

BASIC SCIENCES • ANATOMY

— STUDY NOTES

Veterinary Myology Notes: How a Muscle Is Built, Named and Supplied (PDF)

Myology is the anatomy of the muscles, and this is the layer **underneath** every muscle list rather than the list itself. These notes are the method: what a muscle is made of and why its connective tissue **becomes** the tendon, the five fibre arrangements and the trade each one makes between range and force, what origin and insertion really mean and the case where they swap, what a muscle attaches through, the four jobs muscles do in one movement, and why a muscle's nerve is predictable from where it came from in the embryo.

INSIDE THESE NOTES

- 1 · The branch, and the layer this is
- 2 · Three kinds of muscle
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- 4 · Shape is a machine
- 5 · Origin and insertion, and when they swap
- 6 · What it attaches through, and the four jobs
- 7 · Which nerve, and how a muscle is named

LEVEL

Vets & veterinary students

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LEARNING OBJECTIVES

After working through these notes you will be able to:

- ✓ **Name** the three kinds of muscle tissue on the two axes that separate them.
- ✓ **Trace** the fibrous continuity from one muscle cell to the surface of a bone.
- ✓ **State** the two principles that decide what a muscle's architecture can do.
- ✓ **Identify** the five fibre arrangements and say what each one trades.
- ✓ **Explain** why origin and insertion are a convention, and give the case that proves it.
- ✓ **Distinguish** a prime mover, an antagonist, a synergist and a fixator in one movement.
- ✓ **Predict** which ramus or cranial nerve supplies a muscle from its embryonic source.

TL;DR

Myology is the anatomy of the muscles, and this is the layer **underneath** every muscle list rather than the list itself. These notes are the method: what a muscle is made of and why its connective tissue **becomes** the tendon, the five fibre arrangements and the trade each one makes between range and force, what origin and insertion really mean and the case where they swap, what a muscle attaches through, the four jobs muscles do in one movement, and why a muscle's nerve is predictable from where it came from in the embryo.

AT A GLANCE

THE BRANCH	Myology = the anatomy of the muscles
SKELETAL MUSCLE IS	the ACTIVE part of the locomotor system
THREE SHEATHS	Endomysium → perimysium → epimysium
AND THEY BECOME	the tendon, then Sharpey fibres into bone
RANGE COMES FROM	fibre LENGTH
FORCE COMES FROM	total fibre CROSS-SECTION
ORIGIN / INSERTION	a convention, not a measurement
EPAXIAL	dorsal ramus · dorsal to the transverse processes
HYPAXIAL	ventral ramus · ventral to them, limbs included

01 1 • The branch, and the layer this is

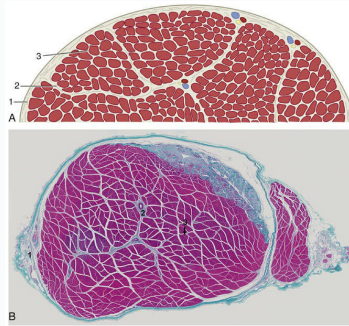
- **Myology** (*myologia*) = the anatomy of the muscles. Skeletal muscle is the **active part of the locomotor system**; bones and joints are the passive part.
- Muscle turns chemical energy into **mechanical energy or heat**. Shivering is the second job.
- This page is the **general** half: what a muscle is made of, what shape it is and what that costs, what it attaches through, what job it does, how it is named, which nerve reaches it.
- **Intrinsic** = wholly within the region it moves. **Extrinsic** = partly outside it, connecting that region to the trunk.
- Out of scope, deliberately: **named muscles with their attachments** (the dog muscle page owns those), **how a muscle contracts** (physiology) and **muscle disease**.

02 2 • Three kinds of muscle

TYPE	STRIATED?	VOLUNTARY?	WHERE, AND HOW IT CONTRACTS
Smooth	No	No	Spindle cells in hollow organs, vessels, glands, spleen, eye, hair follicles. Weak but sustained , usually rhythmic
Cardiac	Yes	No	Heart wall only. Fibre ends contact the sides of others, so it acts as one sheet
Skeletal	Yes	Yes	Multinucleated fibres. This is what myology means

- Two axes, three boxes: there is **no non-striated voluntary muscle**.
- ⚠ The books split them differently. **Sisson**: a flat three. **König**: two classes — smooth and striated — with striated dividing into skeletal and cardiac.
- From here, "muscle" means **skeletal** muscle.

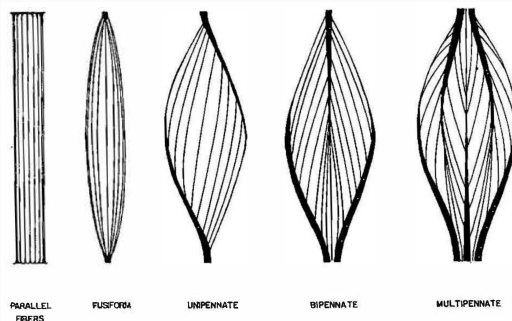
3 • What a skeletal muscle is made of



The three sheaths, drawn (A) and photographed (B). 1 epimysium, 2 perimysium, 3 endomysium. Image — Dyce, Sack & Wensing, *Textbook of Veterinary Anatomy*, 5th ed. Reproduced for educational reference.

- **Butcher's meat**, and about **half the weight of a carcass**.
- A fibre is **10–100 µm across and 5–10 cm long** — visible to the naked eye, and carrying up to several hundred peripheral nuclei.
- Inside it: **myofibrils** in **sarcoplasm**, bounded by the **sarcolemma**. The myofibril is where myology stops and physiology starts.
- Three sheaths: **endomysium** (one fibre) → **perimysium** (a bundle) → **epimysium** (the muscle).
- **The point:** at each end of the belly they **merge and continue as the tendon**, then run on into the periosteum as **Sharpey fibres**. One continuous fibrous system.
- ⚠ **Does muscle regenerate?** Sisson (1975): no new fibres after birth, repair is connective tissue. König (7e): **satellite cells** regenerate it. **The second is current.** Growth in both accounts is by **enlarging existing fibres**.

4 • Shape is a machine



The five fibre arrangements, named on the picture: parallel, fusiform, unipennate, bipennate, multipennate. Image — Sisson & Grossman, *The Anatomy of the Domestic Animals*, Vol. I. Reproduced for educational reference.

ARRANGEMENT	BUYS	COSTS
Parallel (strap)	The most travel	The least force
Fusiform	A compromise; the commonest limb shape	Neither extreme
Unipennate	More fibres, more force	Shorter fibres; the cosine loss starts
Bipennate	More again	Less again
Multipennate	The most force for its bulk	The least travel

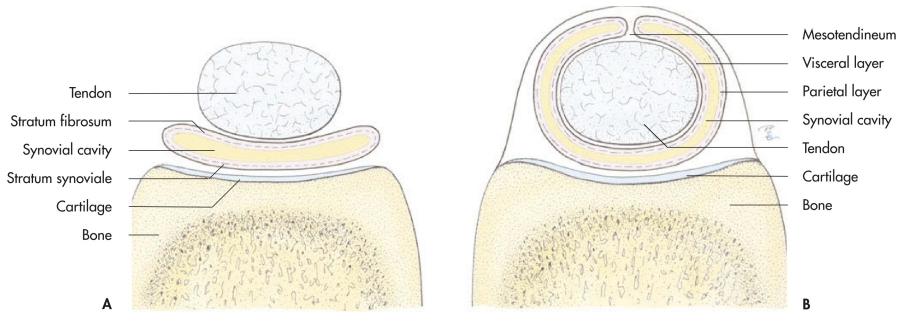
- **Two principles.** Shortening (about 50%) follows **fibre length**. Power follows the **aggregate cross-sectional area** of the fibres. A fibre shortens by only a third to a half of its length.
- **The cost of pennation:** only the **cosine** of the fibre angle pulls along the tendon. So measure the **physiologic** cross-section, not the anatomic one.
- **Why limbs are built this way:** pennate bellies close to the trunk, light tendons to the digits — less energy to swing the limb.
- **Red = slow-twitch**, oxidative, sustained (postural). **White = fast-twitch**, glycolytic, burst. The chicken's pale breast and dark leg. Most muscles are a mixture — two types is a **convenient simplification**.

05 5 • Origin and insertion, and when they swap

RULE	SAYS	BREAKS WHEN
Functional	The end that stays more still is the origin	What the animal is standing on changes
Limb convention	Proximal = origin, distal = insertion	It is a convention, applied regardless of what moved
Punctum fixum / mobile	The end actually held still, and the end that actually moves	It does not — this is the pair that survives

-  **Assigned by convention.** A naming rule, not a measurement of what moved.
- **The case that proves it:** the **biceps femoris** flexes the stifle with the foot off the ground and **extends** it with the foot planted.
- Leverage: an insertion near the proximal end of the next bone gives **speed and range**; broad attachments over a short distance give **strength** instead.
- To move anything, a muscle must **cross at least one joint**.

6 • What it attaches through, and the four jobs



(A) A synovial bursa, between tendon and bone. (B) A tendon sheath, wrapped right around the tendon. Image — König & Liebich, *Veterinary Anatomy of Domestic Animals*, 7th ed. Reproduced for educational reference.

ROLE	DOING WHAT	FLEXING AN ELBOW
Prime mover	Produces the movement	The flexors shorten
Antagonist	Opposes it, and so controls it	The extensors pay out under control
Synergist	Adds to the pull, or cancels a side-effect	An unwanted rotation is opposed
Fixator	Holds another joint still	The shoulder is stabilised

- **Tendon** (cord) · **aponeurosis** (sheet) · **raphe** (midline seam) · **fascia** (envelope) · **retinaculum** (a ring-like thickening of deep fascia that a tendon passes under at a joint, strengthening it) · **bursa** (sac between) · **sheath** (sac wrapped round, with the **mesotendon**).
- **Sesamoid bones** change the direction of a tendon's pull and protect it.
- ⚠️ **Agonist / antagonist** here mean **muscles**, not drug receptors.
- **Isometric** = tension rises, length does not. **Isotonic** = it shortens.
- **Muscle tonus** is a reflex from the muscle spindles — anaesthesia gives **hypotonus**.

7 • Which nerve, and how a muscle is named

- **Epimere** → **dorsal** ramus → **epaxial** muscles. **Hypomere** → **ventral** ramus → **hypaxial** muscles, the body walls and **the limbs**.
- **The landmark:** the vertebral **transverse processes** mark the boundary.
- **Branchial arches keep their cranial nerve.** Arch 1 → trigeminal (the jaw closers). Arch 2 → facial (the mimetic and cutaneous muscles). Arch 3 → glossopharyngeal. Arches 4 and 6 → vagus and accessory. It is why the **digastricus has two nerves**.
- **The fourth source:** the **preotic mesoderm** gives the **eye musculature**, on cranial nerves **III, IV and VI** — neither somite nor arch.

- **Motor unit** = one motor neuron, its axon and every fibre it supplies. Many small units = precise; few large units = powerful. The junction is the **motor end-plate**.

A NAME CAN TELL YOU	LOOK FOR	EXAMPLE
Shape	<i>deltoideus, rhomboideus, teres</i>	<i>M. deltoideus</i>
Fibre direction	<i>rectus, obliquus, transversus</i>	<i>M. obliquus externus abdominis</i>
Size	<i>major/minor, longus/brevis, profundus/superficialis</i>	<i>M. flexor digitorum profundus</i>
Position	<i>supra-, infra-, inter-, lateralis</i>	<i>M. supraspinatus</i>
Action	<i>flexor, extensor, levator, tensor</i>	<i>M. extensor carpi radialis</i>
Attachment	Two bones, origin then insertion	<i>M. sternocephalicus</i>
Heads or bellies	<i>biceps, triceps, digastricus</i>	<i>M. triceps brachii</i>
Consistency	<i>membranosus, carnosus</i>	<i>M. semimembranosus</i>

KEY TERMS — QUICK GLOSSARY

Aponeurosis	A tendon spread into a broad sheet rather than a cord.
Raphe	The seam where paired muscles meet on the midline.
Mesotendon	The double fold joining the two layers of a tendon sheath; it carries the blood supply. Reduced to threads (<i>vincula</i>) where pressure is greatest.
Punctum fixum / mobile	The end actually held still in a movement, and the end that actually moves. They can swap; the labels origin and insertion cannot.
Physiologic cross-section	The plane cutting every fibre transversely — the one that predicts force. The anatomic section slices the belly at its thickest point and misleads in a pennate muscle.
Satellite cell	A stem cell that stays in the muscle for life; regeneration depends on how many survive undamaged.

QUICK REVISION — REMEMBER THESE

- 1 **The connective tissue is not packaging.** Endomysium, perimysium and epimysium merge at each end of the belly and **become the tendon**, which runs on into the periosteum as Sharpey fibres. Muscle and skeleton are one fibrous system.

- 2 **Two numbers compete.** Fibre **length** sets travel; total **cross-section** sets force. A fibre shortens by only a third to a half, so you cannot have both.
- 3 **Pennation is not free.** Only the **cosine** of the fibre angle pulls along the tendon — which is why force follows the **physiologic**, not the anatomic, cross-section.
- 4 **Origin and insertion are assigned by convention.** The biceps femoris flexes the stifle with the foot up and **extends** it with the foot planted.
- 5 **Four jobs, not one** — prime mover, antagonist, synergist, fixator. They are roles in a movement, not properties of a muscle.
- 6 **The nerve is predictable.** Epimere → dorsal ramus → epaxial. Hypomere → ventral ramus → hypaxial and the limbs. Branchial arches keep their cranial nerve, and the preotic mesoderm gives the eye muscles their own three.
- 7 **Eight naming bases** — shape, fibre direction, size, position, action, attachment, head or belly count, consistency. Almost every muscle uses one or two.

MEMORY AIDS

Inside out, small to large — Endomysium round one fibre, perimysium round a bundle, epimysium round the lot. The prefixes are the order.

Length travels, thickness pulls — Long fibres buy **range**; a big total cross-section buys **force**. Every muscle shape is a position on that one trade.

Dorsal over, ventral under — The vertebral **transverse processes** are the line. Above them, epaxial and the **dorsal** ramus; below them, hypaxial and the **ventral** ramus — and the limbs are below.

TEST YOURSELF — ACTIVE RECALL

Cover the answers and try to retrieve each one from memory first — self-testing beats re-reading.

1. Name the three kinds of muscle tissue on the two axes that separate them.
2. Name the three connective-tissue sheaths outermost first, then say what actually matters about them.
3. State the two principles of muscle architecture.
4. What does pennation cost, and what does that imply about measuring force?
5. The biceps femoris flexes the stifle. When does it extend it, and what does that prove?
6. Distinguish a bursa from a tendon sheath.
7. Name the four jobs a muscle can have in one movement.
8. How do you predict which ramus supplies a trunk muscle, and why are the jaw closers trigeminal?

ANSWERS

1. **Smooth** — non-striated, involuntary. **Cardiac** — striated, involuntary. **Skeletal** — striated, voluntary. There is no fourth box: no non-striated voluntary muscle exists.

2. **Epimysium, perimysium, endomysium.** And the point: at each end of the belly they **merge and continue as the tendon**, which runs on into the periosteum as **Sharpey fibres**. They are the beginning of the tendon, not wrapping round the meat.
3. The **shortening** a muscle can show (about 50%) is a function of the **length of its fibres**. The **power** it develops is a function of the **aggregate of their cross-sectional areas**. In a belly of fixed size those compete.
4. Only the **cosine** of the fibre angle pulls along the tendon, so a pennate muscle wastes part of its strength and its travel. So force is predicted by the **physiologic** cross-section — the plane cutting every fibre transversely — not the anatomic one.
5. **When the foot is planted.** Nothing about the muscle changed; what changed was which end was free to move. It proves that **a muscle's action is a result of the muscle, the joint and what is currently fixed** — so origin and insertion are a convention, and an Action column is the usual case, not a law.
6. Geometry. A **bursa** is a flattened sac *between* a tendon and what it rubs against. A **sheath** is the same sac **wrapped right around** the tendon into a tube — parietal layer outside, visceral layer against the tendon, and the double **mesotendon** joining them, carrying the blood supply.
7. **Prime mover** produces it, **antagonist** opposes and therefore controls it, **synergist** adds to the pull or cancels a side-effect, **fixator** holds another joint still. The smaller muscles round a joint usually act in fixation.
8. By which side of the **vertebral transverse processes** it lies on: epimere → **dorsal** ramus → epaxial above them; hypomere → **ventral** ramus → hypaxial below them, limbs included. And the jaw closers are trigeminal because they came from **branchial arch 1**, which keeps its cranial nerve — the facial muscles came from arch 2, which is why their nerve is different.

WHEN TO REFER OR ESCALATE

- A nerve injury: the window is not indefinite. **Unless the nerve regenerates without great delay, the muscle fibres are replaced by connective tissue.**
- An anaesthetised patient going floppy: that is **hypotonus** — the loss of the constant reflex stimulus from the muscle spindles, not the loss of muscle.
- A tendon that will not heal: at **friction points**, where the tendon has become cartilage-like, virtually no blood vessels exist.
- A horse's suspensory ligament: developmentally the **middle interosseous muscle**, and it hardly contains muscle tissue. Under extreme load it can stretch until the fetlock touches the ground.
- Reading an attachment table: the **Action** column is the usual case, not a law. Change what is fixed and the action can reverse.

SOURCES

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4. Constantinescu GM. *Illustrated Veterinary Anatomical Nomenclature*, 4th rev. ed. — the naming authority for the Latin used here.

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