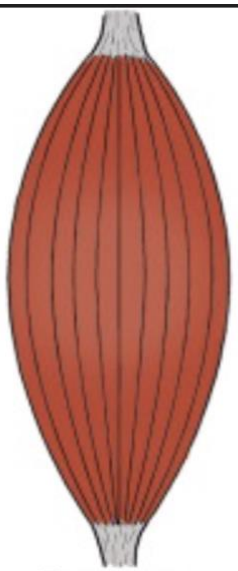
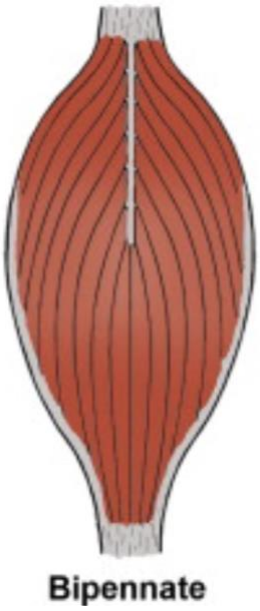
FORCE GENERAITON

- Muscles vary significantly in their shape and size
    - Fibers can be arranged differently, such as inserting onto tendons differently
    - **Differences in muscle architecture explain variability in force production between muscles**
- **Basic Pennation Arrangements:**

	Fusiform Arrangement	**Unipennate Arrangement**	**Bipennate Arrangement**
Definition	Muscle fibres run up and down, making fibre length ≈ muscle length	Fibres insert *obliquely* on *only one side* of the tendon	There is a *central tendon* with fibres inserting *obliquely on both sides*
	 Fusiform	 Unipennate	 Bipennate
Examples	⇒ Biceps ⇒ Brachialis	⇒ Palmar interossei ⇒ Extensor digitorum longus	⇒ Rectus femoris ⇒ Dorsal interossei

- **Architecture and Force Capacity:**
    - Muscles with a larger CSA generally produce more force because more fibers are packed into the same space
    - For example, if Muscle A has a larger angle of fiber insertion, its fibers will be shorter, but more fibers will be packed into the CSA region,

resulting in a larger CSA and greater force production compared to Muscle B (with longer fibers inserting at a lesser angle)

- Force production is proportional to the muscle CSA
- Muscles show architectural specialization, being designed for specific functions
    - **Small muscles are optimised for fine control and dexterity (eg, hands/fingers, eyelids), whereas larger muscles have a greater cross sectional area, optimised for force and power output**

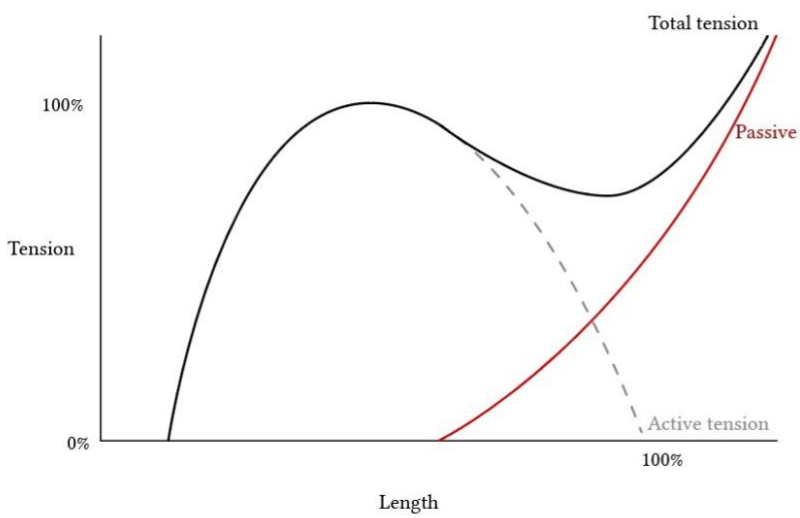
TYPES OF MUSCLE ACTIONS

1. Isometric: Muscle length does not change during contraction
    - This occurs when the force developed by the muscle and the load are equivalent, or when the load is immovable
2. Miometric (Concentric contraction): Muscle length shortens during contraction
    - This happens if the force developed by the muscle is greater than the load on it
3. Pliometric (Eccentric contraction): Muscle length increases during contraction
    - This occurs when the load on the muscle is greater than the force developed by the muscle, causing the muscle to stretch

SKELETAL MUSCLE LENGTH-TENSION RELATIONSHIP

- The amount of force a muscle can produce depends on the overlap between actin and myosin filaments in the sarcomere
    - **Short length:** if the muscle is not stretched, the *filaments interfere with one another*, and the force output is low
    - **Long lengths:** when the muscle is overstretched, *filaments cannot reach each other*, so the force output is also low

⇒ At **medium lengths** (ie moderate amounts of muscle stretch), overlap between actin and myosin filaments is at its highest, enabling maximum force output



Total tension = passive tension + active tension

Passive tension = the force produced by elastic structures in the muscle (eg **titin, connective tissue**) when the muscle is stretched

⇒ Passive tension is **low** at low muscle stretch
⇒ However, it increases with stretch

Active tension = the force produced by **crossbridge cycling**, and depends entirely on **actin-myosin overlap**