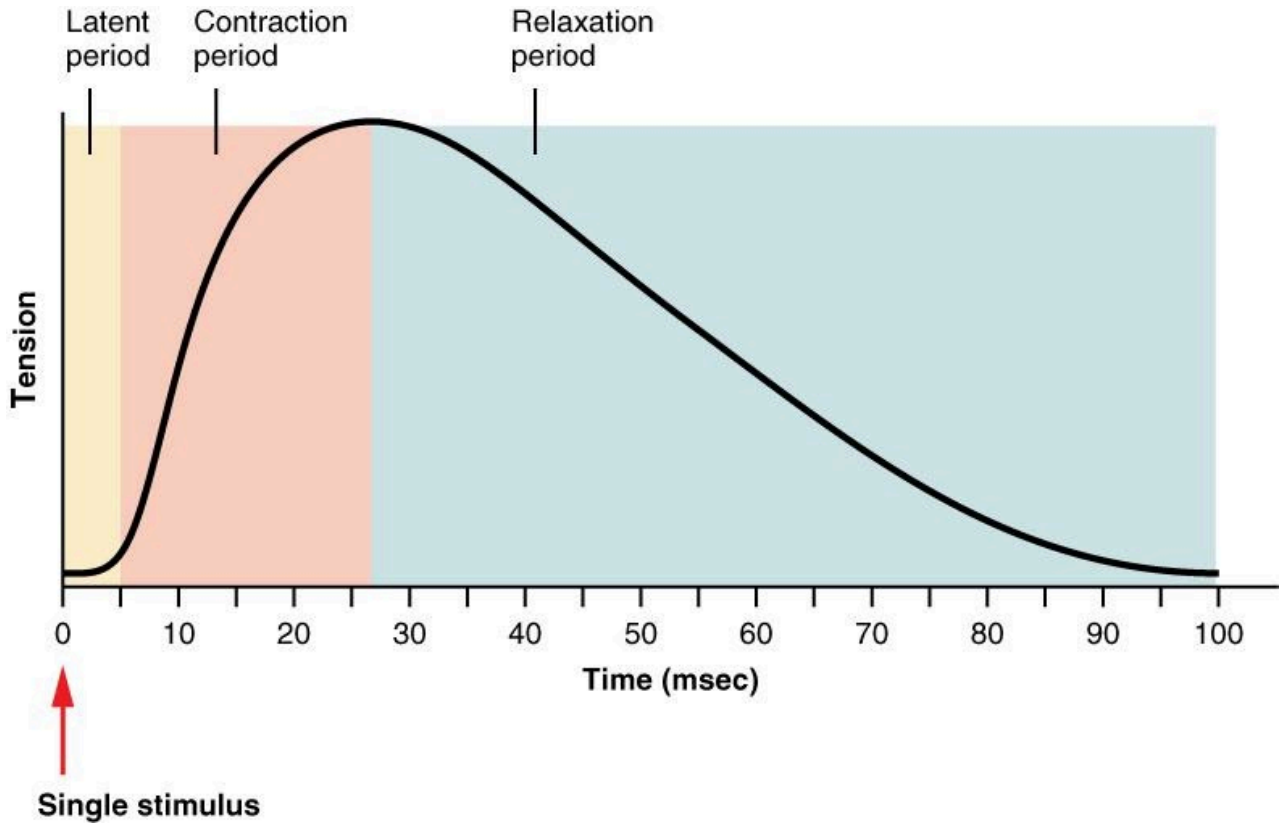
7.4.2

Physiology of a Muscle Twitch



Muscle Twitch Myogram. *Title: File:1012 Muscle Twitch Myogram.jpg; Author: OpenStax College; Site:https://commons.wikimedia.org/wiki/File:1012_Muscle_Twitch_Myogram.jpg; License: This file is licensed under the Creative Commons Attribution 3.0 Unported license.*

When an action potential travels down the motor neuron, it will result in a contraction of all of the muscle fibers associated with that motor neuron. The contraction generated by a single action potential is called a **muscle twitch**. A single muscle twitch has three components: the **latent period** or lag phase, the **contraction phase**, and the **relaxation phase**. The latent period is a short delay (1–2 msec) from the time when the action potential reaches the muscle until tension can be observed in the muscle. This is the time required for calcium to diffuse out of the SR and bind to troponin, the movement of tropomyosin off of the active sites, the formation of cross bridges, and the taking up of any slack that may be in the muscle. The contraction phase is when the muscle is generating tension and is associated with the cycling of cross bridges, and the relaxation phase is the time when the muscle returns to its normal length. The length of the twitch varies between different muscle types and could be as short as 10 msec (milliseconds) or as long as 100 msec (more on this later).

If a muscle twitch is just a single quick contraction followed immediately by relaxation, how do we explain the smooth continued movement of our muscles when they contract and move bones through a large range of motion? The answer lies in the ordering of the firing of the motor units. If all of the motor units fired simultaneously the entire muscle would quickly contract and relax, producing a very jerky movement. Instead, when a muscle contracts, motor units fire asynchronously, that is, one contracts and then a fraction of a second later another contracts before the first has time to relax and then another fires and so on. So, instead of a quick, jerky movement, the whole muscle contraction is very smooth and controlled. Even when a muscle is at rest, there is random firing of motor units. This random firing is responsible for what is known as **muscle tone**. So, a muscle is never "completely" relaxed, even when asleep. However, if the neuron to a muscle is cut, there will be no "muscle tone" and this is called flaccid paralysis. There are several benefits of muscle tone: First, it takes up the "slack" in the muscle so that when it is asked to contract, it can immediately begin to generate tension and move the limb. If you have ever towed a car you know what happens if you don't take the slack out of the tow rope before starting to pull. The second thing muscle tone does is deter muscle **atrophy**.