

Key Steps to Initiate a Skeletal Muscle Contraction

(Note: some steps have been omitted at this time but they will be reintroduced in the future.)

Skeletal muscle is voluntary / requires conscious thought to contract / originates in the brain's prefrontal cortex

Primary motor cortex / the prefrontal gyrus of the brain location of upper motor neuron / sends signal to skeletal muscle

Cortical spinal tract carry action potentials / these tracts also called Upper Motor Neuron, pyramidal tracts or the direct pathway / travel down spinal cord to synapse on lower motor neuron

Lower motor neuron / known as the common pathway to skeletal muscle / exits spinal cord via spinal nerves / LMN also called somatic motor neurons / action potential at distal end of LMN's opens voltage regulated calcium gates which allow calcium to enter terminal knob

SMN synapse on muscle fibers / they do not "touch" fiber's sarcolemma / synapse = presynaptic membrane + synaptic cleft + post synaptic membrane /

Action potential "radiates" away from voltage regulated gates outside neuromuscular junction towards T-tubules / AP travels down T-tubules / at triad AP moves along sarcoplasmic reticulum which opens voltage regulated calcium gates / calcium released into sarcoplasm via diffusion

If there is enough acetylcholine in synaptic cleft then the local potential will reach the voltage regulated gates outside of the neuromuscular junction to initiate an action potential on the sarcolemma

Acetylcholine diffuses to post synaptic membrane / binds to receptors on post-synaptic membrane (sarcolemma) / opens sodium ligand regulated gates / initiates local potential which needs to spread beyond the neuromuscular junction where voltage regulated gates are located

Calcium diffuses into the terminal knob / calcium initiates exocytosis of stored acetylcholine into synaptic cleft / this type of synapse is called the neuromuscular junction

Calcium binds to troponin / this causes tropomyosin to shift which exposes actin's myosin binding sites

All myosin heads are "preloaded" with ATP which cocks the myosin head - ready to flex when a skeletal muscle is at rest / some myosin heads are aligned across from some myosin binding sites on the actin molecule / if myosin heads are not blocked by tropomyosin then myosin binds to actin to form a "cross bridge" / the power stroke = the contraction cycle

As long as acetylcholine is in the synaptic cleft / calcium stays in the sarcoplasm and the contraction cycle continues

To relax the muscle (stop the contraction cycle) acetylcholine must be removed from the synaptic cleft

Calcium is actively pumped into the sarcoplasmic reticulum / if there is no calcium on troponin then tropomyosin covers the actin-myosin binding sites / the contraction cycle stops