

**Embryology – muscles arise from mesenchyme, hypomere and paraxial mesenchyme**

**Appendicular musculature grows outward as myotomes grown downward in fishes**

**Axial muscles originate from myotomes which become the somites**

**Tetrapods have dorsal muscles (epaxial) divided by a septum from ventral muscles (hypaxial)**

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**During development, the myotomes expand into different areas of body**

**Differentiation of muscle groups occurs according to locations**

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**Jaw muscles arise from two sources:**

- Hypobranchial muscles
- Branchiomic muscles

**Hypobranchials from myotomes of somites, spinal nerve innervation**

**Branchiomic muscles from head somitomes and cranial nerve innervations**

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- Extrinsic eye muscles
- Paired
- Six total
- Originate from walls of orbit and insert on outer surface of eyeball
- Arise from preoptic myotomes
- Innervated by cranial nerves I, II, and III
- Differ from intrinsic ocular muscles that control structures within the eyes
- Conservative across all vertebrate groups plus

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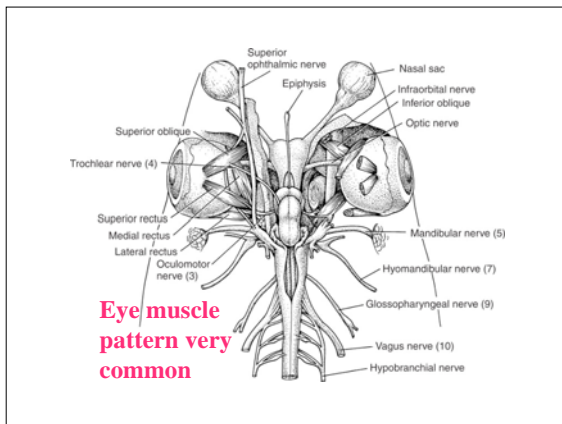
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**Myomere structure and orientation in *Amphioxus* and teleost fishes**

**Horizontal septum that divides muscles into epaxial and hypaxial is absent from cyclostomes**

**Each myomere supplied by spinal nerve which bifurcates into dorsal and ventral rami to epaxial and hypaxial muscles**

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- Axial musculature is main generator of propulsive force in fishes
- In tetrapods appendicular musculature takes over generation of most propulsive forces
- Axial musculature of tetrapods is reduced and appendicular muscles increased in relative mass over fishes
- On land, muscles needed to support body off ground because water buoyancy is no longer present

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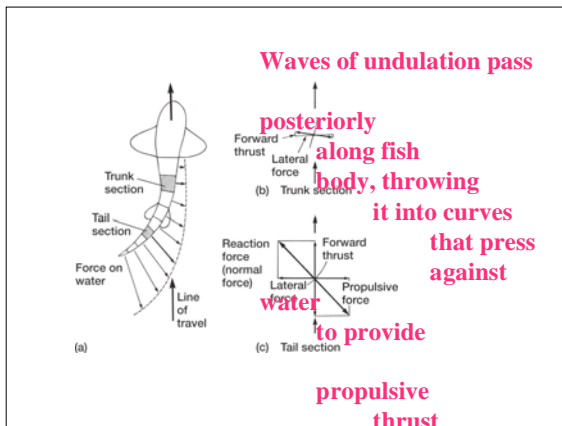
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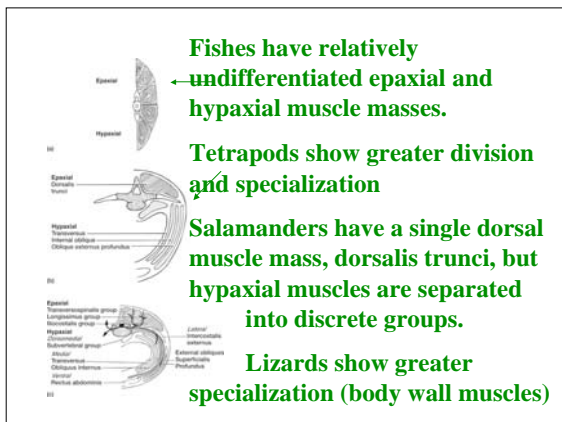
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- In reptiles the horizontal septum is reduced, although dorsal and ventral nerve rami are easily distinguished
- Epaxial musculature reduced when lateral body undulation is reduced as limbs take over locomotor functions
- Reptiles show first epaxial musculature differentiation
  - Transversospinalis
  - Longissimus
  - Iliocostalis

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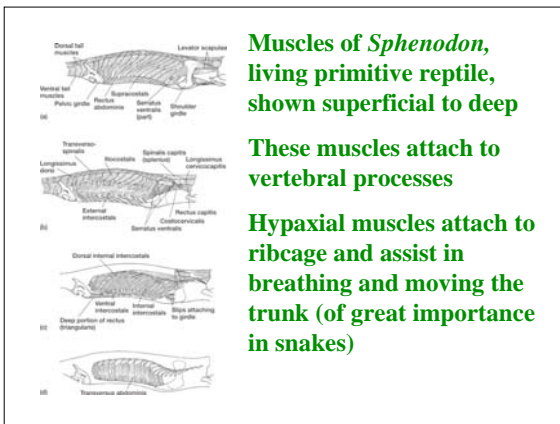
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Muscles of *Sphenodon*, living primitive reptile, shown superficial to deep

These muscles attach to vertebral processes

Hypaxial muscles attach to ribcage and assist in breathing and moving the trunk (of great importance in snakes)

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- Hypaxial muscles arise from four embryonic groups
- Dorsomedial muscles that become longus colli that moves the neck
- Medial musculature that includes the transversus abdominis and internal oblique
- Lateral musculature that is outside the ribcage consisting of external obliques and external intercostals
- Medial and lateral muscles contribute to rectus abdominis

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- **External and internal intercostal muscles have opposite functions in respiration and this can be explained because they originate from different embryonic muscle masses**
- **External intercostals function to assist diaphragm in inspiration**
- **Internal intercostals are most active during expiration and innermost intercostals act with them**
- **Oblique muscles are a continuous sheet only because ribs are absent in the abdomens of mammals**

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- **Appendicular muscles in fishes arise from myotomes that grow out into fins in dorsal and ventral masses**
- **Dorsal muscles elevate fin (= levators)**
- **Ventral muscles depress fin (=depressors)**
- **Appendicular muscles in tetrapods more prominent and relatively larger**
- **Receive contributions from axial muscles and branchiomeric (= gill arch muscles)**
- **Fore and hind limb differences occur because of different attachments of girdles and limb purpose (body support, propulsion, etc.)**

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- **Four muscle sources and muscles then divide and increase specificity of actions as well as complexity at limb**
- **1. Branchiomeric – trapezius and mastoid group**
- **In mammals this group includes: clavotrapezius, acromiotrapezius and spinotrapezius**
- **In mammals the mastoid group includes: cleidomastoid and sternomastoid**

**LEARN TABLE 10.2 –  
HOMOLOGIES!!!!**

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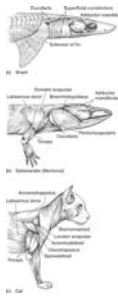
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2. Axial musculature gives rise to the levator scapulae, rhomboideus complex and serratus muscles

With the trapezius complex these muscles provide the muscular sling that suspends the body between the scapulae

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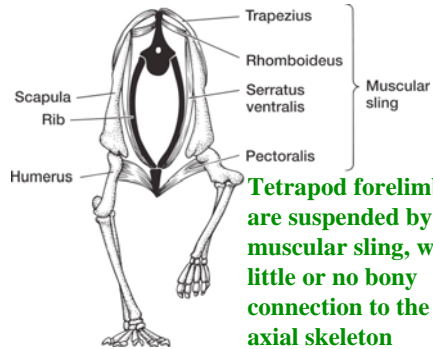
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Tetrapod forelimbs are suspended by a muscular sling, with little or no bony connection to the axial skeleton

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- Turtles are the exception to the forelimb suspension plan here because the shoulder girdle in them is attached to the shell
- In pterosaurs, birds and bats the shoulder girdle rests on the sternum as an adaptation for shoulder stability during flight
- In fishes the pectoral girdle is usually attached to the rear of the skull, but in tetrapods it is not
- 3. Dorsal muscles – insert on the humerus and move it during the stepping cycle

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- **Latissimus dorsi**- originates from body wall outside the limb
- **Teres major** – slip that separates and acquires own attachments on the scapula
- **Other dorsal humeral muscles are: teres minor, subscapularis and deltoideus and the triceps group, although those are extensors of the forearm and not the arm.**
- **Dorsal muscles of the forearm are most of the extensors and straighten the digits via tendons**

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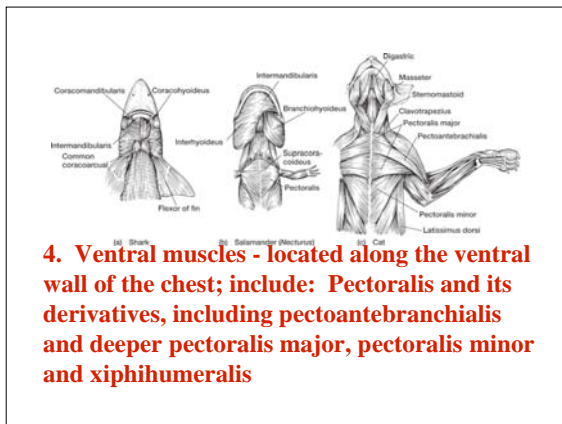
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**4. Ventral muscles - located along the ventral wall of the chest; include: Pectoralis and its derivatives, including pectoantibrachialis and deeper pectoralis major, pectoralis minor and xiphohumeralis**

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- **Supracoracoideus** – from coracoid to humerus in reptiles
- **In mammals, originates dorsally, from the lateral scapular face -- divided into supra and infrapinatus muscles that insert on the humerus.**
- **The coracobrachialis arises from the coracoid and runs along the underside of the humerus**
- **In mammals, the biceps brachii has two heads, and represents the fusion of two muscles with their insertions on the forearm. They are flexors in early tetrapods.**
- **Forearm flexors act on digits through tendons**

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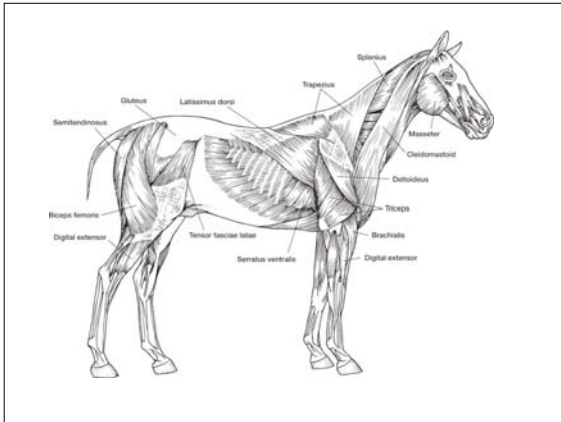
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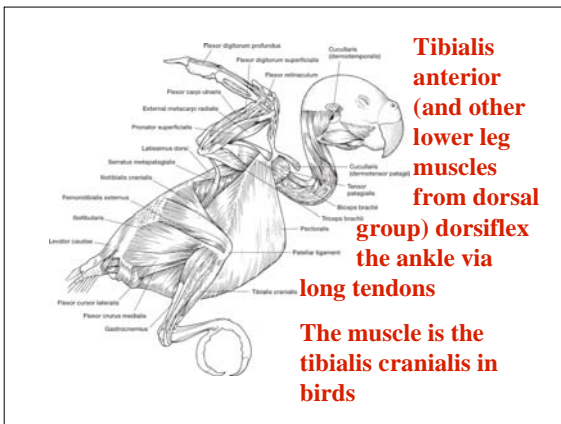
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**Tibialis anterior (and other lower leg muscles from dorsal group) dorsiflex the ankle via long tendons**

**The muscle is the tibialis cranialis in birds**

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- **Quadriceps is a collective name for the rectus femoris, and three heads of the vastus, the lateralis, medialis and intermedius**
- **These surround the anterior medial and lateral aspects of the femur, extend the leg and insert on the patella**
- **Sartorius – two-joint muscle crosses the hip and knee and inserts on the tibia**
- **The ambiens (reptiles) and iliotibialis (amphibians) probably are homologous to the sartorius**

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