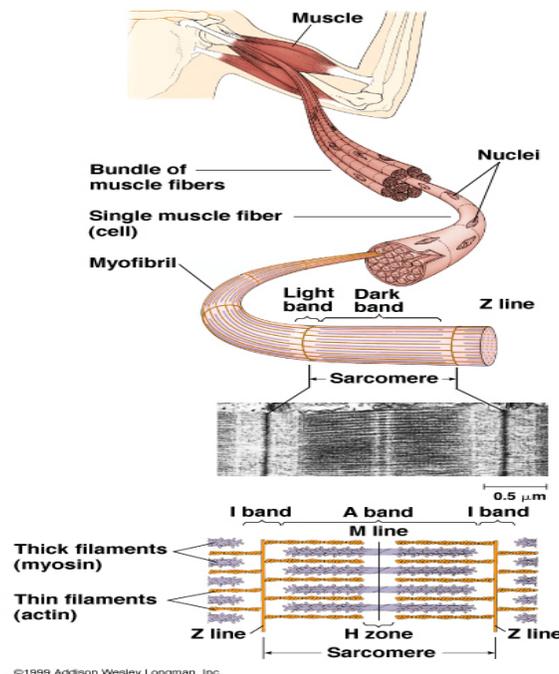




## Muscles and Stretching

What is known about benefits of stretching and flexibility exercises continues to evolve. Some commonly held beliefs are being supported with new research and some beliefs are being proven false. Common beliefs about stretching exercises are that stretching exercises decrease risk of injury, relieves pain associated with stiffness, and improves sports performance. Stretching exercises are thought to increase length and/or flexibility of muscle tissue. In humans it is quite difficult to measure the length of a muscle; therefore the maximum range of motion (measured in degrees) a joint can achieve is used to infer that changes may be occurring in muscle length.

Stretching exercises have been shown to increase the range of motion after a single bout of stretching or after a series of stretching exercises over a period of weeks. What happens or changes in a muscle which explains this increase in range of motion. Muscle consists of cells full of strands called myofibrils, which are in turn made up of contractile units called sarcomeres.



After a brief period of time (less than an hour) the increase in joint motion resulting from single bout of stretching, will return to pre-stretched level.

This is a demonstration of the elastic property of muscle. If something is elastic it resumes the original length after being stretched.

Several weeks of stretching exercises can result in a permanent increase in joint range of motion. There are differing opinions about what might be happening to the properties of muscle tissue which explains this permanent increase in motion. In animal muscle (rodent) long term stretching program has shown there is an actual increase in the number of sarcomeres in series in a muscle cell. In essence if sarcomeres are added in the muscle cell grows longer. Physical Therapists have used this evidence to justify the use of stretching exercises for injury prevention and treatment for years. Animal (rodent) muscle cells are distinctly different than human muscle cells. Unlike humans rodent muscle cells do not reach physical maturity and stop growing, rodent cells are capable of growing throughout their life. Current thinking is once humans reach physical maturity the number of muscle cells and fat cells is fixed. In humans' fat and muscle cells, die, swell, and shrink, but do not increase in number. Because of the technical difficulties of cutting a muscle cell out of human in order to count the number of sarcomeres it is quite difficult to provide evidence that stretching exercises increases the number of sarcomeres.

Investigators have shown that increases in range of motion in response to several weeks of stretching exercises did not change the material properties of muscle. If the muscle tissue was actually longer tests would show that a greater range of motion could be achieved with less force, or a greater range of motion could be achieved with the same force, in other words mechanical measures of muscle stiffness would change. Individuals who demonstrate greater range of motion as a result of a stretching program do not demonstrate change in muscle stiffness measure. Therefore investigators hypothesized that the increase in range of motion is explained by an increase in tolerance by the subject to the pain of stretching. An increase in "stretch tolerance" means the individual feels less pain for the same stretching force applied to the muscle. True stiffness does not change. There is uncertainty as to what is the mechanism of increased pain tolerance to stretch.

Multiple studies have been done comparing different types of stretching exercises (ballistic, static, active, passive, and active isolated stretching), and different durations of stretch. Generally all types of stretching can result increase in range of motion, more research is needed before definitive conclusions can be made if one technique has advantages compared to another. If the explanation for the increase range of motion that occurs is because of a "stretch tolerance" it opens up a variety of

options. Perhaps the meditative portion of yoga facilitates increasing the tolerance to stretching exercises. If you are using stretching exercises to increase your range of motion consider designing your program so that it increases your tolerance to the discomfort that occurs when stretching.

**Related articles:** published at [www.DamienHowellPT.com](http://www.DamienHowellPT.com)

- [Stiffness – Resistance to change: Good or Bad?](#)
- [Should you stretch first or strengthen first?](#)
- [Controversy Regarding Stretching Achilles for Treatment of Heel Pain](#)
- [Stretching Exercise Delays Time to Recovery](#)
- [Hip pain and stretching exercise](#)
- [IT Band Syndrome – Controversy Regarding Stretching Exercise](#)
- [Truths & Myths Regarding Stretching Exercises Preventing Injury](#)