

- **GENERAL MYOLOGY**

# MUSCULAR SYSTEM

unit- muscle = musculus (myos)

- **Active component of the locomotor system- it is controlled by nerves**
- The main demonstration of mechanical function of muscle fibers (on the base of excitations coming through the motor nerve fibers) is their shortening—**contraction** (movement)
- Contractile proteins myosin and actin, form the basis of myofibrils of muscle fibers

**Smooth muscle**

**Heart muscle**

**Striated muscle**

## Function of the muscular system

- **motion** function – muscular system constitutes active component of the locomotor system
- **shape** function - musculature forms exterior (external shape) of a man
- **thermoregulation** – it is releasing heat
- It helps **blood circulation**
- It keeps **basic muscle tension**

## ATTACHMENT

To the bones: skeletal muscles- mm. skeleti- over 600 in the body, mostly paired, they form 1/3-1/2 of entire body weight

To the skin: skin muscles- mm. cutanei- mainly on head and neck

Relationship to organs: organ muscles

To the articular capsules: mm. articulares

# The internal structure of striated muscle

- 1) Striated muscle tissue (myosin and actin)- muscle fiber
- 2) Fibrous tissue (it covers the muscle fibers, primary and secondary fasciculi – important for metabolism between muscle fiber and blood circulation of muscle, on the surface, there is unbroken covering fascia = fascia)
- 3) Logistic components (vessels and nerves)
- 4) Special apparatus

# INTERNAL STRUCTURE OF MUSCLE

**Muscle part**: the basic structural and functional unit of muscular system, it is the muscular fiber, which was created by fusion of many consecutive cells= multinucleated formation

- The fibers inside muscle have following arrangement— form muscle fasciculi, they combine into bundles until they create the entire muscle
- Muscle fibers are interconnected with thin collagenous fibrous tissue, so-called **perimysium internum (endomysium)**
- the surface of whole muscle is covered by fibrous tissue, so-called **perimysium externum (epimysium)**

**Tendon**: tendon is created by regularly arranged fibers of tough collagenous fibrous tissue, which have hierarchical arrangement – single fibers combine to fasciculi, then to larger bundles until they form the whole tendon

- fibers are connected with thin collagenous fibrous tissue, so-called **peritenonium internum (endotenonium)**
- On the surface, there is a fibrous covering, so-called **peritenonium externum (epitenonium)**
- **aponeurosis**- flat tendons

# EXTERNAL STRUCTURE OF MUSCLE

- **origin (*origo*)**: part of the muscle that runs from bone (or skin); it is the place, where the muscle doesn't change its position during contraction (so-called: fixed point- **punctum fixum**), it is usually formed by tendon
- **belly (*venter*)**: fleshy part of muscle, its beginning is called **caput** (head), its end is called **cauda** (tail)
- **insertion (*insertio*)**: is formed by tendon; it is the place, where the muscle changes its position during contraction (so-called: mobile point- **punctum mobile**), the tendon attaches usually to a bone, sometimes to skin or organ



# CLASSIFICATION OF MUSCLES

## 1. ACCORDING TO PREVAILING SIZE

- **Long muscles:** they have ribbon-like or rope-like tendons
- **Short muscles:** they have ribbon-like or rope-like tendons
- **Flat muscles:** they usually have wide flat tendons=**aponeurosis**
- **Round muscles:** ring-like shape, they encircle some openings, they are narrowing during contraction

### **3. ACCORDING TO A NUMBER OF HEADS**

- **Muscles with one head**: one head
- **Muscles with more heads**: more heads (more origins), which connect into one muscle belly. (musculus biceps, musculus triceps, musculus quadriceps)

### **4. ACCORDING TO A NUMBER OF BELLIES**

- **With one belly**: only one belly
- **With more bellies**: two or more consecutive bellies, which are separated from each other by tendons (*tendo intermedius*)

# CLASSIFICATION ACCORDING TO FUNCTION

- Muscle can make its function, only if it span minimal one movable bone junction
- muscle making specific movement is called **agonist** (executor)
- Muscle which participate in some movement are called **synergists**
- Muscles making opposite movement are called **antagonists**

**flexors** × **extensors**

**adductors** × **abductors**

**sphincters** × **dilatators**

**pronators** × **supinators**

**levators** × **depressors**

**erectors**

**elevators**

**tensors**

# Contraction

Isotonic: change of length **concentric**: shortens

**excentric**: extends

Izometric: change of tension

**Vessels**- blood and lymphatic- nutrition of muscle. They enter the muscle in place called porta musculi (hilus musculi)- neurovascular hilus.

## **Nerves**

- diploneural muscles- innervated from two nerves
- plurineural muscles- innervated from more nerves
- **motor fibers**: they bring impulses for contraction of muscle fibers, they are terminated as motor plates on the muscle fiber
- **Senzor fibers**: bring information from muscle into central nervous sytem, about pain, tension.

## **SPECIAL APPARATUS**

- 1. Fascia (*fasciae*):** fibrous membranes, which cover one whole muscle or group of some muscles.
- Septa intermuscularia-** separates single groups of muscles, they are attached to a bone
- Retinacula-** eyelets, which holds muscle tendons to a bone.
- 2. Synovial bursae(*bursae synoviales*):** pouches around the joint, derivatives of the joint capsule, in the places, where tendons and muscle lie directly on the bone
- 3. Synovial sheath (*vaginae tendinum*):** cover long tendons of muscles in areas exposed to mechanical loading.

Layer- superficial- vagina fibrosa- **peritenonium**  
- deep- vagina synovialis- **epitenonium**

# **Muscles of the head**

**Mm. masticatorii**



**M. temporalis**

## **M. temporalis**

**origin: linea temporalis inferior, temporal fascia**

**insertion: processus coronoideus mandibulae**

**innervation: N. trigeminus (nn. temporales profundi from 3rd branch)**

**function: elevation, partly retraction of mandible**

**M. masseter**

**origin: arcus  
zygomaticus and os  
zygomaticum  
insertion: tuberositas  
masseterica  
innervation: N.  
trigeminus (n.  
massetericus from 3rd  
branch)  
function: elevation of  
mandible, chewing  
movements**

M. pterygoideus medialis

M. pterygoideus lateralis

**3) M. pterygoideus medialis**

**origin: fossa pterygoidea and tuber maxillae**

**insertion: tuberositas pterygoidea**

**innervation: N. trigeminus (n. pterygoideus medialis from the 3rd branch)**

**function: elevation of mandible**

**4) M. pterygoideus lateralis**

**origin: lamina lateralis processus pterygoidei, facies infratemporalis  
          alae majoris ossis sphenoidalis**

**insertion: fovea pterygoidea mandibulae**

**innervation: N. trigeminus (n. pterygoideus lateralis from the 3rd branch)**

**function: by double-sided contraction: protraction of mandible**

- **Mimic muscles**



# **Mimic muscles**

**m. occipitofrontalis**

**m. temporoparietalis**

## **Muscles of palpebral fissure**

**m. orbicularis oculi**

**m. depressor supercilii**

**m. corrugator supercilii**

**m. procerus**

### **3) Muscles of the mouth**

**m. orbicularis oris**

**m. depressor anguli oris**

**m. depressor labii inferioris**

**m. risorius**

**m. levator labii superioris  
alaeque nasi**

**m. levator labii superioris**

**m. zygomaticus major**

**m. zygomaticus minor**

**m. levator anguli oris**

**m. buccinator**

**m. mentalis**

### **4) Muscles of the nose**

**m. nasalis**

**m. levator labii superioris  
alaeque nasi**

## Head fasciae

### Fascia temporalis

- together with skull bones, it creates a cavity for m. temporalis

### Fascia masseterica

- continues as fascia parotideomasseterica (to the gland)

### Fascia

#### buccopharyngea

- from the lips to pharynx

**Musculi colli**  
**(muscles of the neck)**

M. platysma

# Platysma

- Subcutaneous muscle, on superficial cervical fascia from clavicle to the face

**O:** fascia pectorialis, fascia deltoidea

**I:** skin of the face

**F:** it stretches cervical skin

**IN:** ramus colli n. facialis

**M. sternocleidomastoideus**

## M. sternocleidomastoideus

**O:** manubrium sterni, sternal end of clavicle

**I:** processus mastoideus, external edge of linea nuchae superior

**F:** at unilateral contraction – lateroflexion, bilateral contraction – retroflexion, auxiliary inspiratory muscles (at fixed head and cervical spine)

**IN:** n. accessorius + C2 - C4



# Musculi suprahyoidei

M. DIGASTRICUS

M. STYLOHYOIDEUS

M. MYLOHYOIDEUS

M. GENIOHYOIDEUS

**M. digastricus**

# M. DIGASTRICUS

Muscle with two bellies

**O: venter anterior:** fossa digastrica,  
it is changing into tendon on hyoid  
bone, continues as **venter posterior**

**I:** incisura mastoidea

**F:** depression of mandible, elevation  
Of hyoid bone

**I:** venter anterior - n. mylohyoideus  
(n. trigeminus)

venter posterior - n. facialis

M. stylohyoideus

## **M. STYLOHYOIDEUS**

Through its cleft tendon m. digastricus passes

**O:** processus styloideus

**I:** body of the hyoid bone

**F:** it elevates the hyoid bone during swallowing

**I:** n. facialis

M. mylohyoideus

# **M. MYLOHYOIDEUS**

Forms the flexible bottom  
of the mouth- diaphragma  
oris

**O:** linea mylohyoidea

**I:** os hyoideum

**raphe mylohyoidea** -  
fibrous connection of both  
muscles

**F:** depression of mandible  
at fixed mandible, elevation  
of hyoid bone

**I:** n. mylohyoideus (n.  
trigeminus)

M. geniohyoideus



## **M. GENIOHYOIDEUS**

Above m. mylohyoideus

**O:** spina mentalis

**I:** body of the hyoid bone

**F:** it participates in forming  
of the bottom of the mouth

**I:** fibers from C1

## Mm. infrahyoidei

1. m. sternohyoideus
2. m. sternothyroideus
3. m. thyrohyoideus
4. m. omohyoideus

**F:** they fix the hyoid bone,  
they participate in  
swallowing reflex

**I:** ansa cervicalis profunda  
C1 - C3 - except m.  
thyrohyoideus -> C1

**M. sternohyoideus**

# **M. STERNOHYOIDEUS**

**O:** dorsal surface of  
manubrium sterni + sternal  
end of clavicle

**Ú:** body of hyoid bone

**M. sternothyroideus**

## **M. STERNOTHYROIDEUS**

behind m. sternohyoideus and  
more laterally

**O:** manubrium sterni and 1st rib

**I:** linea obliqua

M. thyrohyoideus

## **M. THYROHYOIDEUS**

**O:** linea obliqua on cartilago thyroidea

**I:** cornu majus of hyoid bone



M. omohyoideus

## **M. OMOHYOIDEUS**

With two bellies

**O:** venter inferior- margo scapulae  
sup., below m.

sternocleidomastoideus it continues  
as a tendon and then int chnages  
into venter superior

**I:** body of hyoid bone

# **mm. suprahyoidei et infrahyoidei**

The larynx and the hyoid bone are elevated by the suprahyoid muscles during swallowing, infrahyoid muscles return them back

- Mm. scaleni

# Musculi scaleni

## ***Common function:***

at fixed thorax, the muscles by unilateral contraction cause lateroflexion and rotation of the cervical spine, at bilateral contraction they cause anteflexion of cervical column

- auxilliary inspiratory muscles

***I:*** rami ventrales of cervical nerves

## **M. SCALENUS ANTERIOR**

**Z:** transverse processes of C3 - C6

**Ú:** tuberculum m. scaleni anterioris of 1st rib

## **M. SCALENUS MEDIUS**

**Z:** transverse processes of C1 - C7

**Ú:** 1st rib, behind sulcus a. subclaviae

## **M. SCALENUS POSTERIOR**

**Z:** transverse processes of C5 - C7

**Ú:** 2nd rib

- Deep cervical muscles



## **Deep cervical muscles**

***IN:*** rami ventrales of cervical nerves

### **M. LONGUS CAPITIS**

***O:*** tuberculum ant. processus transversi C3 - C6

***I:*** skull base

***F:*** anteflexion of head

### **M. LONGUS COLLI**

***O:*** caudal cervical and cranial thoracic vertebrae

***I:*** tuberculum anterius atlantis + tuberculum ant. proc. transversi C5, C6 + bodies of C2 – C4

***F:*** flexion, lateroflexion, rotation of the head

## **M. RECTUS CAPITIS ANTERIOR**

**Z:** processus transversus atlantis

**Ú:** skull base (behind m. longus capitis)

**F:** bilateral: anteflexion

unilateral: lateroflexion

## **M. RECTUS CAPITIS LATERALIS**

**Z:** processus transversus atlantis

**Ú:** skull base

**F:** lateroflexion

**Musculi thoracis**  
**(Thoracic muscles)**

- Heterochtonous muscles of  
thorax

(common innervation from pars  
supraclavicularis plexus  
brachialis)

**M. pectoralis major**

## **M. PECTORALIS MAJOR**

**O:** clavícula, sternum (+ adjacent parts of ribs 1st – 6th)

**I:** crista tuberculi majoris humeri,

**F:** pars clavicularis – it helps at flexion of arm

pars sternalis and abdominalis

- adduction of arm, pronation

**M. pectoralis minor**

# M. PECTORALIS MINOR

**O:** 3. až 5. žebro

**I:** processus coracoideus

**F:** it pulls scapula forward and downward

**F:** auxiliary inspiratory muscles



**M. subclavius**

# M. SUBCLAVIUS

**O:** costa prima

**I:** sulcus m. subclavii

**F:** it pulls clavicle downward, it elevates the 1st rib

**M. serratus anterior**

## **M. SERRATUS ANTERIOR**

**O:** nine teeth at 1st-9th rib

**I:** medial edge of scapula and  
angulus inferior

**F:** it holds scapula to the thorax,  
it pulls angulus inferior scapulae  
laterally

# Autochthonous thorax muscles

***Common innervation:*** nn.

intercostales I - XI

## MM. INTERCOSTALES EXTERNI

external layer, they direct like hands into the pockets, they continue forward as **membrana intercostalis externa**

***F:*** inspiratory muscles

## MM. INTERCOSTALES INTERNI

middle layer, they direct like hand to the breasts, they continues backward as **membrana intercostalis interna**

***F:*** expiratory muscles

## **MM. INTERCOSTALES INTIMI**

internal layer

the same course and function like  
mm. intercostales interni

## **M. TRANSVERSUS THORACIS**

flat muscle on the internal surface  
of sternum

it is diverging in a ray-shaped form  
cranially and laterally

***F:*** auxiliary inspiratory muscle

## The diaphragm (*diaphragma*)

Flat muscle that separates the abdominal and thoracic cavity

The edges- muscle bundles, **centrum tendineum**

a) ***pars lumbalis***: starts from *lig. longitudinale anterius*, from lumbar vertebrae

b) ***pars costalis***: starts from 7th– 12th rib

c) ***pars sternalis***: starts from *processus xiphoideus sterni*

***I***: centrum tendineum

***IN***: n. phrenicus

***F***: main inspiratory muscle

***Openings:***

In centrum tendineum: foramen v. cavae inferioris

In muscular part: hiatus aorticus (ductus thoracicus), hiatus esophageus (nn. vagi), nn. splanchnici, v. azygos

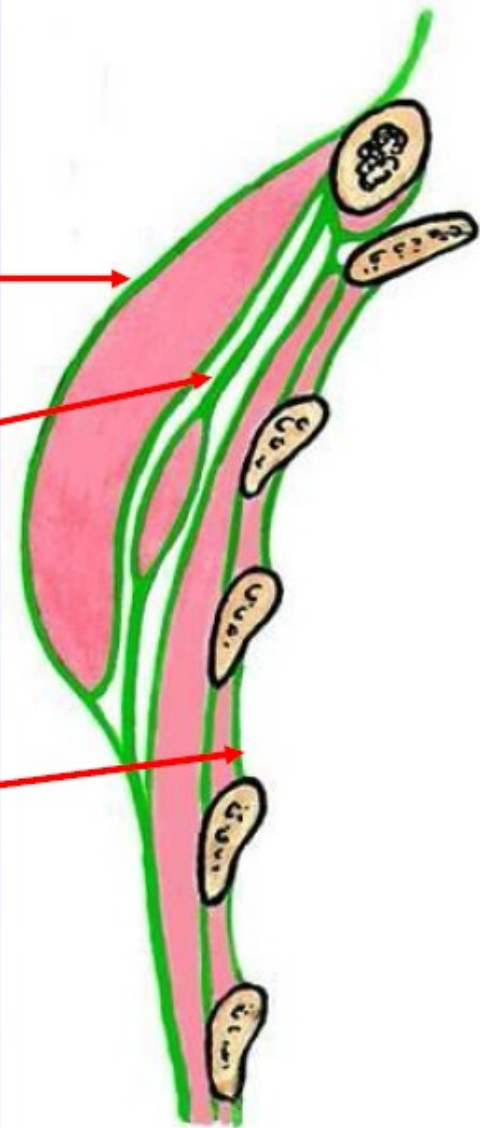
# Fascie hrudníku

fascia pectoralis spfc.

fascia clavipectoralis

– fossa ovalis infraclavicularis

fascia endothoracica  
(Sibsonova fascie)





HYPERTROPHY

ATROPHY