General Myology

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Introduction, ie. What is this good for?!

Dear students, colleagues,

these study materials are supportive aids to our anatomy lectures and practicals. The aim is to draw your attention to important matters and to assist in a correct understanding and fixing, the clinical implications including. Knowledge practicing is based on supplementary questions and sections to be completed.

The following pictograms will accompany you:



to recall or remember



clinical notes



to be completed



Learning goals

i.e. What should you be FINALLY able to describe (demonstrate):

General features of striated muscle, its auxiliary structures (connective tissue, tendons, fascia, tendon synovial (fibrous) sheath, synovial bursa; trochlea) Muscle types and terminology Motor reflex

ABFA EZHQIK AMNEOT PETYO XYQ



What kinds of muscular tissue do you know? Can you state any of their distinctive features?

https://www.youtube.com/watch?v=raCBeQ-gXfs&ab_channel=UniversityofCaliforniaTelevision%28UCTV%29

Skeletal muscles Basic unit: muscle = musculus (m., mm.)

- Active component of the locomotor system: shortening-contraction = movement
- Voluntary contraction of muscle fibers (on the base of excitations coming through the motor nerve fibers)
- Contractile proteins **myosin** and **actin** form the basis of **myofibrils** of muscle **fibers**

MUSCLE (m.), muscles (mm.) mūsculus, ī, m. (lat.) – **m**ys, myos, m. (gr.) sarco – myo –

Fig. Types of Muscular Tissue

Skeletal muscle: voluntary striated muscle that connects usually to bone; striated in appearance (sarcomeres); actin/myosin filaments (syntitia) arranged into sarcomeres.

Cardiac muscle: **involuntary striated** muscle found only in the heart; basic building block is the sarcomere. Cardiac **muscle cells** connect at branching, irregular angles to intercalated discs.

Smooth muscle: spindle-shaped cells, involuntary control; primarily found in the walls of hollow organs (except the heart) – structures such as the esophagus, stomach, intestines, bronchi, blood vessels, urethra, bladder, uterus.



Is the striated muscle found in hollow organs any-/somewhere?





Skeletal muscle is an organ!

musle tissue connective tissue vessels nerves

Connective tissue – muscular structure enclosed Endomysium – fibres Perimysium – fascicles Epimysium – group of fascicles Fascia – muscle belly

Fig. Skeletal muscle structure. All skeletal muscles within the human body display similar organization. Each individual sarcomere is formed by groups of myofilaments which are comprised of <u>contractile proteins</u> (actin and myosin filaments). Groups of sarcomeres are linked together in series (end to end) and in a parallel manner (side by side) to form a myofibril. Groups of myofibrils are surrounded by **connective tissue** called **endomysium** to form a **muscle fiber**. Groups of muscle fibers are surrounded by **perimysium** to form a muscle bundle or **fascicl**e. Finally, groups of fascicles are surrounded by **epimysium** to form a skeletal muscle.

Histo- physiological musle differences (not necessery to learn now)

Skeletal Muscle	Cardiac Muscle	Smooth Muscle
Striated; actin and myosin	Striated; actin and myosin arranged in	Not striated; more actin than myosin; actin inserts into
arranged in sarcomeres	sarcomeres	dense bodies and cell membrane
Well-developed sarcoplasmic	Moderately developed sarcoplasmic reticulum	Poorly developed sarcoplasmic reticulum; no
reticulum and transverse tubules	and transverse tubules	transverse tubules
Contains troponin in the thin filaments	Contains troponin in the thin filaments	Contains calmodulin, a protein that, when bound to Ca ²⁺ , activates the enzyme myosin light-chain kinase
Ca ²⁺ released into cytoplasm from	Ca ²⁺ enters cytoplasm from sarcoplasmic	Ca ²⁺ enters cytoplasm from extracellular fluid,
sarcoplasmic reticulum	reticulum and extracellular fluid	sarcoplasmic reticulum, and perhaps mitochondria
Cannot contract without nerve	Can contract without nerve stimulation; action	Maintains tone in absence of nerve stimulation; visceral
stimulation; denervation results	potentials originate in pacemaker cells of	smooth muscle produces pacemaker potentials;
in muscle atrophy	heart	denervation results in hypersensitivity to stimulation



Striated muscle is formed by MYOFIBRILS, and sarcomeres. (not cells)



Sarcomere (filament) is capable of changing its overall length (process described as the sliding filament theory) in **contraction** or **relaxation**.

Filaments: **actin** (thin), **myosin** (thick) Myofibrils (striped bands, enclosed by the **sarcolemma**) Fascicles (surrounded by the endomysium) Fibers MUSCLE BELLY





Fibres architecture: parallel / pennate

Contraction: vector origin — insertion



Accessory structure/s: fibrous loop, trochlea (obliquus bulbi superior muscle) Fibrous intersections (rectus abdominis muscle)

Fulcrum

Load









Effort





Muscle reflex: afferent and efferent innervation



Striated (skeletal) muscle innervation: MOTOR = SOMATOMOTOR, VOLUNTARY

Innervation of skeletal muscle: MOTOR and sensory

MOTOR (efferent) innervation: slow and fast **alfa motoneurons**, **gamma motoneurons** – motor end motor end-plate, segmental arrangement (in limbs), mediator acetylcholine SENSORY (proprioceptive, afferent) innervation via **muscle spindle, Golgi tendon organ**

Motor - proprioceptive reflex



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• Shape:

deltoid (= triangular), quadratus (= square), rhomboid (= diamond-shaped), teres (= round), gracilis (= slender), rectus (= straight), lumbrical (= worm-like)

• Size:

major, minor, longus (= long), brevis (= short), latissimus (= broadest), longissimus (= longest)

• Number of heads or bellies:

biceps (2 heads), triceps (= 3 heads), quadriceps (= 4 heads), digastric (= 2 bellies bellies)

• Position:

anterior, posterior, interosseus (= between bones)

supraspinatus (= above spine of scapula scapula), infraspinatus (= below spine), dorsi (= of the back), abdominis (= of the abdomen), pectoralis (= of the chest), brachii (= of the arm); femoris (= of the thigh), oris (= of the mouth)

Names of the skeletal muscles, adjectives according to the

• Depth:

superficialis (= superficial superficial), profundus (= deep), externus externus (or externi), internus (or interni interni)

• Attachment:

sternocleidomastoid (from the sternum, clavicle clavicle to the mastoid process) coracobrachialis (from the coracoid process to the arm)

• Action:

extensor, flexor, abductor, adductor, levator (= lifter), depressor, supinator, pronator, constrictor (sphincter), dilator

Skeletal (mimic) muscle description: Origin (usually the fix point) Insertion (usually the moving point) Innervation (peripheral or cranial nerve) Function (vector connecting the origin and insertion)

(In the limbs consider also the osteofascial compartment!)





Fig. Deltoid muscle Notice the different functions of various parts of the pennate muscle

Limbs: osteo-fascial compartments

muscle groups covered by the joint fascia, separated by septa ! Shared innervation, similar function





Fascia of forearm and lower leg.

Fascia forms a band or sheet of connective tissue beneath the skin that attaches, stabilizes, encloses or separates muscles and organs from one another.

! Normal fascia enables gliding, smooth movement of the muscle inside !

Fascia cruris, crural fascia

Differences in collagen fiber organization

Tendon or ligament?!

Ligament

Tendon

Tendons and ligaments show a similar construction pattern. They are composed of dense regular connective tissue, with collagen fibers being the primary building block. **Tendons demonstrate uniform patterns of collagen organization around stress; collagen organization in ligaments is more varied**.

Define the APONEUROSIS

Natatory Ligament

Transverse Palmar Ligament

[\]First Commissural Ligament

Pre-tendinous Cords

Abductor digiti minimi

Synovial bursae

Acromion of

Bursae are pouches **enlined by synovia, filled with fluid**, inserted between tendons to **decrease friction** or cussion the tendons from hard surfaces. Caution! Some bursae my communicate with the joint cavity!

Fig.: Synovial bursa in vicinity of a muscle tenton

Tendon synovial sheaths

develop at the sites with high friction (ankles, wrist, hand, foot)

Fig.: Tendons of the "extrinsic" hand muscles covered with the synovial sheaths within the carpal tunnel, palm and fingers

Fig.: Phlegmona – inflammation within the synovial sheaths spreads freely without a barrier