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Effect of Static Stretching or Foam Rolling on Hamstrings Range of Motion and Strength

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EFFECT OF STATIC STRETCHING OR FOAM ROLLING ON HAMSTRINGS RANGE OF MOTION AND STRENGTH

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A Research Paper

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RESEARCH PAPER APPROVAL

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TITLE: EFFECT OF STATIC STRETCHING OR FOAM ROLLING ON HAMSTRINGS RANGE OF MOTION AND STRENGTH

MAJOR PROFESSOR: Dr. Montier D. Becque

The purpose of this study was to examine the acute effects of foam rolling and static stretching on the hamstrings isokinetic force production as well as knee joint range of motion. Eleven healthy, moderately experienced, male college students participated in the study. It was hypothesized that foam rolling and static stretching would both see significant improvements in range of motion. Static stretching was also believed to have decreases in force production while foam rolling would stay relatively the same. Two treatments, static stretching and foam rolling, were established for within participants pretests and posttests. Both treatments were 5 minutes. Results showed static stretching had a significant increase in flexibility for pretest and posttest ($p = .0011$, $F(1,10) = 20.643$). Foam rolling had a significant increase in flexibility as well ($p = .0055$, $F(1,10) = 12.441$). A significant decrease in isokinetic peak torque was found for the static stretching treatment pretest and posttest ($p = .0186$, $F(1,10) = 7.872$). There was no significant difference in the foam rolling treatment pretest and posttest ($p = .7065$, $F(1,10) = .150$). In conclusion, foam rolling can improve flexibility with no decrements in peak force production.

Key words: foam rolling, static stretching, hamstrings, range of motion, force

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INTRODUCTION

Fascia is a term used to describe the surrounding structures of human organs. This fascia more specifically in the field of exercise science is important because it surrounds the muscles involved in movement. When this surrounding fascia becomes tight from inactivity, injury, or inflammation, it can obstruct the range of motion. This change in range of motion has led to many different methods to maintain flexibility.

Foam rolling has been a popular method of loosening fascia among the physically active population, especially for athletes. However, there are few studies done on this form of self-myofascial release. Foam rolling is commonly used among athletes as their coaches will often use anecdotal evidence to support the effectiveness of foam rolling before exercise (Sherer, 2013). The hamstrings are a common muscle group that needs to be stretched before exercise to reduce risk of injury as a hamstrings injury is very common among athletes (Halperin, Aboodarda, Button, Andersen, & Behm, 2014; Sherer, 2013). Injury leads to scar tissue formation which may reduce range of motion. A method to increase range of motion would be ideal for the reduction of injury. This can be achieved by static stretching (Behm, Blazevich, Kay, & McHugh, 2016; Sherer, 2013). However, there is an issue with static stretching in that it may reduce force output of the muscle being stretched.

Foam rolling is believed to be the best alternative to static stretching. Previous research has shown an increase in range of motion without a decrement in force production. Also, there were no differences in electromyography measurements among the foam rolling treatments meaning the muscles were activated the same for the treatments so there is less chance of an injury (Halperin et al., 2014; Healey, Hatfield, Blanpied, Dorfman, & Riebe, 2014; MacDonald et al., 2013; Su, Chang, Wu, Guo, & Chu, 2016; and Sullivan, Silvey, Button, & Behm, 2013).

Research for foam rolling of the hamstrings is scarce, however these studies have found significant increases in range of motion (Healey et al., 2014; Su et al., 2016; and Sullivan et al., 2013). But will force production change with the increase in range of motion? The purpose of this study was to examine the effects of foam rolling and static stretching on hamstrings range of motion and isokinetic peak torque.

METHODS

Participants

Eleven healthy adult males (height 178.59 ± 6.75 cm, weight 84.24 ± 12.53 kg, age 21.36 ± 3.11 years) with two years of recreational lifting experience and no previous injury to their dominant leg were recruited from Southern Illinois University Carbondale to participate in this study. Each participant was given an informed consent form to read or be read to and sign after understanding the procedures and risks of the study. This study was approved by the Human Subjects Committee of Southern Illinois University Carbondale.

Study Design

The study design was a within participant cross-over pre and posttest. The participants reported to the laboratory for two separate days with at least a 24-hour interval of rest between testing. The order of the conditions was randomized. Day one of testing included practice with the equipment and familiarization of the procedures, along with an informed consent signature from both the researcher and participants. The researcher asked the participants which leg they considered dominant. Both left and right leg dominant participants were eligible to participate in the study. If dominant leg was unknown, the researcher asked which leg the participant kicked a ball with and that leg was that leg was considered dominant. However, all participants in this study were right-leg dominant. Participants were asked if they had at least two years of lifting experience (that being recreational and or professional). If the participant answered no to this question they were excluded from the study. Participants were also asked if they had an injury to their dominant leg. If the answer was yes to this question they were also excluded from the present study. The participants practiced with the equipment to familiarize themselves with the procedures. Isokinetic peak torque was measured with a Biodex System 3 dynamometer.

Flexibility was measured with a modified sit and reach. In between the peak torque and flexibility tests, participants were given a three minute break. Upon completion of these two tests, a five minute break was given before their first condition (lasting another 5 minutes). Upon completion of their first randomized condition participants were again tested for both peak torque and flexibility. On the second day of testing the participants switched conditions and testing for peak torque and flexibility were completed as they were one the first day of testing. Testing was completed in 30 to 45 minutes on both days.

Independent Variables

The two conditions were foam rolling and static stretching treatment. Each condition was completed for 5 minutes. For the foam rolling condition, a dense foam roller was placed under and perpendicular to the participants' dominant leg. The participant used their own body weight to roll from the insertion of their gluteus maximus to the popliteal fossa and back to the insertion of their gluteus maximus in a seated position. Their hands were in contact with the ground and the dominant leg was in contact with the foam roller with the non-dominant leg resting in a figure four position on top of the dominant leg. Rolling at their own pace, they continued this rolling motion for 50 seconds with 10 seconds of rest for five repetitions.

The static stretch condition was completed in a standing position with the dominant leg on a two foot tall bench. Once balance was established, the participant reached as far forward as possible to the point of discomfort but not pain. The ipsilateral arm was on top of the contralateral hand of the dominant leg when reaching. The stretch was held for 50 seconds with 10 seconds of rest for five repetitions. The researcher stood directly next to the participant in case of loss in balance.

Dependent Variables

Flexibility was determined with a modified Sit and Reach Test with the dominant leg extended and the foot placed against the Sit and Reach box without shoes. The non-dominant leg was placed in a figure four position with the sole of the foot touching the medial side of the knee. The participants were then asked to inhale and while exhaling, reach as far as possible. Participants were told to perform the Modified Sit and Reach three times with no break between the repetitions. The furthest reach was then recorded.

Peak torque of the dominant leg's hamstrings was recorded on a Biodex Sysyem 3 isokinetic dynamometer. Three sets of 3 repetitions pf seated maximal flexion were completed at a speed of 60 degrees per second. A one minute rest was given between each set. The participants were told to focus on the maximal flexion motion of the knee rather than the extension. They moved the leg through the extension of motion with ease before starting another repetition. Verbal encouragement throughout the strength testing was given by the researcher. The dynamometer was calibrated before and after data collection, and was within the manufacturer's specifications. Data were collected at a rate of 100 Hz and saved to a excel file for statistical analysis via SPSS.

Statistical Analyses

A two-way repeated measures analysis of variance was used to analyze the data. The main effects of condition and time were disregarded and the condition by time interaction was examined first. Four single degree of freedom contrasts were done to examine the differences between pretest means, differences between the posttest means, and differences from pretest to posttest within each condition. The Bonferoni technique was used and significance accepted when $p < .0125$.

RESULTS

Range of motion

There was no significant Condition by Time interaction found (p = .4888, F (1, 11) = 0.516) in range of motion as measured with a single-leg sit and reach test. On average the range of motion increased from 45.1 ± 8.83 centimeters to 48.1 ± 8.28 centimeters. Foam rolling increased range of motion from 45.2 ± 9.04 centimeters to 47.9 ± 9.06 centimeters (p = .0055, F (1, 11) = 12.441). Static stretching increased range of motion from 45.0 ± 9.04 centimeters to 48.5 ± 7.86 centimeters (p = .0011, F (1, 11) = 20.643). There were no significant differences between the pretest range of motions (p = .8612, F (1, 11) = 0.032). There were no significant differences between the posttest range of motions (p = .4222, F (1, 11) = 0.701). statistical analysis via SPSS.

Isokinetic flexion peak torque

There was a significant Condition by Time interaction found (p = .0475, F (1, 11) = 5.098) in peak torque as measured during seated flexion. On average the peak torque decreased from 149.6 ± 27.84 newton-meters to 142.5 ± 20.25 newton-meters. Foam rolling maintained peak torque from 140.8 ± 24.67 newton-meters to 143.1 ± 17.00 newton-meters (p = .7065, F (1, 11) = 0.150). Static stretching decreased peak torque from 158.3 ± 29.18 newton-meters to 141.8 ± 23.91 newton-meters (p = .0186, F (1, 11) = 7.872). There were significant differences between the pretest peak torques (p = .0139, F (1, 11) = 8.848). There were no significant differences between the posttest peak torques (p = .8314, F (1, 11) = 0.048).

DISCUSSION

The purpose of this study was to examine the acute effects of foam rolling and static stretching on the hamstrings isokinetic force production and range of motion. The major findings of this study were that both foam rolling and static stretching significantly increased the hamstrings range of motion and static stretching significantly decreased the hamstrings strength while the foam rolling had no effect on strength. There are studies which agree and disagree with these findings. Su et al. (2016) found that foam rolling increased range of motion more than static stretching. They also found no significant difference between static stretching and foam rolling for knee flexion isokinetic peak torque. On the other hand, knee extension peak torque improved after foam rolling and was unchanged with static stretching. However Halperin et al. (2014), MacDonald et al. (2013), and Sullivan et al. (2013) had results very similar to the present study. The found and increase in range of motion with static stretching and foam rolling with an increase in maximal force after foam rolling and decrease after static stretching. It is unclear why there are differences between these studies. Some of the differences may be due to the muscle that was tested but there appears to be evidence that foam rolling does not effect muscular strength and static stretching decreases muscular strength.

It is important to address the significant difference in pre-test foam rolling and static stretching peak torque. The participants were assigned to the conditions by a random draw. Nine of the participants were assigned to static stretching on the first day of testing and two participants completed the foam rolling on the first day. This may have lead to some of the difference in the pretest torques. However, the researcher believes the same decline would have been seen regardless of the order of testing. The participants were highly motivated and constantly encouraged by the researcher during the testing.

In conclusion, foam rolling appears to stretch and lengthen the fascia associated with the muscle resulting in an increase in range of motion without a change in force production. On the other hand, static stretching increases range of motion but in many cases, decreases force generation by causing friction between the muscle and fascia and possibly disrupting the contractile unit and the series of elastic component of the muscle.

CONCLUSION

Results found in this study would suggest there is a significant difference among static stretching compared to foam rolling. The foam rolling self myofascial release did not show any significant difference in force production while still maintaining significant increases for range of motion. Static stretching of course showed a significant increase in range of motion, however this treatment resulted in a significant decrease in force production. This study gives strength to the notion that foam rolling can be an effective tool in increasing range of motion while still maintaining force production efficiency as opposed to static stretching.

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