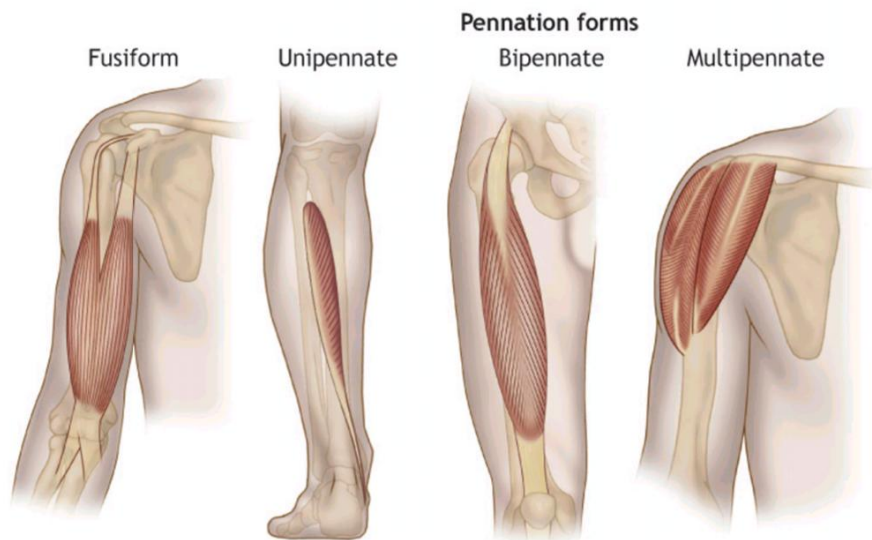
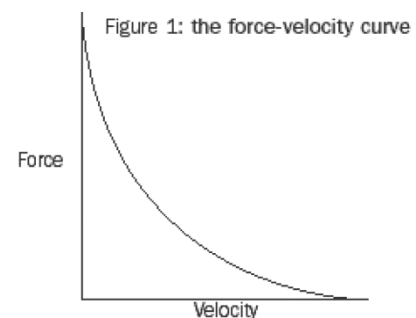


- **Muscle fibre length**
  - Few mm- 30cm (Ratio of fibre length to muscle length 0.2-0.6).
  - Limited by spread of signal from neuromuscular junction.
  - Shorter fibres are usually stronger (force at a shorter length).
  - Longer fibres can shorten faster (higher peak velocity; may be more powerful but not as much force).
  
- **Muscle architecture**
  - Organisation of fibres in a muscle is called 'architecture' (fibre alignment).
  - Arrangement of fibres is described relative to the axis of force.
  - Many types of arrangement but for convenience described as 4 types;
    - Parallel – fibres parallel to force generating axis (also called fusiform).
    - Unipennate – single angle.
    - Multipennate – More than one angle. Pennated fibres oriented at an angle relative to force-generating axis – Angle usually varies between 0 and 300.
    - Circular – fibres arranged around an opening or recess.



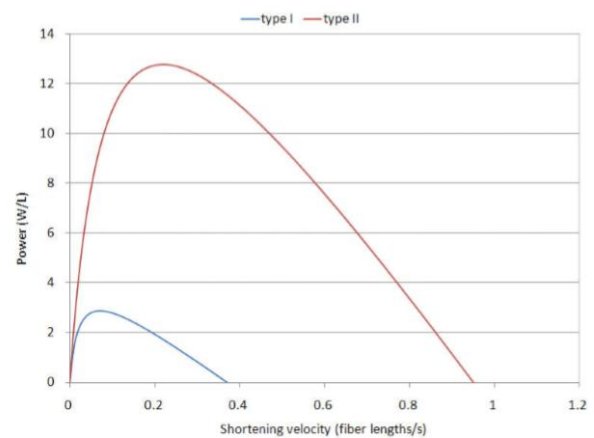
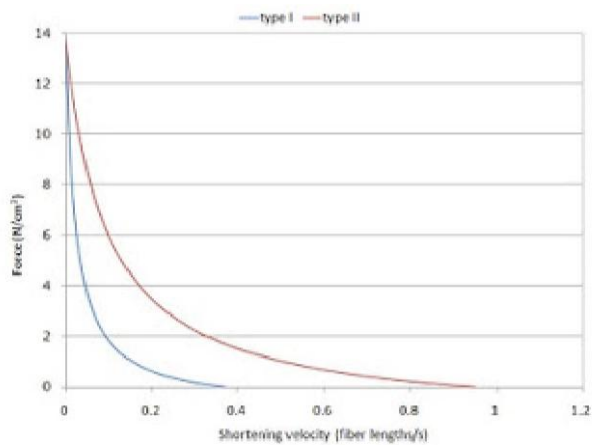
- Influences total physiological cross-sectional area (PCSA) of muscles.
- Pennation increases fibre packing and results in greater PCSA.
- Increased PCSA results in higher force at the same muscle length and at the same velocity.
- Influences length of muscles.
- Alters velocity characteristics of muscles.
- Parallel muscles shorten faster – Fibres typically longer.

- **Shortening velocity**
  1. Muscle force is proportional to physiologic cross-sectional area (PCSA).
  2. Muscle shortening velocity is proportional to muscle fibre length
  3. When a muscle shortens quickly it has less time for the cross-bridges to attach – so force decreases.



- **Fibre type & myosin isoform**

- Type II fibres produce more force and greater power at the same velocity.
- Type II fibres can produce more force and power at higher velocities.



- **Neurological**

- Size of neural drive to muscle to contract i.e. Size & number of motor units recruited.
- Skeletal muscle is slave to the somatic nervous system.
- Recruitment of muscle:
  - Recruit muscle fibres by recruiting motor units (motor unit = group of fibres supplied by 1 motor neuron).
  - All muscle fibres in a motor unit are same.
  - Recruit combinations of motor units best suited to task.
  - Recruitment pattern (which nerves, which fibres) changes with:
    - Force required
    - Duration of activity
    - Availability of energy
    - Fatigue of fibres
  - Categories of motor units:
    - S - Slow twitch; low tension; fatigue resistant (~Type I fibres).
    - FR - fast twitch; moderate force; fatigue resistant (~Type IIA fibres).
    - FF - fast twitch; high force; highly fatigable (~Type IIB fibres).
  - More motor units = more force.
  - Larger motor units = more force.
  - Number of fibres per motor unit varies- small motor units are used for fine motor control, large ones for gross locomotor control.
  - Size varies with muscle group;
    - Eye- 10 fibres/motor unit
    - Finger- 300 fibres/motor unit
    - Gastrocnemius- 2000 fibres/motor unit
  - Number of fibres per motor unit usually varies with motor unit type;
    - S motor units- Smaller number of fibres, smaller increments in force.
    - FF motor units- Larger number of fibres, larger increments in force.