General Anatomy-Muscle

- Definition
- Types
- Attachments
- Architecture
- Muscle Supply
- Tendons
- Group Action

FUNCTIONS

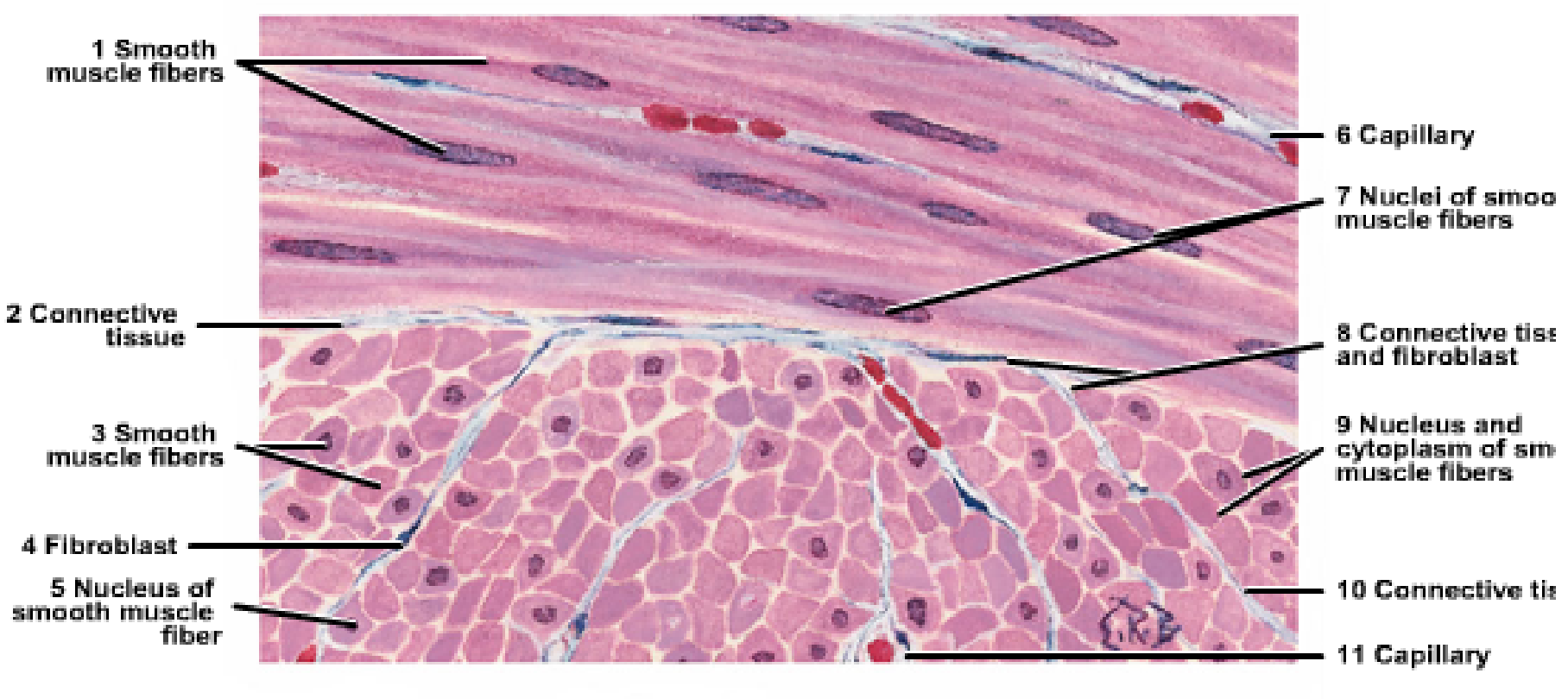
- Mobility: Skeletal Muscle – Exterior environment

  Smooth Muscle – Interior environment in the processes of digestion, circulation, secretion, excretion etc.
- Restriction of movement: to limit normal movement & prevent undesirable movement.

  e.g. Sphincters serve the purpose of temporary stopping/limiting flow.
- Continuous metabolic activity associated with process of oxidation & liberation of heat e.g. shivering.
- Body contour & shape
- Maintenance of normal physiological equilibrium of body.

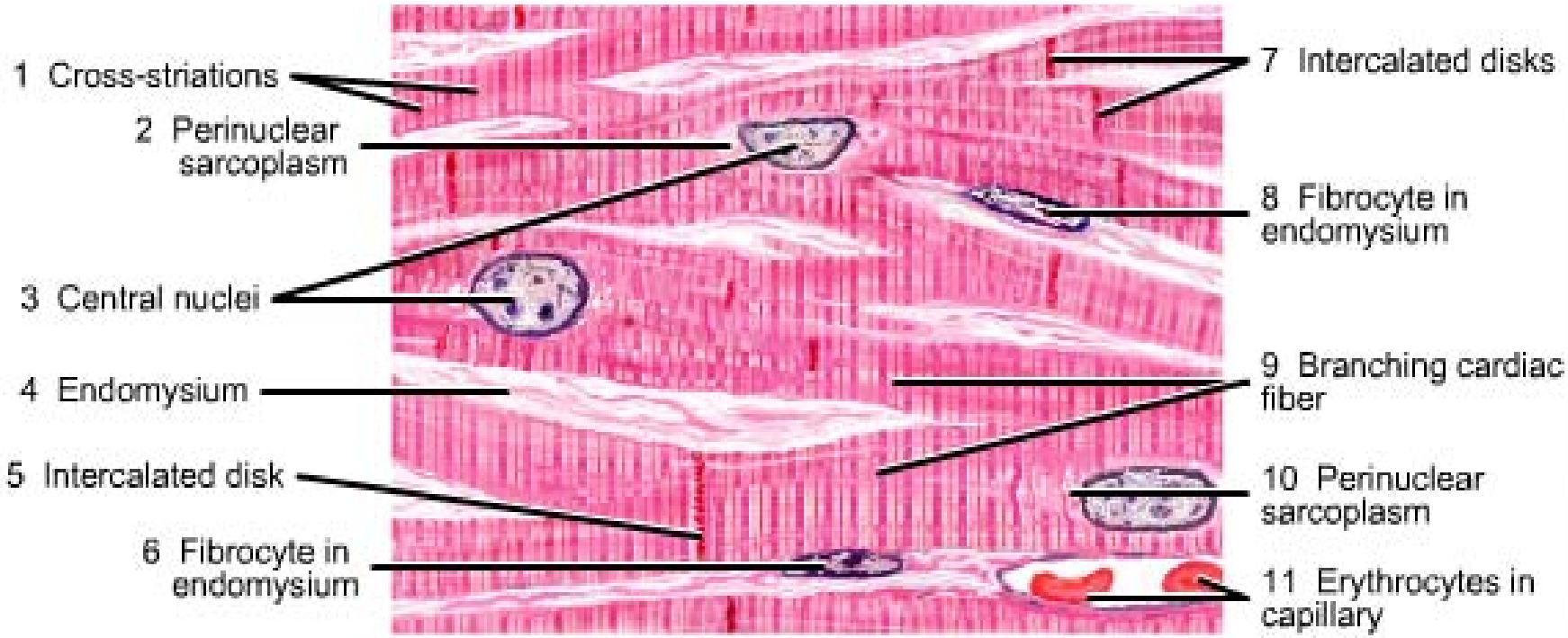
Smooth/nonstriated Muscle

- Innervated by ANS so involuntary.
- It preserves the ability to contract automatically, spontaneously and rhythmically . exception – ciliary muscle is smooth but voluntary.
- Derived mainly from splanchnic mesoderm (except iris, arrector pilli).
- Elongated, spindle shaped fibres with a central oval nucleus.
- Arranged in sheets or layers (not in bundles).
- Circular & longitudinal.
- Peristalsis- Longitudinal-shortening & dilatation of gut
  Circular – constriction
- Hypertrophy (e.g. uterus)
- Nerve supply – Sympathetic & Parasympathetic
  (post ganglionic & non myelinated fibres)


1 Smooth muscle fibers
2 Connective tissue
3 Smooth muscle fibers
4 Fibroblast
5 Nucleus of smooth muscle fiber
6 Capillary
7 Nuclei of smoo muscle fibers
8 Connective tis and fibroblast
9 Nucleus and cytoplasm of sm muscle fibers
10 Connective ti
11 Capillary

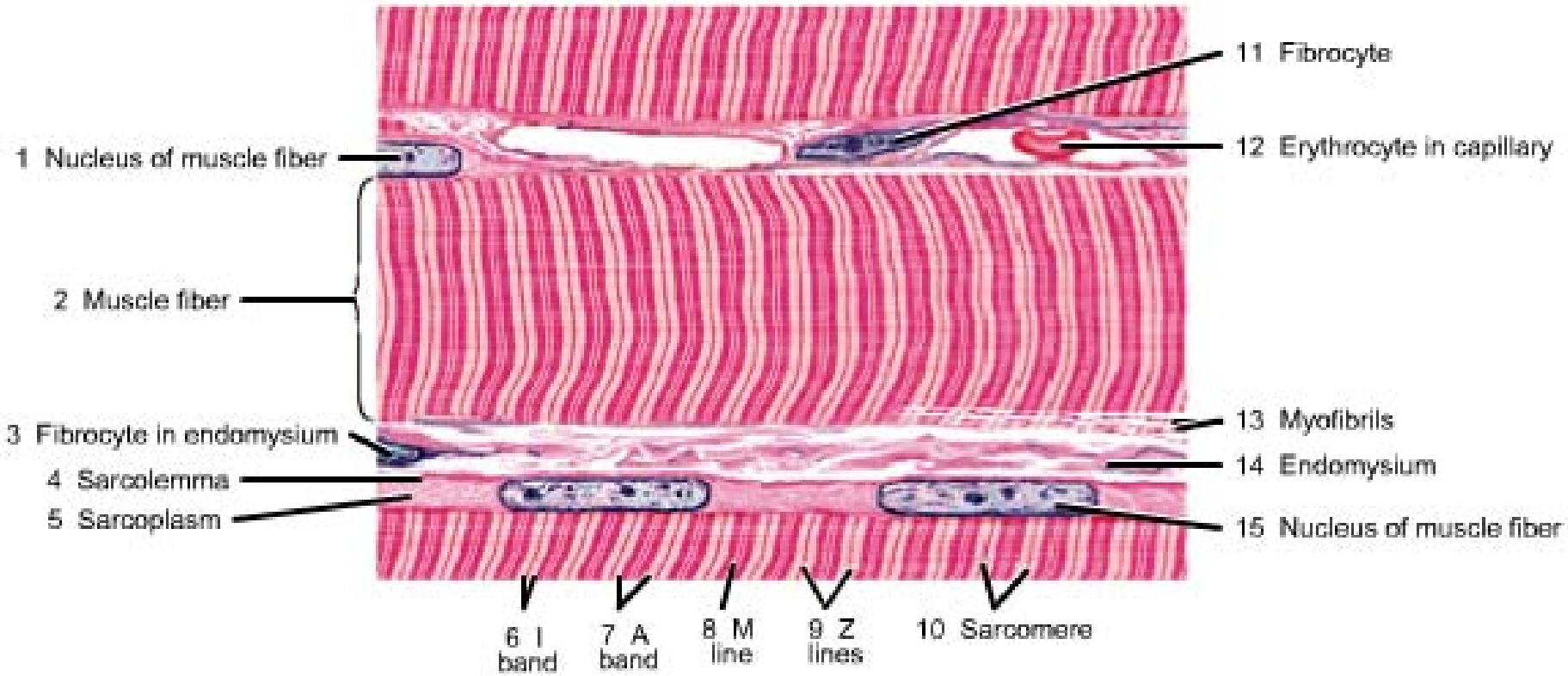
Cardiac Muscle

- Present only in heart
- Centrally placed single nucleus
- Light striations present
- Fibres cylindrical and branched
- Enclosed only in endomysium
- Junctional areas exhibit intercalated disc (dark transverse bands)
- Involuntary
- Innervated by ANS; autorythmicity.


1 Cross-striations
2 Perinuclear sarcoplasm
3 Central nuclei
4 Endomysium
5 Intercalated disk
6 Fibrocyte in endomysium
7 Intercalated disks
8 Fibrocyte in endomysium
9 Branching cardiac fiber
10 Perinuclear sarcoplasm
11 Erythrocytes in capillary

Skeletal Muscle

- Separate cylindrical fibres in a matrix of connective tissue.
- Length- 1 mm – 5 cm - 40 cu
- Width – 10 mm - 100µm
- Sarcolemma, sarcoplasm
- Multinucleated – near periphery
- Transversely striated appearance –series of alternating light and dark bands
- Isotropic (I) light band, a dark transverse line in the centre- Z disc (Krause's membrane).
- Anisotropic (A) dark band. In the centre, a clear area intervenes – H band (Hensen's band), a thin dark line as M line.
- I & A bands have different staining properties.
- Bands differ in chemical composition, no. of striations.


1 Nucleus of muscle fiber
2 Muscle fiber
3 Fibrocyte in endomysium
4 Sarcolemma
5 Sarcoplasm
6 I band
7 A band
8 M line
9 Z lines
10 Sarcomere
11 Fibrocyte
12 Erythrocyte in capillary
13 Myofibrils
14 Endomysium
15 Nucleus of muscle fiber

Skeletal muscle (contd.)

- Myofibrils are essential contractile elements of muscle fibres.
- composed of longitudinal myofilaments arranged in closely packed strands.
- Myofibrils are held together in a clear matrix – sarcoplasm.
- Myofilaments consist of proteins- Actin (fine) & Myosin (rough).
- Sarcomere is the contractile unit between two successive Z disc.
- When myofibril contracts, A band remain constant, I band shortens.

Skeletal Muscle

- Muscle belly
- Tendon/aponeurosis
- **Red Muscle**: Myofibrils – less numerous
  striations – less regular,
  more sarcoplasm
  more primitive

  presence of myoglobin/storage of oxygen

  Fibres present in those muscles which are required to contract over long periods; so they contract slowly and sustain their contraction.
- **White muscle**.
- In humans mixed red & white fibres in one muscle.

Organization

- Endomysium
- Perimysium
- Epimysium
- At attachment – abrupt transition from muscular tissue to tendon. No continuity between myofibrils and tendon fibrils.
- Origin
- Insertion

Fascicular Architecture

Force and Range of Contraction

1. Range of movement is proportional to the length of the muscle fasciculi.
2. Force of contraction is directly proportional to number of fibres
3. Direction of Action

Shape of muscle

- Parallel muscle fibres:
  - Flat -Triangular, quadrate, rhomboidal
  - Strap
  - Quadrate
  - Fusiform
- Muscle fibres attached obliquely to the tendon of insertion.
  - Unipennate
  - Bipennate
  - Multipennate
  - Circumpennate

Shorter muscle fibres, so range of movement is smaller. So muscle gains in strength at the expense of movement so powerful pull through a small distance.

Shape of muscle

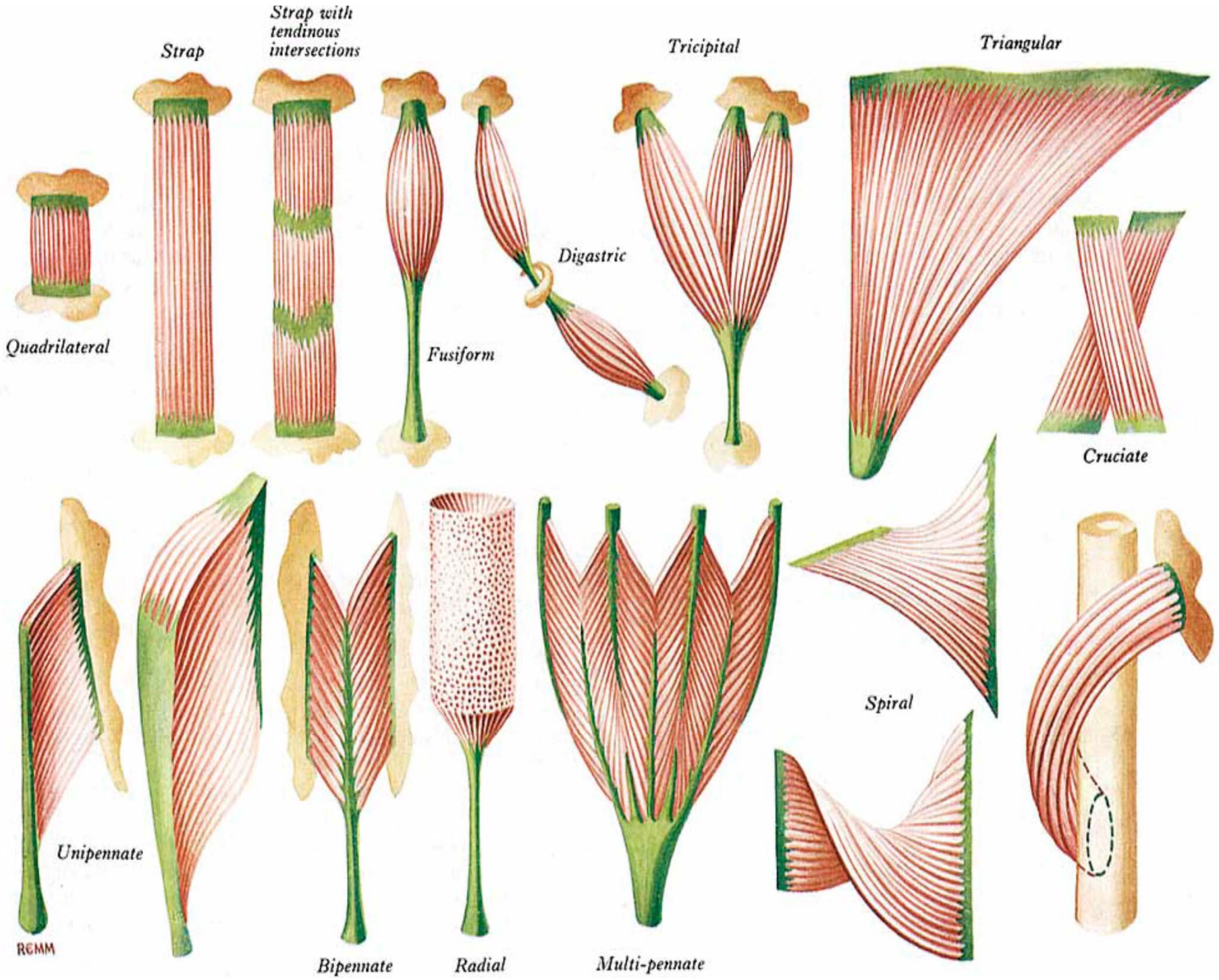
- Where the direction is circular:

  Sphincters
- Number of heads:

  Biceps, Triceps, Quadriceps
- No. of Bellies:

  Digastric

- Panniculus carnosus – extensive sheet of cutaneous musculature , remnants – facial muscles, platysma


Strap
Strap with tendinous intersections
Tricipital
Triangular
Quadrilateral
Fusiform
Digastric
Cruciate
Unipennate
Bipennate
Radial
Multi-pennate
Spiral
RGMM

Naming of a muscle

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)
- biventer (= 2 bellies)

Position

- anterior, posterior, interosseus (= between bones)
- supraspinatus (= above spine of scapula)
- infraspinatus (= below spine of scapula)
- dorsi (= of the back)
- abdominis (= of the abdomen)
- pectoralis (= of the chest)
- brachii (= of the arm)
- femoris (= of the thigh)
- oris (= of the mouth)

Depth

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

Attachment

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

Action

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

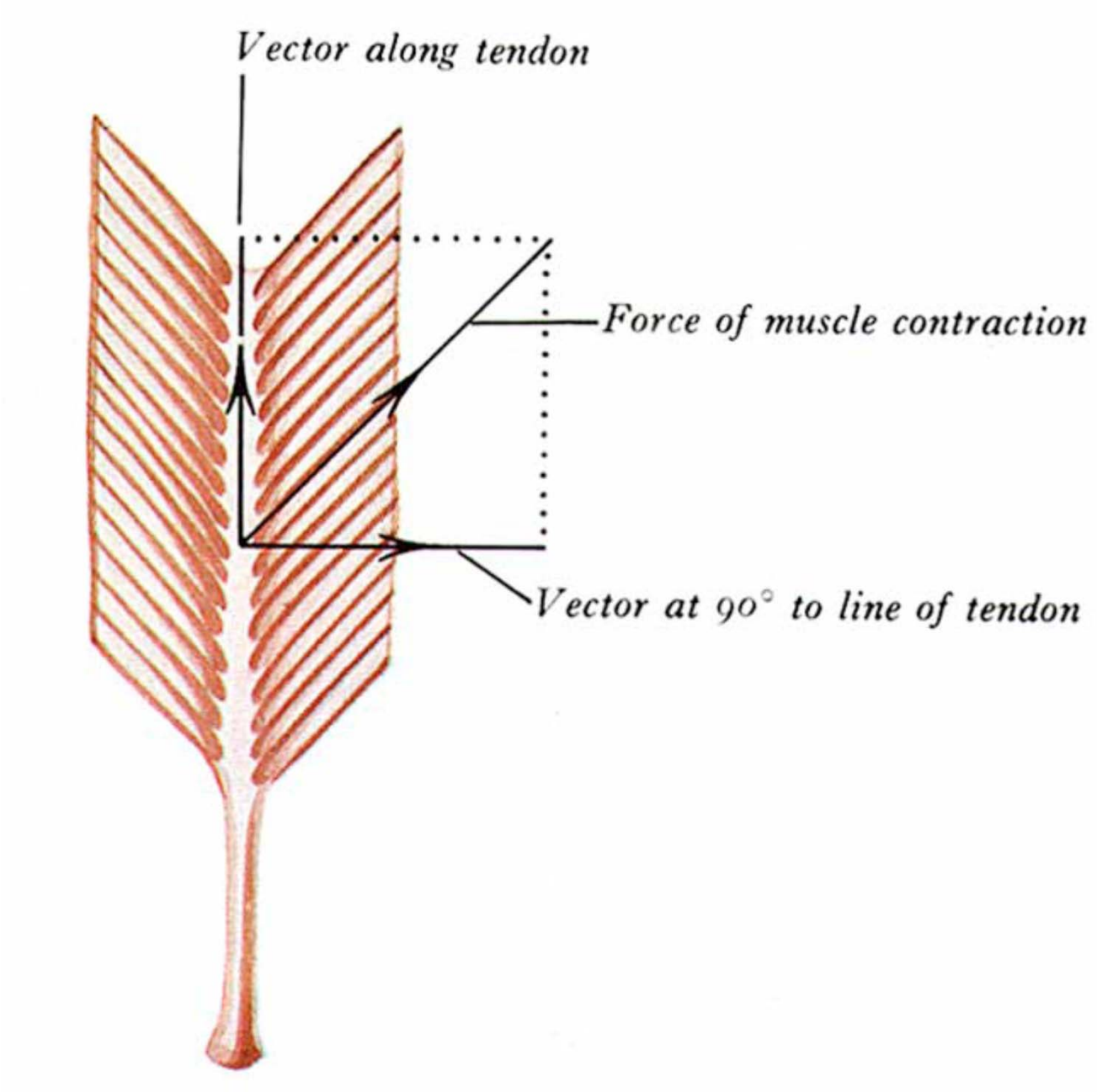
These terms are often used in combination: thus, flexor digitorum longus (= long flexor of the digits), latissimus dorsi (= broadest muscle of the back).

Variations of Muscle

- Progressive: tendency of some muscles to become complex e.g. flexor digitorum profundus
- Retrogressive e.g. palmaris longus, plantaris, coccygeus
- Atavistic – Muscle completely lost during evolution abruptly make an appearance e.g. coraco brachialis, panniculus carnosus, muscles of ear.

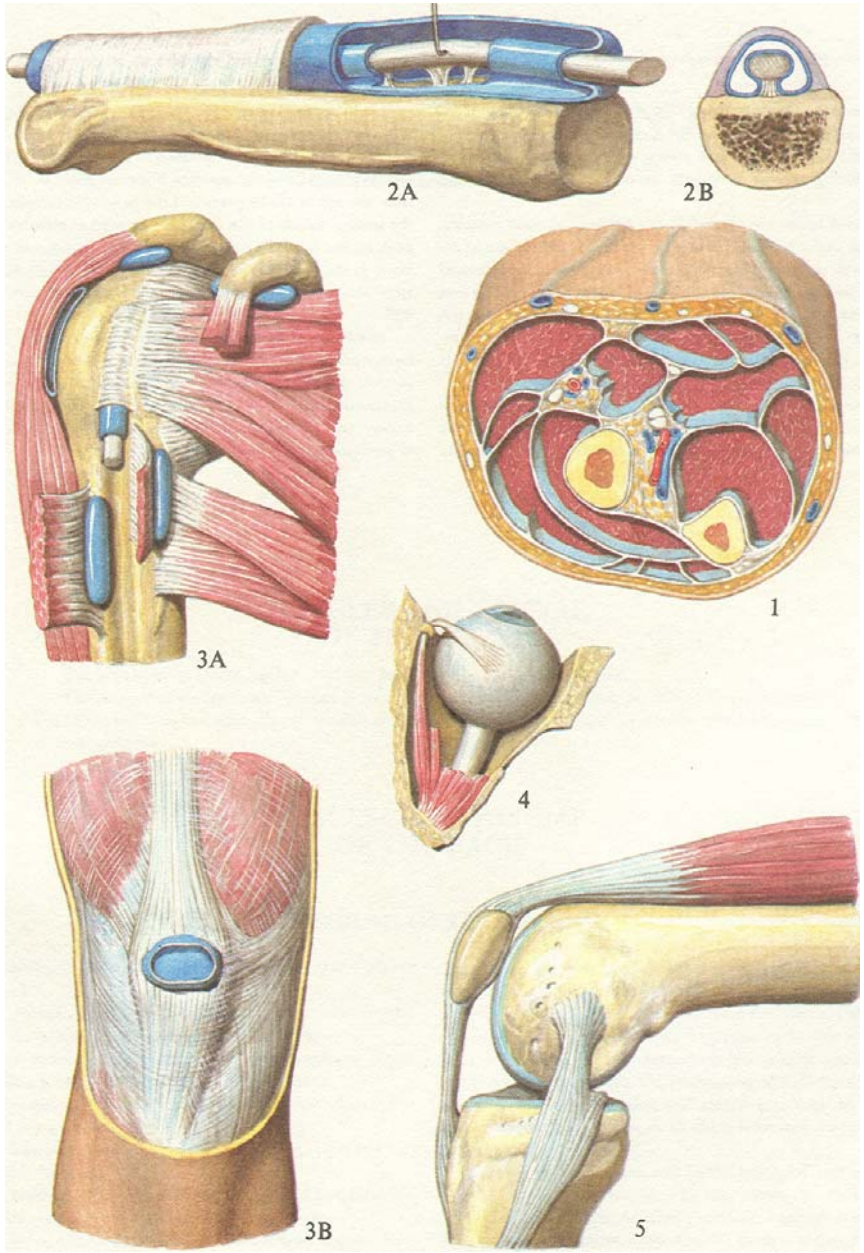
Muscle Action

- Any muscular movement requires the simultaneous action & accurate coordination of a whole series of separate muscles.
- All or none principle
- Acting from insertion usually
- Restriction of movement
- Isometric Contraction: fibres contract with no shortening of muscle as a whole e.g. abdominal muscles.
- Partial contraction e.g. trapezius
- Prime movers
- Synergists
- Fixators
- Antagonists


Vector along tendon
Force of muscle contraction
Vector at 90° to line of tendon

Tendons & tendon sheaths

- Flexible & inextensible cord through which pull of a muscle is transmitted to its insertion.
- Concentrate the pull of a muscle on a small area
- Allow muscles to act from a distance
- Sometimes change the direction of pull
- Structurally white fibrous tissue.
- Collagenous fibres arranged in closely packed parallel bundles. Glistening appearance. Between fibres, single rows of fibroblasts
- Sesamoid bones


2A
2B
3A
1
4
3B
5

Tendon sheaths

- Minimize friction
- Composed of parietal & visceral layers.
- Poor blood supply (vincula vasculosa)
- Abundant nerve supply.
- Synovial bursa.

Blood &Nerve Supply

- **Motor** – Entry at a constant site (motor point), leads to contraction of muscles
  nerve divides into twigs
  within muscle, terminal arborizations
  (motor end plate)
  Motor unit – axon of a single motor neuron together with the muscle fibres which it supplies, forms a functional neuromuscular unit.
- **Sensory** – Muscle spindles.
  Initiation of proprioceptive impulses required for control & regulation of muscular activity. Convey sensations of pain, tension, position and degree of contraction of muscle fibres.
- **Autonomic** – supply smooth muscles of blood vessels within muscle
  Sympathetic, Vasoconstrictor
- **Blood supply** – Richly vascular, arteries enter along with motor nerves
  Red muscles have richer vascular supply.