Does Flexibility Training Increase ROM in Elderly Women?

By Johanna Subotovsky

Introduction

Flexibility training is often an integral part of fitness programs used to warm up, prevent injury, rehabilitate an injury, fix muscular imbalances and increase overall range of motion. A lot of research has been done to investigate the acute and chronic effects of flexibility training. For years people believed that stretching before exercise helped prevent injuries. New research now suggests that stretching before exercise not only does not prevent injury, it might contribute to it. There are many different beliefs and stretching recommendations in the field however, no definitive conclusions have been made on the effects and benefits of stretching. Most exercise prescriptions primarily focus on strength, endurance and aerobic training, especially when focusing on improving the functional status of older adults. Ageing is frequently accompanied with a reduction in range of motion (due to loss of extensibility in the soft tissues surrounding the joints) which affects mobility and balance and the ability of older adults to independently perform their usual activities of daily living. Interventions that apply tension to soft tissue (stretching) are used to increase the extensibility of the soft tissues surrounding the joints.

Biomechanical rational

Increase in range of motion immediately following passive stretching is explained in two ways. The first explanation is by the viscoelastic properties of muscle. When muscles sustain a relatively low force over a period of time, they will deform in a time- dependant manner. When the force is no longer applied, the muscle will return to its original length also in a time dependent manner. This is known as creep. Nearly all tissues in the body exhibit creep. However, muscle differs from other tissues because due to actin and myosin interactions, it can generate force all by itself. Titin, one of the noncontractile cytoskeletal components of muscle is a giant protein and can stretch to at least four times its 1-mm resting length. Titin determines the elastic properties of the muscle fiber contributing to the passive resistance. Passive stretch is transmitted from the endomysium, across the sarcotendinous to noncontractile elements at the Z line. It is thought that Z lines from adjacent myofibrils are connected by molecules that are related to intermediate filaments. The second way is through structural adaptations within muscles and other soft tissues. Research done on animals has shown that days or weeks of uninterrupted stretching provided by casts can stimulate the addition of sarcomeres in series. Evidence in animal studies has also shown that these structural changes can occur as the result of stretching for just fifteen minutes per day. This structural adaptation to prolonged stretching is thought to be less readily reversed with the removal of the stretch. Some researchers have found that stretching for as little as 30 seconds was enough to obtain increased ROM while others found no effect. Clinical experience has shown permanent adaptive responses through stretch based rehabilitation protocols in which the ROM gained was maintained even when the passive stretch was removed. Short term stretching adaptations are thought to be the cause of the viscoelastic properties of muscle while long term adaptations in which the muscle actually becomes longer are thought to be the result of the addition of sarcomeres in series.

Application

As we age, ankle ROM in plantarflexion, dorsiflexion, inversion and eversion tends to decline due to age-related changes in the mechanical properties of the joint structure. In 2003 Gajdosik, R. et al. examined the effects of an eight week stretching program on the passive properties of aged calf muscles of 19 older women ranging in age from 65 to 89 years old with limited ROM. 10 women were assigned to a group that stretched one time a day, three times a week for 8 weeks and nine women were assigned to a control group that did not stretch at all. All 19 women were initially tested in a timed agility course, a timed 10- m walk and a standing functional reach test. In order to measure calf muscle passive properties a dynamometer moved the right ankle from plantarflexion to maximal dorsiflexion and back to plantarflexion at 5 degrees per second. The women in the stretching group were given instructions in the proper methods to perform the stretching exercise and were instructed to hold a static stretch position for 15 seconds and completed 10 repetitions for a total of 150 second of stretch.
during each of the 24 exercise sessions. The stretching group showed increased maximal dorsiflexion ROM, passive resistive forces and the absorbed and retained passive-elastic energy. The functional reach test did not change for either group but the stretching group did have a decreased time for the agility course as well as the 10-m walk. The mechanisms underlying these adaptation were not identified in this study however the authors hypothesized that the changes in calf muscle length might be the result of an increase in sarcomeres or might have been influenced by increase in the non-contractile proteins such as titin, of the sarcomere cytoskeletons as well as by remodeling of the endomysium, perimysium, epimysium and tendon. The authors also acknowledged that the changes observed may not be a result of increased calf muscle length but may have been influenced by adaptation in other structures of the ankle.

Summary

Ageing is frequently accompanied with a decrease in ROM. While no conclusions have been made on the benefits or effects of stretching it is thought that acute changes in muscle length are due to the viscoelastic properties of the muscle while chronic adaptations are the results of an increase in sarcomeres in series. Studies in which the effects of a stretching program on ankle range of motion were examined have demonstrated that stretching increased ankle range of motion in elderly women. Animal studies have demonstrated that when muscles are immobilized by a cast in a lengthen position, an increase in sarcomeres resulted in an increased fiber length. (3, 6) Although the changes in animal muscle have not been shown in humans, it seems possible this is the result of increased ROM in humans. However, these changes may be the result of adaptations in other joint structures. (3) Further study is needed to examine the underlying mechanisms responsible for increases in flexibility.

References:
9. Mecagni, C. Physical Therapy. 80 (10), 2000
10. Shrier, I & Gossal, K. The Physician and Sportsmedicine. 28 (8), 2000

Relationship between ageing and ROM

<table>
<thead>
<tr>
<th>ROM</th>
<th>Ageing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Stretching adaptations due to the addition of sarcomeres in series

![Graph showing muscle length over time]

Stretching adaptations due to the viscoelastic properties of the muscle

![Graph showing tension over time]