STRETCHING: WHAT WORKS?

A review of the current literature by Raphael Bender August 2015

Introduction

Stretching is something we all feel we 'should' be doing more of. The widely quoted benefits of stretching include injury prevention, reduction of muscle soreness, and as an effective warm-up prior to exercise. Sadly none of these ideas are supported in the literature.

There is a wide body of evidence that stretching does indeed increase flexibility, however due to inherent challenges in measuring various factors associated with stretch such as subjective intensity, most research is of low or moderate quality only[1, 2].

How does stretching increase flexibility?

The immediate increase in length of a muscle after stretching is a result of viscoelastic deformation[3-6]. In other words the tissues of the muscle (and its interwoven fascia) actually deform and stretch. However this viscoelastic deformation is only transient and dissipates soon after the removal of the stretch[3, 5].

It seems very likely that the longer-term increased range of motion after stretching is mainly due to increased tolerance for uncomfortable stretch sensations, rather than changes in mechanical properties of the muscle, such as increased muscle length from the addition of sarcomeres in series[7-9].

When a muscle lengthens beyond a certain point, muscle spindles inside the muscle send signals to the spinal cord that result in reflex contraction of the muscle being stretched, preventing it from lengthening further. This is known as the myotatic reflex[10].

It seems that long-term stretching reduces the activity of the muscle spindles, and also trains the central nervous system (CNS) to disregard the signals coming from the muscle spindles. This prevents reflex contraction of the muscle that is being stretched, or in other words suppresses the myotatic reflex. The absence of a reflex contraction allows the muscle to stretch further[6, 11].

In other words, stretching is a skill.

Should you warm up before stretching?

Warming up before stretching, or artificially warming or cooling the muscle about to be stretched, does not alter the results of stretching[12-14].

Short-term effects of stretching

Holding a static stretch for 30 seconds gives the greatest acute increase in flexibility. Increasing the stretch to 60 seconds does not give greater short-term increase in flexibility[15, 16].

The increase in length of a muscle is greatest for the first 15 minutes after stretching, likely due to viscoelastic deformation, and the increased length gradually declines over 24 hours[12].

How often and how long to stretch

It appears that a single 30-second bout of stretching may be the most effective practice, and that periods of greater than 30 seconds are no more effective[15-17].

However studies have shown that stretching for shorter durations with increased repetitions can result in similar range of motion gains and thus that total daily stretch time is more important than the duration of an individual stretch[13, 16-19].

Studies have demonstrated increases in ROM with protocols ranging from 30 seconds x3/week to 2 min/day x 5/week. It appears likely that increased daily stretch duration results in increased effect.

Increases in ROM from a 6 week stretching program are lost within 4 weeks if stretching is not continued[20].

What is the best stretching technique?

In terms of increasing flexibility, there does not appear to be any great difference in effectiveness between relaxed-static, PNF and facilitated stretching[21-26] but 'active' stretching; where the person being stretched actively moves their own limb into the stretch position using the antagonist muscles alone (such as ballistic and dynamic/active stretching) is markedly less effective than all these methods[21, 27].

Body position (e.g. standing, supine, seated) does not alter the effectiveness of stretching[28].

Effect of stretching on muscles soreness and injury risk

Static stretching before or after exercise has no measureable effect on either muscle soreness[29-31] or acute injury risk[29, 31, 32] however there is insufficient evidence to support or refute the notion that long-term stretching has any effect on injury risk[32, 33].

Contrary to popular belief ballistic stretching does not increase injury risk[27].

Stretching as a warm-up

Static stretching causes an acute decrease in both maximum strength and power of the stretched muscle[34-37] and results in decreased jumping and sprinting performance[38, 39]. Thus static stretching should be avoided during warm up.

Dynamic stretching (i.e. active stretching) can result in short-term increases in strength, power and other measures of muscle performance, and is recommended as a warm up activity[39-42]. So active stretching is ineffective for flexibility but works well as a warm up.

There is some evidence that long-term static stretching increases force, jump height and speed, although it has no effect on running economy[36].

Relationship of age to flexibility

Although widely held, the belief that decreases in flexibility is a natural consequence of aging is not supported in the literature. Rather, any decrease in flexibility even in very old adults should be viewed as abnormal, and likely a result of lifestyle rather than aging[43].

Myofascial release and flexibility

An acute bout of self-myofascial release (SMR) increases flexibility immediately afterwards[44-47] and without any loss of contractile force[45, 46].

Indeed SMR can result in performance improvements due to increased ease of movement and reduced resistance to movement (stiffness)[47]. Acute SMR also reduces feelings of fatigue but does not increase endurance performance[48]

SMR followed by passive stretching results in greater increases in ROM than either modality alone[49-51].

Some studies have found that chronic SMR results in long-term increases in flexibility[52], whereas others have found no long-term effect of SMR on flexibility[53]. At this stage it appears the jury is still out on this question.

Summary & conclusions

How stretching works

- The immediate effects of stretching are due to viscoelastic deformation, and mostly return to baseline in around 15 minutes
- Longer-term increases in flexibility are not due to mechanical changes in the muscle, fascia or tendon
- Increased flexibility is thought to be due to increased tolerance to stretch and decreased reflex activity.

Stretching, warm-up and injury

- Static stretching is a poor warm up, however dynamic stretching can increase short-term performance.
- Stretching probably does not increase long-term injury risk.
- Warming up before stretching has no effect.
- Stretching does not affect muscle soreness.

Flexibility and aging

- There is no such thing as an age-related decrease in flexibility, only lifestyle-related decreases flexibility.

Stretching technique

- There is no discernable difference in the results of the various techniques of static stretching, or in body position during the stretch. Time under stretch seems to be the only significant variable.
- Active stretching doesn't work very well to increase flexibility.

Stretching duration and frequency

- For a single set of stretching, holding the stretch for 30 seconds at the point of onset of discomfort produces the optimal result, and longer stretches do not give greater gains.
- Long-term increases in flexibility occur with as little as 30 seconds of stretching, 3 times per week.
- Greatest increase in flexibility seems to be achieved with at least 2 minutes/day, 5 days per week under stretch. This can be achieved by any combination of short or long stretches totalling 2 minutes/day.

Self-myofascial release

- 60 seconds of SMR gives similar short-term increases in flexibility to a 30-second stretch.
- SMR followed by stretching gives greater increases in ROM than either modality alone.
- SMR may be used to increase ROM as part of a warm-up without decreasing performance
- It is unclear whether repeated SMR over time results in long-term increases in flexibility.

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