

Module 8 LO4

Nervous System Control of Muscle Tension

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[Video Recording Link](#)

4. Nervous System Control of Muscle Tension

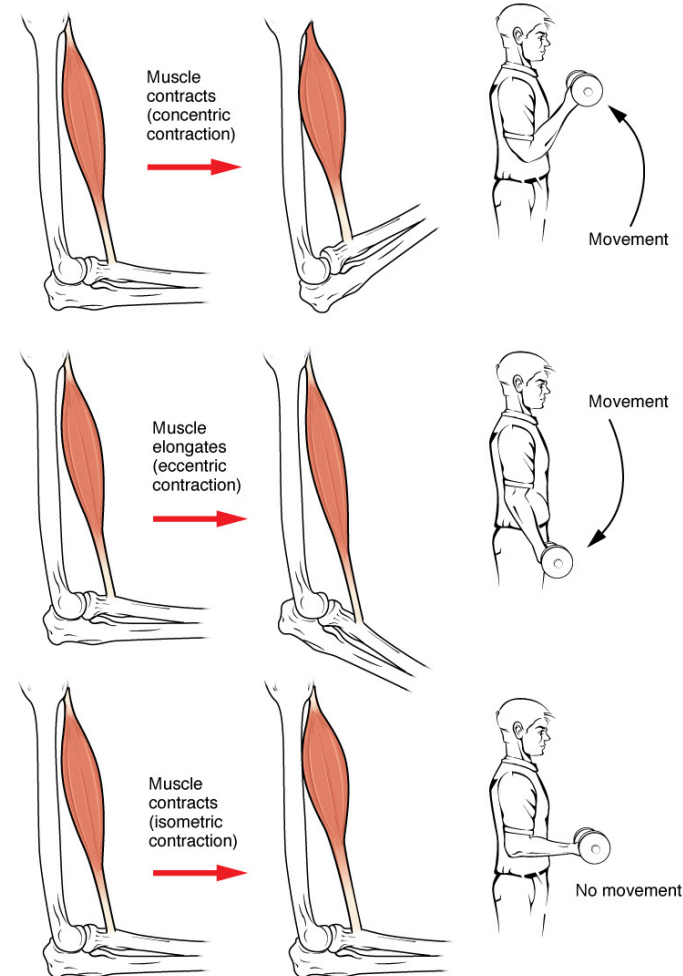
- Muscle tension
 - Force generated by muscle contraction
- Load – object that is moving
 - Muscle tension – generated when muscle is contracting against a load that does not move
 - Results in two types of muscle contractions
 1. Isotonic contractions
 2. Isometric contractions

Types of Muscle Contractions

A. Isotonic contractions – muscle length changes to move a load

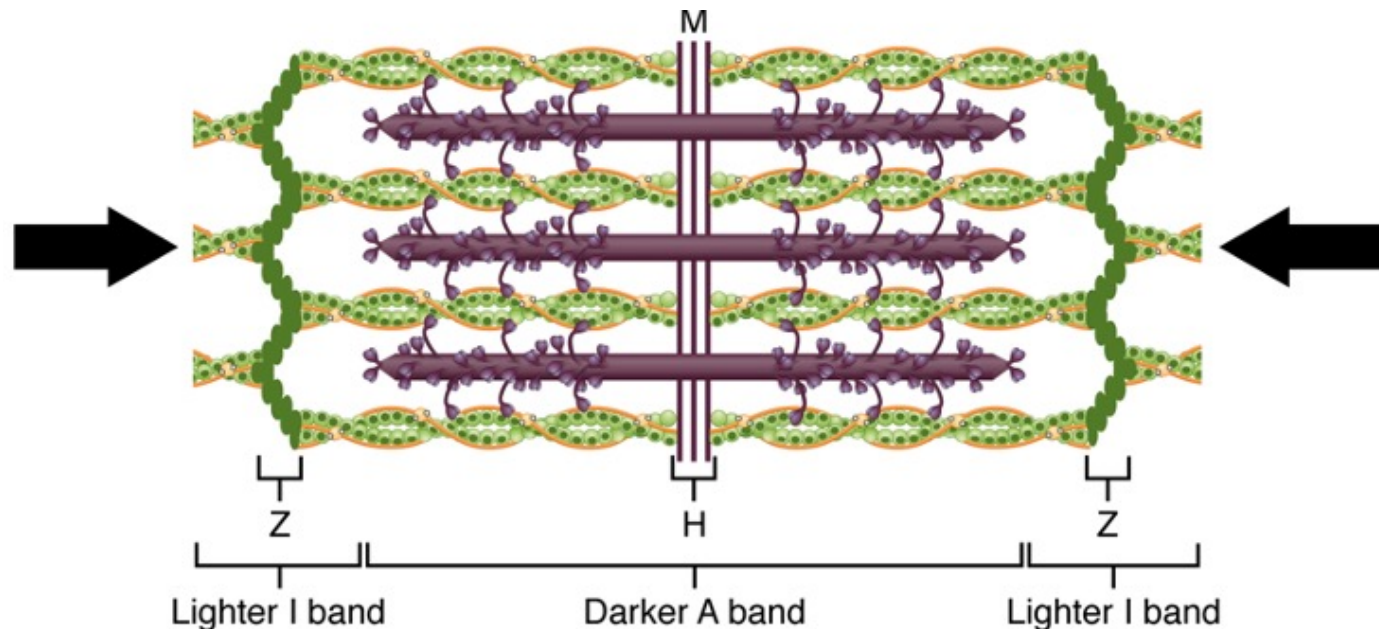
- 1) Concentric contraction
- 2) Eccentric contraction

B. Isometric contractions - muscle length does not change because load exceeds the tension the muscle can generate



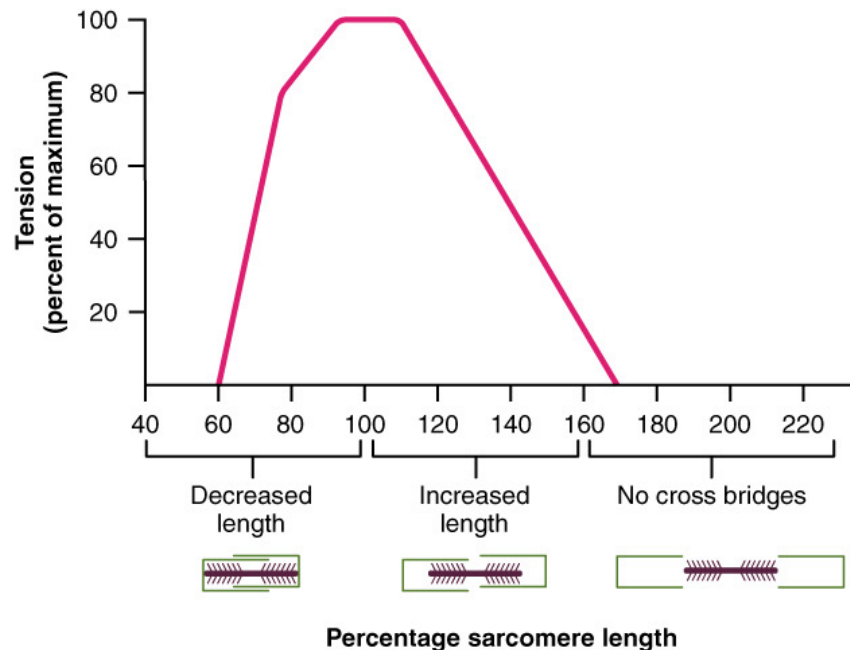
Length-Tension Range of a Sarcomere

1. Myosin heads attach to actin -> cross-bridges
2. Thin filaments sliding over thick filaments
3. Shortening of sarcomere -> creates tension



Ideal Length of a Sarcomere

- Sarcomeres produce maximal tension when thick and thin filaments overlap between about 80 percent to 120 percent.



Frequency of Motor Neuron Stimulation

- Twitch – single action potential -> single contraction
 - Lasts – few milliseconds or 100 milliseconds
 - Depends on muscle type
 - Myogram – instrument that measures amount of tension over time

Myogram of a Muscle Twitch

- Each twitch undergoes 3 phases

1. Latent period

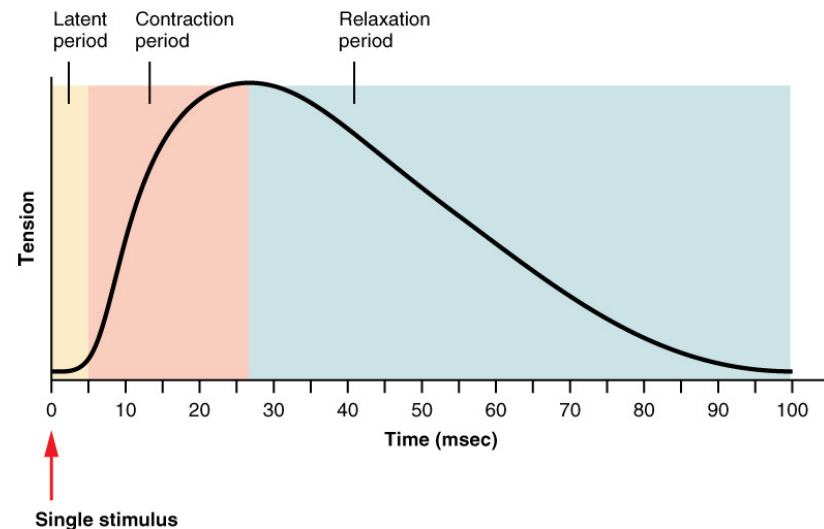
- AP propagated
- Ca^{2+} released

2. Contraction period

- Ca^{2+} bind to troponin
- Formation of cross-bridges
- Sarcomere shortening

3. Relaxation period

- Contraction stops
 - Decrease in tension
- Cross-bridge cycling stops



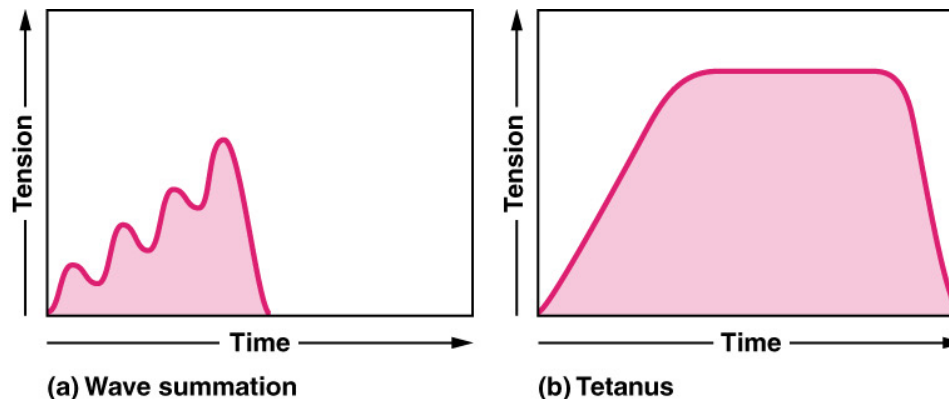
Graded Muscle Response

- A single twitch does not produce muscle activity
- Graded muscle response
 - Series of action potentials -> produce work
- Nervous system input -> produces varying amounts of force
- What affects tension?
 1. Frequency of action potentials
 2. Number of motor neurons transmitting AP

Wave Summation and Tetanus

Rate motor neuron fires AP -> affects tension

- Wave summation – previous twitch + new stimulation
- Tetanus
 - Incomplete tetanus – quick contraction cycles + short relaxation
 - Complete tetanus – relaxation phase disappears



Muscle Tone

- Skeletal muscles
 - Never completely relaxed
 - Contracted without producing movement
- Function
 - Stabilizes joints
 - Maintains posture
- Mechanism
 - Cyclical interaction between nervous system and skeletal muscles
 - Activation of few motor units -> muscles never fatigue
- Conditions
 - Hypotonia – absence of low-level contractions
 - Hypertonia – excessive muscle tone