Does stretching reduce the risk of muscle injury?

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INTRODUCTION

The relationship between stretching and injury is very complicated. Throughout the past, stretching with the goal of increasing flexibility and consequently joint range of motion has been recommended to reduce injury. Some investigators however have found that there is no physiological or biomechanical basis for these practices. Recently many studies have been conducted in order to determine the underlying biomechanical principles of stretching, whether stretching can truly prevent or limit injury and if so what are the parameters involved. That being said, the literature on this subject is plagued with contradictory results. Some researchers have found that stretching does reduce injury, whereas others have found the opposite to be true. Different results have been found regarding whether stretching is beneficial in general, whether stretching will have different results based on contraction type or the particular joint in question, what kind of stretch will yield the most optimal results, and what exactly is occurring in the tissues. Some studies have found that joint laxity contributes to injury and others have found that joint stiffness is a cause. The only somewhat conclusive information available is that stretching is beneficial in athletes who regularly perform eccentric or stretch shortening contractions, but not necessarily concentric contractions.

BIOMECHANICS

An understanding of the mechanisms involved in stretching must begin at the tissue level. When an individual performs a stretch, the resulting lengthening occurs in two main parts, the active contractile component (ACC), and the series elastic component (SEC). The ACC is made up of sarcomeres, which are responsible for muscle contraction. More specifically this active portion of the muscle converts metabolic energy to mechanical work. When a stretch is performed the sarcomeres and accompanying connective tissue lengthen beyond rest. Because a muscle can not generate its optimal amount of tension when in a lengthened position, the muscles will adapt over time by adding more sarcomeres, thereby allowing the original sarcomeres to return to resting length, yet still resulting in an increased length of the muscle. This however does not seem to be where the risk factor for injuries occurs. The SEC, commonly known as the tendon transfers the mechanical work of the muscle to bone in order for joint motion to occur, and has viscoelastic properties that allow for alterations in its length to take place. The tendon functions like a spring which absorbs and then releases energy. If a joint is compliant, the tendons can absorb more energy leading to a more forceful, yet longer time until contraction. In a stiff muscle tendon unit the energy passed on from the ACC is much more quickly transmitted to the bone for movement. It has been believed that lengthening in the muscle tendon unit at a young age occurs by a lengthening of the tendon, whereas in older individuals this adaptation takes place in the muscle. New studies, however, have found that tendon length can increase with flexibility training in adults. It has been hypothesized that this alteration occurs because of realignment of collagen fibers in tendons.

The increase of flexibility and range of motion that is a consequence of the elongation of the SEC has been considered by different researchers to be either positive or negative. Movements which are predominantly eccentric in nature generate a high amount of tension and require the storage of elastic energy in the tendons. In a compliant system, the tendon will allow for this necessary storage of energy. Conversely, a stiff muscle tendon unit will transfer more tension to the contractile components, thereby enhancing muscle damage and increasing the possibility of injury. The opposite is the case for movements that are predominantly concentric in nature. Because there is little energy absorption as metabolic energy is quickly transformed into mechanical work, there is no need for the muscle tendon unit to be compliant. Concentric contractions can not generate as much tension as eccentric contractions and should therefore not overload a stiff system to the point of failure. Conceptually
speaking, stretching to increase flexibility for sports which are mainly comprised of concentric activities should not reduce the risk of injury. Additionally, stretching for concentric activities might decrease athletic performance because the increased absorption ability of the tendon may slow down the speed of force transfer to the bone.

Another conclusion has been that the muscle tendon lengthening which is inherent to individual sports is sufficient to maintain the joint range of motion necessary to perform the activities involved. Stretching beyond this functional range of motion should not only be ineffective in reducing injury, but may actually cause injury. Excessive flexibility and joint laxity have been connected with a high incidence of injury amongst athletes. Though joint laxity is due to flexibility, it is also a function of multiple other factors such as high levels of the hormone relaxin, and activity in the gamma muscle spindle system.

In addition to the question of whether the possibility of injury is decreased with stretching, it must be determined what type of stretching is most beneficial for movements which benefit from stretching. This is affected by the viscoelasticity of the muscle tendon unit. Alterations occurring in viscous are dependant upon time, whereas elastic substances can lengthen but will return to their original length immediately following the withdrawal of the force applied to it. Because muscles are composed of both properties, applying a stretch at a constant length will lead to stress relaxation or the decrease of tension over time. When applying a constant force while increasing length, the muscle tendon unit will lengthen, but will return to its original length once the stretch has been ceased. One again, conflicting results have been found in regards to which stretches are the most effective. In vitro research has shown that few stretches are needed in order to produce elongation. In vivo, studies have shown that it is not the number of stretches, but the duration that is important in achieving lengthening. Multiple studies have found the most change in length occurring within the first 20 seconds of a stretch, whereas others haven’t specified those details. For rehabilitation of injury, one study recommends one 30-sec stretch repeated four times daily for the best results. The authors of this study further add that increasing the frequency of stretching should speed up recovery. Static versus passive motion stretching is another factor which researchers are in disagreement about. Both forms of stretching have been said to produce the best results in different studies. Other studies, have found no advantage of one form over the other. There has also been a recommendation for repetitive motion as a method for increasing flexibility.

APPLICATION

Due to the fact that there are so many unknowns regarding stretching, for athletes or active individuals performing predominantly concentric movements, a conservative recommendation including little or no stretching would be appropriate. For individuals whose activities include a significant amount of eccentric or stretch shortening movements, increasing flexibility through a stretch routine is recommended. Either a static or passive motion stretch lasting 20 seconds in duration should provide results. For rehabilitative purposes stretching is recommended to increase the range of motion for individuals who have suffered a loss in motion due to injury. It must be added, that in many of the studies where stretching was found to provide no benefit for reducing injury, the authors recommended strength training as a more productive method of injury prevention.

![Relationship between injury and flexibility](image)

SUMMARY

Although there have been many studies which have looked at the affects of stretching on injury prevention, the contradictory results suggest that additional research needs to be undertaken. This will be beneficial in order to gain a more complete understanding of how stretching affects the muscle tendon unit, and in order to devise a
protocol for prescribing proper training to the individuals that can benefit from it.

REFERENCES


