Reciprocal Innervation Encyclopedia Article

Reciprocal Innervation

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Reciprocal Innervation

Reflexes that contract a muscle while relaxing the muscles that oppose it are said to feature reciprocal innervation (or reciprocal inhibition). One such reflex is the familiar knee-jerk reflex, in which a hammer-tap just below the kneecap briefly stretches the quadriceps muscle (thigh muscle) above the kneecap. This stimulates several hundred stretch-detecting **neurons** attached to the quadriceps muscle. Impulses travel up the fibers of these sensory neurons to the **spinal cord**, where each fiber forks into two branches. One branch connects directly to 100-150 motor neurons that return directly to the stretched quadriceps muscle. These motor neurons are stimulated to fire, causing the quadriceps muscle to contract and the tapped leg to extend in an involuntary kick. The other branch stimulates local-circuit neurons that travel a short distance inside the spinal cord and form inhibitory synapses on motor neurons connected to the hamstring muscles at the back of the upper leg. Inhibitory synapses are connections that discourage the postsynaptic (receiving) neuron from firing; the net effect of this arrangement is that the hammer-tap discourages the motor neurons of the hamstring muscles from firing. The back of the leg relaxes, allowing the thigh muscle to extend the leg.

The flexor reflex and crossed extension reflex also involve reciprocal innervation. In the flexor reflex, an injury-sensing neuron activated by an injury to the foot stimulates certain motor neurons in the spinal cord while inhibiting others so that the thigh is relaxed, the back of the leg contracted, and the foot bent up. The net effect is to raise the injured foot and leg away from the source of **pain**.

The crossed extension reflex builds on the flexor reflex by adding neurons that cross the spinal cord and reciprocally innervate the muscles of the uninjured leg. While the injured leg is reflexively raised, as described above, the uninjured leg is reflexively straightened, tending to keep the person upright.