# GENERAL ANATOMY: INITIAL CONCEPTS

CARTILAGE: a tissue composed of cells called chondrocytes inside an extracellular matrix with a lot of water and type II collagen. It is flexible and compressible, but not as hard and stiff as bone.

BONE: a tissue composed of cells called osteocytes within a much different extracellular matrix: many crystalline minerals (mostly calcium) and type I collagen fibers, with a different disposition. This gives bone tissue great mechanical strength.

CLASSIFICATION OF BONES
Bones are classified according to their shape:

- Long bones are tubular (e.g., the humerus in the arm).

- Short bones are cuboidal and are found only in the tarsus (ankle) and carpus (wrist).

- Flat bones usually serve protective functions (e.g., the flat bones of the cranium protect the brain).

- Irregular bones have various shapes other than long, short, or flat (e.g., bones of the face).

- Sesamoid bones (e.g., the patella or kneecap) develop in certain tendons and are found where tendons cross the ends of long bones in the limbs; they protect the tendons from excessive wear and often change the angle of the tendons as they pass to their attachments.



JOINT: A set of hard and soft tissues which allow the connection between two or more bones.

- SOLID or NON-SYNOVIAL: They are either fibrous or cartilaginous, according to the kind of tissue interposed between bones.

    - SOLID JOINTS: FIBROUS JOINTS. SUTURES. Fontanelles in the infant. Unions between the plane bones of the cranial vault. In the end they become synostoses.
    - SOLID JOINTS: FIBROUS JOINTS. SYNDESMOSES. Interosseous membranes of the leg and forearm.
    - SOLID JOINTS: FIBROUS JOINTS. GOMPHOSIS. Dental-alveolar joint, in the maxillary bone and mandible.

- SOLID JOINTS: CARTILAGINOUS JOINTS. PRIMARY CARTILAGINOUS JOINTS OR SYNCHONDROSIS. They are usually the union between bones which are completing their endochondral ossification process, separated by their respective growth cartilages (bones of the base of the skull, epiphysis and diaphysis of long bones). In the end they usually become synostoses.
- SOLID JOINTS: CARTILAGINOUS JOINTS. SECONDARY CARTILAGINOUS JOINTS OR SYMPHYSIS. Intervertebral disc joints, pubic symphysis.

- MOBILE or SYNOVIAL (diarthrosis). Several types: plane or arthrodial joint, hinge or trochlear joint, condyloid joint, saddle or reciprocal reception joint, pivot or trochoid joint, enarthrosis or ball and socket joint

  COMPONENTS: articular cartilage, articular capsule, synovial membrane, passive and active ligaments, menisci

  - PLANE OR ARTHRODIAL JOINT: Between flat surfaces. Small sliding movements. Example: intermetacarpal joints.
  - HINGE OR TROCHLEAR JOINT, GINGLYMUS: Between a pulley-shaped convex surface and another concave surface with a central ridge that fits inside the groove of the pulley. Movements only around one axis (flexion / extension). Example: humeroulnar joint, interphalangeal joints.
  - CONDYLOID JOINT: Between two ellipsoidal segments, one convex ("condyle") and one concave. Movements around two axes (flexion, extension / adduction, abduction / circumduction) Example: wrist joint, between carpus and radius.
  - SADDLE OR RECIPROCAL RECEPTION JOINT: Between two opposing surfaces which are reciprocally concave-convex. Movements around two axes (flexion, extension / adduction, abduction / circumduction). Example: the joint between the carpus (trapezium bone) and the first metacarpal.
  - TROCHOID OR PIVOT-JOINT: Between a surface with the shape of a solid cylinder and another with the shape of an empty cylinder. The axis of the convex cylinder is parallel to the longitudinal axis of the bone. Movements around this longitudinal axis (rotation). Example: proximal radioulnar joint.
  - ENARTHROSIS OR BALL-AND-SOCKET JOINT: Between two segments of a sphere, one concave and one convex. Movements around all three axes (flexion / extension, adduction / abduction, circumduction, longitudinal rotation). Examples: glenohumeral joint, coxofemoral joint.

FUNCTIONAL JOINTS. Examples from the tarsus: MIDTARSAL OR CHOPARTJOINT (calcaneocuboid + talonavicular); TARSOMETATARSAL OR LISFRANC´S JOINT (1st cuneiform-1st meta + 2nd and 3rd cuneiforms-2nd and 3rd meta + cuboid- 4th and 5th meta)

SYNOSTOSES. Unions between bones with bone between them. They are not included properly in any of the former subtypes. Examples: intervertebral sacral joints, sutures in the adult.

# GENERAL ANATOMY

# Bones, ligaments and joints of the spine

**TYPICAL VERTEBRA**

**Anterior element:**
**vertebral body +**
**intervertebral disc**

**Posterior element:**
**neural arch + processes**

# TYPICAL VERTEBRA



**1: vertebral body (loading column)**
**2: neural arch (pedicles + laminae)**
**3: left articular processes**
**4: right articular processes**
**5: left transverse process**
**6: right transverse process**
**7: spinous process**

Author:
Daniel Sánchez
Zanuda
(Universitat de València)

**INTERVERTEBRAL FORAMEN**
**Boundaries:**
**-superior:** inferior vertebral notch of the upper vertebra
**-inferior:** superior vertebral notch of the lower vertebra
**-anterior:** vertebral bodies and intervertebral disc
**-posterior:** zygapophysial joint
**Contents:** spinal nerve and surrounding tissues

# INTERVERTEBRAL LIGAMENTS

**Anterior longitudinal ligament**

**Posterior longitudinal ligament**

**Interspinous ligament**

**Supraspinous ligament**

**Ligamentum flavum**

**Articular capsule**

**Annulus fibrosus and nucleus pulposus**

## BONES OF THE OCCIPITO-ATLANTO-AXIAL JOINT

**THREE joints:**

**-ATLANTO-OCCIPITAL: between the occipital condyles and the superior articular processes of the atlas (BICONDYLAR: flexion-extension)**

**- LATERAL ATLANTO-AXIAL JOINT: between the inferior articular processes of the atlas and the superior articular processes of the axis (PLANE JOINT: sliding)**

**-MEDIAN ATLANTO-AXIAL JOINT: between the odontoid process and the anterior arch of the atlas/ transverse ligament of the atlas (PIVOT JOINT: axial rotation)**

| LEVEL | BODY | TRANSVERSE PROCESS | ARTICULAR PROCESS | SPINOUS PROCESS | ATYPICAL VERTEBRAE |
|---|---|---|---|---|---|
| **CERVICAL** | Small, wider side to side than anteroposteriorly, concave superior surface with **uncinate processes** on the lateral borders, convex inferior surface. **Vertebral foramen**: triangular | **Transverse foramen** with **anterior and posterior tubercles**; the anterior tubercle of C6 is the **carotid tubercle** (**Chassaignac**); the **vertebral artery** passes through the foramen, | Flat; superior ones are oriented posterosuperiorly, inferior ones anteroinferiorly. | Bifid and short, although they elongate progressively down to C7. | **C1: atlas.** Without a body; anterior and posterior arches; no spinous process (posterior tubercle). **C2: axis.** Its body presents a superior projection which articulates with the atlas (odontoid process or dens). **C7: vertebra prominens.** Has a long and prominent spinous process which is palpable from the skin surface; only vertebral veins pass through its transverse foramen, not the artery. |
| **THORACIC** | Larger, increases in size progressively down to T12; regular, heart-shaped; posterolaterally, one or two **costal facets or demi-facets. Vertebral foramen:** round. | With **facets** to articulate with costal tubercles. | Flat; superior ones are oriented posteriorly, inferior ones anteriorly. | Long and at an angle, oriented posteroinferiorly. | **T1:** spinous process as long or longer than C7; complete costal facet for the first rib, and a demi-facet for the second **T10, T11, T12:** only have a complete costal facet for their ribs, and usually without a facet on their transverse processes. **T12:** has mammillary and accessory processes. |
| **LUMBAR** | Massive, wider side to side than anteroposteriorly, kidney-shaped. **Vertebral foramen**: triangular. | AKA costal or costiform process; the **accessory process** is on the posterior surface of their base | Curved, C-shaped Superior ones: **mammillary process** on posterior surface, concave and oriented posteromedially. Inferior ones: convex, oriented | Short, horizontal, square, thick and tall. | **L5:** the biggest mobile vertebra, its body is taller anteriorly than posteriorly (wedge-shaped). |



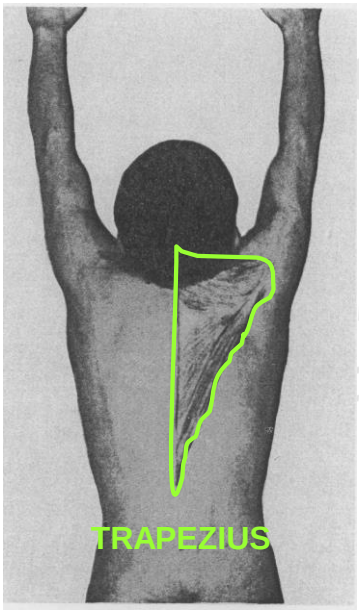
# GENERAL ANATOMY

# Back muscles

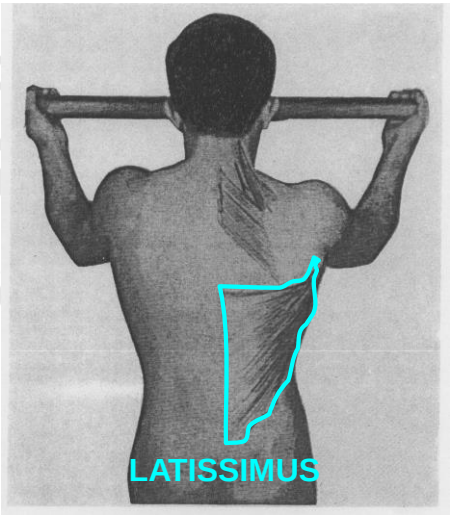
| EXTRINSIC MUSCLES | PROXIMAL ATTACHMENT | DISTAL ATTACHMENT | INNERVATION AND FUNCTION |
|---|---|---|---|
| **TRAPEZIUS** | Superior nuchal line of the occipital bone, nuchal ligament and spinous processes of all thoracic vertebrae. | Lateral part of the clavicle, acromion and spine of the scapula. | Accessory nerve (XI cranial nerve). Rotates and elevates the scapula: important for upper limb abduction; extends head and neck; first stage of climbing. |
| **LATISSIMUS DORSI** | Spinous processes of the last six thoracic vertebrae and all the lumbar ones, median sacral crest, iliac crest. | Intertubercular or bicipital groove of the humerus. | Thoracodorsal nerve (collateral branch of brachial plexus). Adduction, extension and internal rotation of the humerus; with arms raised and fixed, it raises the trunk; second stage of climbing. |
| **RHOMBOID MAJOR AND MINOR** | Spinous processes of C7, T1 (**minor**) and first thoracic vertebrae (**major**). | Medial border of the scapula (minor just inferior to levator scapulae, major inferior to minor). | Dorsal scapular nerve (collateral branch of brachial plexus). They retract the medial border of the scapula medially and superiorly ('standing upright'). |
| **LEVATOR SCAPULAE** | Transverse processes of first cervical vertebrae. | Supero-internal angle of the scapula. | Dorsal scapular nerve (collateral branch of brachial plexus). It rises the scapula / lateralises the neck (depending on the fixed attachment). |
| **SERRATUS POSTERIOR SUPERIOR** | Nuchal ligament and spinous processes of the first thoracic vertebrae. | Posterior surface of the first ribs. | First (superior) and last (inferior) intercostal nerves. Their function is not clear: they mobilise the ribs, and have been related to breathing and trunk/spine proprioception. |
| **SERRATUS POSTERIOR INFERIOR** | Spinous processes of the last thoracic and first lumbar vertebrae. | Posterior surface of the last ribs. | |

## CLIMBING

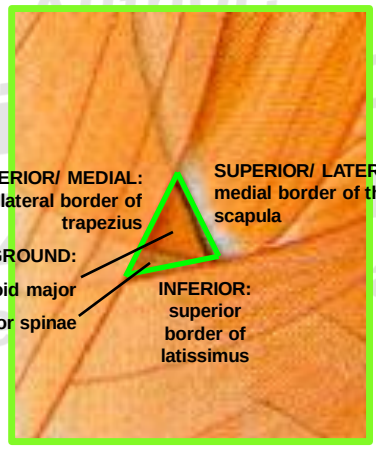
### 1st STAGE




### 2nd STAGE



# TRIANGLE OF AUSCULTATION




| INTRINSIC back muscles: SUPERFICIAL | | | ATTACHMENT | ATTACHMENT | FUNCTION |
|---|---|---|---|---|---|
| SPLENIUS | CERVICIS | | Transverse processes of atlas, axis and C3. | Spinous processes T3-T6. | Ipsilateral neck ROTATION (unilateral contraction) and neck EXTENSION (bilateral contraction). |
| SPLENIUS | CAPITIS | | Mastoid process and lateral surface of the occipital bone. | Inferior fibers: C7 and first thoracic vertebrae spinous processes. Superior fibers: nuchal ligament. | Ipsilateral head ROTATION (unilateral contraction) and head EXTENSION (bilateral contraction). |
| ERECTOR SPINAE (from medial to lateral) | SPINALIS | | Spinous processes of the first thoracic vertebrae. It can reach cervical levels. | Spinous processes from T11 to L2. | Ipsilateral spine LATERAL FLEXION (unilateral contraction), spine EXTENSION (bilateral contraction). |
| ERECTOR SPINAE (from medial to lateral) | LONGISSIMUS | | **Capitis:** Mastoid process. | Transverse processes of inferior cervical and superior thoracic vertebrae. | |
| ERECTOR SPINAE (from medial to lateral) | LONGISSIMUS | | **Cervicis:** Transverse processes of the cervical vertebrae. | | |
| ERECTOR SPINAE (from medial to lateral) | LONGISSIMUS | Thoracis | **Pars thoracis**: Ribs and transverse processes of thoracic vertebrae. | Wide tendon in the posterior surface of the iliac crest and sacrum (sacrolumbar common mass). | |
| ERECTOR SPINAE (from medial to lateral) | LONGISSIMUS | Thoracis | **Pars lumborum**: Accessory processes of lumbar vertebrae. | | |
| ERECTOR SPINAE (from medial to lateral) | ILIOCOSTALIS | Lumborum | **Pars thoracis**: Angles of the lower ribs. | | |
| ERECTOR SPINAE (from medial to lateral) | ILIOCOSTALIS | Lumborum | **Pars lumborum:** Tips of the lumbar transverse processes. | | |
| ERECTOR SPINAE (from medial to lateral) | ILIOCOSTALIS | | **Thoracis (costo-costal):** Angles of the higher ribs. | Angles of the lower ribs. | |
| ERECTOR SPINAE (from medial to lateral) | ILIOCOSTALIS | | **Cervicis (costo-cervical)**: Transverse processes of the lower cervical vertebrae. | Angles of the higher ribs. | |

| INTRINSIC back muscles: DEEP | | INFERIOR ATTACHMENT | SUPERIOR ATTACHMENT | FUNCTION |
|---|---|---|---|---|
| INTERTRANSVERSARII, INTERSPINALES | | Between contiguous transverse (intertransversarii) and spinous (interspinales) processes; they are not at all spinal levels: well developed mostly at the cervical level. | | Too short to mobilise the spine; they contain many neuromuscular spindles: they are PROPRIOCEPTIVE, about the position of vertebrae. |
| TRANSVERSOSPINALES | **SEMISPINALIS** (the most superficial)<br>• **THORACIS**<br>• **CERVICIS**<br>• **CAPITIS** | Transverse processes of the inferior thoracic vertebrae (thoracis), of the superior thoracic vertebrae (cervicis and capitis), and of the inferior cervical vertebrae, until C4 (only capitis). | Spinous processes of the superior vertebrae (4-6 segments above). Capitis: occipital bone. | EXTENSION of the thoracic and cervical spine, and the head (only capitis). |
| | **MULTIFIDUS** | Dorsal surface of the sacrum, mammillary processes of lumbar vertebrae, transverse processes of thoracic vertebrae, superior articular processes of the inferior cervical vertebrae, until C4. | Spinous processes of the superior vertebrae (1-4 segments above); thicker at the lumbar level. | EXTENSION of the lumbar, thoracic and cervical spine; stabilises the spine. |
| | **ROTATORES** (the deepest ones, just superficial to intertransversarii and interspinales) | Transverse processes, mostly thoracic, they are difficult to separate from the multifidus at cervical and lumbar levels. | Rotatores BREVES: inferior border of the lamina of the first vertebra above. Rotatores LONGI: base of the spinous process, two levels above. | Extension, but not very intense, given their short length; they could also be proprioceptive. |

## SUBOCCIPITAL TRIANGLE: suboccipital muscles

**Above** and **medially**: **Rectus capitis posterior major**. From the spinous process of the axis to the inferior nuchal line ***(rectus capitis posterior minor*** *goes from the same line, more medial, to the posterior tubercle of the atlas)*

**Above** and **laterally**: **Obliquus capitis superior**. From the transverse process of the atlas to the occipital bone, just above the attachment of rectus major

**Below**: **Obliquus capitis inferior**. From the spinous process of the axis to the transverse process of the atlas

**Contents:** posterior arch of atlas; vertebral artery and dorsal branch of the first cervical nerve C1

**INNERVATION OF THE INTRINSIC BACK MUSCLES: METAMERIC NERVES**

**Irrigation is also mainly metameric, from branches of the aorta: dorsal branches of posterior intercostal and lumbar arteries.**



# GENERAL ANATOMY

# Bones, joints and ligaments of the lower limb

LOWER LIMB

PELVIS
(ilium, ischium, pubis)

THIGH
(femur)

LEG
(tibia and fibula)

FOOT

FOREFOOT

Distal tarsal row (MIDFOOT)

Proximal tarsal row (HINDFOOT)



**LIGAMENTS OF THE COXOFEMORAL JOINT**

-**Iliofemoral (of Bertin):** restricts mostly extension, also external rotation.
-**Pubofemoral:** restricts mostly abduction and external rotation.
-**Ischiofemoral**: restricts mostly internal rotation.

The surface of the acetabulum and the head of the femur are maximally congruent in a **QUADRUPED** position (hip flexed). In extension, ligaments are twisted and pull the femoral head against the acetabulum.
In flexion + adduction ligaments are maximally relaxed: this is a very unstable position for the joint.

# KNEE JOINT

- **Tibiofemoral joint:** Distal extremity of the femur (condyles) + proximal extremity of the tibia

- **Patellofemoral joint:** Distal extremity of the femur (trochlea) + patella

*The **superior tibiofibular joint** (between the external surface of the proximal extremity of the tibia and the head of the fibula) is close to the knee but does not participate in its movements.*

*Between the tibia and fibula there is an interosseous membrane (syndesmosis).*

## KNEE: LIGAMENTS

INTRACAPSULAR: cruciate ligaments, anterolateral and posteromedial (they prevent hyperextension, medial rotation and anteroposterior displacements of the tibia over the femur).

EXTRACAPSULAR:

- POSTERIOR (they prevent hyperextension):
  - Arcuate popliteal ligament
  - Expansions of semimembranosus muscle attachments:
    - Reflex tendon
    - Direct tendon
    - Recurrent tendon: OBLIQUE POPLITEAL LIGAMENT

- ANTERIOR (they keep the patella in line with the femur):
  - Medial and lateral meniscus-patellar ligaments (attached to menisci)
  - Patellar / Quadricep tendon
  - Medial and lateral patellar retinacula (crossed expansions of vastus medialis and lateralis)

- LATERAL: collateral ligaments (they prevent hyperextension and lateral rotation, and give transversal stability to the knee)
  - Medial or tibial
  - Lateral or fibular

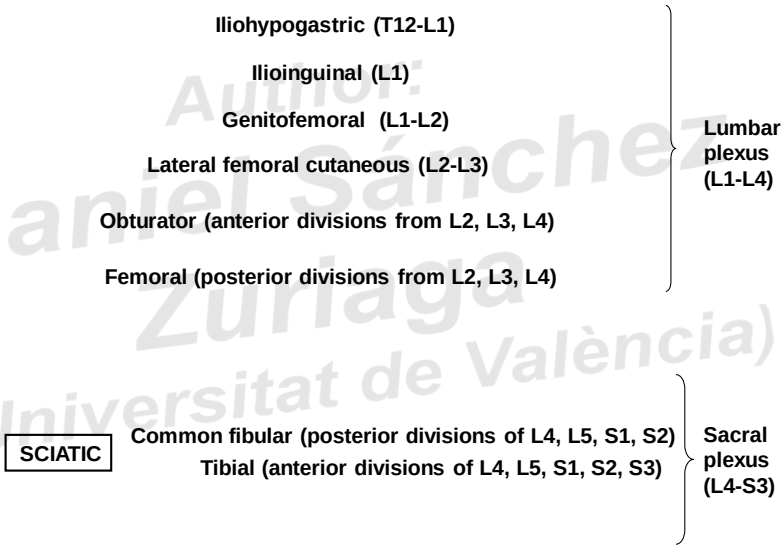
**ADDUCTION (transverse tarsal joints)**
**+ PLANTAR FLEXION (tibiotarsal joint)**
**+ INVERSION (subtalar joint) =**
**SUPINATION**

**ABDUCTION (transverse tarsal joints)**
**+ DORSAL FLEXION (tibiotarsal joint)**
**+ EVERSION (subtalar joint) =**
**PRONATION**

# GENERAL ANATOMY

## Lumbosacral plexus. Muscles of the plantar surface of the foot and the posterior aspect of the leg.





## NEUROMUSCULAR SYSTEMS OF THE LOWER LIMB

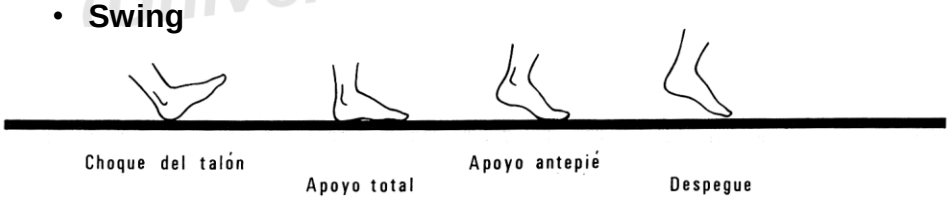
- Plantar muscles. Short muscles which sustain the plantar arches (tibial nerve, **plantar nerves**).
- Posterior aspect of the leg. Long muscles which sustain the plantar arches and mobilise the heel (**tibial nerve**).
- Posterior aspect of the thigh. Hamstring muscles, knee flexors and hip extensors (**sciatic nerve**).
- Proximal muscles of the lower limb. **Pelvitrochanteric** muscles. Orientation of the limb for support, hip stabilisation (collateral branches of the sacral plexus).
- Dorsum of the foot and anterolateral aspect of the leg. Dorsiflexor and evertor muscles of the foot (**common fibular nerve,** superficial and deep branches).
- Anterior aspect of the thigh. "First stage of gait": knee extensor and hip flexor muscles (**femoral nerve**).
- Anterior aspect of the thigh. Adductor muscles. "Second stage of gait": hip and knee flexion, external rotation and adduction of the limb (**obturator nerve**).

## STATICS: BALANCE IN STANDING

- **Expansion of the base of support**
- **Fixation of joints (rigid column)**
- **Trunk extension**
- **Preservation of the plantar arches**

## DYNAMICS: GAIT CYCLE

- **Support**
  - **initial contact: heel strike (EXTENSION)**
  - **toe off (FLEXION)**
- **Swing**



| PLANTAR muscles | | | Proximal attachment | Distal attachment | Function |
|---|---|---|---|---|---|
| INTEROSSEI | Dorsal (four: two on the 2nd toe, 3rd and 4th toes) | | Lateral surfaces of both metatarsals of the interosseous space | Lateral surface of the proximal phalanx and tendons of toe extensor muscles | Flexion of the metatarsophalangeal joint, extension of interphalangeal, fixation of the 2nd toe, PRESERVATION OF THE TRANSVERSE ARCH |
| | Plantar (three: 3rd,4th and 5th toes) | | Medial aspect of its metatarsal | | |
| Lateral muscles: FIFTH TOE (digiti minimi) | OPPONENS (inconstant) | | Cuboid, sheath of the peroneus longus, base of the 5th metatarsal (OPPONENT-FLEXOR MASS) | Distal half of the 5th metatarsal | FLEXION of the 5th metatarsophalangeal joint |
| | FLEXOR BREVIS | | | Lateral surface of the base of the 5th toe proximal phalanx | |
| | ABDUCTOR | | Calcaneal tuberosity, styloid process of the 5th metatarsal | | ABDUCTION from the longitudinal axis of the foot, and flexion of the 5th toe |
| Medial muscles: HALLUX / HALLUCIS (big toe) | ADDUCTOR | Oblique head | Cuboid, sheath of the peroneus longus, base of the 3rd, 4th and 5th metatarsals | Lateral sesamoid bone and base of the proximal phalanx of the big toe | ADDUCTION of the big toe towards the longitudinal axis of the foot, increase in longitudinal and transverse arches |
| | | Transverse head | 3rd, 4th and 5th metatarsophalangeal joints | | |
| | FLEXOR BREVIS | Lateral portion | Cuboid, 2nd and 3rd cuneiform bones, tendon of the extensor | | Flexion of the metatarsophalangeal joint, extension of interphalangeal (“interosseous” of the big toe) |
| | | Medial portion | | Medial sesamoid bone and base of the proximal phalanx of the big toe | |
| | ABDUCTOR | | Calcaneal tuberosity | | ABDUCTION from the longitudinal axis of the foot |

# INNERVATION

- **MEDIAL PLANTAR NERVE**
  - Abductor hallucis
  - Medial portion of the flexor hallucis brevis
  - Flexor digitorum brevis
  - First lumbrical
  - Quadratus plantae (double innervation)
- **LATERAL PLANTAR NERVE**
  - Opponens, flexor brevis and abductor digiti minimi
  - Lateral portion of the flexor hallucis brevis
  - Adductor hallucis
  - Interossei
  - Second to fourth lumbricals
  - Quadratus plantae (double innervation)

| | Muscle | | | Proximal attachment | Distal attachment | Function |
|---|---|---|---|---|---|---|
| DEEP | FLEXOR HALLUCIS LONGUS | | | Two inferior thirds of the posterior surface of the fibula and interosseous membrane | Distal phalanx of the hallux | Flexor hallucis: flexion of the hallux interphalangeal.<br>Flexor digitorum: flexion of the distal interphalangeal, 2nd to 5th toes.<br>All three of them:<br>Plantar flexion + inversion= SUPINATION<br>They close the ankle mortise.<br>MEDIAL ACTIVE LIGAMENTS OF THE PLANTAR VAULT: mostly tibialis. Flexor hallucis longus is an important tensor of the medial longitudinal arch. |
| | | | | Tendon is posterior to the sustentaculum tali, talus and tibial malleolus | | |
| | FLEXOR DIGITORUM LONGUS | | | Posterior surface of tibia, medial to tibialis posterior | Distal phalanx, 2nd to 5th toes | |
| | | | | Posterior to the tibial malleolus. It crosses the tendon of the flexor hallucis longus at the sole of the foot (PLANTAR CHIASM) | | |
| | TIBIALIS POSTERIOR | | | Interosseous membrane, medial surface of fibula, posterior surface of tibia (between the two flexor longus) | Plantar arch: navicular tuberosity, three cuneiforms, cuboid, bases of the 2nd to 4th metatarsals | |
| | | | | Posterior to the tibial malleolus, crosses the tendon of the flexor digitorum longus at the inferior third of the tibia (CRURAL CHIASM) | | |
| SUPERFICIAL | TRIC. SURAE | SOLEUS | | Medial border and SOLEAL LINE. Head and superior portion of the fibula. Between them: TENDINOUS ARCH OF SOLEUS | Posterior surface of the calcaneus (CALCANEAL or ACHILLES TENDON) | With the proximal attachment as a fixed point: all three of them, PLANTAR FLEXION.<br>PRESERVATION OF BALANCE WHILE STANDING ("ankle strategy"), mainly the soleus. |
| | | GASTROCNEMIUS | MEDIAL HEAD | Medial femoral condyle | | ONLY GASTROCNEMIUS: with the distal attachment as a fixed point, knee flexion. It fixes the knee joint. |
| | | | LATERAL HEAD | Lateral femoral condyle | | |
| | PLANTARIS | | | | | Inconstant, no clear function |
| | POPLITEUS | | | Lateral femoral condyle and lateral | Tibia, above the | Begins KNEE FLEXION. Draws the lateral meniscus |

# GENERAL ANATOMY

# Muscles of the posterior aspect of the thigh
# Sciatic nerve
# Pelvitrochanteric muscles

| Muscle | | Proximal attachment | Distal attachment | Function |
|---|---|---|---|---|
| **SEMIMEMBRANOSUS** *(Its proximal attachment is continued by a tendinous membrane; its distal attachments make up the PES ANSERINUS PROFUNDUS and extend to the medial meniscus)* | | **Ischial tuberosity** | **RECURRENT tendon: lateral femoral condyle (OBLIQUE POPLITEAL LIGAMENT)** | **Protects the knee articular capsule from being crushed during flexion. Helps to avoid knee hyperextension.** |
| | | | **REFLEX tendon: anterior portion of the medial condyle of the tibia** | **With its distal attachment fixed, they EXTEND THE HIP/PELVIS.** **With its proximal attachment fixed, they FLEX THE KNEE.** **Adductors.** **Medial (ST/SM) or lateral (BF) rotators of the knee, according to the side of the tibia they attach to.** |
| | | | **DIRECT tendon: posterior portion of the medial condyle of the tibia** | |
| **SEMITENDINOSUS** *(very long tendon; its distal attachment is part of the PES ANSERINUS SUPERFICIALIS)* | | | **Superior portion of the tibial diaphysis, posterior and inferior to sartorius and gracilis** | |
| **BICEPS FEMORIS** **Portions:** | **LONG or ISCHIAL** | | **Head of fibula and lateral condyle of tibia** | |
| | **SHORT or FEMORAL** | **Between the two ridges of the linea aspera** | | |
| **ISCHIOCONDYLAR PORTION of ADDUCTOR MAGNUS** *("vertical portion")* | | **Ischial tuberosity** | **Medial femoral condyle (ADDUCTOR TUBERCLE)** | **Adducts / abducts the hip, depending on its starting position (vertically aligns the medial condyle with the ischium to transmit weight).** **Extends the hip/pelvis.** |



# MUSCLES INNERVATED BY THE SCIATIC NERVE AT THE POSTERIOR ASPECT OF THE THIGH

**Tibial division of the sciatic nerve:**

- Semitendinosus
- Semimembranosus
- Ischiocondylar portion of adductor magnus
- Long head of biceps femoris

**Common fibular division of the sciatic nerve:**

- Short head of biceps femoris

| Muscle | | Proximal attachment | Distal attachment | Function |
|---|---|---|---|---|
| GLUTEUS MAXIMUS | | Iliac crest; gluteal surface of the ilium, posterior to the posterior gluteal line; posterior surface of sacrum and coccix; sacotuberous ligament | Superior portion of the linea aspera and its lateral trifurcation line (gluteal tuberosity); Iliotibial tract | EXTENDS PELVIS/HIP (most powerful muscle of the whole body).<br>Superior portion and fibres attached to the iliotibial tract: abduction.<br>Inferior portion (bigger): ADDUCTION.<br>Lateral rotation. |
| GLUTEUS MEDIUS | | Gluteal surface of the ilium, between the anterior and posterior gluteal lines. | Greater trochanter | MAIN HIP ABDUCTOR<br>Balances the pelvis ipsilaterally (TRANSVERSAL BALANCE).<br>Extends pelvis/hip;<br>mostly lateral rotation. |
| GLUTEUS MINIMUS | | Gluteal surface of the ilium, anterior to the anterior gluteal line. | | Hip abduction and transversal balance;<br>mainly hip flexor and medial rotator |
| PIRIFORMIS | | Anterior surface of sacrum. | | Abduction, extension and lateral rotation |
| OBTURATOR INTERNUS | | Internal surface of obturator membrane and foramen.<br>*It crosses the lesser sciatic foramen.* | | Adduction or abduction, depending on the limb start position;<br>lateral rotation. |
| GEMELLUS | SUP | Sciatic spine | | |
| | INF | Ischial tuberosity | | |
| QUADRATUS FEMORIS | | Ischial tuberosity (below gemellus inf.) | Intertrochanteric line | Adduction and lateral rotation; hip flexor or extensor, depending on limb start position. |
| TENSOR FASCIAE LATAE | | Anterior-superior iliac spine | Iliotibial tract (to the lateral condyle of the tibia) | Hip flexion + abduction + medial rotation<br>Balances pelvis ipsilaterally (TRANSVERSAL BALANCE).<br>Knee flexion (although when the leg is extended, it blocks extension). |



## COLLATERAL BRANCHES OF THE SACRAL PLEXUS: Innervation of the pelvitrochanteric muscles

- **Superior gluteal nerve:** gluteus medius, gluteus minimus and tensor fasciae latae
- **Inferior gluteal nerve:** gluteus maximus
- **Piriformis nerve:** piriformis
- **Obturator internus nerve:** obturator internus and gemellus superior
- **Quadratus femoris nerve:** quadratus femoris and gemellus inferior

# GENERAL ANATOMY

## Muscles of the anterior aspect of the thigh
## Femoral and obturator nerves



| Muscle innervated by the obturator n. | Proximal attachment | Distal attachment | Action |
|---|---|---|---|
| **ADDUCTOR LONGUS** *("first")* | **Pubis, below the pubic tubercle (between pectineus laterally and gracilis medially)** | **Middle part of the linea aspera** | **ADDUCTION of the hip (the most powerful one: adductor magnus)**<br>**Adductors: medial rotators**<br>**Obturator: lateral rotator**<br>**Flexors of the hip, except when it is already in intense flexion (INVERSION OF THE FLEXION COMPONENT)** |
| **ADDUCTOR BREVIS** *("second")* | **Pubis, beginning of the inferior pubic ramus** | **Upper part of the linea aspera** | |
| **PUBOFEMORAL/ ISCHIOFEMORAL PORTIONS OF ADDUCTOR MAGNUS** *("third")* | **Inferior pubic and ischial rami** | **Linea aspera and gluteal tuberosity** | |
| | Torsion of the fibres: the ones coming from the pubis attach to the upper part of the linea aspera (almost horizontally). As their proximal attachment moves towards the ischium, they attach distally at lower levels along the linea aspera. | | |
| **OBTURATOR EXTERNUS** | **Lateral surface of the obturator membrane** | **Trochanteric fossa** | |
| **GRACILIS** | **Medial margin of the body of the pubis** | **Superior portion of the tibial diaphysis (pes anserinus superficialis)** | **Flexor and medial rotator of the knee** |

## HIP ADDUCTORS

1: ADDUCTOR MAGNUS (ischiofemoral portion); ADDUCTOR LONGUS and BREVIS are included here.

2: ADDUCTOR MAGNUS (pubofemoral portion)

3: ADDUCTOR MAGNUS (ischiocondylar portion)

4: GRACILIS

5: SEMIMEMBRANOSUS

6: SEMITENDINOSUS

7: BICEPS FEMORIS

8: GLUTEUS MAXIMUS

9: QUADRATUS FEMORIS

10: PECTINEUS

11: OBTURATOR INTERNUS

12: OBTURATOR EXTERNUS



## OBTURATOR NERVE

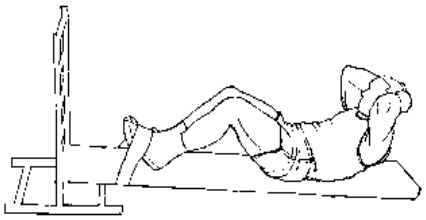
• **POSTERIOR (DEEP) BRANCH:**
**Pubofemoral and ischiofemoral portions of adductor magnus.**
**Obturator externus.**

• **ANTERIOR (SUPERFICIAL) BRANCH:**
**Adductor brevis**
**Adductor longus**
**Gracilis**
***It may partially innervate the pectineus (the pectineus is usually innervated only by the femoral nerve).***

| Muscles innervated by the femoral nerve | | Proximal attachment | Distal attachment | Action |
|---|---|---|---|---|
| PECTINEUS | | Horizontal ramus of the pubis (pectineal surface) | Middle trifurcation line of linea aspera (pectineal line) | Adduction, flexion and lateral rotation of the hip |
| ILIO-PSOAS | Psoas major | Body, discs and transverse processes T12-L5 | Lesser trochanter | 1) FLEXION + lateral rotation of the hip<br>2) FLEXION of pelvis and spine<br>INCREASES LORDOSIS |
| | Iliacus | Internal iliac fossa | | |
| QUADRICEPS | Vastus intermedius | Anterior surface of the femur | *A portion to the knee synovial membrane (**articularis genu**)* | Knee extension |
| | Vastus medialis | Medial ridge of linea aspera | Quadriceps tendon (to the patella) + patellar tendon (from the patella to the anterior tibial tuberosity) | |
| | Vastus lateralis | Lateral ridge of linea áspera | | |
| | Rectus femoris | Anterior inferior iliac spine, rim of the acetabulum | | Rectus femoris also flexes the hip. |
| SARTORIUS | | Anterior superior iliac spine | Medial-superior portion of the tibial diaphysis (pes anserinus superficialis) | Hip: flexion, abduction, lateral rotation;<br>knee flexion |

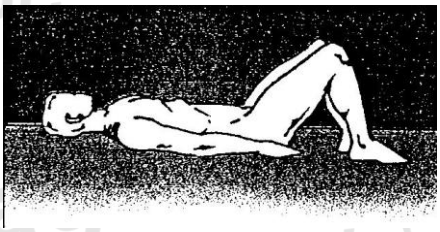
## ABDOMINAL TRAINING

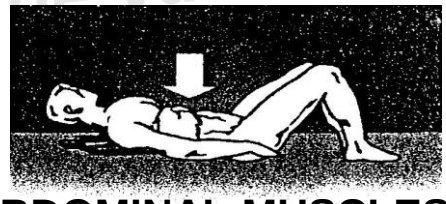
**NO**



**ILIOPSOAS**

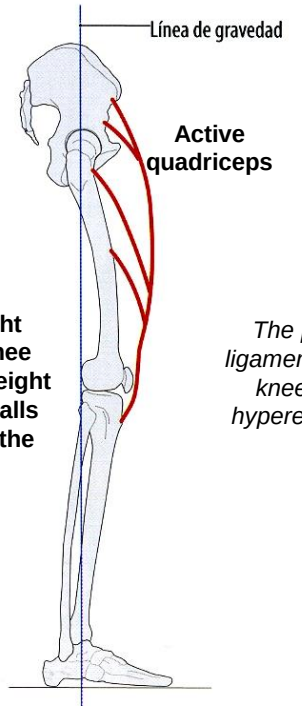
**YES**





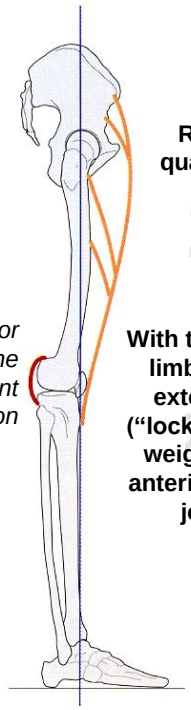
**ABDOMINAL MUSCLES**

## ANTERO-POSTERIOR STABILITY OF THE KNEE




**Active quadriceps**

**From a slight degree of knee flexion, the weight of the body falls posterior to the joint.**

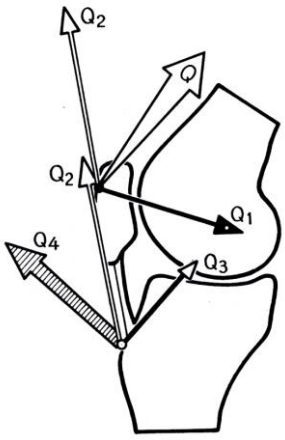


**Relaxed quadriceps**

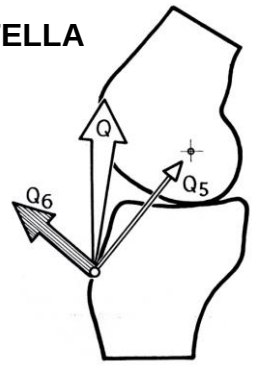
*The posterior ligaments of the knee prevent hyperextension*

**With the lower limb in full extension ("locked"), the weight falls anterior to the joint.**

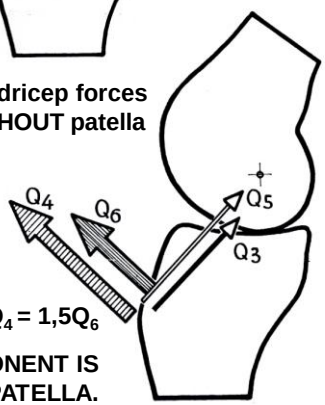
## THE ROLE OF THE PATELLA




**Quadricep forces WITH patella**




**Quadricep forces WITHOUT patella**




**$Q_4 = 1{,}5Q_6$**

**THE KNEE EXTENSOR COMPONENT IS MUCH HIGHER WITH PATELLA.**

# GENERAL ANATOMY

## Muscles of the anterior and lateral compartments of the leg. Fibular nerves.



| | Muscle | Proximal attachment | Distal attachment | Action |
|---|---|---|---|---|
| DEEP PERONEAL | EXTENSOR HALLUCIS LONGUS | Middle part of the fibula and interosseus membrane. | Distal phalanx of the hallux. | Extension of the hallux interphalangeal joint; dorsal flexion of the foot. |
| | EXTENSOR DIGITORUM LONGUS | Upper part of the fibula and interosseus membrane, lateral tibial condyle. | Middle and distal phalanges of the last four toes. | Extension of the interphalangeal joints of the last four toes; dorsal flexion of the foot. |
| | | Tendons are connected at the level of the metatarsophalangeal joints. Extensor tendons are attachments for interossei, lumbricals and extensor brevis. | | |
| | TIBIALIS ANTERIOR | Upper part of the tibia and interosseus membrane, lateral tibial condyle. | Plantar surface of the medial cuneiform and base of the first metatarsal. | Dorsal flexion of the foot; Inversion. |
| | EXTENSOR DIGITORUM / HALLUCIS BREVIS | Anterior part of the dorsal surface of the calcaneus. | HALLUCIS: proximal phalanx of the hallux<br>DIGITORUM: tendons of extensor longus for the 2nd, 3rd and 4th toes | Extension of 1st, 2nd, 3rd and 4th toes. |
| | | Only short muscle of the dorsum of the foot; covered by the tendons of extensor longus. | | |
| | PERONEUS TERTIUS | Inferior part of the fibula and interosseus membrane | Base of the 5th metatarsal | Dorsal flexion of the foot<br>EVERSION |
| | | Inconstant; it may be part of the extensor digitorum longus; may be innervated by the superficial peroneal nerve. | | |
| SUPERF | PERONEUS LONGUS | Head and upper part of the fibula | Plantar surface of the medial cuneiform and the base of the 1st metatarsal | Peroneus longus is an important LATERAL ACTIVE LIGAMENT OF THE PLANTAR VAULT. |
| | | Its tendon crosses the sole of the foot transversally, from lateral to medial. It causes a groove on the cuboid and on the calcaneus, and is posterior to the lateral malleolus. The peroneus longus covers the peroneus brevis. | | Plantar flexion of the foot<br>EVERSION |
| | PERONEUS BREVIS | Inferior part of the fibula | Tuberosity of the 5th metatarsal | |

## INNERVATION: branches of the SCIATIC nerve

**TIBIAL nerve**

**COMMON FIBULAR nerve**

- **DEEP FIBULAR nerve**
- **SUPERFICIAL FIBULAR nerve**



# GENERAL ANATOMY

## Vessels of the lower limb

**BOUNDARIES AND CONTENTS OF THE CRURAL LACUNAE**

| | |
|---|---|
| **SUPERIOR / ANTERIOR** | **Inguinal ligament (abdominal external oblique muscle aponeurosis), with iliopubic tract.** |
| **INFERIOR / POSTERIOR / LATERAL** | **Anterior border of the coxal; covered by the pectineal ligament medially to the iliopectineal eminence.** |
| **MEDIAL** | **Lacunar ligament (Gimbernat's)** |

| | |
|---|---|
| **MUSCULAR LACUNA** | **SUPERIOR/ANTERIOR: lateral half of the inguinal ligament.**<br>**INFERIOR/POSTERIOR/LATERAL: anterior border of the coxal, from the anterior superior iliac spine to the iliopectineal eminence.**<br>**MEDIAL: iliopectineal arch.**<br><br>**CONTENTS: iliopsoas muscle, femoral nerve, lateral cutaneous nerve of the thigh.** |
| **VASCULAR LACUNA ("crural ring")** | **SUPERIOR/ANTERIOR: medial half of the inguinal ligament.**<br>**INFERIOR/POSTERIOR: anterior border of the coxal, covered by the pectineal ligament.**<br>**LATERAL: iliopectineal arch**<br>**MEDIAL: lacunar ligament**<br><br>**CONTENTS (medial to lateral): Rosenmüller's lymph node, femoral vein and artery, femoral branch of the genitofemoral nerve.** |

**BOUNDARIES AND CONTENTS OF THE FEMORAL TRIANGLE (SCARPA)**

| | |
|---|---|
| **LATERAL** | **Medial border of sartorius** |
| **MEDIAL** | **Medial border of adductor longus *(lateral border of gracilis)*** |
| **BASE (entry)** | **Crural lacunae (inguinal ligament)** |
| **FLOOR** | **Lateral to medial, superior to inferior: iliopsoas, pectineus, adductor longus.** |
| **COVERING** | **Superficial fascia of the thigh (cribriform fascia)** |
| **VERTEX (exit)** | **Beginning of the adductor or Hunter's canal *(beginning of the vastoadductor membrane)*** |
| **CONTENTS** | **Femoral artery and vein.**<br>**Branches of the femoral nerve.** |

**BOUNDARIES AND CONTENTS OF THE ADDUCTOR CANAL (HUNTER'S)**

| | |
|---|---|
| **LATERAL** | **Vastus medialis** |
| **POSTERIOR/ MEDIAL** | **Adductor magnus** |
| **ANTERIOR** | **Vastoadductor membrane** |
| **EVEN MORE ANTERIOR, covering everything** | **Sartorius** |
| **ENTRY** | **Beginning of the vastoadductor membrane** |
| **EXIT** | **Adductor hiatus *(femoral vessels→popliteal, in the popliteal fossa)*** |
| **CONTENTS** | **• Femoral artery and vein**<br>**• Descending genicular artery *(branch of the femoral artery inside the canal: it anastomoses inferiorly with the medial superior genicular artery, a branch of the popliteal artery)***<br>**• Saphenous nerve *(sensitive branch of the femoral nerve)***<br>**• Branches of the femoral nerve for vastus medialis** |

**BOUNDARIES AND CONTENTS OF THE POPLITEAL FOSSA**

| | |
|---|---|
| **SUPERIOR / LATERAL** | **Biceps femoris** |
| **INFERIOR / LATERAL** | **Plantaris and lateral head of gastrocnemius** |
| **SUPERIOR / MEDIAL** | **Semimembranosus and semitendinosus** |
| **INFERIOR / MEDIAL** | **Medial head of gastrocnemius** |
| **ANTERIOR *("floor")*** | **Popliteus muscle, oblique popliteal ligament, posterior surfaces of femur and tibia.** |
| **POSTERIOR *("roof")*** | **Popliteal fascia, perforated by the lesser saphenous vein and the sural nerve.** |
| **CONTENTS** | **• Popliteal vessels**<br>**• Tibial *(centred)* and common fibular *(close to biceps femoris)* nerves**<br>**• Lesser saphenous vein and sural nerve**<br>**• The beginning of the posterior cutaneous femoral nerve** |

**BRANCHES OF THE INTERNAL ILIAC ARTERY FOR THE LOWER LIMB**

- SUPERIOR GLUTEAL ARTERY: It originates from the posterior trunk of the internal iliac. It leaves the pelvis through the suprapiriform space, along with the superior gluteal nerve (which is its satellite).
  It has a **superficial** branch (between the gluteus maximus and medius muscles) and a **deep** branch (between the gluteus medius and minor muscles). It anastomoses, among others, with the inferior gluteal and branches of the lateral and medial femoral circumflex arteries.
  It irrigates the pelvic-trochanteric muscles, gluteus maximus and especially the gluteus medius and minor and the tensor fasciae latae.
- INFERIOR GLUTEAL ARTERY: It originates from the anterior trunk of the internal iliac. It leaves the pelvis through the infrapiriform space, along with the lower gluteal, sciatic and posterior femoral cutaneous nerves.
  It has branches for the pelvic-trochanteric muscles, especially the gluteus maximus. It anastomoses with the superior gluteal and perforating branches of the deep femoral artery. It supplies a **satellite branch of the sciatic nerve** (which irrigates only the nerve itself).
- OBTURATOR ARTERY: It originates from the anterior trunk of the internal iliac. It leaves the pelvis through the obturator/ subpubic canal, with the obturator nerve (which is its satellite).
  It supplies several intrapelvic branches, including an anastomotic branch with the inferior epigastric artery (branch of the external iliac), which forms the so-called **corona mortis artery**.
  Outside the pelvis it leads its terminal branches, **anterior** and **posterior**. These surround the obturator foramen, anastomosing between them and with the inferior gluteal and medial femoral circumflex arteries. They irrigate the superior portion of the musculature innervated by the obturator nerve.
  The posterior branch supplies an **acetabular** branch, which in turn supplies the **artery of the round ligament**, in the head of the femur.

**DEEP FEMORAL ARTERY**: It is a lateral branch of the femoral artery *(some authors consider that the femoral artery down to the origin of the deep femoral artery constitutes the "common femoral artery", while the femoral artery from that origin would be the "superficial femoral artery")*. It goes posterior to the femoral vessels, medial to the femur. Its branches:

- LATERAL FEMORAL CIRCUMFLEX ARTERY: It is the first branch of the deep femoral. It supplies branches that are anastomosed, among others, with branches of the superior and inferior gluteal arteries, and the medial femoral circumflex, forming part of the anastomotic circles that surround the trochanters and the femoral neck. Descending branches are anastomosed inferiorly with branches of the popliteal artery.
- MEDIAL FEMORAL CIRCUMFLEX ARTERY: It irrigates most of the muscles innervated by the obturator nerve.
- PERFORATING ARTERIES: These are branches of the deep femoral artery that cross the adductor magnus to irrigate the structures of the posterior aspect of the thigh. All of them are anastomosed with one another and with the neighbouring vessels, including branches of the popliteal artery.
  There are **three**, with the **terminal branch of the deep femoral artery constituting a fourth**.
- MUSCULAR ARTERIES. The deep femoral artery supplies many muscular branches, some of which also cross the adductor magnus and irrigate the posterior muscles. Sometimes a **quadriceps artery** may be separated from the rest.

  All these interconnected branches form an **anastomotic circuit** in the circulation of the thigh. From proximal to distal, there are anastomoses between the gluteal arteries – the femoral circumflexes – the perforating branches – the superior muscular branches of the popliteal. All this allows the circulation of the limb to be maintained through various collateral pathways in the event of an occlusion of the femoral artery, even proximal to the origin of the deep femoral artery.

# SENSORY AREAS OF THE LOWER LIMB

We saw at the beginning of the block the branches of the lumbar and sacral plexuses. We have reviewed the branches that have motor fibres and innervated muscles. Now we will look at those which collect information from sensory receptors in the skin, muscles and ligamentous structures (somatic sensitivity). Keep in mind that the thick nerves we have already seen (femoral, obturator, sciatic nerve and its branches) are not exclusively motor, they also carry sensory fibres (so, they are **mixed** nerves).

## SENSORY AREAS OF THE ANTEROPROXIMAL PORTION OF THE THIGH

The highest branches of the lumbar plexus innervate the skin of the most proximal and anterior part of the thigh, near the genital areas. The iliohypogastric and ilioinguinal nerves (branches of L1) innervate at the lower limb, respectively, the most lateral portion of the gluteal region (lateral branch of iliohypogastric) and the most medial and superior portion of the thigh, adjacent to the scrotum in men and the labia majora in women (ilioinguinal nerve).

## GENITOFEMORAL NERVE

The **genitofemoral nerve** comes mostly from L2 (check the lumbosacral plexus!). It has two branches: genital and femoral.

We will look at the **genital branch** when we discuss the innervation of the testicle. It is a mixed branch: it has sensory fibres which are responsible for the sensitivity of the skin in the region of the scrotum in males and the area of the labia majora in women. It also has motor fibres which cause contraction of the cremaster muscle of the testicle.

The **femoral branch** passes under the inguinal ligament within the lacuna vasorum. It captures the sensitivity of the superior and medial portion of the thigh.

## LATERAL FEMORAL CUTANEOUS NERVE

The **lateral femoral cutaneous nerve** is mostly a branch from L2. It passes below the inguinal ligament, through the muscular lacuna (in its most lateral portion), and runs over the sartorius.
It is responsible for the sensitivity of the lateral portion of the thigh, almost to the level of the knee.

## FEMORAL NERVE

We have already talked about the **femoral nerve** as a motor nerve, but it also has many sensitive branches.

It gives rise to **anterior sensitive branches**: the **medial and intermediate femoral cutaneous nerves**, which are responsible for the sensitivity of the medial and anterior portions of the thigh. Some of their branches can pierce the sartorius to reach the skin.

The **saphenous nerve** is also a branch of the femoral nerve. It follows the femoral artery in the Hunter's canal, although it doesn't go its entire extension: it pierces the vastoadductor membrane and runs along the medial side of the leg, with the great saphenous vein. It is responsible for the sensitivity of the medial side of the leg to the medial arch of the foot.

In addition, the femoral nerve gives rise to the articular branches for the knee joint.

# OBTURATOR NERVE



We have also treated the **obturator nerve** as a motor nerve, but it also has some (a few) sensory branches.

Its **anterior branch** leads to cutaneous branches which complete the innervation of the medial part of the thigh, above the territory of the medial femoral cutaneous nerve (a branch of the femoral nerve).

Its **posterior branch** has just small branches which contribute to innervating the knee joint.

The skin of the **GLUTEAL REGION** is innervated by the **cluneal nerves**.

The **superior cluneal nerves** are branches of the lumbar plexus, and innervate the superior portion of the gluteal region.

The **medial cluneal nerves** are branches of the sacral plexus and innervate the medial part of the gluteal region.

The **inferior cluneal nerves** are branches in turn of the **posterior femoral cutaneous nerve** (classically called the "lesser sciatic" nerve). This posterior femoral cutaneous nerve is a purely sensory branch of the sacral plexus. It leaves the pelvis by the infrapiriform space, covered by the gluteus maximus muscle. It runs superficially to the long head of biceps femoris, and ends in the skin covering the popliteal fossa and the highest portion of the back of the leg. It is responsible for the sensitivity of the entire posterior aspect of the thigh, the lower part of the gluteal region and the most superior portion of the back of the leg.

The sensory innervation of the **LATERAL ASPECT OF THE LEG** comes from branches of the sciatic nerve. The lowest part, to the lateral arch of the foot, is innervated by the **sural nerve** (satellite of the lesser saphenous vein), which usually joins the tibial nerve at the popliteal fossa. The sural nerve has a **communicating branch** to the lateral sural cutaneous nerve. Some authors have renamed this **the sural nerve starting at that communicating branch**, and have called the portion between the communicating branch and the union to the tibial nerve the **medial sural cutaneous nerve**. The top of the lateral aspect of the leg is innervated by the **lateral sural cutaneous nerve**, which joins the common peroneal nerve.

## SENSORY AREAS OF THE DORSUM OF THE FOOT



The **dorsum of the foot** is innervated mainly by the **superficial peroneal nerve**, which, after being positioned between the peroneal muscles (which it innervates), becomes superficial and reaches the dorsum of the foot, where it breaks into multiple branches.

The **deep peroneal nerve**, after innervating the muscles of the anterior compartment of the leg, crosses under the extensor retinaculum, innervates the extensor digitorum/hallucis brevis muscles, and runs satellite to the dorsalis pedis artery (continuation of the anterior tibial artery). It ends as a sensory nerve which innervates the skin of the dorsum of the first interdigital space.

## SENSORY AREAS OF THE SOLE OF THE FOOT

The skin of the **sole of the foot** is innervated mainly by the plantar nerves, coming from the bifurcation of the tibial nerve.

The **medial plantar nerve** supplies the skin of the medial half of the sole of the foot. It also innervates both sides of the first, second and third toes, and the medial side of the fourth, through its branches, the common plantar digital nerves.

The **lateral plantar nerve** innervates the skin of the lateral half of the sole of the foot, both sides of the fifth toe and the lateral half of the fourth.

The skin of the heel is innervated by a direct branch of the tibial nerve: the **medial calcaneus cutaneous nerve**.



# GENERAL ANATOMY

# Bones and joints of the upper limb

# SEGMENTS OF THE LIMBS

| | LOWER LIMB | UPPER LIMB |
|---|---|---|
| **Girdle** | Pelvic girdle | Shoulder girdle |
| **Stylopodium** | Thigh | Arm |
| **Zeugopodium** | Leg | Forearm |
| **Autopodium** | Foot | Hand |

# SCAPULOTHORACIC JOINTS: MOVEMENTS

**Elevation / depression**

**Retroposition / anteposition**

**Tilt (glenoid upwards / downwards)**

## ACTIVE LIGAMENTS OF THE SCAPULO-HUMERAL JOINT: THE ROTATOR CUFF

**1: Supraspinatus**

**2: Infraspinatus**

**3: Teres minor**

**4: Subscapularis**



## MOVEMENTS OF THE SHOULDER ARTICULAR COMPLEX: ABDUCTION

**Up to 60º: scapulohumeral joint**

**From 60º to 120º: tilt of the scapulothoracic joint**

**From 120º to 180º: contralateral inclination of the trunk**

## LIGAMENTS BETWEEN ULNA AND RADIUS

1. Interosseous membrane (anterior fibres)
2. Interosseous membrane (posterior fibres)
3. Oblique cord (Weitbrecht's)
4. Anterior and posterior ligaments of the distal radioulnar joint
5. Annular ligament of radius
6. Anterior fibres of the ulnar and radial collateral ligaments of the elbow
7. Triangular fibrocartilage
8. Posterior fibres of the ulnar collateral ligament of the elbow



## MOVEMENTS OF THE ELBOW (and the distal radioulnar joint): PRONATION/ SUPINATION

**SUPINATION: palm facing forward, thumb at the lateral side**

**PRONATION: palm facing backwards, thumb at the medial side**

# CARPOMETACARPAL JOINTS



**First metacarpal (TRAPEZIOMETACARPAL JOINT): SADDLE JOINT**

**Last four metacarpals: PLANE JOINTS**

**Interphalangeal joints: HINGE joint**

**Metacarpophalangeal joint: CONDYLOID joint**

Author: Daniel Sánchez Zuriaga (Universitat de València)

**MOVEMENTS OF THE INTERPHALANGEAL JOINTS**

- **Extension (MINIMAL IN BOTH INTERPHALANGEAL JOINTS)**
- **Flexion**

**MOVEMENTS OF THE METACARPOPHALANGEAL JOINTS**

- **Flexion- extension**
- **Adduction-abduction**

**The index finger has the maximal amplitude of lateral movement.**

# GENERAL ANATOMY

# Brachial plexus. Muscles of the palm and anterior aspect of the forearm.



## BRACHIAL PLEXUS: collateral branches

**DORSAL SCAPULAR NERVE**
Collateral branch of C5 ventral ramus.

**LONG THORACIC NERVE**
Collateral branch of C5 to C7 ventral rami.

**SUPRASCAPULAR NERVE**
Collateral branch of the upper trunk.

**THORACODORSAL NERVE**

**UPPER AND LOWER SUBSCAPULAR NERVES**

**AXILLARY NERVE**
Collateral branches of the posterior cord.

**LATERAL AND MEDIAL PECTORAL NERVES, which make up the ANSA PECTORALIS**
Collateral branches of the medial cord (MEDIAL PECTORAL) and lateral cord (LATERAL PECTORAL).

**MEDIAL CUTANEOUS NERVES OF THE ARM AND THE FOREARM**
Collateral branches, purely sensory, of the medial cord.

## NEUROMUSCULAR SYSTEMS OF THE UPPER LIMB

- Muscles of grip and cubital deviation. **Ulnar nerve**.
- Muscles of pronation and flexion of the hand and the wrist (manual pinch). **Median nerve.**
- Muscles of supination and flexion of the forearm (embrace muscles I). **Musculocutaneous nerve**.
- Muscles of adduction and medial rotation of the upper limb. **Collateral branches** of the brachial plexus: long thoracic , thoracodorsal, subscapular, ansa pectoralis and subclavius (embrace muscles II).
- Muscles of supination and extension of the hand and the wrist. **Radial nerve (deep branch, posterior interosseous nerve)**.
- Muscles of extension, abduction and lateral rotation of forearm, arm and shoulder. **Radial, axillary and suprascapular nerves.**

**ANTERIOR divisions of the trunks = FLEXOR terminal branches (ulnar, median, musculocutaneous), with muscles of the ANTERIOR aspect of the upper limb.**

**POSTERIOR divisions of the trunks = EXTENSOR terminal branch (radial), with muscles of the POSTERIOR aspect of the upper limb.**

| Muscles of the ulnar nerve | | | Proximal attachment | Distal attachment | Action |
|---|---|---|---|---|---|
| INTEROSSEI | Dorsal (four: 2nd and 4th fingers, two in the 3rd finger) | | Lateral surfaces of both metacarpals of the interosseus space | Proximal phalanx and extensor tendons of the last four fingers | Flexion of the metacarpophalangeal + extension of the interphalangeals ("visor hand") |
| | Palmar (three: 2nd, 4th and 5th fingers) | | Medial surface of its metacarpal | | Fixation of the 3rd finger: finger abduction ("spread") (dorsal); adduction (palmar) |
| FIFTH FINGER *(digiti minimi)*: HYPOTHENAR eminence | OPPONENS | | Hamulus of the hamate | 5th metacarpal | Flexion + lateral rotation of 5th finger |
| | FLEXOR BREVIS | | | Base of the proximal phalanx of the 5th finger | FLEXION of 5th metacarpophalangeal |
| | ABDUCTOR | | Pisiform | | ABDUCTION of the 5th finger from the 4th |
| THUMB *(pollicis)*: THENAR eminence *(opponens and abductor brevis are innervated by the median nerve)* | ADDUCTOR | Oblique | Capitatum and base of 2nd and 3rd metacarpals | Ulnar sesamoid and base of the proximal phalanx of the thumb | Adduction of the thumb, towards the axis of the hand |
| | | Transverse | 3rd metacarpal | | |
| | FLEXOR BREVIS | Deep | Trapezoid and capitatum | Radial sesamoid and base of the proximal phalanx of the thumb | Flexion of the metacarpophalangeal |
| | | Superficial *(innervated by the median)* | Trapezium | | |

| Muscles of the ulnar nerve II | Proximal attachment | Distal attachment | Action |
|---|---|---|---|
| **PALMARIS BREVIS** | Skin of the ulnar border of the palm | Palmar aponeurosis | It tenses the skin of the hypothenar eminence. |
| **FLEXOR CARPI ULNARIS**<br>*Ulnar nerve passes through the hiatus formed by its two proximal heads.* | Medial epicondyle (HUMERAL head), olecranon and posterior surface of the ulna (ULNAR head) | Pisiform and hamate | With flexor carpi radialis: palmar flexion of the wrist<br>With extensor carpi ulnaris: ULNAR DEVIATION of the wrist |
| **FLEXOR DIGITORUM PROFUNDUS**<br>*Double innervation: ulnar half –4th and 5th fingers– ulnar nerve, radial half –2nd and 3rd fingers– median nerve.* | Ulna and interosseous membrane | Distal phalanx of the four last fingers (PIERCING tendon) | FLEXION OF THE DISTAL INTERPHALANGEAL JOINT of 2nd to 5th fingers.<br>Flexion of the proximal interphalangeal and palmar flexion of the wrist. |
| | The muscle head for the 2nd finger is usually separated, and can act independently. | | |
| **LUMBRICALS**<br>*1st and 2nd are innervated by the median nerve.* | Tendons of flexor digitorum profundus | Proximal phalanx and extensor tendons of the last four fingers *(same as interossei)* | Flexion of the metacarpophalangeal + extension of the interphalangeals ("visor hand")<br>Their action doesn't depend on the degree of flexion: THEY INITITIATE METACARPOPHALANGEAL FLEXION. |

| MUSCLES OF THE MEDIAN NERVE | | PROXIMAL ATTACHMENT | DISTAL ATTACHMENT | ACTION |
|---|---|---|---|---|
| THUMB *(pollicis)*: THENAR eminence | OPPONENS | Tubercle of trapezium | Lateral border of the 1st metacarpal | OPOSITION of the thumb |
| | ABDUCTOR BREVIS | Scaphoid | Lateral border of the proximal phalanx of the thumb | ABDUCTION of the thumb |
| **FLEXOR POLLICIS LONGUS** | | Radius *(superior to pronator quadratus)* and interosseous membrane | Distal phalanx of the thumb | FLEXION OF THE THUMB INTERPHALANGEAL<br>Flexion of the 1st metacarpophalangeal + trapeziometacarpal |
| **FLEXOR DIGITORUM SUPERFICIALIS**<br>*Median nerve and ulnar artery pass through the hiatus formed by its two proximal heads.* | | Double: 1) Medial epicondyle and coronoid process of the ulna; 2) Radius | Middle phalanx of the four last fingers (PIERCED tendon) | FLEXION OF THE PROXIMAL INTERPHALANGEAL of the last four fingers.<br>Flexion of the metacarpophalangeals and the wrist. |
| | | *The four heads are independent, with tendons in two layers: superficial (3rd + 4th fingers) and deep (2nd + 5th)* | | |
| **FLEXOR CARPI RADIALIS** | | Medial epicondyle | Base of the second metacarpal | Palmar flexion of the wrist *(depends on joint actions of other carpal flexors/ extensors).* |
| **PALMARIS LONGUS** *(variable)* | | | Palmar aponeurosis | It fixates skin and palmar aponeurosis. |
| **PRONATOR QUADRATUS** | | Distal portion of anterior surface of ulna | Distal portion of the anterior surface of the radius | MAIN PRONATOR of the forearm |
| **PRONATOR TERES**<br>*Median nerve enters the forearm between its two proximal heads.* | | Medial epicondyle (EPITROCHLEAR head), coronoid process (CORONOID head) | Central portion of the radius | It helps with pronation when it is fast or intense. |
| + superficial head of flexor pollicis brevis, lateral portion of flexor digitorum profundus, 1st + 2nd lumbricals | | | | |

# GENERAL ANATOMY

## Embrace muscles. Flexors of the elbow, adductors, medial rotators. Proximal and anterior arm muscles.



| MUSCLES OF THE MUSCULOCUTANEOUS NERVE | | PROXIMAL ATTACHMENT | DISTAL ATTACHMENT | ACTION |
|---|---|---|---|---|
| CORACOBRACHIALIS | | Coracoid process of the scapula | Body of the humerus | Flexion + adduction of the shoulder |
| BRACHIALIS | | Body of the humerus *(just distal to coracobrachialis)* | Coronoid process of the ulna | Flexion of the elbow |
| BICEPS BRACHII | SHORT head | Coracoid process of the scapula | Radial tuberosity | FLEXION OF THE ELBOW<br>Supination<br>Flexion of the shoulder |
| | LONG head | Supraglenoid tubercle of the scapula | | Active ligament of the scapulohumeral joint (intraarticular tendon) |

| | Proximal muscles | Proximal attachment | Distal attachment | Nerve | Action |
|---|---|---|---|---|---|
| POSTERIOR | SERRATUS ANTERIOR | First 10 ribs (in 3 portions) | Medial border of the scapula (in 3 portions) | Long thoracic | Fixes the scapula. Moves shoulder anterior, lateral and superiorly. Inspiratory. |
| | SUBSCA-PULARIS | Anterior surface of the scapula | Lesser tubercle of the humerus | Upper and lower subscapular nerves | Adduction and medial rotation<br>Teres major and latissimus: also extensors of the humerus.<br>Latissimus: with arms raised and fixed, it raises the trunk. Second stage of climbing. |
| | TERES MAJOR | Lateral border and inferior angle of the scapula | Medial lip of the bicipital groove | | |
| | LATISSIMUS DORSI | Spinous processes of the last 6 thoracic vertebrae and all the lumbar ones, median sacral crest, iliac crest | Bicipital groove | Thoracodorsal | |
| ANTERIOR | SUBCLAVIUS | First rib and costal cartilage | Clavicle | Subclavius | It stabilises the clavicle, and protects the vessels. |
| | PECTORALIS MINOR | 3rd, 4th and 5th ribs | Coracoid process | Ansa pectoralis | Depression and adduction of the shoulder. Inspiratory. |
| | PECTORALIS MAJOR | Clavicle, sternum, 6 first ribs | Lateral lip of the bicipital groove | | ADDUCTION and medial rotation. Inspiratory. |



# GENERAL ANATOMY



## Abductor and extensor muscles. Suprascapular, axillary and radial nerves.

| | Muscle | | Proximal attachment | Distal attachment | Action |
|---|---|---|---|---|---|
| SUPRASC | SUPRASPINATUS | | Supraspinous fossa | Greater tubercle of the humerus | **Abduction**<br>Shoulder pain |
| SUPRASC | INFRASPINATUS | | Infraspinous fossa | | Lateral rotation (INFRAESPINATUS is the main lateral rotator) |
| AXILLARY | TERES MINOR | | Superior portion of the lateral border of the scapula | | |
| AXILLARY | DELTOID | | Spina of scapula, acromion, lateral portion of the clavicle | Deltoid tuberosity | ABDUCTION<br>*Extension, or even adduction, according to the specific portion it is activating.* |
| RADIAL | ANCONEUS | | Lateral epicondyle | Olecranon | Elbow extension.<br>It fixes the ulna during pronation. |
| RADIAL | TRICEPS BRACHII | MEDIAL HEAD | Medial/inferior border of the radial groove | | ELBOW EXTENSOR |
| RADIAL | | LATERAL HEAD | Lateral/superior border of the radial groove | | |
| RADIAL | | LONG HEAD | Infraglenoid tubercle | | |

## STAGES OF SHOULDER ABDUCTION: MUSCLES

**Up to 60º: deltoid (1) + supraspinatus (2)**

**From 60º to 120º: add trapezius (3 and 4) + serratus anterior (5)**

**From 120º to 180º: add triceps spinae from the opposite side (6)**

## TOPOGRAPHIC SPACES

**Medial axillary space / omotricipitale triangle: scapular circumflex artery**

**Lateral axillary space/ humerotricipitale square: posterior humeral circumflex artery and axillary nerve**

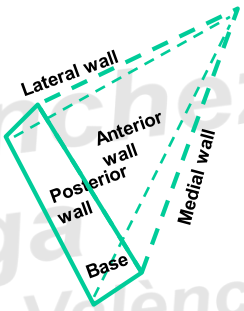
**Triceps hiatus/ humerotricipitale triangle: deep brachial artery and radial nerve**

## AXILLA

**ANTERIOR wall: pectoralis major and minor**

**POSTERIOR wall: from superior to inferior, subscapularis, teres major and latissimus.**

**MEDIAL wall: serratus anterior, first ribs and intercostal muscles.**




**LATERAL wall: coracobrachialis and long head of biceps brachii, bicipital groove.**

**BASE: skin and axillary fascia, covering the axillary space.**

| Muscles of the radial n. | Proximal attachment | Distal attachment | | Action |
|---|---|---|---|---|
| SUPINATOR | Lateral epicondyle, lateral border of ulna | External surface and neck of the radius | | SUPINATION |
| | *Its fibres are separated into a **superficial** and a **deep** portion by the deep branch of the radial nerve.* | | | |
| BRACHIORADIALIS | Lateral border of the humerus, distal to the radial nerve groove. | Styloid process of radius | | Stabilisation+FLEXION of the elbow, mostly in mid pronation. |
| EXTENSOR CARPI RADIALIS LONGUS | Lateral epicondyle | Base of the 2nd metacarpal | | EXTENSION and radial deviation of the carpus. |
| EXTENSOR CARPI RADIALIS BREVIS | | Base of the 3rd metacarpal | | |
| EXTENSOR CARPI ULNARIS | | Base of the 5th metacarpal | | EXTENSION and ulnar deviation of the carpus. |
| ABDUCTOR POLLICIS LONGUS | Ulna, interosseous membrane and radius. | Lateral surface of the base of the 1st metacarpal. | | Abduction of the thumb. |
| EXTENSOR POLLICIS BREVIS | Radius and interosseous membrane, just distal to abductor longus. | Proximal phalanx of the thumb. | | Extension of the thumb. |
| EXTENSOR POLLICIS LONGUS | Ulna and interosseous membrane. | Distal phalanx of the thumb. | | |
| EXTENSOR INDICIS | | Dorsal aponeurosis of the three phalanxes | Index | Extension of the corresponding fingers. |
| EXTENSOR DIGITI MINIMI | Lateral epicondyle | | 5th finger | |
| EXTENSOR DIGITORUM | | | 2nd, 3rd, 4th and 5th fingers | |



# GENERAL ANATOMY

## Arteries and veins of the upper limb.

**BRANCHES OF THE SUBCLAVIAN ARTERY** *(down to the first rib)*

• THYROCERVICAL TRUNK:

- Transverse cervical: dorsal scapular (deep branch)
- Suprascapular

**BRANCHES OF THE AXILLARY ARTERY** *(down to the inferior border of pectoralis or teres major)*

• SUPERIOR THORACIC

• THORACO-ACROMIAL. Pectoral, acromial, clavicular and deltoid branches.

• LATERAL THORACIC OR EXTERNAL MAMMARY

• SUBSCAPULAR

-Scapular circumflex

-Thoracodorsal

• ANTERIOR HUMERAL CIRCUMFLEX

• POSTERIOR HUMERAL CIRCUMFLEX

**BRANCHES OF THE BRACHIAL ARTERY** *(it bifurcates into ulnar and radial arteries)*

• DEEP BRACHIAL ARTERY

-Middle collateral (posterior)

-Radial collateral (anterior)

• NUTRIENT ARTERY OF THE HUMERUS

• SUPERIOR ULNAR COLLATERAL

• INFERIOR ULNAR COLLATERAL

**BRANCHES OF THE RADIAL ARTERY**

• RADIAL RECURRENT *(it anastomoses with the radial collateral from the deep brachial artery)*

• Muscle branches at the forearm

• Palmar carpal branches

• Superficial palmar branch: SUPERFICIAL PALMAR ARCH

• FIRST DORSAL METACARPAL

• DORSAL CARPAL ARTERY: dorsal metacarpal arteries: dorsal digital arteries

• DEEP PALMAR ARCH

**BRANCHES OF THE ULNAR ARTERY**

• ANTERIOR AND POSTERIOR ULNAR RECURRENT ARTERIES *(they anastomose between them and with branches of the ulnar collaterals of the brachial artery)*

• COMMON INTEROSSEOUS ARTERY

-Anterior interosseous

-Posterior interosseous

* Recurrent interosseous artery

• Muscle branches at the forearm

• Palmar carpal branches *(they anastomose with the ones from the radial)*

• Deep palmar branch: DEEP PALMAR ARCH

• SUPERFICIAL PALMAR ARCH

## CUBITAL FOSSA: boundaries and contents

- **Proximal:** a horizontal line between both epicondyles
- **Radial:** brachioradialis
- **Ulnar:** pronator teres

**Contents:** median nerve, bifurcation of the brachial artery, biceps tendon, and superficially the median cubital vein and the lateral and medial cutaneous nerves of the forearm.

## PULSE GROOVE: between the tendons of flexor carpi radialis and brachioradialis. Radial pulse is palpated pressing the artery against the radius and pronator quadratus.

# SENSORY AREAS OF THE UPPER LIMB

SENSORY AREAS OF THE UPPER LIMB

Author:
Daniel Sánchez
Zuriaga
(Universitat de València)

The **cutaneous nerves of the arm and the forearm** are purely sensory collateral branches of the medial cord of the brachial plexus. The one in the arm innervates the medial aspect of the arm, both anteriorly and posteriorly. The one in the forearm does the same to the forearm, reaching the wrist.

The **lateral cutaneous nerve of the forearm** is the direct continuation of the musculocutaneous nerve, when it emerges between the biceps brachii and brachialis muscles, lateral to the distal tendon of biceps in the cubital fossa. It runs close to the cephalic vein, along the radial border of the forearm down to the wrist. It innervates the skin of the anterolateral aspect of the forearm, down to the thenar eminence.

## SENSORY AREA OF THE AXILLARY NERVE. "REGIMENTAL BADGE"


The **axillary** nerve, apart from providing motor branches for the deltoid and teres minor muscles, has some sensitive branches. The most important one is the **superior lateral cutaneous nerve of the arm,** which innervates an area of skin over the inferior portion of the deltoid muscle and the superior portion of the long head of triceps. Classically this territory is described as the *regimental badge* because it overlaps with the skin that is usually below the area of the sleeve that displays the badge identifying the regiments of the military (see picture).

## SENSORY AREA OF THE RADIAL NERVE



The **radial nerve**, in addition to all its motor branches, sends several sensory branches, which collect the innervation of most of the dorsal and some of the anterior surfaces of the upper limb. In the **arm**, it forms the following cutaneous branches: 1) the **inferior lateral cutaneous nerve of the arm**, which innervates the skin of the lateral half of the distal part of the arm (distal to the area innervated by the axillary nerve); 2) the **posterior cutaneous nerve of the arm**, which innervates the skin from the dorsal part of the arm down to the olecranon; 3) the **posterior cutaneous nerve of the forearm**, which innervates the dorsal skin of the forearm down to the wrist.

In the **forearm** the radial nerve has a superficial branch (anterolateral, covered by the brachioradialis muscle), and a deep one (dorsal, which is called posterior interosseous nerve). The **superficial branch** is sensitive. It reaches the back of the hand, at the level of the anatomical snuffbox, and is divided into four or five dorsal digital nerves, which innervate the skin of the back of the first three fingers (except the distal phalanx, which is innervated by the median nerve) and the lateral half of the dorsum of the hand, with the border of the thenar eminence.

## SENSORY AREA OF THE MEDIAN NERVE



The sensory area of the **median nerve** is in the wrist and hand.

Before entering the carpal tunnel, it gives a **palmar cutaneous branch** which doesn't pass through the carpal tunnel, and which innervates the skin of the thenar eminence and the central part of the palm (so the sensitivity of these regions will NOT be affected in carpal tunnel syndrome).

After crossing the carpal tunnel, it is divided into four or five **digital palmar branches**. These are placed between two fingers, providing innervation to the radial side of one and to the ulnar side of the adjacent one. Thus, they innervate the palmar aspect of the first, second and third fingers, and the radial side of the palmar aspect of the fourth.

The digital branches send small **dorsal extensions**, which innervate the dorsal aspect of the distal phalanges (with the fingernails) of the first, second and third fingers, and the radial half of the fourth finger.

## SENSORY AREA OF THE ULNAR NERVE

The **ulnar nerve** also has its sensitive territory in the distal part of the forearm, wrist and hand.

It sends a **dorsal branch** proximal to its passage through the Guyon's canal. This branch follows the medial border of the wrist and hand and divides into two or three dorsal digital nerves. This dorsal branch innervates the medial part of the wrist and hand dorsum, and the back of the fourth and fifth fingers (except for the radial half of the distal phalanx of the fourth, which is innervated by a dorsal branch of the median nerve) .

In the **palmar** surface, the **superficial branches of the ulnar nerve** innervate the skin of the medial part of the palm. They send two digital nerves, which innervate the entire palmar surface of the fifth finger and the ulnar side of the palmar surface of the fourth finger.



# GENERAL ANATOMY

# Ribs. Costal muscles. Diaphragm

| Muscle | | Attachments | | Actions |
|---|---|---|---|---|
| INTER-COSTALS | EXTERNAL | External surface of the superior border of the rib below. | External surface of the inferior border of the rib above . | Elevation of the ribs. Increase of the anterior-posterior and transversal diameters of the ribcage: INSPIRATION. |
| | INTERNAL | Superior border of the rib below. | External lip of the groove of the rib above. | Lowering of the ribs. Decrease of the anterior-posterior and transversal diameters of the ribcage: Forced EXPIRATION. |
| | INNERMOST | | Internal lip of the groove of the rib above. | |
| LEVATORES COSTARUM | | Thoracic transverse processes. | Posterior surface of the first (BREVES) or second (LONGUS) rib below. | Elevation of the ribs. INSPIRATION. |
| SUBCOSTALES | | Superior border of the rib, between the tubercle and the angle. | Internal surface of the second rib below. | Lowering of the ribs. Forced EXPIRATION. |
| TRANSVERSUS THORACIS | | Posterior surface of the sternum. | 2nd to 6th costal cartilages | Lowering of the costal cartilages. Forced EXPIRATION. |

# INTERCOSTAL MUSCLES



**EXTERNAL INTERCOSTAL: from the costal tuberosity to the costo-chondral junction (external intercostal membrane)**

**INTERNAL and INNERMOST INTERCOSTALS: from the costal angle to the external border of the sternum (internal intercostal membrane)**

**POSITION OF THE DIAPHRAGM**



**FORCED EXPIRATION: RIGHT, 4th costal cartilage (right nipple) / LEFT: one rib lower**

**INSPIRATION (chest x-ray): 6th rib**

# GENERAL ANATOMY



# Muscles of the abdominal walls. Inguinal Canal.

| Muscle | Attachments | | Action |
|---|---|---|---|
| EXTERNAL OBLIQUE | Eight last ribs | Iliac crest.<br>Inguinal ligament.<br>Sheath of the rectus abdominis, and surpassing it the linea alba, even crossing to the opposite side at its inferior portion. | Common to the abdominal girdle.<br>ROTATION OF THE TRUNK TO THE OPPOSITE SIDE.<br>Flexion of the trunk. |
| INTERNAL OBLIQUE | Lumbar transverse processes (thoracolumbar fascia).<br>Iliac crest and external portion of the inguinal ligament. | Three last ribs.<br>Sheath of the rectus abdominis, and surpassing it the linea alba. Inferior fibres go to the pubis (conjoint tendon). | Common to the abdominal girdle.<br>ROTATION OF THE TRUNK TO THE SAME SIDE.<br>Flexion of the trunk. |
| TRANSVERSUS ABDOMINIS | Six last costal cartilages.<br>Lumbar transverse processes (thoracolumbar fascia).<br>Iliac crest and external portion of the inguinal ligament. | Sheath of the rectus abdominis, and surpassing it the linea alba. Inferior fibres go to the pubis (conjoint tendon). | Common to the abdominal girdle. |
| RECTUS ABDOMINIS | 5th to 7th costal cartilages.<br>Xiphoid process. | Pubis, between the pubic tubercle and the symphysis. | Common to the abdominal girdle.<br>FLEXION OF THE TRUNK. |
| PYRAMIDALIS | Pubic symphysis. | Linea alba, below the umbilicus. | Tenses the linea alba. |

# INNERVATION



**- Last intercostal nerves (THORACO-ABDOMINAL NERVES): all of them.**

**- ILIOHYPOGASTRIC and ILIOINGUINAL nerves (lumbar plexus): internal oblique and transversus abdominis.**

# VASCULAR SUPPLY

- **Last intercostal arteries**
- **Lumbar arteries**
- **Branches of the external iliac artery:**
  **inferior epigastric artery**
  **deep circumflex iliac artery**
- **Branches of the femoral artery:**
  **superficial circumflex iliac artery**
  **superficial epigastric artery**
- **Branches of the internal thoracic artery:**
  **superior epigastric artery**
  **musculophrenic artery**



## WALLS OF THE INGUINAL CANAL

| | |
|---|---|
| **ROOF** | **Fibres of internal oblique and transversus abdominis going towards their attachment at the conjoint tendon.** |
| **FLOOR** | **Inguinal ligament.** |
| **ANTERIOR WALL** | **Aponeurosis of the external oblique muscle.** |
| **POSTERIOR WALL** | **Transversalis fascia, with reinforcements which are, from lateral to medial:**<br>**-interfoveolar ligament of Hesselbach + lateral umbilical fold (inferior epigastric vessels)**<br>**-ligament of Henle + medial umbilical fold (fibrosed umbilical arteries)**<br>**Between both reinforcements: MEDIAL INGUINAL FOVEA**<br>**Lateral to the ligament of Hesselbach and the lateral umbilical fold: LATERAL INGUINAL FOVEA, which is the same as the deep inguinal ring.** |

| | | |
|---|---|---|
| **Entry: DEEP INGUINAL RING** | **Invagination of the transversalis fascia, at the posterior aspect of the abdominal girdle.** | **SUPERIOR/LATERAL: arcuate fibres of internal oblique and transversus abdominis going towards their attachment at the conjoint tendon.**<br>**INFERIOR/LATERAL: inguinal ligament**<br>**MEDIAL: inferior epigastric vessels + ligament of Hesselbach** |
| **Exit: SUPERFICIAL INGUINAL RING** | **Dehiscence of external oblique aponeurosis.** | **LATERAL: lateral crus**<br>**MEDIAL: medial crus**<br>**SUPERIOR: arciform or intercrural fibres between both crura**<br>**POSTERIOR: posterior crus (=reflex/Colles ligament)** |

## CONTENTS OF THE INGUINAL CANAL

**IN BOTH SEXES: genital branches of the nerves of the lumbar plexus.**
**- ILIOINGUINAL**
**- GENITOFEMORAL (in males inside the spermatic cord).**

**IN FEMALES: ROUND LIGAMENT of the uterus**
**(with some fibres of the cremaster muscle).**

**IN MALES: SPERMATIC CORD, surrounded by the**
**CREMASTER muscle and spermatic fasciae.**

## COMMON ACTIONS OF THE ABDOMINAL GIRDLE

**• TRUNK FLEXION (mostly RECTUS ABDOMINIS)**

**• ANTIGRAVITATORY PRESS**

**• EVACUATORY PRESS (labour, expulsion of urine and faeces).**

**• BREATHING**

**• MODERATING PRESS (visceral venous return).**

**• COADJUVATION TO SPINE EXTENSION:**

**Straightening of lumbar lordosis (mostly RECTUS ABDOMINIS).**

**Reduction of compressions.**

**HOW MANY PACKS ARE THERE IN SIX-PACK? SIX? EIGHT?**

**EIGHT-PACK… but there may be more.**

The muscle fibres of rectus abdominis are interrupted by **three fibrous bands or tendinous intersections**. One is usually situated at the level of the umbilicus, another opposite the free end of the xiphoid process and a third about midway between the other two. These intersections pass transversely or obliquely across the muscle in a winding manner. They are rarely completely thick and may extend only half-way through the body of the muscle. They usually fuse with the fibres of the anterior lamina of the sheath of the muscle…

…Sometimes, **one or two incomplete intersections are present below the umbilicus**.

| Muscles of the posterior wall of the abdomen | | Attachment | Attachment | Action |
|---|---|---|---|---|
| **QUADRATUS LUMBORUM** Innervated by the subcostal nerve and the upper three-four lumbar anterior roots. It has three portions: | Costo-iliac (posterior) | 12th rib | Iliac crest | Unilateral contraction: ipsilateral spine flexion. Bilateral contraction: lumbar spine extension. It fixates the last rib. It helps stabilising the attachments of the diaphragm, so it collaborates with its contraction during inspiration. |
| | Transverse-iliac (middle) | Transverse processes L1 to L4 | | |
| | Costo-transverse (anterior) | 12th rib | Transverse processes L1 to L4 | |
| **ILIOPSOAS** | You already know about this one (lower limb, innervated by the femoral nerve). The roots of the lumbar plexus pass through its fibres. | | | |
| **PSOAS MINOR** *(it's variable)* | | Vertebral bodies and intervertebral discs T12-L1 | Iliopectineal arch and eminence | Collaborates with psoas major in trunk flexion. It tenses their fascia. |

# POSTERIOR WALL OF THE ABDOMEN: LUMBAR PLEXUS

**Lumbar plexus is the most important content of the lumbo-iliac region. Its roots pass between the fibres of psoas major and innervate mostly the lower limb.**

**THORACOLUMBAR FASCIA:** it's a structure made up of **three layers**: an **anterior** one which attaches to the anterior surface of the lumbar transverse processes and covers anteriorly the quadratus lumborum muscle, and is continuous with the fascia transversalis; a **middle** one which attaches to the tip of the lumbar transverse processes and covers quadratus lumborum posteriorly; and a **posterior** one which attaches to the spinous processes and covers the back muscles, mostly erector spinae. This posterior layer is also one of the attachments of latissimus dorsi. The three layers become fused laterally to the erector spinae, forming the **lateral raphe**. Some fibres from the internal oblique and many fibres of transversus abdominis muscle attach to this raphe.

**This fascia has important actions on spine biomechanics, collaborating to keep its stability and its movements.**

**ABDOMINAL HERNIA: the exit of abdominal contents out of the cavity through some point of the abdominal wall (more often the inguinal canal). Look at the layers of the hernia sac, which represent the layers of the abdominal wall.**

**INDIRECT INGUINAL HERNIA: inguinal hernias occur above the inguinal ligament, that is, at some point in the inguinal canal. An indirect inguinal hernia occurs through the deep inguinal ring, the "entry" to the canal (i.e., lateral to the inferior epigastric vessels: remember the ring's boundaries), so the herniated material has to traverse the entire inguinal canal before reaching the outside (it gets there, let's say, "indirectly"). In addition, the hernia sac will be covered by all the layers which cover the spermatic cord and the testicle (in fact, the sac is "inside" the cord). They are the most frequent hernias.**

**DIRECT INGUINAL HERNIA: they occur through the medial inguinal fovea (i.e., medial to the inferior epigastric vessels). The herniated material finds immediately the superficial inguinal ring (which is also medial) and gets to the surface (that is to say, it gets there "directly", without traversing the length of the inguinal canal). The hernia sac is only surrounded by peritoneum and the transversalis fascia which makes up the posterior wall of the canal, pulled by the hernia sac. This stays to the side and clearly independent from the spermatic cord.**



**CRURAL OR FEMORAL HERNIAS**

**Crural hernias are those which occur below the inguinal ligament. The abdominal content gets out through the lacuna vasorum or musculorum, more frequently through the medial portion of the lacuna vasorum, between the femoral vein and the lacunar ligament (in green).**

**INGUINOSCROTAL HERNIA: in this case, the hernia sac exits through the superficial inguinal ring and proceeds to the scrotum, following the complete path of the spermatic cord. This occurs mostly in indirect hernias.**
**For further information…**
**https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3199728/**

**ADDITIONAL CONCEPTS**

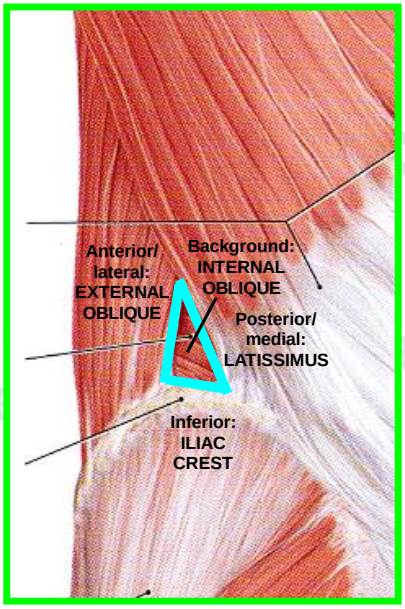


**EPIGASTRIC HERNIAS (an abdominal hernia through the linea alba, between the umbilicus and the xiphoid process), UMBILICAL HERNIAS (an abdominal hernia through the umbilical ring) and EVENTRATIONS (a general term, defining the protrusion of abdominal content through a portion of the abdominal wall which has been debilitated surgically, traumatically or pathologically, usually different from the weak points or natural openings through which the abdominal hernias protrude)**

**SEMILUNAR OR SPIEGELIAN HERNIA: an abdominal hernia through the linea semilunaris (also known as line of Spiegel). Remember, that's where the muscle belly of transversus abdominis becomes aponeurosis (which usually overlaps with the lateral margin of rectus abdominis).**

**INFERIOR LUMBAR OR PETIT'S TRIANGLE:** it is a small space on the posterior portion of the abdominal wall where there is a missing layer (the external oblique muscle). That's why we can get hernias at this level.

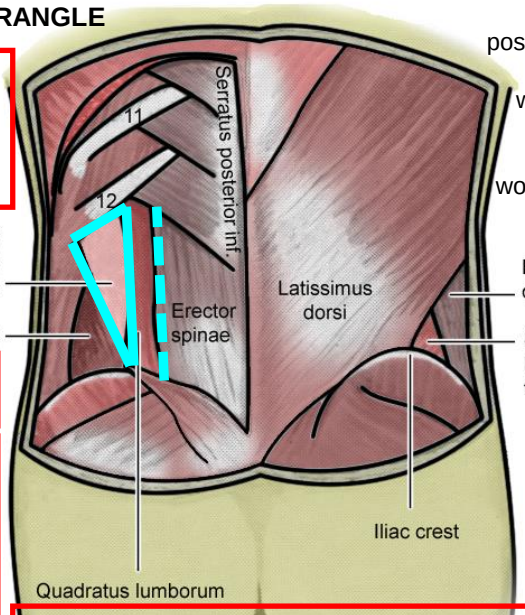
**LUMBAR HERNIAS: hernias through Petit's triangle or Grynfeltt's triangle/ quadrangle.**



**SUPERIOR LUMBAR OR GRYNFELTT'S TRIANGLE/ QUADRANGLE**

It is another weak point of the posterior aspect of the abdominal wall, superior to Petit's triangle, and deeper (it would be covered by latissimus dorsi).

**Superior/ lateral: 12th RIB (if SERRATUS POSTERIOR INFERIOR is wider it may form a fourth border, superior/medial, and then we would have a quadrangle instead of a triangle).**




**Lateral: INTERNAL OBLIQUE**

**Background: transversus abdominis, joining the thoracolumbar fascia.**

**At this level we have the subcostal neurovascular bundle (XII intercostal nerve and vessels).**

**It is a surgical access point to the inferior pole of the kidney.**

**Medial: lateral border of QUADRATUS LUMBORUM (or lateral border of erector spinae: then the lateral border of quadratus lumborum is in the background of the triangle).**



# GENERAL ANATOMY

## Pelvic and perineal muscles

The pelvis can be divided into two parts, upper and lower, separated by the pelvic inlet or superior opening of the pelvis. The upper part is called the greater or false pelvis, and the lower is called the lesser or true pelvis.

**Greater or false pelvis**
The cavity of the greater pelvis is a part of the abdominal cavity. It contains parts of the abdominal organs (intestinal loops, mostly) and part of the uterus during pregnancy. Its limits:
• Laterally, the inner surface of the iliac wings.
• Posteriorly, the last two lumbar vertebrae.
• Anteriorly, the lower anterior abdominal wall.

**Lesser or true pelvis**
The cavity of the lesser pelvis contains the rectum, urinary bladder and parts of the reproductive organs. In women, it contains both the non gravid uterus and vagina, and during labour it **has to allow the passage of the foetal head** (forming what is known as the **birth canal**). Its limits:
• Anteriorly, both superior pubic rami and the symphysis of the pubis.
• Posteriorly, the anterior surface (with concave shape) of the sacrum and coccyx.
• Laterally, the area between ilium and ischium.
Its walls are covered largely by the piriformis muscle.

**Pelvic inlet**
It is the entry to the true pelvis from the false pelvis (i.e., from the abdomen). It represents the first opening the foetal head has to overcome in the birth canal. It is bounded on each side by:
• the sacral promontory (the eminence formed by the angle between the anterior faces of the last lumbar and first sacral vertebrae).
• the wings of the sacrum and the sacroiliac joint.
• the **linea terminalis**, which, in turn, consists of:
  ✓ the arcuate line of the ilium
  ✓ the pecten pubis or pectineal line

**Pelvic inlet diameters**
• **Antero-posterior o conjugate diameters**
They are three, all of them from the promontory. They end at different points of the pubic symphysis.
- Anatomical conjugate diameter: it ends at the superior edge of the pubic symphysis. It is on the same level as the pelvic inlet, as we defined it before.
- Obstetric or true conjugate diameter: it ends at the most posterior edge of the pubic symphysis. It is obviously the narrowest of the three.
- Diagonal conjugate diameter: it ends at the inferior edge of the pubic symphysis.
• **Transverse diameter**
From the arcuate line of one side to the arcuate line of the opposite side at the points of maximum separation.
• **Oblique diameters**
From the sacroiliac joint of one side to the iliopubic eminence of the opposite side.

**Inferior aperture or pelvic outlet**
It's the "exit" opening of the pelvis, and it represents the end of the birth canal. Its limits are, from anterior to posterior:
• the inferior edge of the pubic symphysis
• the inferior rami of the pubis
• the ischial tuberosities
• the sacrotuberous ligament, closing inferiorly the sciatic notches
• the tip of the coccyx

**Pelvic outlet diameters**
•**Antero-posterior diameter or straight conjugate:** from the tip of the coccyx to the lower edge of the pubic symphysis. It varies quite a lot due to the displacement of the tip of the coccyx with sacroiliac nutation and counternutation.
• **Transverse or bituberous diameter:** between both ischial tuberosities.

* The diameter between both sciatic spines (**bisciatic or bispinous**) is at the midpoint of the lesser pelvis (this point is called in Obstetrics "**middle strait**"). It's the narrowest point of the birth canal, just wider than the biparietal diameter of the foetal head.

| MUSCLES OF THE PELVIC DIAPHRAGM | | ATTACHMENTS | | ACTION |
|---|---|---|---|---|
| LEVATOR ANI | **PUBOCOCCYGEUS**<br>***Some of its fibres surround the anal canal –PUBOANALIS muscle.***<br>***In females, some of its fibres surround the vagina – PUBOVAGINALIS muscle. In males, they surround the urethra below the prostate – PUBOPROSTATICUS muscle, or levator prostatae.***<br>***Both pubovaginalis and puboprostaticus have extensions which form a sling for the urethra (PUBOURETHRALIS muscle).*** | Posterior surface of the body of the pubis | External anal sphincter, coccyx and anococcygeal ligament. | Pubococcygeus and puborectalis compress the visceral ducts which cross the pelvic diaphragm.<br>Puborectalis helps in the formation of the external urethral sphincter.<br>Puborectalis helps in the formation of the external anal sphincter. |
| | **PUBORECTALIS bundle.**<br>***Sometimes described as a part of the puboccygeus.*** | | It surrounds the anal canal. It meets the contralateral muscle at the anococcygeal ligament. | |
| | **ILIOCOCCYGEUS bundle** | Sciatic spine and tendinous arch of the levator ani, over obturator fascia. | Coccyx and ano-coccygeal ligament. | **THE FOUR BUNDLES form the PELVIC DIAPHRAGM:**<br>• holds the pelvic viscera<br>• helps in the contention of micturition and defecation: it has to relax to allow the pass of urine and faeces.<br>• helps to increase intraabdominal pressure. |
| **COCCYGEUS.** ***It may be considered another bundle of levator ani.*** | | Sciatic spine | Last sacral vertebrae and coccyx. | |

| | Perineal muscle | | Attachments | | Actions |
|---|---|---|---|---|---|
| superficial | SPHINCTER ANI EXTERNUS | | With fibres of the puborectalis, it surrounds the anal canal. Posterior to it, it attaches to the coccyx and anococcygeal ligament. Anteriorly, to the central tendon of the perineum. | | Closes the anal canal at will. (CONTINENCE) |
| | ISCHIO-CAVERNOSUS | | Medial surface of the ischial tuberosity | Inferior branch of the pubis, just below the root of the corpora cavernosa of the penis or the clitoris. | They cover the proximal portion of corpora cavernosa. When the muscles contract, they squeeze the corpora, and blood displaces distally: they contribute then to the ERECTION of the penis and the clitoris. |
| | BULBO-SPONGIOSUS | ♂ | Central tendon of the perineum or perineal body | Median raphe at the inferior surface of the penile bulb, joining the contralateral bulbospongiosus. | It helps to: 1) Expel urine from the urethra in the last stage of micturition; 2) Squeeze blood from the penile bulb, facilitating erection; 3) Expel semen during ejaculation. |
| | | ♀ | | The muscles of each side are separated, and each one covers the vaginal vestibule bulb of its side. They are joined anteriorly at the base of the clitoris. | Constricts the vaginal orifice, and squeezes the lubricant secretions of the vestibular glands. |
| | TRANSVERSUS PERINEI SUPERFICIALIS | | | Medial surface of the ischial tuberosity. | It is a narrow strip of muscle, anterior to the anus. Its function is not clear: it frequently fuses with the transversus perinei profundus. |
| | TRANSVERSUS PERINEI PROFUNDUS (surrounded by the superior and inferior fasciae of the urogenital diaphragm, which bound the deep perineal space) | | | Inferior branch of the pubis (anteriorly it does not reach the union of both branches, leaving a gap). | It conforms the most important part of the urogenital diaphragm, which supports bladder and prostate.<br>It compresses the veins of the erectile bodies which traverse it: it is a COADJUVANT AGENT OF ERECTION. |
| | EXTERNAL SPHINCTER MUSCLE OF URETHRA | | Together with fibres of the pubourethral bundle of levator ani, it surrounds the membranous portion of the urethra. | | It closes the urethra at will. (CONTINENCE) |

## SPACES INFERIOR TO LEVATOR ANI

**SUBFASCIAL SPACE: ISCHIO-ANAL FOSSA (posterior)**

| | |
|---|---|
| **SUPERIOR/ MEDIAL** | **Deep fascia over levator ani.**<br>**Anal sphincter at the inferior part.** |
| **INFERIOR** | **Skin and subcutaneous fat.**<br>**ANTERIORLY: superior fascia of the urogenital diaphragm, bounding the ANTERIOR RECESS OF THE ISCHIO-ANAL FOSSA.** |
| **LATERAL** | **Obturator internus and its fascia, covering the pelvic wall.** |
| **CONTENTS** | ➢**Pudendal nerve and internal pudendal vessels in Alcock's or pudendal canal (obturator internus fascia).**<br>➢**Inferior rectal nerve and vessels.**<br>➢**A lot of fat, continuous with subcutaneous fat.** |



## SPACES INFERIOR TO LEVATOR ANI

**SUPERFICIAL PERINEAL SPACE (anterior)**

| | |
|---|---|
| **SUPERIOR** | **Inferior fascia of the urogenital diaphragm (perineal membrane).** |
| **INFERIOR** | **Perineal aponeurosis.** |
| **LATERAL** | **Corpus cavernosum, surrounded by the ischio-cavernosus muscle.** |
| **MEDIAL** | **Corpus espongiosum, surrounded by the bulbo-spongiosus muscle.** |
| **CONTENTS** | **Superficial pudendal nerves and vessels (genital branches of the internal pudendal artery and the pudendal nerve).** |

# GENERAL ANATOMY

## Cervical parietal muscles, vessels and nerves. Aponeurology and topographic anatomy.



| Group | Muscle | | Attachments | | | Action |
|---|---|---|---|---|---|---|
| PRE-VERTEBRAL (anterior vertebral muscles) | Longus colli | Longitu-dinal | Bodies first cervical vert. | | Bodies last cervical and first thoracic vert. | All: anterior neck flexion<br>Obliques: ipsilateral neck flexion, contralateral rotation |
| | | Superior oblique | Anterior tubercle of atlas | | Anterior tubercles of the transverse processes of C3 to C6 vert. | |
| | | Inferior oblique | Bodies first thoracic vert. | | | |
| | Longus capitis | | Basilar portion of the occipital bone | | | Anterior head flexion |
| | Rectus capitis anterior | | | | Transverse process of atlas | |
| | Rectus capitis lateralis | | Jugular process of the occipital bone | | | Ipsilateral head flexion |
| SCALENIC (lateral vertebral muscles) | Scalenus anterior | | Anterior or posterior tubercles of the transverse processes of vertebrae: | Ant.,C3-C6 | Scalene tubercle on first rib | Lateral and anterior neck flexion.<br>They are accessory INSPIRATORY muscles<br>TOPOGRAPHICAL RELATIONSHIPS OF SCALENUS ANTERIOR!! |
| | Scalenus medius | | | Post.,C2-C7 | First rib | |
| | Scalenus posterior *(may be blended with scalenus medius)* | | | Post.,C4-C6 | Second rib | |
| INFRAHYOID (ansa cervicalis) | Thyrohyoid | | Oblique line of the thyroid cartilage | | Hyoid bone | They displace the larynx in voice modulation.<br>Inferior traction of the hyoid bone. With the suprahyoid muscles, they stabilise it. |
| | Sternothyroid | | | | Sternal manubrium | |
| | Sternohyoid | | Hyoid bone | | | |
| | Omohyoid<br>*It is a digastric muscle.* | | | | Superior scapular border | |
| ACCESSORY NERVE | Sternocleidomastoid | | Mastoid process | | Medial 1/3 of the clavicle. Sternal manubrium. | Unilateral: head extension + lateralisation + contralateral rotation (torticollis)<br>Bilateral: with prevertebrals, flexion or hyperlordosis |

**STERNOCLEIDOMASTOID: BILATERAL CONTRACTION AND ANTAGONISM-SYNERGY WITH PREVERTEBRAL MUSCLES**



**Prevertebral muscles in contraction:**
**straightening of lordosis + neck flexion**

**Prevertebral muscles relaxed:**
**head extension + hyperlordosis**

**CERVICAL PLEXUS**

- Anterior roots from C1 to C4
- PHRENIC nerve: C3, C4, C5. Descends anterior to the scalenus anterior muscle.
- ANSA CERVICALIS: superior root (C1, goes with hypoglossal) + inferior roo.t (C2+C3). It innervates the infrahyoid muscles, excepting thyrohyoid (only C1).
- ACCESSORY NERVE: accessory or spinal accessory nerve (cranial nerve XI) + cervical fibres ("ansa spinalis"): they innervate trapezius and sternocleidomastoid.



**CERVICAL PLEXUS: senstitive branches**

- LESSER OCCIPITAL nerve: mastoid area.
- GREATER AURICULAR nerve: ear.
- TRANSVERSE CERVICAL nerve: suprahyoid region and the superior-anterior portion of the neck.
- SUPRACLAVICULAR nerves: inferior portion of the neck, above the clavicle.

SUBCLAVIAN ARTERY

• THYROCERVICAL trunk (*"thyrobicervicoscapular"*):

- suprascapular
- transverse cervical: superficial branch *(muscular branches, mostly for the trapezium)*
- inferior thyroid
  - ↳ascending cervical (muscular and spinal branches)
  - ↳inferior laryngeal
    - ↳tracheal and oesophageal branches
    - ↳muscular branches

EXTERNAL CAROTID ARTERY

• SUPERIOR THYROID artery:

- superior laryngeal
- cricothyroid branch
- sternocleidomastoid branch

**NEUROVASCULAR BUNDLE OF THE NECK**

**COMMON CAROTID (medial) + INTERNAL JUGULAR (lateral) + VAGUS (posterior, in the angle between the common/internal carotid and the internal jugular)**

**-RELATIONSHIPS:**
**ANTERIOR: thyroid lobes, infrahyoid muscles and sternocleidomastoid. Ansa cervicalis.**
**POSTERIOR: prevertebral muscles.**
**MEDIAL: trachea, oesophagus, larynx and pharynx.**

**- The bundle is enveloped by a common sheath: the CAROTID SHEATH.**

**- The common carotid artery splits into internal and external carotid 1 cm above the superior border of the thyroid cartilage of the larynx. This happens more often at the level of C4, but it is quite variable.**

**- The external carotid artery is anterior to the internal one.**

**- At the beginning of both (more at the base of the internal) there is a dilation: the CAROTID SINUS (baroreceptor, innervated by the IX cranial nerve: glossopharyngeal).**

**- Posterior to the bifurcation, there is a small corpuscle surrounded by capillary vessels: the CAROTID GLOMUS or CAROTID BODY (chemoreceptor, also innervated by the IX cranial nerve).**

**The EXTERNAL JUGULAR VEIN drains the blood from the cranial walls, deep facial regions and the posterior and lateral part of the neck.**
**- It runs superficial to the sternocleidomastoid.**
**- It ends at the subclavian vein.**

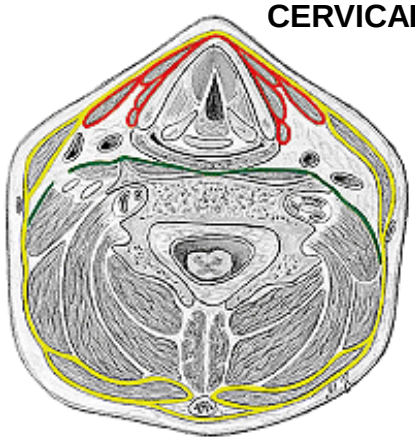
**The ANTERIOR JUGULAR VEIN drains the blood of the anterior part of the neck.**

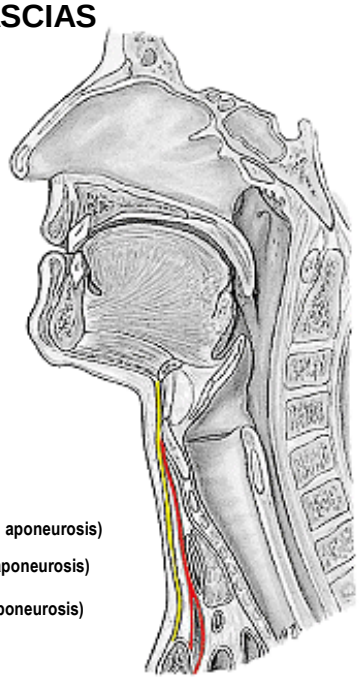
**It also ends at the subclavian.**



All the jugular veins from one side and the other anastomose variably.

## CERVICAL FASCIAS





SUPERFICIAL FASCIA (superficial cervical aponeurosis)

PRETRACHEAL FASCIA (middle cervical aponeurosis)

PREVERTEBRAL FASCIA (deep cervical aponeurosis)

**The SUPERFICIAL fascia splits into two to surround the sternocleidomastoid muscle.**

**The PRETRACHEAL fascia covers the infrahyoid muscles with two layers:**
**- SUPERFICIAL layer: surrounds the omohyoid and sternohyoid.**
**- DEEP layer: surrounds the sternothyroid and thyrohyoid.**

**The PREVERTEBRAL fascia covers the prevertebral and scalene muscles.**

## TOPOGRAPHIC ANATOMY

**BOUNDARIES OF THE NECK:**

**- ANTERIOR and SUPERIOR: hyoid bone and a curved line which follows approximately the outline of the posterior belly of the digastric muscle *(some authors say that this antero-superior boundary is the mandible).***

**- ANTERIOR and INFERIOR: jugular notch of the sternum and clavicles.**

**- POSTERIOR and SUPERIOR: external occipital protuberance and superior nuchal line.**

**- POSTERIOR and INFERIOR: a line between the acromion and the spinous process of C7.**

## TOPOGRAPHIC ANATOMY OF THE NECK

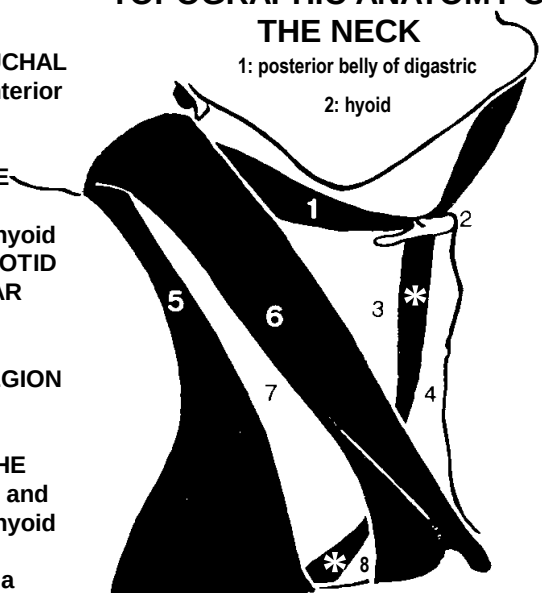
**REGIONS OF THE NECK:**

**- POSTERIOR CERVICAL or NUCHAL REGION (5): posterior to the anterior border of the trapezius muscle.**

**- ANTERIOR TRIANGLE OF THE NECK (3+4): anterior to sternocleidomastoid. The omohyoid muscle (*) divides it into a CAROTID TRIANGLE (3), and a MUSCULAR TRIANGLE (4).**

**- STERNOCLEIDOMASTOID REGION (6): overlaps with the muscle.**

**- POSTERIOR TRIANGLE OF THE NECK (7+8): between trapezius and sternocleidomastoid. The omohyoid muscle (*) divides it into an OCCIPITAL TRIANGLE (7), and a SUPRACLAVICULAR or SUBCLAVIAN TRIANGLE (8).**




**- Deep to them: PREVERTEBRAL REGION, with prevertebral muscles and the deep cervical aponeurosis.**

## POSTERIOR TRIANGLE OF THE NECK

**The inferior belly of the omohyoid muscle divides it into two triangles: OCCIPITAL TRIANGLE (superior) and SUPRACLAVICULAR or SUBCLAVIAN TRIANGLE (inferior, with the brachial plexus and the subclavian vessels).**

## ANTERIOR TRIANGLE OF THE NECK

**LAYERS OF THE MUSCULAR TRIANGLE:**

1) **Skin, subcutaneous fat.**
2) **Superficial cervical fascia.**
3) **Omohyoid and sternohyoid muscles, surrounded by the superficial layer of the pretracheal fascia.**
4) **Sternothyroid and thyrohyoid muscles, surrounded by the deep layer of the pretracheal fascia.**
5) **Thyroid gland**
6) **Larynx / trachea**
7) **Pharynx/oesophagus**

## CAROTID TRIANGLE

**It contains the carotid bifurcation.**

**FARABEUF'S TRIANGLE: between the internal jugular vein, the thyrolinguofacial trunk and the hypoglossal nerve. It usually contains the origin of the external carotid artery.**

## STERNOCLEIDOMASTOID REGION

**It contains, deep into the muscle, the neurovascular bundle of the neck.**



# GENERAL ANATOMY

# Osteology of the cranial vault, facial skeleton and base of the skull

## FONTANELLES AND SUTURES



**•ANTERIOR, BREGMATIC OR GREATER: until the middle of the second year.**

**• POSTERIOR or LAMBDOID: 2-3 months after birth.**

**• SPHENOIDAL, ANTEROLATERAL or PTERIC: 2-3 months after birth.**

**• MASTOID, POSTEROLATERAL or ASTERIC: at the end of the first year.**

**The cranial vault passes through three stages: FONTANELLAR, OSTEO-SUTURAL (until approx. 45 years of age the vault can vary in size) and SENILE (synostoses are formed).**

| BOUNDARIES OF THE ORBIT (quadrilateral pyramid) | |
|---|---|
| Base/ anterior boundary: ORBITAL OPENING | Superior: supraorbital margin (frontal bone), with the supraorbital foramen.<br>Lateral: frontal process of the zygomatic bone + zygomatic process of the frontal bone.<br>Inferior: infraorbital margin (zygomatic laterally, maxilla medially).<br>Medial: frontal (superior) + lacrimal crest of the frontal process of the maxilla. |
| Superior wall /roof | Frontal (orbital plate).<br>At the union between the roof and the medial wall, at the posterior end: optic foramen. |
| Medial wall | From anterior to posterior: frontal process of the maxilla, lacrimal, ethmoid (lamina papyracea) and sphenoid.<br>Between lacrimal and maxilla, lacrimal canal. It ends at the lacrimonasal duct, at the anterior part of the infero-medial border.<br>On the suture between the lamina papyracea and the frontal bone, we have the posterior and anterior ethmoidal foramina. |
| Lateral wall | Greater wing of the sphenoid and zygomatic bone.<br>Between the lateral wall and the roof, at the posterior end: SUPERIOR ORBITAL FISSURE. |
| Inferior wall/ floor | Mostly maxilla, with zygomatic. Posteriorly, orbital process of palatine bone.<br>Infraorbital groove and foramen. INFERIOR ORBITAL FISSURE. |
| Vertex/ posterior end | Medial portion of the SUPERIOR ORBITAL FISSURE. |

| BOUNDARIES OF THE NASAL FOSSAE | |
|---|---|
| Anterior boundary: ANTERIOR NASAL APERTURE | This is an unpaired opening, between the frontal process of the maxilla laterally, the nasal bones superiorly and the maxilla inferiorly.<br>Actually there are two nasal fossae, separated medially by cartilages: septal and greater alar cartilages. |
| Roof | From anterior to posterior: nasal bones, lamina cribosa of the ethmoid and body of the sphenoid, with the openings of the sphenoidal sinuses. |
| Medial wall: NASAL SEPTUM | Formed by the perpendicular plate of the ethmoid (anterosuperior) and the vomer (posteroinferior, between the body of the sphenoid and the hard palate: its posterior border is free of bony articulations).<br>Its most anterior portion is formed by the septal cartilage. |
| Floor | Superior aspect of the hard palate: palatine process of the maxilla (anterior) and horizontal plate of palatine bone (posterior).<br>In the anterior portion, incisive canal, which communicates with the oral cavity. |
| Lateral wall | Maxilla (body and frontal process) + sphenoid (medial plate of the pterygoid process) + palatine (vertical or perpendicular plate) + lacrimal + ethmoid + inferior concha.<br>Three conchae (SUPERIOR and MIDDLE, which are part of the ethmoid bone; INFERIOR, an independent bone), which cover one MEATUS each. |
| Posterior boundary: POSTERIOR NASAL APERTURES (CHOANAE) | Separated by the posterior border of the vomer. Inferiorly, they have the border of the horizontal plate of the palatine bone, superiorly the sphenoid and laterally the medial plates of the pterygoid processes. |



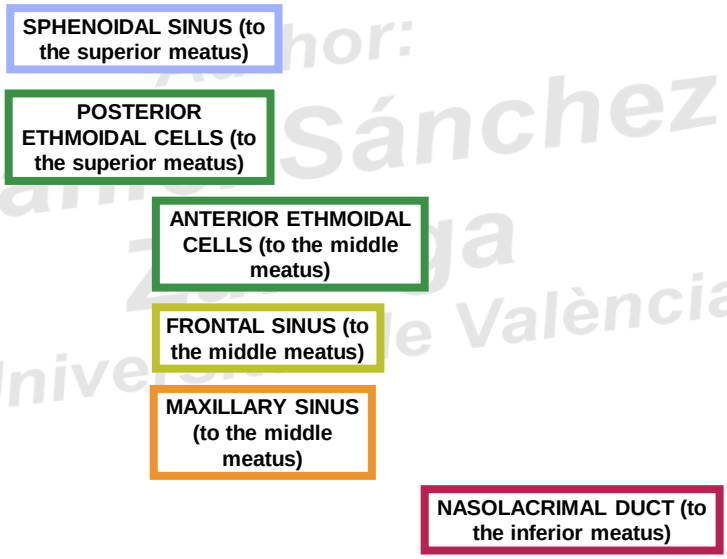
## PARANASAL SINUSES



- **MAXILLARY:** middle meatus
- **ETHMOIDAL:** posterior (superior meatus) and anterior (middle meatus)
- **SPHENOIDAL:** superior meatus
- **FRONTAL:** middle meatus

**The NASOLACRIMAL DUCT drains to the inferior meatus.**

# PARANASAL SINUSES




| BOUNDARIES OF THE INFRATEMPORAL FOSSA | |
|---|---|
| LATERAL, INFERIOR, POSTERIOR | There is no definite boundary. The mandible would close laterally the infratemporal region. |
| ANTERIOR | Maxillary tuberosity |
| SUPERIOR | Inferior surface of the greater sphenoidal wing (with spinosum and ovale foramina), part of the squamous portion of the temporal bone. Lateral and superior to the infratemporal crest (union of the temporal and horizontal surfaces of the greater wing of the sphenoid), the infratemporal fossa is continuous with the temporal fossa. |
| MEDIAL | Lateral plate of the pterygoid process. Anterior to the pterygoid process, PTERYGOMAXILLARY FISSURE, which communicates with the PTERYGOPALATINE FOSSA (the background of the infratemporal fossa). Superiorly, the pterygomaxillary fissure communicates with the posterior portion of the INFERIOR ORBITAL FISSURE, which communicates the infratemporal fossa with the orbit. |
| CONTENTS | Pterygoid muscles, maxillary vessels and branches of maxillary and mandibular nerves. |

| BOUNDARIES OF THE PTERYGOPALATINE FOSSA | |
|---|---|
| **LATERAL** | It is open to the infratemporal fossa through the pterygomaxillary fissure. |
| **MEDIAL (deep end of the fossa)** | Vertical/ perpendicular plate of the palatine. At its superior portion, SPHENOPALATINE FORAMEN, which opens to the lateral wall of the nasal cavity. |
| **ANTERIOR** | Medial surface of the maxillary tuberosity. |
| **POSTERIOR** | Anterior surface of the pterygoid process, with the pterygoid or vidian canal at its upper portion. |
| **SUPERIOR** | Greater wing of the sphenoid (with foramen rotundum and inferior orbital fissure). |
| **INFERIOR (vertex of the pterygopalatine fossa)** | Union between the pterygoid process, the pyramidal process of the palatine and the maxillary tuberosity.<br>The greater and lesser palatine canals are close to the vertex. |
| **CONTENTS** | The MAXILLARY nerve (second branch of the trigeminal) enters the endocranium by the foramen rotundum, and it gets formed at the fossa, from branches entering the fossa from different foramina.<br>The VIDIAN NERVE or NERVE OF THE PTERYGOID CANAL (cephalic autonomous nerves) enters the fossa through the pterygoid canal and finds in the fossa the PTERYGOPALATINE ganglion, the origin of several branches which are distributed through the different foramina.<br>MAXILLARY vessels also create branches in the fossa. |

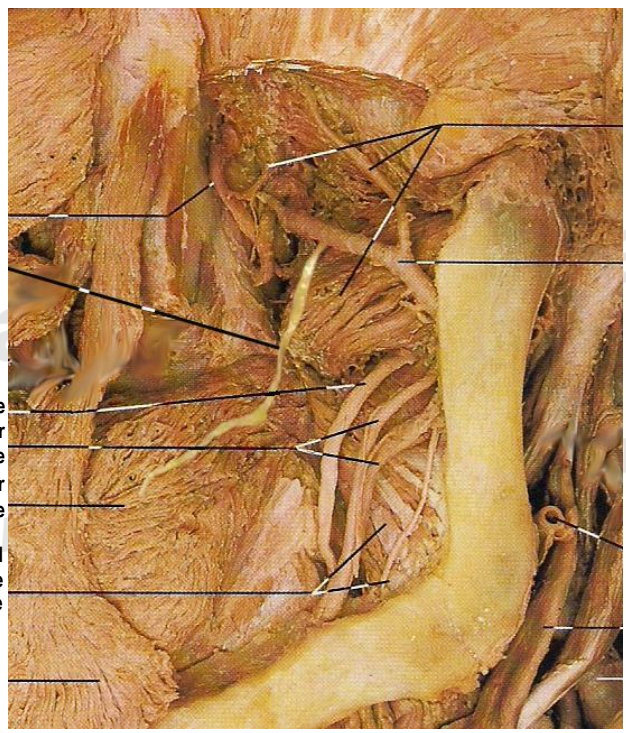


# GENERAL ANATOMY

## Mandible and temporomandibular joint. Muscles of mastication.

| Muscle | | Attachment | Attachment (mandibular) | Action |
|---|---|---|---|---|
| MASTICATORY | LATERAL PTERYGOID | SPHENOID or SUPERIOR head: horizontal surface + infratemporal crest of the greater wing of the sphenoid. | Pterygoid fossa of the head of the mandible. *Some textbooks say that the superior head goes to the articular disc.* | MEDIAL alone, bilaterally: ELEVATION of the mandible. LATERAL alone, bilaterally: PROTRUSION. Medial + lateral, bilaterally: protrusion. Medial + lateral, unilaterally: rotation to that side, which, when repeated alternating sides causes grinding/ chewing motions (diduction). |
| | | PTERYGOID or INFERIOR head: lateral surface of the lateral plate of the pterygoid process. | | |
| | MEDIAL PTERYGOID | DEEP head: pterygoid fossa. | Medial surface of the mandibular angle. | |
| | | SUPERFICIAL head: lateral plate of the pterygoid process and maxillary tuberosity. | | |
| | TEMPORALIS | Temporal fossa | Coronoid process | ELEVATION and side rotation of the mandible. Retrusion: posterior fibres of temporalis, deep of the masseter. Protrusion: only slightly masseter. |
| | MASSETER | SUPERFICIAL portion: zygomatic arch, anterior 2/3 of its inferior border. | Lateral surface of the mandibular ramus, from the mandibular notch to the mandibular angle. | |
| | | DEEP portion: zygomatic arch, medial surface, posterior 1/3 of its inferior border. | | |
| MYLOHYOID | | Anterior surface of the hyoid bone. Its fibres crisscross with the fibres of the other side at the midline (raphe). | Mylohyoid line, on the inner surface of the mandible. | DEPRESSION of the mandible/ elevation of the hyoid bone. They help with mandibular retrusion. They make up the floor of the mouth, and they elevate it together with the tongue during deglutition. |
| ANTERIOR BELLY OF THE DIGASTRIC MUSCLE | | Intermediate tendon at the lesser horn of the hyoid bone. | Digastric fossa on the anterior portion of the inner surface of the mandibular body. | |
| | | It is in contact with the inferior surface of the mylohyoid. The posterior belly goes to the mastoid process, innervation: facial nerve. | | |

All these muscles are innervated by the motor branches of the **mandibular nerve** (third branch of the trigeminal nerve, cranial nerve V). It also innervates **tensor veli palatini** and **tensor tympani.**



# GENERAL ANATOMY

## Facial muscles and nerves

| | MUSCLE | ATTACHMENT | ATTACHMENT | ACTION |
|---|---|---|---|---|
| NON EMI GRA TED | Stylohyoid | Styloid process | Body of the hyoid | It raises the hyoid bone. |
| | Digastric (posterior belly) | Mastoid notch | Tendon through a hyoid pulley | Mandible depression/ hyoid elevation |
| | Stapedius | Tympanic cavity | Neck of the stapes | It fixates stapes. |
| EPI CRA NIAL | Occipitofrontalis | Highest nuchal line (occipital). Superficial fascia eyebrows (frontal). | Anterior and posterior borders of the epicranial aponeurosis. | It raises the eyebrows and throws the forehead into transverse wrinkles. |
| OR BIT | Orbicularis oculi | Medial border of the orbit, lacrimal canal. The fibres form complete ellipses. There are orbital, palpebral and lacrimal fibers. | | Sphincter muscle of the eyelids. It aids tear drainage. |
| | Corrugator supercilii | Medial end of the superciliary arch. | Skin above the supraorbital margin. | They move the eyebrows, and cause frowning ("corrugator glabellae"). |
| NA SAL | Procerus | Nasal bone | Skin of the glabella | |
| | Nasalis (transverse and alar parts) | Maxilla (nasolabial fold) | Bridge of nose (transverse) Lateral border of the nostril (alar) | Transverse: closes the nostrils. Alar: dilates the nostrils. |
| | Depressor septi nasi | Maxilla (incisors) | Mobile part of the nasal septum | It dilates the nostrils. |
| BU CCO LA BIAL | Levator labii superioris alaeque nasi | Frontal process of the maxilla. | Major alar cartilage of the nose, lateral portion of the upper lip. | LLSAN also dilates the nostrils. |
| | Levator labii superioris | Bone above the infraorbital foramen. | Upper lip | They raise and evert the upper lip, deepen the nasolabial fold. |
| | Levator anguli oris | Maxilla, just below the infraorbital foramen. | Angle of the mouth (modiolus) | They raise the angle of the mouth in smiling, and deepen the nasolabial fold. |
| | Zygomaticus major | Zygomatic bone | | |
| | Zygomaticus minor | | Upper lip | Raises upper lip, deepens nasolabial fold. |
| | Mentalis | Mandible (incisors) | Skin of the chin | Protrusion + eversion of lower lip (pout) |
| | Depressor labii inferioris | Medial portion of the oblique line of the mandible. | Medial portion of the lower lip, blending with the other one. | It draws the lower lip downwards and laterally. |
| | Depressor anguli oris | Oblique line, lateral/ inferior to DLI. | Angle of the mouth (modiolus) | It draws down the angle of the mouth. |
| | Orbicularis oris | It is attached to both modioli. Its fibres fan out, spliting into several segmental portions which fuse with the nearby muscles. | | It closes the oral fissure. Takes part in speech and suction. |
| | Buccinator | Alveolar processes of maxilla and mandible, pterygomanbibular raphe. | Angle of the mouth (modiolus). | It closes the space between maxilla and mandible, and compresses the cheek against the teeth (blowing). |
| Auricular (ant, sup, post and intrinsic) | | Cartilages of the auricle. | Epicranial aponeurosis (not intrinsic). | Vestigial, very little effect. |
| Platysma | | Skin of the shoulder girdle | Skin of the chin, lower lip, | It draws down the angle of the mouth |

## EXTRAPETROUS PORTION OF THE FACIAL NERVE



**Before the parotid gland:**

**- Posterior auricular nerve (auricular and occipital from occipitofrontalis muscles). It may also carry sensitivity from the external acoustic duct and part of the tympanic membrane and the auricle (not well known).**

**- Nerve for the sylohyoid and posterior belly of the digastric.**

**Inside the parotid gland:**

**- Temporofacial (temporal, zygomatic and superior buccal branches) .**
**- Cervicofacial (inferior buccal, mandibular and cervical branches).**



# GENERAL ANATOMY

# Dermoneural systems of the head. Trigeminal nerve.

**TRIGEMINAL NERVE: OPHTHALMIC BRANCH ($V_1$):** intracranially, it results in the **tentorial nerve** (meninges). The rest of its branches enter the orbit through the superior orbital fissure.

- LACRIMAL NERVE (outside the common tendinous ring / annulus of Zinn)

  - It gets autonomic fibres of the superior salivatory nucleus from the zygomaticotemporal nerve.

  - It innervates the lacrimal gland, the near conjunctiva and part of the skin of the superior eyelid.

- FRONTAL NERVE (outside the common tendinous ring / annulus of Zinn)

  - **Supratrochlear nerve**. It innervates parts of the conjunctiva, the superior eyelid and the skin of the forehead.

  - **Supraorbital nerve**. It passes through the supraorbital foramen. It innervates part of the conjunctiva and the upper eyelid, the frontal sinus and a great portion of scalp.

- NASOCILIARY NERVE (through the common tendinous ring / annulus of Zinn). It connects with the ciliary ganglion (**long ciliary nerves** and **communicating branches to the ciliary ganglion + short ciliary nerves**: sensitive + autonomic innervation of the eye)

  - **Anterior ethmoidal nerve**. It goes through the anterior ethmoidal foramen into the ethmoidal cells, and then enters the intracranial cavity close to the lamina cribosa. From there, it goes into the nasal cavity, and innervates part of its lateral and medial walls.

  - **Posterior ethmoidal nerve**. It goes through the posterior ethmoidal foramen, to innervate the sphenoidal sinus and part of the ethmoidal cells.

  - **Infratrochlear nerve**. It innervates the skin of the medial portion of the eyelids, the lacrimal sac, and the lateral portion of the nose.

**TRIGEMINAL NERVE: MAXILLARY BRANCH ($V_2$)**

It has meningeal branches, and crosses the foramen rotundum towards the pterygopalatine fossa. It carries autonomic branches of the pterygopalatine ganglion.

- ZYGOMATIC NERVE: It enters the orbit through the inferior orbital fissure.

- **Zygomaticotemporal nerve**. It goes through the zygomatic bone and enters the temporal fossa. It innervates the skin of the temple. It carries autonomic fibres to the lacrimal nerve.
- **Zygomaticofacial nerve.** It goes through the zygomatic bone, innervating the prominence of the cheek.

- POSTERIOR SUPERIOR ALVEOLAR (DENTAL) NERVE: it joins the maxillary nerve in the pterygopalatine fossa. It perforates the maxilla, innervating the maxillary sinus and the superior molars.

- INFRAORBITAL NERVE (terminal branch): infraorbital groove and canal, and through the infraorbital foramen. It innervates the lateral portion of the nose, the inferior eyelid, the skin of the cheek and upper lip.
  - **Middle superior alveolar (dental) nerve.** Variable. It arises from the infraorbital nerve as it runs in the infraorbital groove, and innervates the upper premolar teeth.
  - **Anterior superior alveolar (dental) nerve.** It leaves the infraorbital nerve in its canal and supplies the superior incisor and canine teeth. It gives off a nasal branch, which passes through a minute canal in the lateral wall of the nasal cavity to supply anterior areas of the lateral, inferior and medial walls of the nasal cavity.

- PALATINE NERVES: Through the palatine ducts. With autonomic + gustatory fibres (supratympanic pathway)
- **Greater palatine nerve.** Inside the greater palatine duct, provides branches for the posterior portion of the nasal cavity and the inferior concha. It leaves through the greater palatine foramen. It supplies the gums and the mucosa and glands of the hard palate, excepting its most anterior portion.
- **Lesser palatine nerve.** It leaves through the lesser palatine foramen. It supplies the soft palate.

- NASAL NERVES: Through the sphenopalatine foramen
- **Lateral posterior superior nasal nerve.** It innervates the superior and middle conchae.
- **Nasopalatine nerve.** It follows and innervates the nasal septum down to the incisive duct, through which it passes to the most anterior portion of the hard palate.

- PHARYNGEAL BRANCH: it arises in the pterygopalatine fossa. It goes through the palatovaginal canal, to innervate the mucosa of the nasopharynx.

**TRIGEMINAL NERVE: MANDIBULAR BRANCH ($V_3$)**

It goes through the foramen ovale. It carries sensitive and motor fibres (masticatory muscles). It gives off the **recurrent meningeal nerve** and the **nerve to medial pterygoid** (which in turn provides the **nerve to tensor veli palatini** and the **nerve to tensor tympani**). Then it divides into an **anterior trunk** (with most of the motor branches) and a **posterior trunk** (sensitive, excepting the **nerve to mylohyoid**, which innervates mylohyoid and anterior belly of the digastric muscles).

- RECURRENT MENINGEAL NERVE: it re-enters the intracranial cavity through the spinous foramen with the middle meningeal artery. It innervates the dura mater of the middle and anterior cranial fossae.

• ANTERIOR TRUNK

- **Motor branches:** masseteric nerve, deep temporal nerves, lateral pterygoid nerve.
- **Buccal nerve:** It crosses between the two heads of the lateral pterygoid muscle, and innervates the skin of the cheek, the oral mucosa and part of the gums.

• POSTERIOR TRUNK

- **Auriculotemporal nerve:** it is born as two roots which encircle the middle meningeal artery, and then converge in a single nerve. It gives off anterior branches to the auricle, and innervates also the external acoustic duct and tympanic membrane, the temporomandibular joint and the temporal region. *It carries parasympathetic fibres of the otic ganglion to the parotid gland.*
- **Lingual nerve:** It crosses between the lateral and medial pterygoid muscles. It innervates the anterior 2/3 of the tongue, the mucosa infero-lateral to the tongue at the floor of the mouth and the lingual side of the gums of all the inferior teeth. *It also carries the gustatory sensitivity of the chorda tympani nerve (infratympanic pathway), and autonomic fibres to the submandibular and sublingual glands.*
- **Inferior alveolar (dental) nerve:** It also crosses between the lateral and medial pterygoid muscles. Before entering the mandibular duct it gives off the **nerve to mylohyoid** (motor). It follows the mandibular duct and innervates the molars and premolars, until between both premolars it splits into the **incisive nerve** (terminal branch, which follows the canal and innervates the incisors and the canines) and the **mental nerve** (which leaves through the mental foramen, and innervates the lower lip, chin and part of the gums).

## MENINGEAL INNERVATION

**Ophthalmic nerve:**

- recurrent meningeal branch (tentorial nerve)
- anterior and posterior ethmoidal nerves

**Maxillary nerve:** meningeal branches

**Mandibular nerve:** recurrent meningeal branch (nervus spinosus)

**FUNCTIONS OF THE TRIGEMINAL NERVE**

- **Sensory innervation of the face.**
- **Sensory innervation of the nasal, lingual, palatine and nasopharyngeal mucosae. It carries parasympathetic innervation.**
- **Gustatory sensitivity of the two anterior thirds of the tongue (fibres of the chorda tympani nerve, infratympanic pathway) and the soft palate (supratympanic pathway).**
- **Motor innervation of the masticatory muscles.**



# GENERAL ANATOMY

# External carotid artery

## NON-TERMINAL BRANCHES OF THE EXTERNAL CAROTID ARTERY

• SUPERIOR THYROID, with infrahyoid, superior laryngeal, cricothyroid and sternocleidomastoid branches.



• LINGUAL. It will be explained with the rest of the lingual structures.

• ASCENDING PHARYNGEAL ARTERY. It ascends vertically between the internal carotid and the pharynx.

-**Pharyngeal branches.**

-**Meningeal branches.** They enter the intracranial cavity through several foramina (jugular, hypoglossal…) and irrigate the near meninges. The **posterior meningeal artery** passes through the jugular foramen and it is the terminal branch of the ascending pharyngeal artery.

• FACIAL. It is tortuous and superficial. It ascends surrounding the submandibular gland and the mandible, anterior to the masseter muscle (pulse palpation). It crosses the buccinator and ascends lateral to the nose, ending at the medial angle of the eye anastomosed to branches of the ophthalmic artery. It anastomoses a lot to branches of the contralateral facial, lingual, maxillary or ophthalmic arteries.

- **Ascending palatine artery.** It ascends with the pharynx to the soft palate and the palatine tonsil.
- **Tonsillar.** The main artery of the palatine tonsil.
- **Glandular branches.** For the submandibular gland.
- **Submental.** It irrigates the submental muscles (mylohyoid, digastric).
- **Inferior and superior labial arteries.** They separate from the facial at the oral angles and run along the borders of their respective lips until they anastomose to the contralateral. The superior gives off a **septal** branch for the nasal septum.
- **Lateral nasal.** It irrigates the ala and dorsum of the nose.
- **Angular.** It is the terminal branch of the facial artery. It ascends lateral to the nose until it anastomoses with the dorsal nasal artery, a branch of the ophthalmic artery.



• OCCIPITAL. It runs posterior and superior, behind the mastoid process and the posterior belly of the digastric. It irrigates the sternocleidomastoid and the posterior back muscles, the meninges of the posterior cranial fossa (through several foramina) and the occipital cranial region.

• POSTERIOR AURICULAR. It also runs posterior and superior, between the parotid gland, the styloid and mastoid processes. It irrigates the muscles of the area, the parotid gland, the auricle and the occipital region (where it anastomoses with the occipital artery).

- One of its branches is the **stylomastoid artery**, which joins the facial nerve through the stylomastoid foramen and irrigates the tympanic cavity.

## MAXILLARY ARTERY

It arises behind the neck of the mandible, and is at first imbedded in the substance of the parotid gland. After crossing the neck of the mandible, it enters the infratemporal fossa. Then it passes through the two heads of the lateral pterygoid muscle (there are many variations) and enters the pterygopalatine fossa. It has then THREE portions: **mandibular** (related to the neck of the mandible), **pterygoid** (in the infratemporal fossa, related to the pterygoid muscles) and **pterygopalatine** (in the pterygopalatine fossa).

**BRANCHES AT THE MANDIBULAR PORTION**

• DEEP AURICULAR. It is inside the parotid gland. It pierces the wall of the external acoustic duct and irrigates it with the tympanic membrane. It irrigates the temporo-mandibular joint.

•ANTERIOR TYMPANIC. It irrigates the tympanic cavity through the petrotympanic fissure.

•MIDDLE MENINGEAL. It is the biggest of the meningeal arteries. The auriculotemporal nerve wraps around the artery, which enters the cranial cavity through the spinous foramen. Its branches form grooves on the inner cranial surface.

- The middle meningeal artery has an **anastomotic branch**, which enters the orbit through the superior orbital fissure, and anastomoses with the lacrimal artery (a branch of the ophthalmic, which in turn comes from the internal carotid).

•INFERIOR ALVEOLAR (DENTAL). Its course and branches are similar to the nerve of the same name. It irrigates the lower teeth and the mental region.

**BRANCHES AT THE PTERYGOID PORTION:** muscular branches for the masticatory muscles and buccal artery. Very similar and satellite to the branches of the anterior trunk of the mandibular branch of the trigeminal ($V_3$).

**BRANCHES AT THE PTERYGOPALATINE PORTION** *(similar and satellite to the branches of $V_2$).*

• SUPERIOR POSTERIOR ALVEOLAR (DENTAL). It follows a course parallel to the nerve. It irrigates the maxillary sinus, the superior molars and premolars and their gums.

• INFRAORBITAL Course and branches parallel to the nerve.

- At the infraorbital duct the **superior anterior alveolar (dental) artery** gives off**.** It irrigates the maxillary sinus, the incisors and the superior canine.

• GREATER or DESCENDING PALATINE. It descends through the palatine canal. It Irrigates the hard palate through the greater palatine foramen.

- **Lesser palatine branches.** They emerge from the lesser palatine foramina and irrigate the soft palate and the palatine tonsil.
- **Anastomotic branch with the sphenopalatine artery.** It is the terminal branch of the greater palatine artery and goes up to the nasal cavity through the incisive duct.

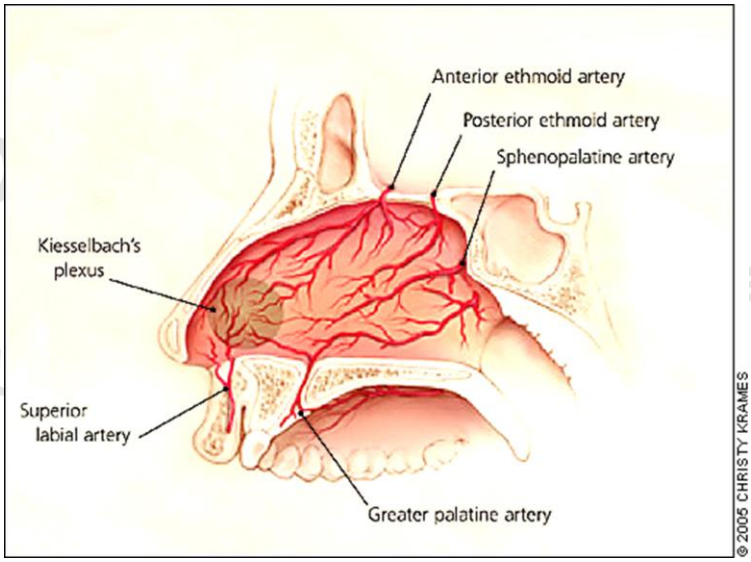
• PHARYNGEAL. It irrigates the nasopharynx through the palatovaginal duct.

• VIDIAN or ARTERY OF THE PTERYGOID CANAL. It goes through the vidian or pterygoid canal and irrigates the mucosa of the roof of the pharynx.

• SPHENOPALATINE. It is the terminal branch of the maxillary artery. It enters the nasal cavity through the sphenopalatine foramen and it branches on its lateral and medial walls (**posterior septal** and **posterior lateral nasal** arteries).

## IRRIGATION OF THE NASAL CAVITY: KIESSELBACH'S AREA

At **Kiesselbach's area** four nasal irrigation systems are anastomosed: branches of the anterior ethmoidal, sphenopalatine, greater palatine and superior labial arteries. More than 80% of nosebleeds (epistaxis) come from here.




## SUPERFICIAL TEMPORAL ARTERY

It comes from the final bifurcation of the external carotid artery imbedded at first in the substance of the parotid gland. It ascends between the neck of the mandible and the auricle.

It irrigates the parotid gland, the temporo-mandibular joint and the masseter. Branches:

•TRANSVERSE FACIAL. It is originated inside the parotid gland. It runs anteriorly towards the cheek, irrigating the gland and the masseter, and forming anastomoses with all the arteries of the region.

• ANTERIOR AURICULAR BRANCHES. For the auricle.

• ZYGOMATICO-ORBITAL. It runs over the zygomatic arch to the external border of orbicularis oculi. It is anastomosed with branches of the ophthalmic artery. It is often a branch of the middle temporal artery.

• MIDDLE TEMPORAL. It irrigates the temporalis muscle.

•TERMINAL BRANCHES:

- **Frontal or anterior**
- **Parietal or posterior**

# GENERAL ANATOMY

# Veins of the cephalic region. Topographic anatomy.

## INTERNAL JUGULAR VEIN

It is formed by the union of the **inferior petrosal and sigmoid sinuses** at the **jugular foramen**. It goes down the neck together with the internal carotid and common carotid arteries inside the cervical neurovascular bundle. It ends joining the subclavian vein to form the **brachiocephalic vein** (both brachiocephalic veins merge to form the superior vena cava). Tributaries (apart from the sigmoid and inferior petrosal sinuses):

• **MIDDLE THYROID VEIN**

• **SUPERIOR THYROID VEIN.** Drains the **superior laryngeal** vein.

• **LINGUAL VEIN**

• **PHARYNGEAL VEINS**

• **FACIAL VEIN.** Its first portion is the **angular** vein, which is formed by the union of the supratrochlear and supraorbital veins at the medial angle of the orbit. Tributaries:

- **Supratrochlear.** It runs along the midline of the forehead.
- **Supraorbital.** It passes deep to orbicularis oculi. One of its branches comes from the superior ophthalmic vein (which in turn drains to the cavernous sinus) through the supraorbital foramen.
- **Deep facial.** It drains blood from the pterygoid plexus (also communicated with the cavernous sinus), and facial structures (inf. palpebral, labial, buccinator, parotid, masseteric veins…)
- **Submental, tonsillar…**

**EXTERNAL JUGULAR VEIN**

It is formed usually inside the parotid gland, like the union of the **posterior auricular vein** and the **posterior division** of the **retromandibular vein** (its anterior division joins the facial vein). It is superficial to the sternocleidomastoid muscle and drains to the subclavian vein. It may be absent or very thin if the retromandibular vein drains exclusively through its anterior division to the facial vein. Tributaries:

• **SUPERFICIAL TEMPORAL.** It drains part of a diffuse web of veins which gets the blood of the cranial vault also to other trunks, such as the supratrochlear, supraorbital, posterior auricular and occipital.

• **MAXILLARY.** The venous blood from the maxillary system drains to the **PTERYGOID PLEXUS.** This plexus drains partially to the deep facial vein and gets some branches from the cavernous sinus. However, its main drainage is through the **maxillary vein**, which joins the superficial temporal vein.

• The union of the maxillary and superficial temporal veins forms the **RETROMANDIBULAR VEIN.** This vein is inside the parotid gland, and drains through two branches: an **anterior** one to the facial vein, and a **posterior** one which joins the posterior auricular to form the external jugular vein.

• **POSTERIOR AURICULAR .** It drains the blood of the parieto-occipital region of the cranium and the auricle. It may drain also the **occipital vein** (which may also drain directly to the external jugular or to posterior veins of the neck)**.**

## SUBMANDIBULAR TRIANGLE

| | |
|---|---|
| **MEDIALLY** | **Anterior belly of the digastric muscle** |
| **ANTERO-LATERALLY** | **Inferior border of the mandible** |
| **POSTERO-LATERALLY** | **Posterior belly of the digastric muscle** |
| **CONTENTS** | **Submandibular gland with vessels, nerves and its duct** |

## SUBMENTAL TRIANGLE (unpaired)

| | |
|---|---|
| **INFERIORLY** | **Body of the hyoid** |
| **LATERALLY** | **Both anterior bellies of the digastric muscle** |
| **CONTENTS** | **Mylohyoid muscles, submental lymph nodes** |



## BUCCAL FAT PAD OR BICHAT'S FAT PAD

In the cheek we find, between the most superficial muscle fibres (zygomaticus major/ minor and risorius) and the deeper ones (mostly the buccinator) the **buccal fat pad** (also called **Bichat's fat pad**).

# STRUCTURES TO IDENTIFY IN THE BACK. ANATOMY: PRACTICE SESSION

**VERTEBRAE:** differentiate them and check all their specific features. Cervical, thoracic, lumbar and sacrum.

**CADAVER: muscles**

- Trapezius
- Rhomboids:
  - Major
  - Minor
- Levator scapulae
- Serrati posterior:
  - Superior
  - Inferior
  - Interserratic fascia
- Latissimus dorsi
- Erector spinae
  - Spinalis
  - Longissimus
    - Thoracis (with its lumbar portion)
    - Cervicis
    - Capitis
  - Iliocostalis
    - Lumborum
    - Thoracis
    - Cervicis
  - Sacrolumbar common mass
- Splenius
  - Cervicis
  - Capitis
- Semispinalis
  - Cervicis
  - Capitis
    - Greater occipital nerve (Arnold, C2)
    - Occipital artery
- Suboccipital muscles (suboccipital triangle): inside, posterior arch of the atlas + vertebral artery + suboccipital nerve, dorsal branch of C1).
  - Rectus capitis posterior
    - Major
    - Minor
  - Obliquus capitis
    - Inferior
    - Superior

**STRUCTURES TO IDENTIFY IN THE FIRST LOWER LIMB PRACTICESESSION**

## BONES

- **Femur**
  - Condyles
    - Lateral condyle
    - Medial condyle
- **Tibia**
  - Tibial plateau
    - Articular facets
    - Lateral condyle
    - Medial condyle
    - Intercondylar eminence
    - Anterior intercondylar area
    - Posterior intercondylar area
  - Condyles
    - Lateral condyle
    - Medial condyle
  - Tibial tuberosity
  - Soleal line
  - Medial malleolus
- **Fibula**
  - Head
  - Lateral malleolus
- **Bones of the foot**
  - Calcaneus
    - Lesser process or sustentaculum tali
    - Greater process (articular facet for the cuboid)
    - Calcaneal tuberosity
  - Talus
  - Cuboid
  - Navicular
  - Cuneiform bones
    - Medial
    - Intermediate
    - Lateral
  - Metatarsals
    - First
      - ✓ Sesamoid bones
    - Second
    - Third
    - Fourth
    - Fifth
      - ✓ Tuberosity or styloid process of the fifth metatarsal
  - Toes: phalanges
    - Proximal
    - Middle
    - Distal
    - First toe (hallux): proximal and distal phalanges

## CADAVER

- **Sole of the foot**
  - Plantar fascia
  - Central group of muscles
    - Flexor digitorum brevis
    - Flexor digitorum longus tendon
      - ✓ Quadratus plantae
      - ✓ Lumbricals
  - Medial group of muscles
    - Abductor hallucis
    - Flexor hallucis brevis
    - Flexor hallucis longus tendon
      - ✓ Plantar chiasm
  - Lateral group of muscles
    - Abductor digiti minimi
    - Opponens/flexor digiti minimi brevis
  - Plantar nerves and vessels, with their bifurcation:
    - Lateral
    - Medial
  - Toes:
    - Piercing tendon (flexor digitorum longus)
    - Pierced tendon (flexor digitorum brevis)
- **Posterior aspect of the leg (calf)**
  - Lesser saphenous vein
  - Sural nerve
  - Gastrocnemius muscle
    - Lateral head
    - Medial head
  - Plantaris muscle

- Soleus muscle
  - Tendinous arch of the soleus
  - Popliteal vein
  - Popliteal artery
- Calcaneal or Achilles tendon
- Popliteal muscle
- Nerves and vessels of the posterior compartment of the leg:
  - Posterior tibial artery
  - Fibular artery
  - Tibial nerve
    - ✓ Bifurcation of medial and lateral plantar nerves
- Deep muscles:
  - Flexor hallucis longus
  - Flexor digitorum longus
  - Tibialis posterior
    - ✓ Crural chiasm

## STRUCTURES TO IDENTIFY IN THE SECOND LOWER LIMB PRACTICE SESSION

### BONES

- **Pelvis**
  - Ilium
    - Iliac crest
    - Gluteal lines
    - Iliac spines
      - ✓ anterosuperior
      - ✓ anteroinferior
      - ✓ posterosuperior
      - ✓ posteroinferior
    - Iliopubic or iliopectineal eminence
    - Greater sciatic notch
    - Arcuate or innominate line
    - Sacroiliac joint
  - Pubis
    - Superior ramus
      - ✓ Pectineal surface
      - ✓ Obturator groove
    - Inferior ramus
    - Body
      - ✓ Pubic tubercle
      - ✓ Pubic symphysis
      - ✓ Subpubic angle or arch
  - Ischium
    - Ischial tuberosity
    - Sciatic or ischial spine
    - Lesser sciatic notch
  - Acetabulum
    - Lunate surface
    - Notch
    - Limbus
- **Femur**
  - Head
    - Fossa of the head of femur
  - Neck
  - Trochanters
    - Greater trochanter
    - Lesser trochanter
    - Intertrochanteric line
    - Intertrochanteric crest
    - Trochanteric fossa *("digital")*
  - Gluteal tuberosity
  - Linea aspera
  - Condyles
    - Lateral condyle
    - Lateral epicondyle
    - Medial condyle
    - Medial epicondyle
    - Adductor tubercle
    - Intercondylar fossa
  - Patellar surface (femoral trochlea)

- **MUSCLES: Posterior aspect of the thigh**
  - Semitendinosus
    - Pes anserinus superficialis
  - Semimembranosus
  - Biceps femoris
    - Long head (ischial)
    - Short head (femoral)
  - Adductor magnus, in the background
    - Adductor hiatus
    - Perforating vessels
  - Posterior femoral cutaneous nerve
  - Sciatic nerve
    - Division into tibial and common fibular nerves
  - Popliteal fossa
    - Popliteal artery
    - Popliteal vein

- **MUSCLES: Gluteal region**
  - Gluteus maximus
  - Gluteus medius
  - Gluteus minimus
  - Piriformis
    - Suprapiriform foramen
      - ✓ Superior gluteal nerves and vessels
    - Infrapiriform foramen
      - ✓ Inferior gluteal nerves and vessels
      - ✓ Sciatic nerve
      - ✓ Posterior femoral cutaneous nerve
      - ✓ Pudendal nerve
  - Obturator internus
    - Gemellus superior
    - Gemellus inferior
  - Quadratus femoris

**STRUCTURES TO IDENTIFY IN THE THIRD LOWER LIMB PRACTICE SESSION**

- **Anterior aspect of the thigh**
  - Tensor fasciae latae
    - Fascia lata
    - Lateral cutaneous femoral nerve
  - Sartorius
  - Quadriceps femoris
    - Rectus femoris
    - Vastus medialis
    - Vastus lateralis
    - Vastus intermedius
    - Patella and quadriceps tendon
    - Patellar tendon
    - Cruciate ligaments inside the knee joint
  - Iliopsoas
    - Femoral nerve
    - Saphenous nerve
  - Pectineus
  - Adductor longus
  - Adductor brevis
    - Anterior branch of the obturator nerve
    - Posterior branch of the obturator nerve
  - Adductor magnus
    - Vastoadductor membrane
  - Gracilis
    - Pes anserinus superficialis
  - Femoral artery and vein
    - Deep femoral artery and vein
    - Circumflex femoral artery
    - Perforating branches
  - Great saphenous vein
    - Saphenous arch

- **Anterior and lateral aspects of the leg**
  - Tibialis anterior
    - Anterior tibial vessels
    - Deep peroneal nerve
  - Extensor hallucis longus
  - Extensor digitorum longus
    - Peroneus tertius
  - Peroneus longus
    - Bifurcation of the common peroneal nerve
    - Superficial peroneal nerve
  - Peroneus brevis
  - Interosseous membrane

- **Dorsal surface of the foot**
  - Extensor retinaculum
  - Extensor digitorum/hallucis brevis
  - Dorsalis pedis artery (dorsal artery of the foot)

On the dorsal surface of the foot many structures we have listed at more proximal levels are continued (deep peroneal nerve, tendons of the extensor muscles, etc.), and they should be identified too. The same happens at the level of the leg with the structures listed on the thigh (saphenous nerve, great saphenous vein, etc.).

**STRUCTURES TO IDENTIFY IN THE FIRST UPPER LIMB PRACTICE SESSION**

## BONES

- **Radius**
  - Head (with articular surface for the humeral capitulum) and neck
  - Radial tuberosity
  - Styloid process
  - Ulnar notch/ sigmoid cavity
  - Grooves for the extensor tendons and dorsal tubercle
  - Facets for scaphoid and lunate bones
- **Ulna**
  - Trochlear notch/ greater sigmoid cavity
    - Olecranon
    - Coronoid process
  - Radial notch/ lesser sigmoid cavity
  - Styloid process
  - Head
- **Bones of the hand**
  - Scaphoid
    - Tubercle of the scaphoid
  - Lunate
  - Triquetrum
    - Pisiform
  - Trapezium
    - Tubercle of the trapezium
  - Trapezoid
  - Capitate
  - Hamate
    - Hamulus (hook of the hamate)
  - Metacarpals
    - First
    - Second
    - Third
    - Fourth
    - Fifth
  - Fingers: phalanxes
    - Proximal
    - Middle
    - Distal
    - Thumb: proximal and distal phalanxes, sesamoid bones

## CADAVER

- **Palm**
  - Palmar aponeurosis
  - Central group of muscles
    - Tendons of flexor digitorum superficialis
      - ✓ Pierced tendon
    - Tendons of flexor digitorum profundus
      - ✓ Piercing tendons
      - ✓ Lumbricals
  - Thenar eminence
    - Abductor pollicis brevis
    - Flexor pollicis brevis
    - Opponens pollicis
    - Adductor pollicis
    - First dorsal interosseus
    - Tendon of flexor pollicis longus
  - Hypothenar eminence
    - Palmaris brevis
    - Abductor digiti minimi
    - Flexor brevis and opponens digiti minimi
  - Median nerve:
    - Carpal tunnel (transverse carpal ligament)
    - Branches for the fingers, from 1$^{st}$ to radial side of 4$^{th}$
  - Ulnar nerve:
    - Guyon's canal
    - Branches for the 5$^{th}$ finger and ulnar side of 4$^{th}$
  - Ulnar artery:
    - Superficial palmar arch
    - Digital branches

- **Anterior surface of the forearm**
  - Superficial veins:
    - Cephalic
    - Basilic
    - Median cubital
  - Lateral cutaneous nerve of the forearm

- Medial cutaneous nerve of the forearm
- Brachioradialis
  - Superficial branch of the radial nerve
- Superficial layer muscles:
  - Pronator teres
  - Flexor carpi radialis
    - ✓ Radial vessels on the pulse canal
  - Palmaris longus
  - Flexor carpi ulnaris
    - ✓ Ulnar vessels
    - ✓ Ulnar nerve
- Flexor digitorum superficialis
- Flexor digitorum profundus
  - Median nerve
- Flexor pollicis longus
- Pronator quadratus
  - Anterior interosseous vessels
  - Anterior interosseous nerve
- Interosseous membrane

**STRUCTURES TO IDENTIFY IN THE SECOND UPPER LIMB PRACTICE SESSION**

**BONES**

- **Scapula**
  - Superior border
    - Scapular, superior, coracoid or suprascapular notch
    - Coracoid process
    - Supero-medial angle
    - Supero-lateral angle
      - ✓ Glenoid cavity
      - ✓ Supraglenoid tubercle
      - ✓ Infraglenoid tubercle
  - Medial and lateral borders
    - Inferior angle
  - Posterior surface
    - Spina of scapula
      - ✓ Acromion
      - ✓ Supraspinous fossa
      - ✓ Infraspinous fossa
      - ✓ Greater scapular or spinoglenoid notch
  - Anterior surface:
    - ✓ Subscapular fossa
- **Clavicle**
  - Acromial extremity
    - Trapezoid line
    - Conoid tubercle
  - Sternal extremity
- **Humerus**
  - Head
  - Anatomical and surgical necks
  - Tubercles:
    - Greater tubercle
    - Lesser tubercle
    - Intertubercular/ bicipital groove
  - Deltoid tuberosity
  - Radial sulcus
  - Humeral capitulum
    - Lateral epicondyle
    - Radial fossa
  - Trochlea
    - Medial epicondyle
      - ✓ Ulnar nerve groove
    - Coronoid fossa
    - Olecranon fossa

**BRACHIAL PLEXUS**

- Deltoid muscle
- Pectoralis major muscle
  - Deltopectoral groove
- Pectoralis minor muscle
  - Ansa pectoralis
- Anterior and posterior divisions
- Cords:
  - Medial
    - ✓ Ulnar nerve
    - ✓ Medial branch of the V of the median nerve
    - ✓ Medial cutaneous nerve of arm
    - ✓ Medial cutaneous nerve of forearm
  - Lateral
    - ✓ Musculocutaneous nerve
    - ✓ Lateral branch of the V of the median nerve
  - Posterior
    - ✓ Radial nerve
    - ✓ Axillary nerve
- Other collateral branches:
  - Long thoracic nerve
    - ✓ Serratus anterior
  - Thoracodorsal nerve
    - ✓ Latissimus dorsi
- Axillary artery and vein

**ANTERIOR ASPECT OF THE ARM**

- Superficial veins:
  - Cephalic
  - Basilic
- Coracobrachialis and brachialis muscles
- Biceps brachii
  - Long and short heads
  - Lacertus fibrosus
- Brachial artery
- Path of musculocutaneous, median and ulnar nerves on the arm
  - Lateral cutaneous nerve of forearm

## STRUCTURES TO IDENTIFY IN THE THIRD UPPER LIMB PRACTICE SESSION

- **Muscles and spaces of the scapula and the posterior aspect of the arm**
  - Serratus anterior muscle
  - Triceps brachii
    - Long head
    - Medial head
    - Lateral head
  - Deltoid muscle
  - Teres minor
  - Teres major
    - Triangular space
      - ✓ Circumflex scapular artery
    - Quadrangular space
      - ✓ Axillary nerve
        - ➢ Superior lateral cutaneous nerve of the arm
      - ✓ Posterior humeral circumflex artery
    - Humerotricipital triangle
      - ✓ Radial nerve
      - ✓ Deep brachial artery
  - Supraspinatus muscle
  - Infraspinatus muscle
    - Suprascapular nerve and vessels
  - Extrinsic back muscles associated to the scapula:
    - Rhomboid major and minor
    - Trapezius
    - Levator scapulae
    - Serratus posterior superior
    - Latissimus dorsi

- **Posterior aspect of the arm and the hand**
  - Retroepitrochlear portion of the ulnar nerve
  - Sensitive nerves:
    - Superficial branch of the radial nerve
    - Dorsal branch of the ulnar nerve
  - Dorsal muscles of the forearm, superficial layer:
    - Anconeus
    - Extensor carpi radialis longus
    - Extensor carpi radialis brevis
    - Extensor carpi ulnaris
    - Extensor digiti minimi
    - Extensor digitorum
  - Dorsal muscles of the forearm, deep layer:
    - Supinator
    - Abductor pollicis longus
    - Extensor pollicis brevis
    - Extensor pollicis longus
      - ✓ Anatomical snuffbox
      - ✓ Radial artery
    - Extensor indicis
  - Posterior interosseous nerve and vessels
  - Extensor retinaculum
  - Dorsal aspect of the hand:
    - Dorsal superficial veins (continuity with cephalic and basilic veins)
    - Tendons of the extensor muscles
    - Dorsal interosseous muscles

**STRUCTURES TO IDENTIFY IN THE NECK AND BODY WALLS PRACTICE SESSION**

- **Check the pelvimetric material with the actual pelvis**

- **Thoracic walls:**
  - Ribs osteology:
    - Head
      - ✓ Articular facets for vertebral body
    - Neck
    - Tubercle
      - ✓ Articular facet for the transverse process
    - Angle
    - Groove
    - First rib:
      - ✓ Scalenic tubercle
      - ✓ Groove for the subclavian artery
      - ✓ Groove for the subclavian vein
  - Sternum osteology:
    - Manubrium
      - ✓ Jugular notch
      - ✓ Clavicular notch
      - ✓ Notch for the first rib
      - ✓ Half notch for the second rib
    - Angle
    - Body
      - ✓ Half notch for the second rib
      - ✓ Costal notches 2 to 7
      - ✓ Xiphoid process
  - Intercostal muscles

- **Abdominal walls**
  - External oblique
    - Superficial inguinal ring
      - ✓ Spermatic cord with cremaster muscle
      - ✓ Ilioinguinal nerve
      - ✓ Inguinal hernias
  - Internal oblique
  - Transversus abdominis
    - Linea semilunaris
    - Conjoint tendon
    - Innervation and blood supply branches
  - Transversalis fascia as the posterior wall of the inguinal canal
    - Inferior epigastric vessels (follow their path behind rectus abdominis)
  - Rectus abdominis
    - Thoracoabdominal nerves
    - Anterior layer of the rectus sheath
    - Posterior layer of the rectus sheath
      - ✓ Arcuate line or arch of Douglas
      - ✓ Transversalis fascia below the arcuate line
  - Pyramidalis

- **Neck:**
  - Platysma
  - External jugular vein
  - Anterior jugular vein
  - Sternocleidomastoid
    - Accessory nerve
    - Erb's point and sensory branches of the cervical plexus
  - Neurovascular bundle of the neck
    - Common carotid artery
      - ✓ Bifurcation into internal and external carotid arteries
    - Vagus nerve
    - Internal jugular vein
  - Branches of the thyrocervical trunk
    - Ascending cervical artery
  - Scalene muscles
    - Scalenus anterior, note its position relative to:
      - ✓ Subclavian vein
      - ✓ Phrenic nerve
      - ✓ Subclavian artery
      - ✓ Nerve roots of the brachial plexus
    - Middle and posterior scalene muscles
  - Infrahyoid muscles
    - Sternohyoid
    - Thyrohyoid
    - Sternothyroid
    - Omohyoid
    - Ansa cervicalis

**STRUCTURES TO IDENTIFY IN THE FIRST HEAD ANATOMY PRACTICE SESSION**

- **Skull:**
  - Frontal bone
    - Metopic or frontal suture
    - Coronal suture
    - Orbital portion
    - Supraorbital foramen
  - Parietal bone
    - Sagittal suture
    - Grooves for the branches of the middle meningeal vessels
  - Temporal bone
    - Squamous portions
    - Processes:
      - ✓ Mastoid
      - ✓ Styloid
      - ✓ Zygomatic
    - Mandibular fossa
    - Tympanic bone
    - Petrous portion: intracranial view
      - ✓ Crest
      - ✓ Anterior surface (middle cranial fossa)
      - ✓ Posterior surface (posterior cranial fossa)
    - Foramina:
      - ✓ External acoustic meatus
      - ✓ Internal acoustic meatus
      - ✓ External opening of the carotid canal
      - ✓ Stylomastoid
      - ✓ Petrotympanic fissure
      - ✓ Jugular (between temporal and occipital bones)
      - ✓ Lacerum (between temporal, occipital, and sphenoid bones)
  - Occipital bone
    - Squamous portion
    - Lambdoid suture
    - Nuchal lines:
      - ✓ Inferior
      - ✓ Superior
      - ✓ External occipital protuberance
    - Basilar portion
      - ✓ Clivus
      - ✓ Pharyngeal tubercle
    - Foramina:
      - ✓ Magnum
      - ✓ Hypoglossal canal
  - Sphenoid bone
    - Greater wings
      - ✓ Infratemporal crest
    - Lesser wings
    - Spine
    - Pterygoid processes:
      - ✓ Medial plate
      - ✓ Lateral plate
      - ✓ Pterygoid fossa
      - ✓ Scaphoid fossa
      - ✓ Hamulus
    - Sella turcica:
      - ✓ Anterior clinoid process
      - ✓ Chiasmatic groove and tuberculum sellae
      - ✓ Dorsum sellae
      - ✓ Posterior clinoid process
    - Foramina:
      - ✓ Rotundum
      - ✓ Spinosum
      - ✓ Ovale
      - ✓ Optic canal
      - ✓ Superior orbital fissure
      - ✓ Inferior orbital fissure
  - Maxillary bone
    - Processes:
      - ✓ Palatine
      - ✓ Frontal
      - ✓ Zygomatic
      - ✓ Alveolar
      - ✓ Maxillary tuberosity
    - Foramina:
      - ✓ Incisive canal
      - ✓ Alveolar
      - ✓ Infraorbital
      - ✓ Pterygomaxillary fissure (entry to the pterygopalatine fossa)
  - Palatine bone
    - Horizontal plate
    - Vertical plate
    - Pyramidal process
    - Foramina:
      - ✓ Greater palatine
      - ✓ Lesser palatine
  - Ethmoid bone
    - Cribriform plate or lamina cribosa
    - Orbital lamina or lamina papyracea
    - Crista galli

- Vomer
- Nasal bone
- Inferior concha
- Mandible:
  - Body
    - ✓ Mental foramen
    - ✓ Mylohyoid
  - Ramus
    - ✓ Head (condyle)
    - ✓ Neck
    - ✓ Mandibular notch
    - ✓ Coronoid process
    - ✓ Mandibular foramen
    - ✓ Lingula
  - Angle

- **Superficial dissection of the face**
  - Muscles of mastication:
    - Masseter
    - Temporal
  - Suprahyoid muscles:
    - Anterior belly of the digastric muscle
      - ✓ Hypoglossal nerve
    - Mylohyoid
  - Facial muscles:
    - Platysma
    - Occipitofrontalis muscle
    - Orbicularis oculi muscle
    - Nasalis muscle
    - Levator labii superioris alaeque nasi muscle
    - Zygomaticus major muscle
    - Risorius muscle
    - Levator anguli oris
    - Depressor anguli oris muscle
    - Depressor labii inferioris muscle
    - Buccinator muscle
  - Parotid gland
    - Parotid or Stensen's duct
    - Branches of the facial nerve
      - ✓ Temporal
      - ✓ Zygomatic
      - ✓ Buccal
      - ✓ Marginal mandibular
      - ✓ Cervical
    - Retromandibular vein
  - Facial artery
    - Angular artery
    - Point of palpation of the facial pulse
  - Facial vein
    - Farabeuf's triangle
      - ✓ Carotid bifurcation

**STRUCTURES TO IDENTIFY IN THE SECOND HEAD ANATOMY PRACTICE SESSION**

- Masticatory muscles:
  - Masseter
  - Temporalis
  - Medial pterygoid
  - Lateral pterygoid
- Suprahyoid muscles:
  - Anterior belly of the digastric
  - Posterior belly of the digastric
  - Stylohyoid
  - Mylohyoid
- Lingual muscles (we will see them in Visceral Anatomy)
  - Hypoglossal nerve
- Parotid gland: parotid (Stensen's) duct
- External carotid artery
  - Superficial temporal artery
  - Maxillary artery
- Mandibular nerve branches:
  - Buccal nerve
  - Lingual nerve
    - ✓ Chorda tympani
  - Inferior alveolar nerve
    - ✓ Nerve to mylohyoid