Skeletal Muscle Contraction Action

Skeletal muscle contraction action describes the process by which the muscle contracts, starting with calcium binding to troponin. The calcium enters the cell through the opening of voltage-gated calcium channels and binds to troponin within muscle cells. This causes an allosteric shift that moves tropomyosin and exposes the active binding site on actin. The myosin head binds to the active site and uses ATP hydrolysis (and phosphate release) to drive a conformational change, which results in myosin pulling on actin, an action also known as the power stroke. Finally, the release of ADP causes the myosin head to disengage from actin. This process results in large amounts of ATP consumption, so muscle cells must have many mitochondria producing ATP to adequately keep up with energy demand.



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Characteristics

Calcium Binds Troponin
Cows grabbing the T-rope
An action potential in a motor neuron leads to acetylcholine release. Acetylcholine binds with receptors on the muscle fibers, opening sodium channels, with release of calcium. Calcium influx from voltage-gated calcium channels results in calcium binding to troponin on the muscle fiber.

Active Site Exposed
Revealed Action-clapperboards
The calcium binding causes an allosteric change in troponin, shifting tropomysin, which was blocking the active site. This movement exposes the binding sites on the actin filament.

Many Mitochondria Produce ATP
Mitochondria-factory Producing ATP-batteries
The power stroke of contraction requires ATP, so to keep up with muscle demands for ATP there are many mitochondria producing ATP in muscle cells.

Myosin Head Binds
Mayo-sun Head Binds to active-site
The myosin head binds to the newly available active site, initiating the power stroke. They do so by breaking down ATP to ADP and a phosphate group.

Power Stroke
Swimming Stroke
The power stroke occurs when multiple myosin molecules generate force through ATP hydrolysis, which causes a conformational shift and myosin to pull against actin.

Myosin Head Releases Active Site
Mayo-sun Head Disconnects from Action-clapper
The release of the ADP allows the myosin head to unbind from the active site on actin, until more ATP hydrolysis occurs with another power stroke.

ATP Consumed
ATP-battery Chomped Into ADP and P
Many ATP are consumed for ATP hydrolysis, which allows the power stroke and muscle contraction to occur.

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