THE MUSCULAR SYSTEM

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Thinking About Muscles

- Architecture
  - general information
  - fiber
  - tendon, fascia etc.
- Naming
- General Principles
- Function
- Muscles by region

General Information

- ~700 muscles
- Muscle fiber: structural unit
- Motor unit: motor neuron + the muscle fibers it control (1- several 100)

General Information

- Origin
- Insertion
- Innervation*
- Function

<u>The forces developed by skeletal muscles are transferred to bones by;</u>

Å Tendon
Å Aponeurosis
Å Fascia

Naming Muscles-1

- **Shape:** **quadratus, rhomboids**
- **Location:** **subclavius, occipitalis**
- **Number of heads:** **biceps, quadriceps**
- **Primary action:** **flexor digitorum, supinator**

Naming Muscles-2

- **Size:** **gluteus magnus, medius, minimus**
- **Course:** **rectus abdominis, obliquus superior**
- **Length:** **é longus, é . brevis**
- **Origin-insertion: coracobrachialis, sternohyoideus**

Architecture of Muscles

- Fibers parallel to tendon
  - **short, flat, straplike or fusiform**

Greater Range of Motion

- Fibers oblique to tendon
  - **pennate, semipennate or multipennate**

Greater Power

The Role of Fascia

Protection / Connection / Compartmentalization

Superficial Fascia

- **subcutaneous tissue**
- **hypodermis**
- Individuality
- Storage
- Muscles of facial expression

Deep Fascia

- more fibrous & ordered
- invests muscles
- can be site of attachment
- variable thickness
- spread of fluid & infection
- compartmentalizes muscles

Attachments & Pull Angles

- Attachments
- DYNAMIC
  - **cord like (biceps)**
  - **strap like (lat dorsi)**
  - **sheet like (bicipital aponeurosis)**

Å? Single pull point

Å? multiple pull points (fan shaped muscles)

Å? Why long tendon vs short

Å? What is the effect of the pull on attachment sites

What different leverage systems are created by attachments?

Muscles By Region

Regions are typically between joints or groups of similar joints.
Regions are further divided into muscle groups by similar locations or functions

Region	Groups/Compartments
back	superficial and deep
trunk	pectoral, intercostal, abdominal
arm/forearm	flexor & extensor (deep & superficial)
hand	thenar, hypothenar, central
thigh	flexor, adductor, extensor
leg	anterior, posterior, lateral
foot	layer 1, 2, 3, 4
head	facial, masticators, orbital

MUSCLES OF APPENDICULAR SKELETON

MM. OF SHOULDER AND ARM

Deltoid

Subscapularis

Infraspinatus

Supraspinatus

Teres major

Teres minor

Biceps brachii

Brachialis

Coracobrachialis

Triceps brachii

Deltoid

- O: 3 parts
  -clavicular, acromial, spinal
- I: humerus (deltoid tuberosity)
- Inn: axillary nerve
- F: the strongest abductor of the arm***
  -clavicular part: add+med. rot.
  -acromial part: abd**********
  (15-90 degrees)
  -spinal: add+lat. rot.

Subscapularis

- O: subscapular fossa
- I: humerus (greater tuberosity)
- Inn: subscapular nerve
- F: med. rot.**

Supraspinatus

- O: supraspinous fossa
- I: humerus (greater tuberosity)
- Inn: suprascapular nerve
- F: abd. (0-15 degrees)*****

Infraspinatus

- O: infraspinous fossa
- I: humerus (greater tuberosity)
- In: suprascapular nerve
- F: lat. rot.

Teres minor

- O: lateral border of the scapula
- I: humerus (greater tuberosity)
- Inn: axillary nerve
- F: lat. rot, add.

Teres major

- O: inferior angle of scapula
- I: crest of lesser tuberosity
- Inn: subscapular nerve
- F: med. rot, add, ext.

Rotator Cuff Muscles

- They form a musculotendinous cuff around the glenohumeral joint.
- They resist displacement of the head of the humerus from the glenoid cavity.

Rotator Cuff Muscles

S	**S**upraspinatus	Suprascapular n.
I	**I**nfraspinatus	Suprascapular n.
T	**T**eres minor	Axillary n.
T	**S**ubscapularis	Upper/lower subscapular n.

Posterior Arm
=
Extensor Muscles of the forearm

Triceps Brachii

Long Head

Lateral Head

Medial Head

ÅO: Three heads (long, lat, med)
ÅI: olecranon
ÅF: ext. ****Strongest extensor of the forearm ********
ÅInn: radial nerve

Anterior arm
=
Flexor muscles of the arm and forearm

- Biceps brachii
- Brachialis
- Coracobrachialis

- Inn: Musculocutaneous nerve

Biceps brachii

- O: 2 heads
  - long: supraglenoid tubercle
  - short: coracoid proc.
- I: radial tuberosity
- F: flex, med. rot (supination)

Brachialis

- O: humerus
- I: ulnar tuberosity
- F: flex. (only forearm)

Coracobrachialis

- O: coracoid proc.
- I: humerus
- F: add, med. rot

Muscles of the Forearm

- Radius, ulna and the interosseous membrane connecting them divide into anterior (flexor-pronator) and posterior (extensor-supinator) compartments

Muscles of the Forearm

- Ant: flex.
- Inn: median and ulnar nerves

Muscles of the Forearm

- Post.: ext.
- Inn: radial nerve

MUSCLES OF THE LOWER EXTREMITY

Gluteal Muscles

- **Gluteus maximus:**
  - ext**, lat. rot, abd/add
  - inf. gluteal nerve
- **Gluteus medius:**
  - abd**, flex/ext, med/lat. Rot
  - sup. gluteal nerve
- **Gluteus minimus:**
  - abd, flex/ext, med/lat rot
  - sup. gluteal nerve

External Rotators

- Piriformis
- Obturator internus
- Obturator externus
- Gemelli sup, and inf
- Quadratus femoris

Muscles of the Anterior Thigh

Quadriceps = 4 heads

Sartorius

Rectus femoris

Vastus lateralis

Vastus medialis

Vastus intermedius

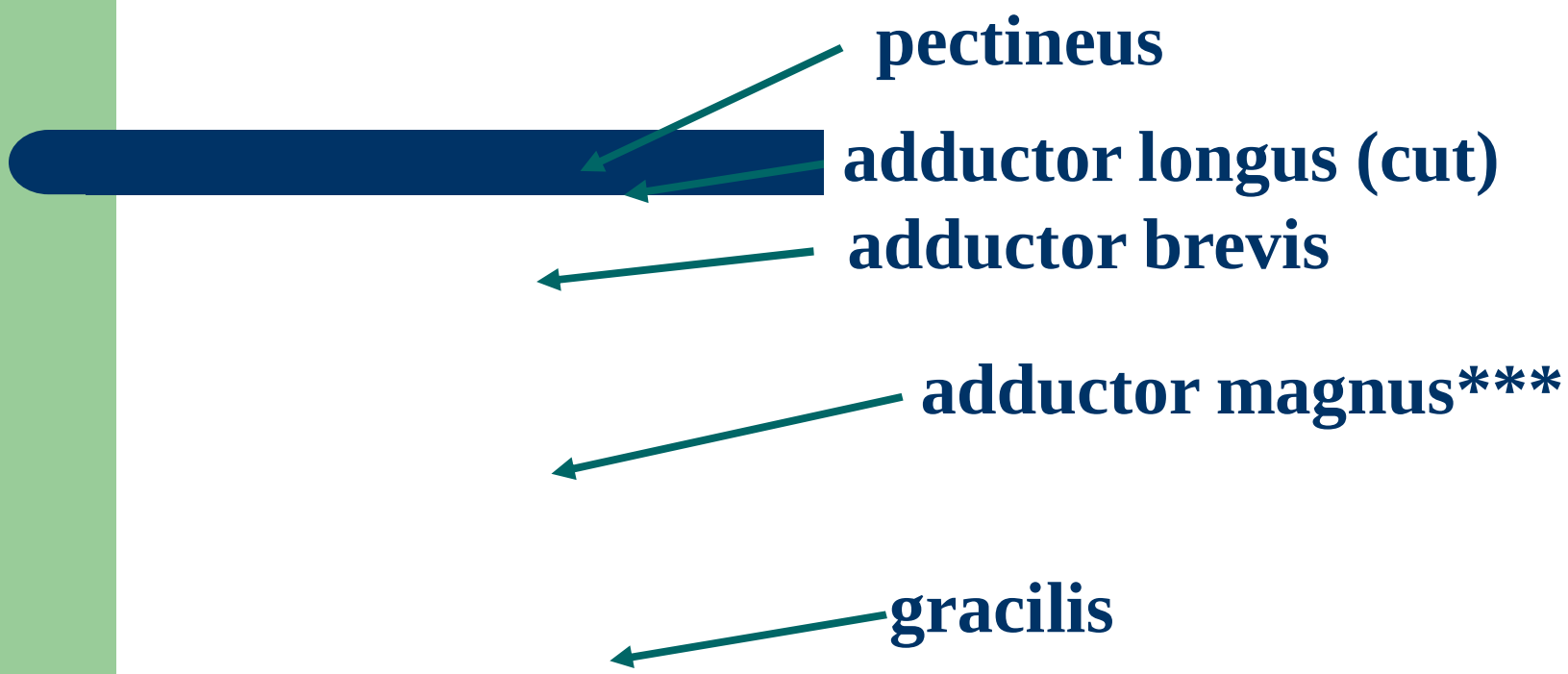
Quadriceps femoris

- O: 4 heads
- I: patella, tibial tuberosity
- Inn: femoral nerve
- F:
  - hip: flex (rectus femoris)
  - knee: extension********

Sartorius

- ~62 cm
- O: ASIS
- I: Tibia (pes anserius)
- Inn: femoral nerve
- F:
  - Hip: flex+abd+lat. rot
  - Knee: flex+med. rot

Deep View Anterior & Medial Thigh



Inn: obturator nerve

Hamstring Muscles (Ischiocrural Muscles)

- Biceps femoris (long and short heads)
- Semitendinosus
- Semimembranosus

- Inn: sciatic nerve (tibial and common fibular divisions)***
- F:
  - Hip: ext
  - Knee: flex**

Triceps surae

- Gastrocnemius
  - O: 2 heads, lat and med femural condyles
  - I: calcaneus
    (tendo calcanei-achilles)
  - Inn: tibial nerve
  - F: plantar flex***, raises heel during walking and flexes leg at knee joint

Triceps surae

- Soleus
  - O: fibula, tibia
  - I: calcaneus
  - Inn: tibial nerve
  - F: plantar flexes ankle and steadies leg on ankle

Deep posterior compartment

- Inn: tibial nerve
- F: flexion

Muscles of the Foot

- **Extensor hallucis brevis**
- **Extensor digitorum brevis** (medial 4 digits)

Muscles of the Foot

- Muscles in the sole of the foot:

- 4 layers
- 17 muscles

MUSCLES OF AXIAL SKELETON

- MM. OF FACE
- MM. OF MASTICATION
- NECK MM.
- MM. OF ABDOMINAL WALL
- MM. OF BACK

MUSCLES OF FACE (FACIAL EXPRESSION MUSCLES)

- Located in subcutaneous tissue; they move the skin.
- Surround the orifices of mouth, eyes and nose; act as sphincters or dilators.
- Change facial expressions to convey mood.
- *******All are innervated by the **facial nerve.**

MUSCLES OF FACE

- Orbicularis oculi: closes eyelids.
- Orbicularis oris: compresses and protrudes lips (whistling, sucking).
- Buccinator: presses cheek against molat teeth (aid chewing), Expels air from oral cavity (wind instrument), sucking
- Corrugator supercilii: frowns
- Levator labii superioris: smiles
- Levator anguli oris: makes a big smile
- Levator labii superioris alaeque nasi:???

MUSCLES OF FACE

- Zygomaticus major ve minor: smiles
- Risorius: grins
- Depressor labii inferioris: sulks
- Depressor anguli oris: pouts
- é é .

MUSCLES OF MASTICATION

Temporalis

- Temporalis: closes the jaw
- Masseter: closes the jaw
- Medial pterygoid: closes the jaw
- Lateral pterygoid: **opens the jaw**

Masseter

**********All are innervated by the **trigeminal nerve**

NECK MUSCLES

- **Platysma:** muscle of fascial expression, draws corners of mouth inferiorly (fascial nerve)
- **Sternocleidomastoideus:** tilts head to one side, flexes neck and rotates it so face is turned superiorly toward opposite side; actinh together, flex the neck (cranial accessory nerve)
- **Infrahyoid muscles**
- **Suprahyoid muscles**

PECTORAL MUSCLES (ANT. THORACOABDOMINAL MUSCLES)

- **Pectoralis major:**

✓ 3 PARTS:

- clavicular
- sternocostal
- abdominal

✓ inserts on humerus

✓ add********** and medial rotation of the arm

✓ med. and lat. pectoral nerves

PECTORAL MUSCLES (ANT. THORACOABDOMINAL MUSCLES)

- **Pectoralis minor:**
  - ✓3-5 ribs-coracoid process
  - ✓Stabilizes scapula by drawing it inferiorly
  - ✓If insertion is fixed, helps inspiration
  - ✓Inn: med. pectoral nerve

ANT. THORACOABDOMINAL MUSCLES

- **Serratus anterior:**
  - 1st to 8th ribs-medial border of scapula
  - rotates scapula, holds it against thoracic wall
  - long thoracic nerve
- **Subclavius:**
  - Anchors and depresses clavicle

Intercostal muscles

- **External intercostal:**
  - superficial layer, inferomedial
  - elevates the ribs (inspiration)
- **Internal intercostal:**
  - middle layer, inferolateral
  - depress ribs (expiration)
- **Innermost intercostal:**
  - deepest layer
  - depress ribs (expiration)

MUSCLES OF ANTEROLATERAL ABDOMINAL WALL

- **external oblique:** superficial, inferomedial
- **internal oblique:** intermediate
- **transverse abdominal:** innermost, horizontal
- **rectus abdominis:** long, broad, strap-like, tendinous intersections
- **pyramidalis:** small triangular muscle

MUSCLES OF ANTEROLATERAL ABDOMINAL WALL

Actions:

ÅCompresses (urination, defecation, vomiting, parturition etc) and support abdominal viscera

ÅFlex the trunk.

ÅRotate the trunk.

ÅInnervated by the anterior rami of thoracic spinal nerves

MUSCLES OF POSTERIOR ABDOMINAL WALL

Åpsoas major*/minor:

- flexes and externally rotates the thigh
- inn : anterior rami of lumbar nerves

Åiliacus:

- flexes and externally rotates the thigh
- inn : femoral nerve

(psoas + iliacus = iliopsoas:
also classified in anterior thigh muscles)

Åquadratus lumborum:

- helps inspiration, laterally rotates the trunk
- inn : anterior rami of lumbar nerves

PELVIC DIAPHRAGM

- Ålevator ani: 2 parts
  - Åpubococygeus
  - Åiliococygeus
- Åcocygeus

Actions:

Åresists increases in intra-abdominal pressure

Åhelps to support pelvic viscera

UROGENITAL DIAPHRAGM

Åsuperficial/ deep*** transverse perineal muscles

Åexternal urethral sphincter

Åbulbospongiosus-ischiocavernosus

MUSCLES OF THE BACK

Two Layers

- Superficial = extrinsic = migratory
- Deep = intrinsic

- Superficial muscles act on upper limb
- Deep muscles act on vertebral column

Superficial Muscles of the Back

- **Trapezius**
  - 3 parts: ascending, descending, transverse
  - Functions according to fiber alignment (elevates, retracts and rotates scapula)
  - **spinal accessory n./ascending transverse cervical a.**
- **Latissimus dorsi**
  - Raises the arm to trunk (chin-ups), adducts, medially rotates and extends the arm
  - **thoracodorsal n./a.**
- **Rhomboid major/minor**
  - Abducts the scapula, fixing the scapula during movements of the arm
- **Levator scapulae**
  - Elevates scapula
  - **dorsal scapular n./descending branch transverse cervical a.**
- **Serratus posterior superior**
- **Serratus posterior inferior**
  - **Intercostal nerves/intercostal arteries**

Deep Muscles of the Back

- **Splenius capitis/cervicis**
- **Erector spinae**
- **Transversospinalis**
- **Minor Deep Group**

Deep Muscles of the Back

- Stabilizes spine
- Extend head, cervical and thoracal regions accordingly,
- rotate head, cervical and thoracal regions contralaterally
- Innervated by the post. rami of spinal nerves