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THE EFFECTS OF MYOFASCIAL RELEASE VS STATIC STRETCHING ON HAMSTRINGS RANGE OF MOTION

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The purpose of this study was to investigate the effects of three days of foam rolling on the hamstrings range of motion in comparison with static stretching. Lower extremity injuries are prevalent in strength training and sports today. Poor flexibility has been found to increase the risk of overuse injuries and significantly affect the individual's level of function and performance. Self myofascial release (SMR), foam rolling, is a recent modality clinically used to increase flexibility. On the other hand, there are few research studies on the technique.

Twenty college students participated in this study. Ten participants were in the static stretching group, while ten participants were in the SMR group. Participants received the treatment three times in one week with at least 48 hours between treatments. The treatments were static stretching and SMR for three minutes of stretching the hamstrings muscles. The wall sit-and-reach test was used to measure hamstrings range of motion. Measurements were made at the beginning of the study and after each treatment.

The acute stretching programs increased hamstrings range of motion in the self myofascial release group (28.9%) and static group (33.2%) respectively. The Group by Time ANOVA for flexibility revealed that there was no main effect of Group ($F(1,18) = 3.629$, $p = 0.0729$), but that there was a main effect of Time ($F(3,54) = 32.130$, $p = .0001$). At the same time there was no Group by Time interaction ($F(3,54) = 1.152$, $p = .3366$). These data suggest that self myofascial release compared to static stretching did not have a greater effect on hamstrings range of motion, but both groups increased range of motion from pretest to posttest.

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Introduction

Many stretching methods have been used to help individuals increase flexibility in muscles and joints. Flexibility is a key component decreasing injuries and helping with rehabilitation. Poor flexibility has been found to potentially increase several musculoskeletal overuse injuries, (Wiltvrouw, Mahieu, Danneels, & McNair, 2004; Andersen, 2006) associated with low back pain, and lower extremity injuries (Croisier, Forthomme, Namurois, Vanderthommen, Crielaard, 2002; Andersen, 2006; Sexton & Chambers, 2006). Duration of stretching has also been studied, Ayala & Andujar (2010) study found that active stretching at increments of 15 seconds, 30 seconds and 45 seconds were all equally effective at increasing hamstrings range of motion. Three of the most common stretching methods are static, dynamic, and ballistic. The most widely known, static stretching involves a slow and constant stretch, with the end position held for 15-30 seconds. Another common stretching method is dynamic stretching; it places an emphasis on movement rather than individual muscles. The individual actively moves the joint through a full range of motion causing a stretch. Ballistic stretching involves actively moving to the end of the range of motion and then bouncing (Baechle & Earle, 2008). The individual does not hold the end position, but actively bounces to rapidly stretch the muscle.

Myofascial release uses physical manipulation to release tension in fascial tissue. These are connective tissues that surround muscles, bones, nerves, and organs of the body. Fascial tension can place pressure on nerves and muscles causing chronic pain (Spine-Health, 2014). This technique has been used in rehabilitation settings to help correct muscle imbalances, improve joint range of motion, relieve muscle soreness

and joint stress, and help maintain normal functional muscular length. Myofascial release is a massage technique, but a new modality has surfaced that is simpler, self myofascial release (SMR). The main difference between myofascial release and SMR is instead of a therapist providing the pressure on the muscle tissue; the individual uses their own body weight to create pressure on the muscle tissue. The most common modality for SMR is foam rollers. Myofascial release is thought to occur through two neural receptors that are located in skeletal muscle tissue, the muscle spindle and golgi tendon organ. Muscle spindles sense changes in fiber length and rate of change to the central nervous system. When the central nervous system senses the change in fiber length it triggers the stretch reflex (Clark & Russell, 2014). The stretch reflex alters the normal length-tension relationship through three main components; first the muscle spindle responds to a stretch, secondly, an afferent nerve fiber carries the sensory impulse from the spindle to the spinal cord decreasing the alpha motor neuron firing. Lastly, there is an efferent spinal cord motor neuron activation of the stretched muscle fibers, which shortens muscle tissue and alters the normal length-tension relationship. (McArdle, Katch, & Katch, 2007). The golgi tendon organs protect the muscle and its connective tissue from injury from excessive load by responding to feedback due to tension created in the muscle when it shortens and to tension when the muscle stretches passively (McArdle et al., 2007). When tension increases the golgi tendon organs increase the firing threshold of the alpha motor neuron. This causes relaxation. This reflex relaxation is autogenic inhibition. When stimulation increases, muscle spindle activity is inhibited, golgi tendon organs are stimulated which in turn causes relaxation and there is a decrease in muscular tension. Foam rolling increases muscle

tension, causing the golgi tendon organ to relax the muscle, decreasing pain, restoring muscle length-tension, and improves function (Robertson, 2008). While using a foam roller you use your body weight to stretch the muscle. Slowly roll over the muscle for 1-2 minutes while going over tender parts, then move onto the next muscle. Therapists and fitness professionals have implemented SMR as a recovery maintenance tool to aid in the process of soft-tissue healing (MacDonald, Penney, Mullaley, Cuconato, Drake, Behm, & Button, 2013). Foam rollers have been widely praised, but there has been a limited amount of research to support its use.

Static stretching is a well-documented form of stretching. DePino, Webright, & Arnold (2000) investigated an acute static stretching protocol and found that after static stretching that there was an enhancement in hamstrings flexibility. Ayala & Andujar (2010) investigated a 12-week static stretching protocol of 15, 30, and 45 seconds of active stretching. They found that there were no significant differences between the three treatment groups, and all were equally effective at increasing hamstrings length.

Only a few research studies have documented myofascial release. Huang, Santo, Wadden, Cappa, Alkanani, & Behm (2010) investigated the effectiveness of 3 massage conditions on hip flexion range of motion (no massage, 10-second massage, and 30-second massage) and found that 10 and 30 second seconds of musculotendinous massage induced a greater range of motion in the hamstrings. Healy, Hatfield, Blandpied, Dorfman, & Riebe (2013) found that 30 seconds of foam rolling on each of the lower-limbs and back had no effect on performance. MacDonald et al. (2013) found that an acute bout of SMR on the quadriceps effectively enhanced knee joint range of motion without a concomitant deficit in muscle performance. Sherer

(2013) investigated the effects of hamstrings flexibility during a 4-week foam rolling protocol. She found that the foam rolling group mean hamstrings flexibility increased compared to initial measurements.

The purpose of this study was to assess and compare the acute effects of hamstrings self myofascial release and static stretching on hamstrings range of motion. We hypothesized that acute SMR would increase hamstrings range of motion and SMR would have a greater effect than static stretching.

Methods

Introduction

This section provides information regarding the procedures used in this study. This chapter consists of the following section: (a) Selection of Participants, (b) Equipment, (c) Data Collection Procedures, and (d) Data Analysis Procedures.

Selection of Participants

Participants were recruited from Southern Illinois University Carbondale (SIUC) Kinesiology department classes. The recruitment procedure and data collection procedures were approved by the SIUC Human Subjects Committee. Ten healthy college-age male participants (age, 22 ± 2 years; height, 172.7 ± 4 cm; mass, 74.6 ± 15.3 kg) volunteered to be in the self-myofascial release group and ten healthy college-age male participants (age, 22 ± 2 years; height, 179.4 ± 5.9 cm; mass, 76.6 ± 11.1 kg) volunteered to be in the static stretching group of this study. Participants were asked to come in for a one day pre-screening before participants entered the study. The purpose and procedures of the study were explained verbally to the participants. The participants then read and signed an informed consent form. At the pre-screening the participants'

height, weight, and age was recorded. Participants then filled out a health history questionnaire and completed three trials of hamstrings flexibility using the Wall Sit-and-Reach Test (Beam & Adams, 2011). Participants were excluded from the study if they had experienced any lower extremity injury, undergone any lower extremity surgical procedures in the past year, or tested above the 30th percentile (Beam & Adams, 2011) in the Wall Sit-and-Reach. Those who were willing to participate in the study were scheduled to come to the laboratory three times the following week for testing.

Equipment

An 18" Flexibility Roller was used for the self-myofascial release technique. A Figure Finder Flex-Tester (Novel Products, Rockton, IL) was used to measure hamstrings flexibility to the nearest 0.5 cm. A Detecto-medic Scale (Detecto Scales, Brooklyn, NY) was used to measure weight to the nearest 0.23 kg. A standard stadiometer was used to measure height to the nearest millimeter.

Data Collection Procedures

All data collection was done in the Exercise Physiology laboratory. The first participant who arrived was assigned to the static stretching group and the second was assigned to the self-myofascial stretching group. This process was repeated until there were ten participants in each group. Participants were instructed to come into the laboratory three times in one week with at least 24 hours between each testing appointment and to not alter any physical activity during their daily lives. Upon arrival participants were instructed to complete a five minute warm up of walking around the gymnasium at a consistent walking pace. After completing the warm up the participants were familiarized with the stretching procedure and equipment using both visual and

verbal descriptions. The participants were shown visual images of hamstrings self-myofascial release from the website bodybuilding.com (Bodybuilding.com, LLC., 2014) and visual images of static stretching from DePino et al. (2000). Verbal instructions were given to the individuals by the instructor. Instructions were based on which group they were in and consisted of telling the participant the proper way to stretch. The participants in the self-myofascial group used an 18" Flexibility Roller and were instructed to sit down on the floor mat in a seated position, extend their leg over the foam roller, and place their hands to the side of their hips to support their weight. Using their hands to lift their hips off of the floor, the participants rolled over the foam roller with as much body mass as possible, using a 1…2…3 count pace, from the ischial tuberosity to the posterior knee using their body weight (Bodybuilding.com, LLC., 2014). While the participant was foam rolling the hamstrings the participant kept their knee extended, ankle flexed, and used their arms and opposite leg for support during the foam rolling. The participants in the static stretching group performed the stretch while standing, facing a padded evaluation table with the heal of the right limb placed on the edge of the table in a relaxed plantar flexion. Neutral right hip rotation was maintained by keeping the foot pointed straight up. The standing leg was positioned so that the left foot was perpendicular to the table. The subject was then instructed to flex at the waist. During the stretch, the subject attempted to maintain a flat back with the pelvis in relative anterior rotation, neutral position of the head, and full extension of the stretched leg. Each subject flexed at the waist and stopped when a stretch sensation was experienced in the hamstrings. Between stretches, subjects were allowed to remove the leg from the bench and flex the knee. Corrective verbal feedback was given throughout

the stretching protocol to ensure that proper technique was maintained. The same instructor gave all instruction and feedback. All participants started with the right hamstrings and then switched to the left hamstrings. A rest period in between each repetition and set was given. Each stretch or foam roll lasted 30 seconds with a 15 second rest in between each repetition. There was a 30 second rest period in between each set. Participants completed one repetition per leg and three sets, for total of three minutes of stretching each day. After completion of the stretching protocol the participant then completed three trials of the wall sit-and-reach test. The participant removed their shoes, sat on the floor, with the back, hips, and head against the wall. The participant then placed their feet underneath the Flex-Tester Sit and Reach Flexibility Test Box and fully extended their legs, with their feet several centimeters apart. The participant's legs remained extended throughout the three trials. The participant then placed one hand on top of the other and placed their hands on top of the Flex-Tester Sit and Reach Flexibility Test Box. The starting position was determined by the participant reaching forward as far as possible along the Sit and Reach Flexibility Test Box without having the head and back leave the wall; however, the shoulders were permitted to hunch forward into a rounded position. The instructor then recorded the starting position to the closest 0.5 cm. After recording the starting position, the participant slowly reached forward as far as they could. The instructor reset the reach indicator to the original position after each trial. The instructor recorded each of the three trials, after the third trial the participant had completed the testing protocol (Bean & Adams, 2011). The following two test days the participants completed the same stretch protocol they were assigned at the beginning of the study.

Data Analysis Procedure

Data were collected pre-test and on three days using the Flex-Tester Sit and Reach Flexibility Test box. The three flexibility scores for each day were averaged. Hamstrings flexibility was determined by subtracting the pretest reach of the participant from the average of the three scores on each day of testing.

Statistical Analyses

All statistical analyses were performed using SuperAnova (Abacus Concepts, Inc., Berkeley, CA). Standard statistical methods were used to calculate the mean and SD hamstrings flexibility. Differences between the two groups were analyzed using a One Way ANOVA (age, body mass, stature). A two way repeated measures ANOVA (time by group) was used to analyze the hamstrings flexibility scores.

Results

The mean pretest, post-treatment Day 1, Day 2, and Day 3 hamstrings flexibility for the SMR and Static stretch groups are presented in Table 1. The pretest hamstrings flexibility of the SMR group was 27.7 cm ± 4.3 and the Static stretch group was 23.9 cm ± 7.0. After the first treatment (Day 1), hamstrings flexibility of the SMR group was 32.3 cm ± 5.5 and the static stretch group was 25.7 cm ± 7.1. This was a 17.0% increase for the SMR group and 7.5% increase for the Static stretch group from pretest. After the second treatment (Day 2) hamstrings flexibility of the SMR group continued to increase to 34.2 cm ± 5.8 and the Static stretch group to 29.6 cm ± 6.8. This was a 5.9% and 15.5% increase in hamstrings flexibility of the SMR and Static stretch groups from the first treatment, respectively. After the third treatment hamstrings flexibility of the SMR group further increased to 35.6 cm ± 4.8 and the Static stretch group increased to 31.8

cm ± 5.8. These increases were 4.1% and 7.1% increases in hamstrings flexibility of the SMR and the Static stretch groups from the second treatment, respectively.

The Group by Time ANOVA for flexibility revealed that there was no main effect of Group ($F(1,18) = 3.629, p = 0.0729$), but that there was a main effect of Time ($F(3,54) = 32.130, p = .0001$). At the same time there was no Group by Time interaction ($F(3,54) = 1.152, p = .3366$)

Table 1

Mean pretest, day one, day two, and day three hamstrings flexibility (cm) for the SMR and Static stretch groups

	Count	Mean	SD
SMR Pretest	10	27.7	4.3
SMR Day One	10	32.3	5.5
SMR Day Two	10	34.2	5.8
SMR Day Three	10	35.6	4.8
Static Pretest	10	23.9	7.0
Static Day One	10	25.7	7.1
Static Day Two	10	29.6	6.8
Static Day Three	10	31.8	5.8

Discussion

Foam rollers are being used as a SMR modality in fitness and physical therapy. SMR is used during the warm-up, recovery, and maintenance phases of a workout to help improve joint ROM and enhance muscular function. This study examined SMR as part of an acute stretching program in participants with restricted ROM in the hamstrings muscle. The most important finding was that in an acute stretching program all individuals in both the SMR (28.9% increase) and static (33.2% increase) groups increased their range of motion and that the increases were parallel and not significantly different between the groups.

The findings in this study are comparable to effects of stretching programs in other studies using myofascial release to increase muscle range of motion. An acute bout of SMR increased range of motion without a decrease in muscle activation or force in individuals whom foam rolled (MacDonald et al., 2013). The study found a significant increase in knee joint ROM at 2 minutes postfoam rolling (12.7%) as well as 10 minutes postfoam rolling (10.3%) of the quadriceps muscle group. In another study comparing foam rolling to a control group after a four week stretching program, Sherer (2013) showed a significant increase in hamstrings flexibility in the foam roller group (6.8%) in comparison to the control group (0.0%). Huang, Santo, Wadden, Cappa, Alkanani, & Behm (2010) looked at musculotendinous friction during a 10 second and 30 second massage of the hamstrings muscle group. They found a significant increase in hamstrings flexibility from pre to posttest of 5.9 and 7.2% increase in comparison to the control group for the 10 and 30 second massage conditions, respectively. There are a few research studies on SMR and like the present study they show an increase in range of motion from myofascial release.

New techniques and equipment are introduced into the fitness industry every year, but range of motion remains vital. Maintenance of range of motion has been shown to decrease injuries and increase function and performance. Studies have examined ballistic, static, and dynamic stretching. A new technique SMR has recently become popular and there are few studies looking at its efficacy. In this study we compare the well-known, static stretching, to the new technique, SMR. Our objective was to compare the acute effects of both techniques on range of motion. We found an acute response to SMR by the hamstrings muscle group and to static stretching. We

hypothesized that SMR would have a greater affect than static stretching during an acute stretching program on hamstrings range of motion, but we found that range of motion increased similarly using both techniques.

Conclusion

In conclusion, foam rolling the hamstrings resulted in a similar increase in range of motion to static stretching. Foam rolling is a simple and effective method of acutely increasing range of motion. Further research should continue to examine the benefits of foam rolling especially looking at the long-term adaptations to foam rolling.

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