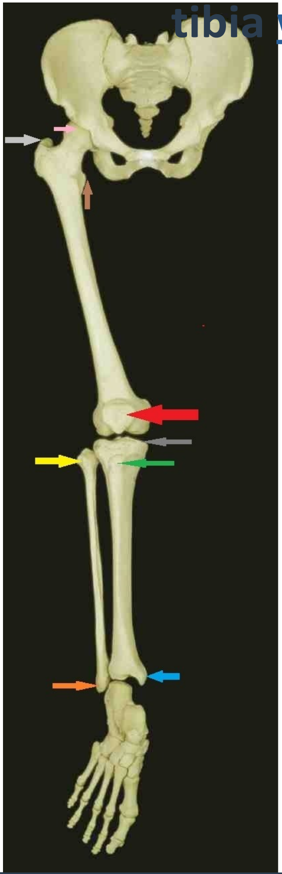
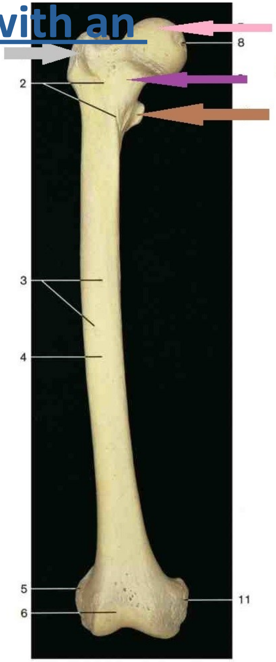
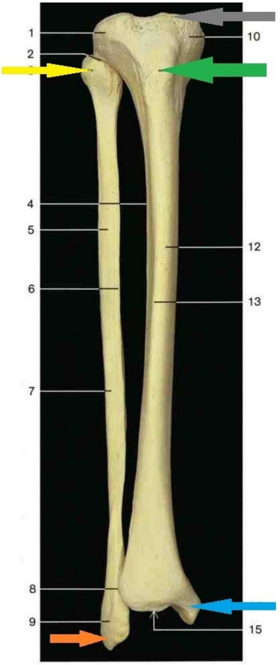
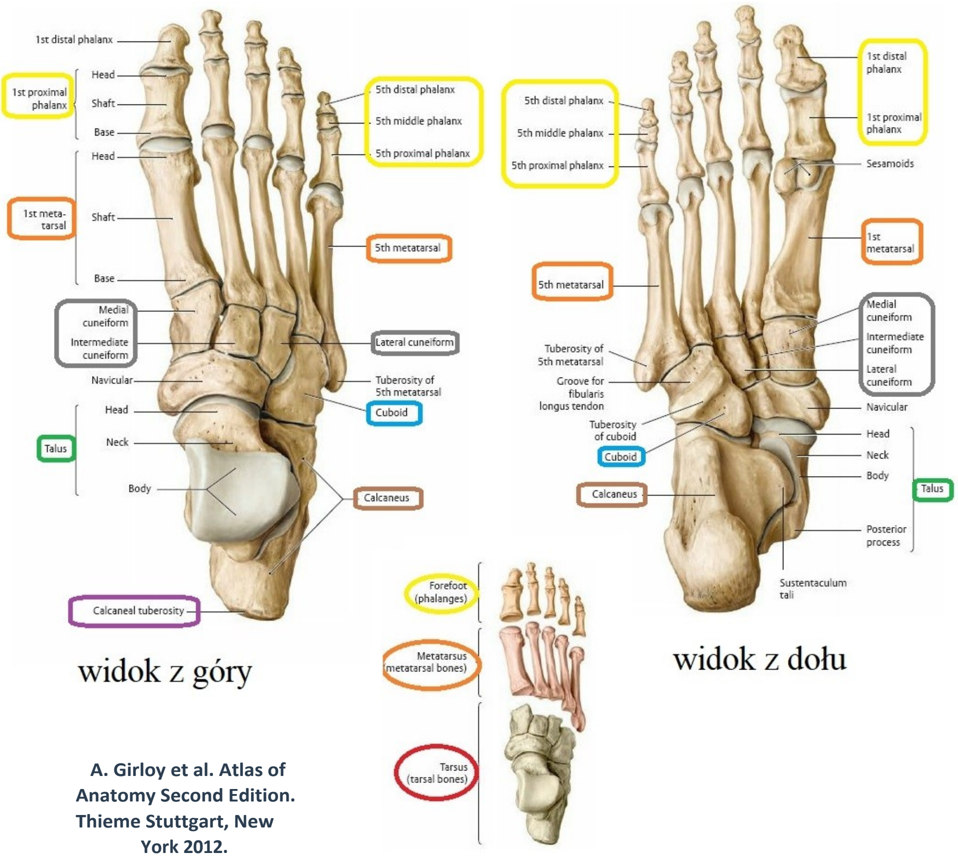





ankle medial.

# Knee joint




**A. Girloy et al. Atlas of Anatomy Second Edition. Thieme Stuttgart, New York 2012.**

- **The bones of the foot are divided into: tarsal bones, metatarsals and phalanges.**
- **The tarsal bones include the ankle, calcaneus (with the tuberosity), scaphoid, cuboid and cuneiform (medial, intermediate and lateral).**
- **The distal epiphyses of the lower leg bones (fibula and tibia join with the ankle bone to form the upper ankle joint). The ankle bone then fuses with the subsequent tarsal bones to form the lower**

# Rate

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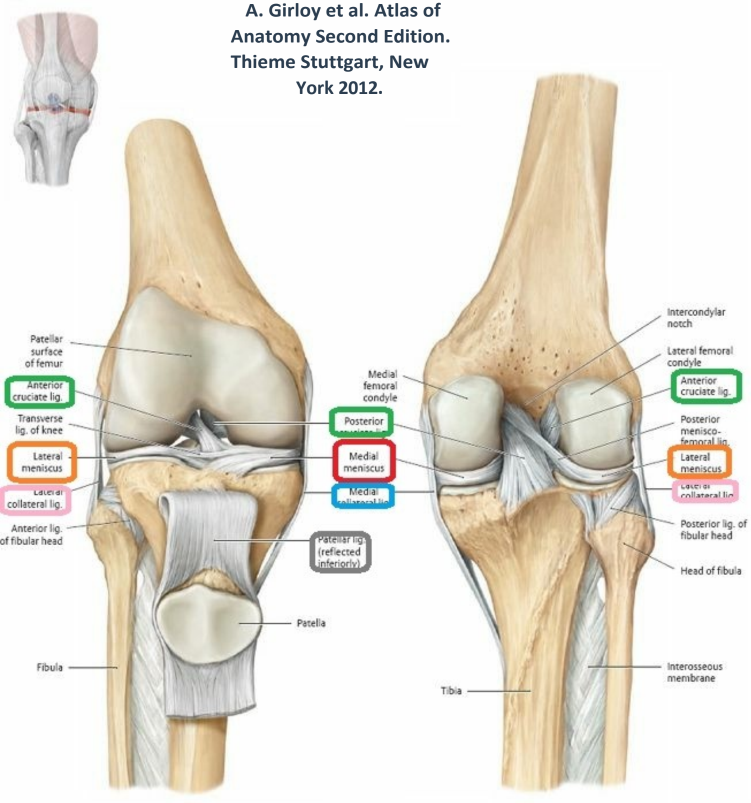
# Knee joint

A. Girloy et al. Atlas of Anatomy Second Edition. Thieme Stuttgart, New York 2012.




widok od przodu

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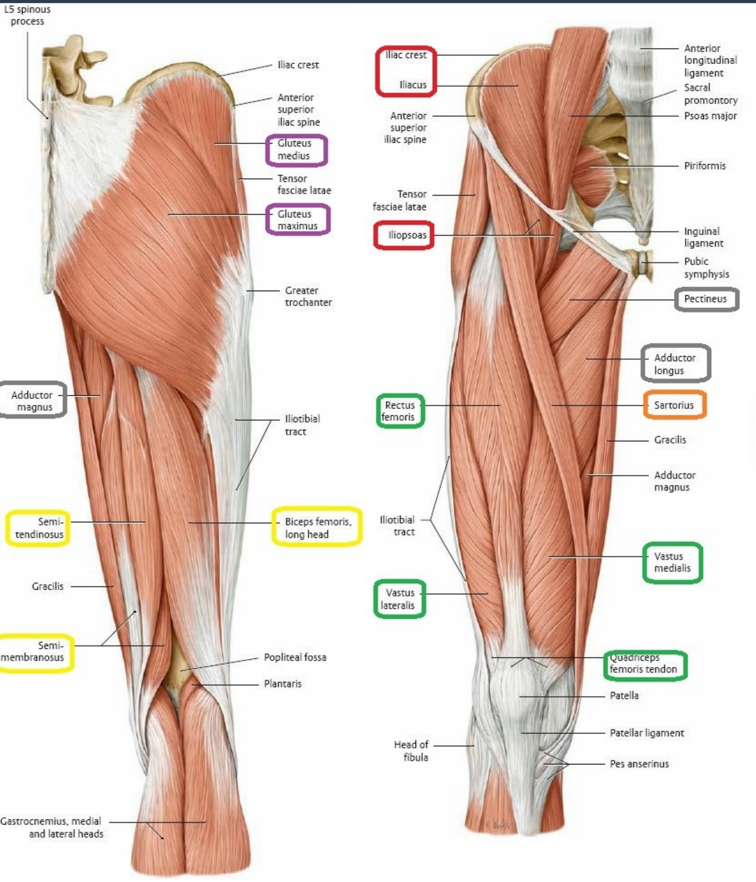
- **The knee joint is formed by the condyles of the femur, the plateau of the tibia and the patella (in the figure it hangs loosely after the quadriceps tendons are severed - exposing the front of the joint). It is a hinge joint (movements only in the sagittal plane), and is stabilized by ligaments: cruciate (inside the joint - anterior and posterior) and collateral ligaments (medial and lateral).**
- **Between the condyles of the femur and the tibial plateau are 2 cartilaginous-fibrous discs - the meniscus (medial and lateral).**
- **From the front, the knee joint is reinforced by the patella with its ligament, which is attached to the tibial tuberosity.**

# Thigh muscles



A. Girloy et al. Atlas of Anatomy Second Edition. Thieme Stuttgart, New York 2012.

- The thigh muscles are divided into 3 groups: flexors (anterior), extensors (posterior) and adductors (medial). These names correspond to the movements of the hip joint, not the knee (the extensors of the thigh flex the knee joint, and the flexors of the thigh straighten the knee joint).
- The largest of the thigh flexors is the quadriceps of the thigh (ends at the patella, so it acts on both joints). In addition, the important muscles of the anterior group are the iliac-lumbar muscle (proximal attachments at the L spine and hip plate - hip flexion) and the tailor's muscle (flexion and external rotation).
- In the posterior group, the gluteal muscles, gluteus maximus muscle and others are responsible for hip extension and external rotation (which is the basis for maintaining an upright posture). In addition, the muscles of the posterior group: the biceps femoris, semimembranosus, semitendinosus with their distal attachments reach the lower leg (so their contraction flexes the knee).

# Knee joint

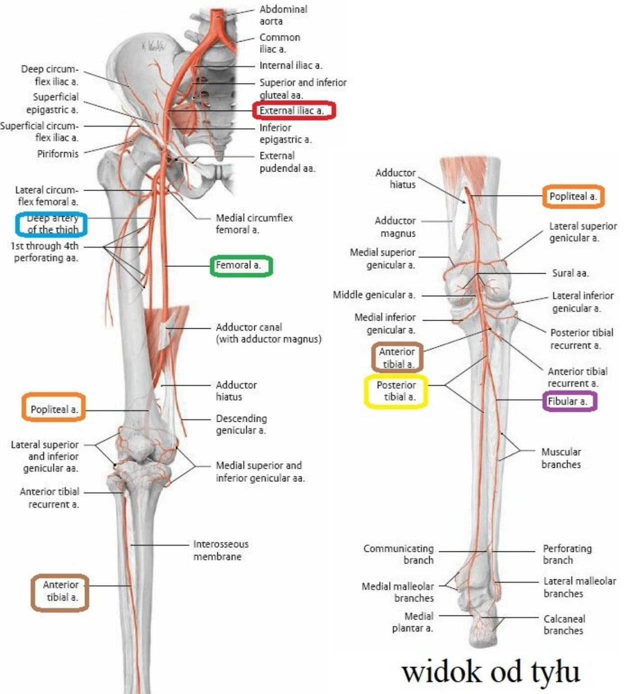
# Arterial vessels of the lower limb

- There are 3 groups of muscles on the lower leg: anterior (extensors), posterior (flexors) and lateral (sagittal).
- The anterior group is responsible for straightening the toes and straightening (otherwise known as dorsiflexion) the foot.
- The muscles of the lateral group run along the fibula, and are responsible for sole flexion, inversion, and foot conversion (elevation of the side of the foot).
- The muscles of the posterior group (calf) are responsible for sole flexion of the foot and toes. In addition, adduction and inversion of the foot (elevation of the medial part of the foot).
- On the foot, like the hands, there are short muscles that are responsible for toe movements and strengthen the arches of the foot. From underneath, the

# Muscles of the lower leg and foot

muscles are covered by a thick connective tissue layer - the soleus tendon.

# Arterial vessels of the lower limb



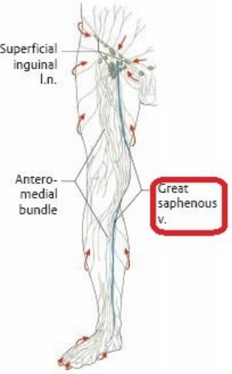

A. Girloy et al. Atlas of Anatomy Second Edition. Thieme Stuttgart, New York 2012.

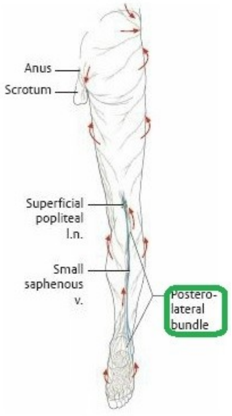
- The external iliac artery, after passing under the inguinal ligament, changes its name to the femoral artery, from which the deep artery of the thigh branches off in its initial segment. The femoral artery runs in the adductor canal (medially from the femur) and passes backward. After exiting the adductor canal, it changes its name to the popliteal artery (runs backward from the joint).
- The popliteal artery is divided into the anterior and posterior tibial arteries. From the posterior tibial artery, the fibular artery branches off.
- There are a total of 3 arterial vessels reaching the foot. The posterior tibial artery can be felt behind the medial ankle (supplying mainly the sole part). The anterior tibial artery passes into the dorsal artery of the foot (supplying mainly the dorsum of the foot). The fibular artery supplies mainly the lateral and

# Muscles of the lower leg and foot

**posterior parts of the foot.**

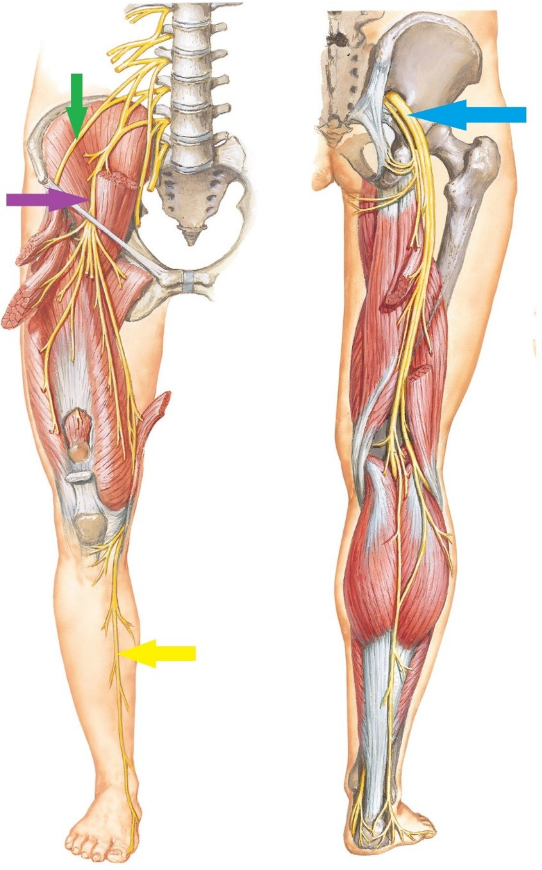
# Lower limb innervation




- As on the upper limb, there are 2 systems of venous blood flow.
- The deep vein system accompanies the arteries and the nomenclature of both vessels is the same. The superficial venous system flows into 2 large vessels.
- The saphenous vein begins in front of the medial ankle and flows just below the inguinal ligament into the femoral vein.
- The dorsiflexion vein begins at the side of the foot and runs along the back side of the lower leg, flowing into the popliteal vein.
- The superficial and deep vein system is "communicated" by numerous perforator veins.

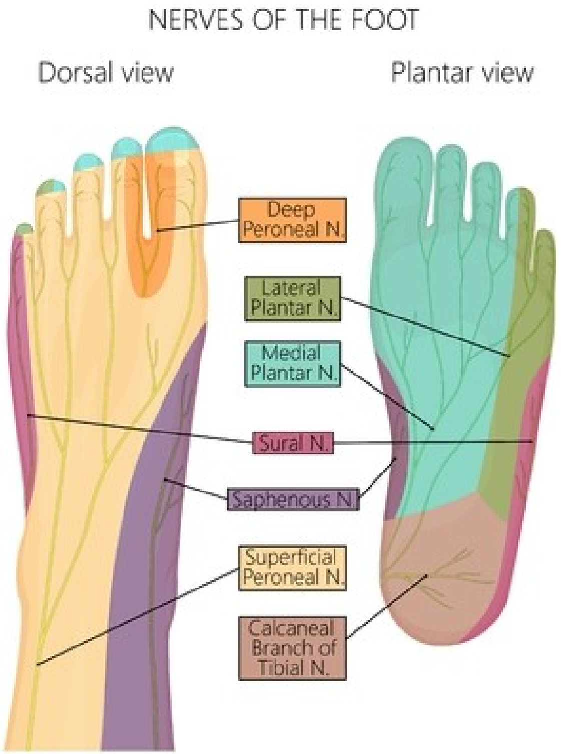
# Venous vessels of the lower limb



- The lower limb is innervated by 2 large nerves: the femoral (anterior part of the thigh motor and sensory, further sensory in the form of the femoral-ankle nerve (medial part of the lower leg and medial ankle area) and the sciatic (runs at the back of the thigh without giving off significant branches, then branches off in the popliteal fossa into the common fibula and tibial nerve). The common fibular nerve wraps around the fibular head area, where it is particularly sensitive to compression and damage.
- In addition, the thigh is innervated by the obturator nerve (medial part of the thigh along with the adductor group of the thigh) and the lateral cutaneous and posterior cutaneous nerve of the thigh (sensory). The buttock innervates the gluteal nerves.

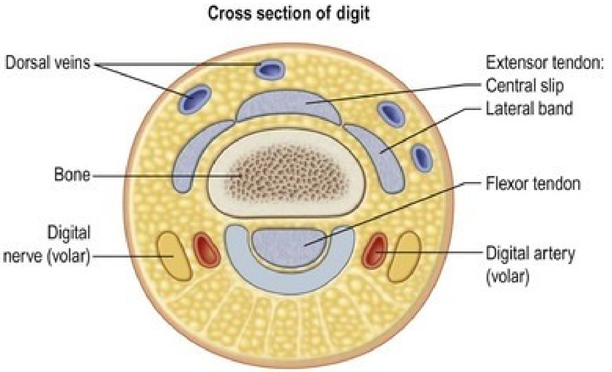
# Lower limb innervation

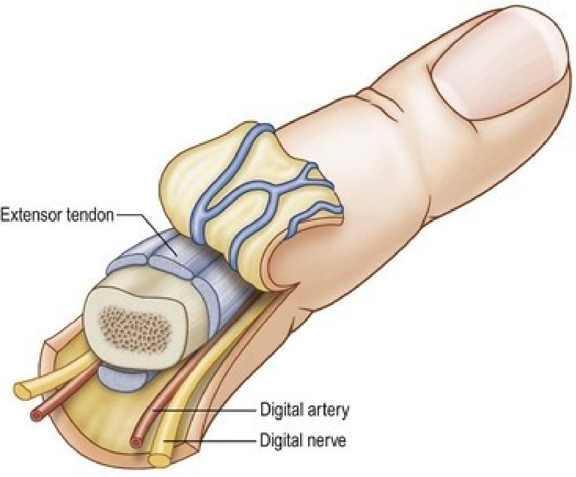
# Foot innervation




- There are 5 nerves reaching the foot.
- The femoro-femoral nerve passes forward from the medial ankle.
- The tibial nerve passes backward from the medial ankle (innervates the soleus).
- The calf nerve passes backward from the lateral ankle innervating the side of the foot.
- The deep fibular nerve passes forward from the lateral ankle (innervates the skin between the toe and the 2nd toe).
- The superficial fibular nerve reaches the foot accompanying the dorsal artery of the foot (innervates the dorsum of the foot).

# Fingers and nails




- **The structure of the fingers of both limbs is similar. The thumb / phalanx (i.e., the 1st finger) is built from 2 phalanges, the other fingers from 3.**
- **The nail grows from the matrix located under the posterior (proximal) shaft. The nail plate covers the placenta. On the side from the nail are the lateral shafts.**
- **Cross-section through the finger: the extensor tendons run dorsally, the flexor tendons run palmar. On the lateral-palm side, 2 arteries and 2 nerves (1 on each side) reach the finger. Veins run mainly dorsally.**

# Foot innervation

# Clinical cases (BUNA for RM)

25) What will be the symptoms of sciatic nerve damage?

a) foot drop

b) weakening of thigh flexion

c) Sensory disturbances of the antero-medial part of the lower leg

d) sphincter dysfunction

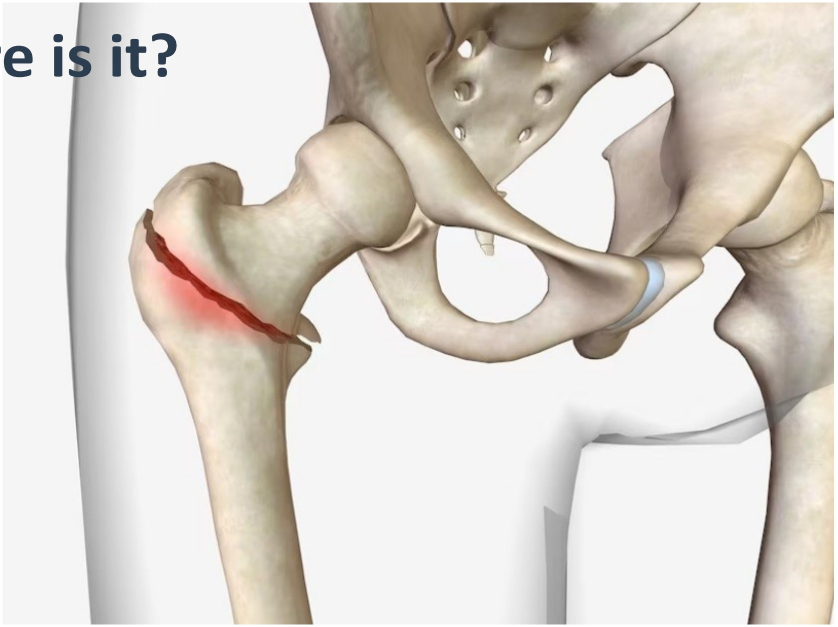
e) gluteal muscle dysfunction

f) sensory disturbances of the foot

26) Which fibula fractures are more serious for lower limb biomechanics: proximal or distal?

27) What upper limb nerve are we testing by asking you to straighten your fingers and hand at the wrist?

28) What kind of fracture is it?



**29) When giving wired anesthesia to a finger, the needle should be inserted on the dorsal side. TRUE / FALSE**

**30) A fracture of the shaft of the humerus can lead to damage to the nerve.......... and artery..............**