STRETCHING

Stretching has traditionally been performed to prepare for exercise or competition and to reduce the chance of injury. There is much debate in the literature regarding its efficacy in these factors: is it beneficial? does it improve my recovery or even my performance? And will it reduce my risk of injury? These are difficult questions to answer as stretching exercises play an important part in the routine and ritual in the build-up prior to performing at your best. In attempts to answer these questions, this article will discuss the latest evidence in stretching and how to apply this practically.

- What happens when a muscle is stretched?
- Types of stretching / stretching techniques
- How does stretching affect performance?
- How to implement stretching into my routine.

Prior to answering these questions, it is important to understand a few basic principles of muscle tissue.

1. Muscles contract (get shorter) and relax (get longer) in order to produce movement and work in pairs – when one muscle is contracting its opposite pain will relax. This is called antagonistic muscle action.
2. Muscles act as either stabilizers or mobilizers. The stabilizers are often smaller and situated closer the joint in order to maintain stability whilst the joint moves. The mobilizers are larger muscles capable of producing greater force for movement and athletic movement. it is the mobilizer muscles that often get tight.
3. Muscles work in teams. In order to perform a movement, we need not only synergistic action of the stabilizing and mobilizing muscles, but also of neighbouring muscles within a chain of muscle tissue. Tightness of one muscle can affect the functioning of other muscles within this team.
4. Muscles move joints. If these joints are restricted [pain, poor posture, joint injury to name a few] then the muscles will not be able to contract or relax across their full range and can lead to adaptations.
5. Muscles are controlled by nerves. Specialized receptors within the muscle provide feedback to the central nervous system [CNS] which then co-ordinated muscle contraction and relaxation.
6. Over time muscles adapt to the demands that they are exposed to, this is called 'Specific Adaptations to Imposed Demands' or the SAID principle.

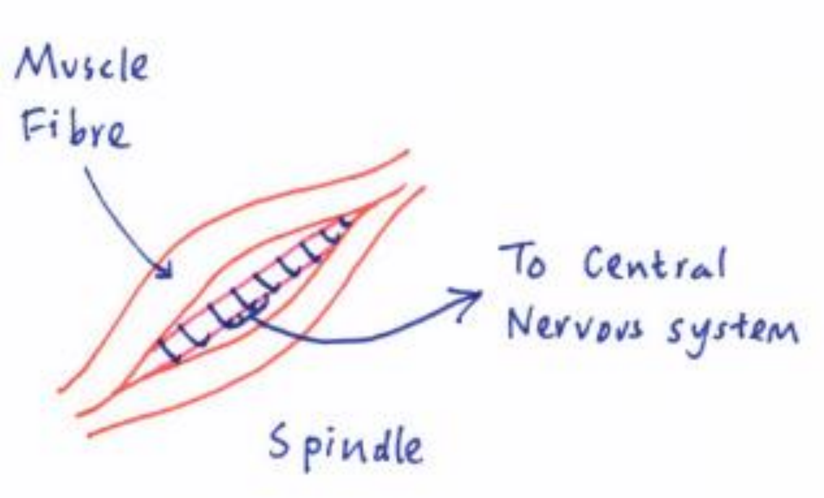
WHAT HAPPENS WHEN A MUSCLE IS STRETCHED?

Stretching involves taking a body part to its end range and holding it there over time. This may be momentarily or could be for long periods. This involves not only the muscles but the joints of the body and other soft tissue surrounding the joint. Muscles are designed to stretch and are capable of relaxing in order to allow joints to work through their full range. Over stretching muscles and other structures can lead to injury and therefore specialist receptors (muscle spindles and Golgi Tendon Organs) within the muscle and tendons are designed to provide feedback to our central nervous system (CNS) to inform us of the length and rate of muscle stretching, and tension generated within the muscle when it is either stretching or contracting (getting shorter).

When we stretch a muscle, the muscle spindles are activated, and this relays a message to the CNS to inform it of the amount of stretch, and the rate of stretch. This tells my CNS where my joint is– this is called proprioception. If the stretch is held for greater than 6 seconds, then the Golgi Tendon Organs (GTO) are activated in response to the increased tension generated within the muscle tissue. The CNS will respond to this information by allowing a deeper relaxation of the muscle thereby allowing further stretch [see static stretching below] This is a protective mechanism to prevent damage to the muscle. Holding these stretches for longer periods can also allow the connective tissue to slacken (this is called creep) and is similar to holding an elastic band on stretch.

Muscle spindles and the Stretch Reflex

Within our muscle tissue we have specialized receptors called 'muscle spindles' (fig. 2). These detect the amount of stretch in a muscle and continuously feed back to our CNS (the control centre) to make adjustments in movement and posture. This is called a *stretch reflex*



So as we can see, stretching can be influenced by the mechanical properties of the joint and the nervous systems control response and this can also be influenced by time. However, recent research has identified that holding stretches for longer periods of time may have detrimental effects on our performance; and this may be explained by the inability of a muscle to generate power effectively at longer muscle lengths. Let's have a close look at this:

Consider performing a biceps curl. You will probably have noticed that you are at the strongest point midway through the movement and feel weaker at initial contraction and towards the end of the movement. This is because there is more overlap of the contractile elements (actin & myosin) within the muscle at the mid-range and therefore more tension can be developed at this point compared to the beginning and end of the movement where less overlap exists. This can be demonstrated using the length tension curve. Fig 3A shows the amount of tension developed within a muscle as it contracts through range. You will notice that as the muscle increases in length, the tension is also increased, building towards a muscle length where optimal tension can be developed (area of optimal overlap). Further lengthening of the muscle shows a reduction in muscle tension as contractile elements are no longer able to overlap resulting in reduced ability to generate force. I have superimposed a representation of the contractile elements demonstrating different amounts of overlap at different muscle lengths to help you understand this concept.

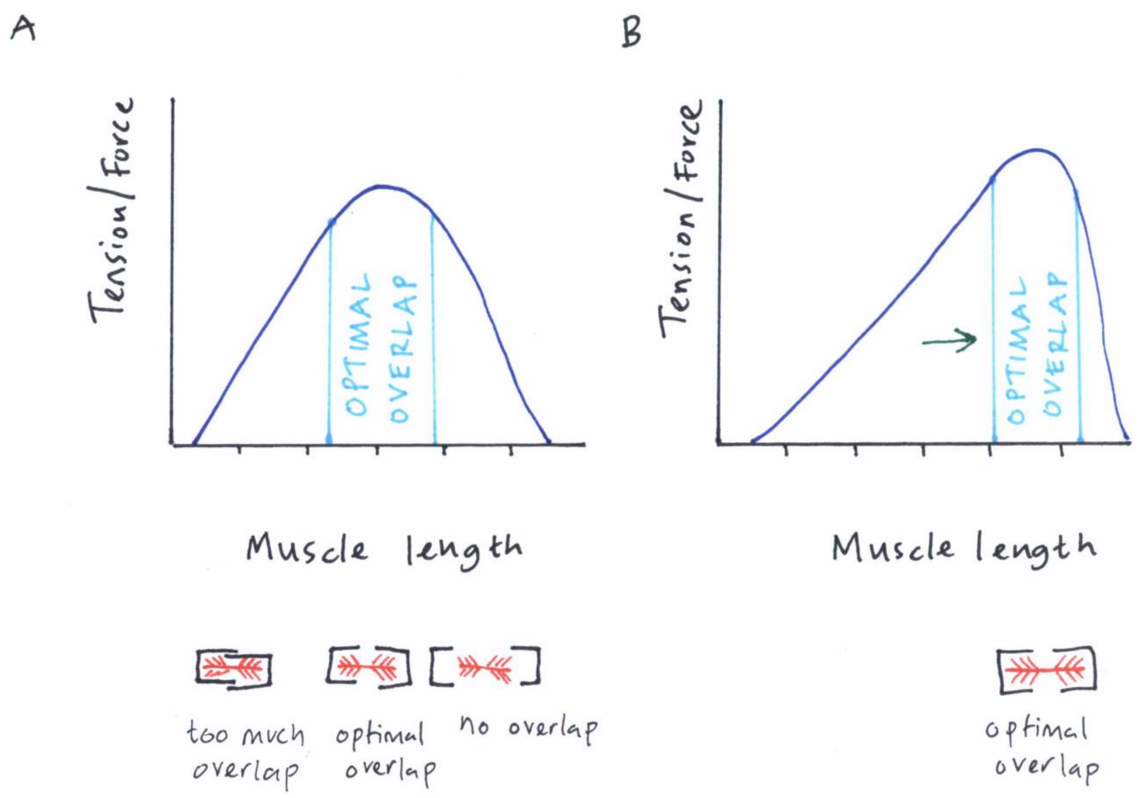


Fig 3: **Length tension curve.**

3A showing increased tension as the muscle lengthen to an area of optimal tension before reducing in tension as the muscle gains further length. This is superimposed with a representation of the contractile elements and overlap.

3B: shows the area of optimal overlap has shifted to the right (green arrow) as tension is lower at shorter muscle lengths and develops with longer muscle lengths.

STRETCHING TECHNIQUES

1. **Static stretching**

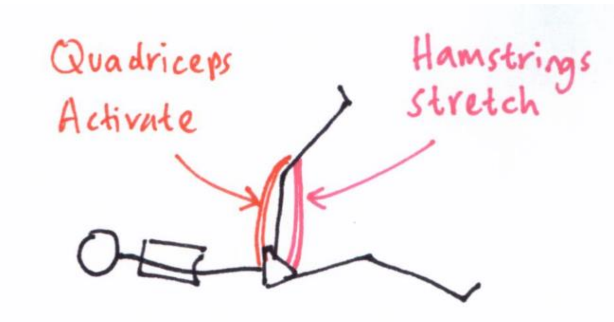
This involves stretching a muscle to a point of discomfort for a period. As the stretch is maintained, you will feel a relaxation of the muscle (as a result of activation of specializes receptors within the muscle) and you will be able to take the stretch further. Holding this stretch for 30 seconds and repeating 4 – 5 times should be performed.

However, this form of stretching has no bearing on functional movements and limited carryover into athletic or functional performance. Care should be taken if you have a muscle injury as you risk aggravating muscle fibres and you should take advice from a physio or coach. To get the most from static stretching, I recommend performing these after a good warm up and as a separate training session with the longer-term aim of developing greater joint and muscle mobility over a longer period of time.

Static stretching program

2. **Active stretching**

Active stretching replicates functional movements and has shown to improve performance and also reduce injury rates therefore should be included in a warmup prior to activity. Techniques involve actively contracting the muscles opposite the ones to be stretched to move a joint through its functional range. For example, to stretch the hamstring muscles (large muscles at the back of your thigh) you would activate your quadriceps (large muscles on the front of your thigh), which allows the hamstrings to relax and facilitate a stretch. This replicates how our muscles perform and so prepares muscles for performance.



3. **Ballistic stretching**

This involves adding repetitive bouncing movements at the end of a muscles available range. Caution should be exercised here as there is risk of uncontrolled stretching and induced injury. This type of stretching should be conducted with a professional and as a progression to static stretching. Progressions should be with caution in terms of range of movement and speed of stretch.

4. **Contract – relax stretching.**

This type of stretching utilizes specialized receptors within our muscles in order to gain increased mobility at a joint or muscle. Resisting against a movement (*contracting the muscle*) increases the tension within the muscle and this activates specialized receptors called Golgi Tendon Organs which monitor the amount of tension within a muscle. When this reaches a threshold, it relays a message to the central nervous system which will then allow the muscle to *relax* - facilitating further stretching.

STRETCHING FOR PERFORMANCE

Muscle tissue has the ability to adapt to the activities that we expose it to. For example, adding resistance to a movement will stimulate muscle hypertrophy through protein synthesis resulting in a bigger and stronger muscle with the ability to tolerate increased loading. Our muscle tissue will also adapt to sustained postures over a period of time. For example, sitting at a desk for many hours each day will gradually increase the resting length of some muscles and they will adapt to this again through protein synthesis and subsequently, shift the optimal length-tension of the muscle to greater muscle lengths. This is represented in figure 3B by the green arrow shifting to greater muscle lengths. This will have detrimental effects particularly on the stabilizing musculature around a joint as they will not be able to generate sufficient tension to stabilize an articulating joint effectively and increase risk of injury.

With all of this information in mind, it would make sense to employ mobility exercises that allow muscles and joints to work through their full range of movement whilst also maintaining stability and nervous system control (proprioception) at a joint, and this should be employed over an extended period of time in order to allow structural adaptations to occur. It is important to note that previous injury or the presence of pain can influence movement and should be assessed by a healthcare professional.

The exercise program that follows includes whole body movement patterns without sustained holds making it a good preparation for planned exercise / sports. It exploits the activate and mobilize components of the R.A.M.P. warm up system and should ideally follow some progressive cardiovascular exercise to raise your core body temperature facilitating neural conductivity and muscle elasticity.

Performing mobility drills through a progressive range of movement using movements that will be performed in the activity later will combine joint stability and control contributing to better performance. By slowly bringing muscle and joint stretches on through active movements, the nervous system will become conditioned to the movements and allow you to reach new ranges of movement thereby improving joint and muscle flexibility in the longer term.

Active stretching has several benefits over static stretching:

1. The stretch is acquired whist performing functional (or every day) activities which has a carry over to performance.
2. It facilitates muscle contractions (strengthening of the opposite muscle) and therefore contributes to muscle balance (recall the poor sitting posture scenario earlier).
3. It gives you control over the joint range and therefore very useful in the early stages of rehabilitation.
4. It can be progressed dynamically meaning a greater carry over towards sports and daily activities.

Functional Mobility

LONG TERM ADAPTATIONS TO STRETCHING

So far, we have discussed how to stretch a muscle and how to train the nervous system in order to increase joint range of movement whilst maintaining stability and activation of the joints. You can see that this is far superior and safer than stretching and holding this position in order to increase range of movement. But this doesn't answer the question on how we can physically increase the length of a muscle. *So now we get all physiological!!* Like an elastic band, when you release a stretch on the muscle, it returns to its original length, so in order to gain a training adaptation in terms of muscle length, we need to expose the muscle to **load**. Muscle tissue is made up from many muscle fibres and these fibres are made up from sarcomeres which are arranged in series (see fig. 4). In order to increase the length of the muscle tissue, we need to increase the number of sarcomeres which will make the muscle longer. The opposite also applies. For example, when we immobilize a joint after injury, the joint and muscle tissue is not exposed to load and therefore sarcomeres are lost resulting in a physically shortened muscle that needs rehabilitation. So how do we load muscle to encourage sarcomere growth?

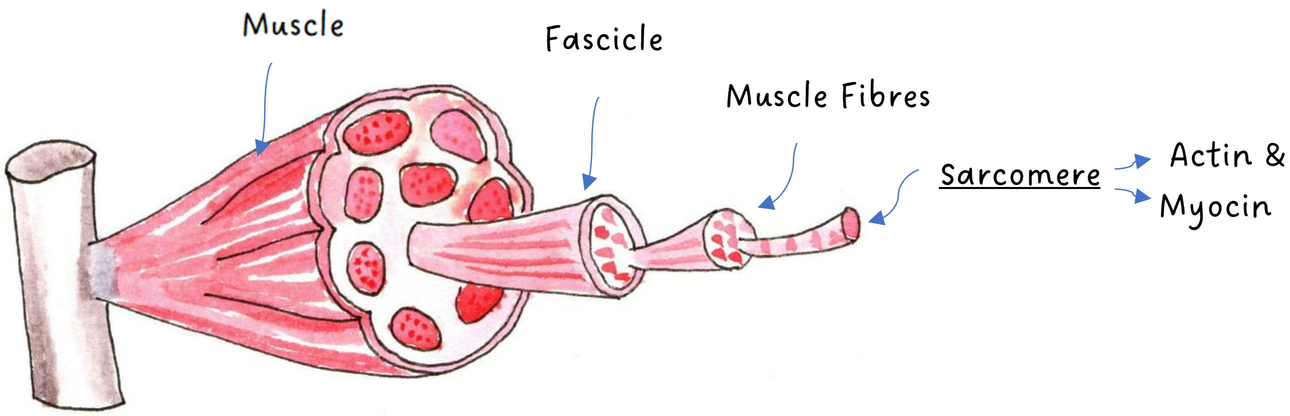


Fig 4: The makeup of muscle tissue showing the sarcomeres

An increase in the number of sarcomeres in series can be stimulated by the exposure to eccentric muscle contractions. This is the negative phase of a movement for example lowering your heels when returning from tip toes for the calf muscles or lowering the bar to your chest when performing bench press for the pectoral muscles. These movements are controlled by the muscle lengthening under tension and is the part of the movement that causes soreness in a muscle after training (commonly referred to as delayed onset muscle soreness or DOMS). So, for an adaptive lengthening of the hamstring muscles, the lowering phase of the stiff leg deadlift would focus an eccentric load on the muscle tissue and stimulate muscle lengthening if performed regularly over a period of time. It must also be noted that in order to gain adaptations, the appropriate load must be applied; eccentric contractions are able to generate much greater force than concentric contractions (the opposite part of the movement when you would be shortening a muscle under tension (i.e. raising onto tip toes for the calf or pushing the bar away during a bench press for the pectorals). So, for the eccentric contraction to be effective a heavy load must be applied, and the movement must be strict and controlled throughout the available range of movement.

[Eccentric load mobility training]

WHOLE BODY MYOFASCIAL MOBILITY

Although it is important to focus upon areas of stiffness, it is also a good idea to maintain whole body mobility on a regular basis. This will maintain optimal joint range of movements that will allow muscles to work effectively over the kinetic chain. Often, an injury in one body part can be as a result of stiffness or dysfunction at a point distal from the injury. Compensatory movement patterns as a result of this stiffness can lead to overload of other tissues that subsequently result in pain. To help you get on your way, start with the myofascial mobility exercises. These exercises also form the ACTIVATE and MOBILIZE phase of the RAMP warmup.

Myofascial sling mobility program