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The Acute Effects of Static Stretching or Foam Rolling on Range of Motion and 1RM Hamstring Muscular Strength

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A Research Paper

Submitted in Partial Fulfillment of the Requirements for the

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RESEARCH PAPER APPROVAL

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TITLE: THE ACUTE EFFECTS OF STATIC STRETCHING OR FOAM ROLLING ON RANGE OF MOTION AND 1RM HAMSTRING STRENGTH

MAJOR PROFESSOR: Dr. Motier D. Becque

The purpose of this study was to compare the acute effects of static stretching or foam rolling on range of motion and 1RM hamstring strength. Even though static stretching has been the main method for increasing flexibility, it has also been associated with reductions in strength gains. Foam rolling is a form of self-myofascial release which facilitates restricted fascia. Ten college students participated in this study. Five participants were in the Static Stretching Group, and five participants were in the Foam Rolling Group. Participants met on two separate days. On day one, the Modified Sit and Reach Box was used for all participants to access their range of motion. The Iso-lateral kneeling Leg Curl machine was used to determine the 10RM for hamstring strength for every participant so that they could be evenly matched into the Static Stretching Group or the Foam Rolling Group. On day two the Static Stretching Group performed five minutes of intense stretching and five minutes of cycling before the final testing of their range of motion and 1RM hamstring strength. The Foam Rolling Group performed five minutes of intense foam rolling before the final testing of their range of motion and 1RM were performed.

The data collected indicate that there were significant improvements in range of motion for both the Static Stretching Group and the Foam Rolling Group. However, the 1RM hamstring strength for both the Static Stretching Group and the Foam Rolling Group did not significantly change from pretest to posttest. In conclusion, flexibility increased for both groups, but isotonic muscular strength was unaffected by acute static stretching or foam rolling.

Keywords: self-myofascial release, range of motion, 1RM, isotonic, hamstring

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INTRODUCTION

Recent studies have analyzed the effects of the foam rolling technique in comparison to the traditional means of static stretching flexibility and muscular strength (Barnes, 1997; MacDonald et al., 2013). Sure, we are familiar with the slow and static form of stretching, holding a position from seconds to minutes, to the point of discomfort to increase flexibility; however, static stretching has also been associated with decreased muscle strength (Behm, Button, Butt, 2001). Flexibility is defined as the ability of a joint to move through its full range of motion while a 1RM is defined as the ability to lift the maximum weight possible one time. Fascia is tough connective tissue that spreads throughout the body in a three-dimensional web (Barnes, 1997). The fascia surrounds every muscle, bone, nerve, blood vessel and organ to its cellular level. The fascial system provides support, cushioning, stability and also contributes to locomotion and dynamic flexibility (Barnes, 1997). When the fascial system is traumatized, it tightens as a protective mechanism and loses its pliability, and is a source for tension throughout the entire body (Barnes, 1997). Results from this type of trauma to the fascia can be very disturbing. Collagen may become dense and fibrous, and the elastin may become less resilient. Poor muscular biomechanics, altered structural alignment, and decrease in strength, endurance and motor coordination are all results that can occur over time. Functional capacity is diminished and the person is in constant pain (Barnes, 1997). Fascial restrictions are often the results of inflammation, inactivity, disease, or injury (MacDonald, Button, Drinkwater, & Behm, 2013). Myofascial release was developed by Mark F. Barnes in 1997 and is a hands-on soft tissue technique that facilitates the restricted fascia. Pressure is sustained between

90 to 120 seconds into the restricted tissue until it undergoes length changes allowing for the first release to be felt and after a few releases the tissue becomes softer and more pliable (Barnes, 1997).

Foam rolling has been used in several training and rehabilitation programs to promote optimal skeletal muscle functioning, enhance flexibility and produce soft tissue extensibility (MacDonald et al., 2013). Foam rollers are used before and after exercising but it is suggested that the use of self-myofascial release before exercise allows for the participant to decrease the restrictions endured by the fascia being traumatized and also allows the participant to increase his volume of exercise and training (Boyle, 2009) and (Clark & Russell, 2009).

Therefore, the purpose of this investigation was to study the acute effects of static stretching or foam rolling on range of motion and 1RM hamstring muscular strength of college-age resistance trained males. The significance of this study was to determine if there were significant acute changes in flexibility and isotonic muscular strength as a result of static stretching or foam rolling.

METHODS

Introduction

This section provides the procedures that were used for this study and consists of the following sections: (a) Selection of Participants, (b) Data Collection Procedures, and (c) Data Analysis Procedures.

Selection of Participants

Participants were recruited on a volunteer basis from the student body at Southern Illinois University Carbondale. The recruitment and data collection procedures

were approved by the SIUC Human Subjects Committee. Ten experienced, resistance trained college-aged males (age 25.1 ± 2.2 years, height 176.26 ± 8.5 cm, mass 80.78 ± 8.0 kg) were used for this study. The participants were verbally explained the purpose of the study upon the initial encounter. Participants completed a medical history form and signed an informed consent. Participants were excluded from this study if they had two or more health risk factors or had any lower leg injury. The participants met on two different days. On the first day, the participants' height, weight, range motion, and 10RM were recorded. The range of motion test was given using Wall Sit-and- Reach Box and the 10RM test was given using the Standing Leg Curl Machine at the SIUC Recreation Center. Once day one was completed the ten participants were matched according to their 10RM strength and randomly placed into a Static Stretching Group or a Foam Rolling Group.

Data Collection Procedures

All of the data was collected at the SIUC Recreation Center. After the Static Stretching Group and the Foam Rolling Group were determined, day two of testing began. An 18 inch Flexibility Foam Roller was used by the Foam Rolling Group. Flexibility was determined by use of the Modified Sit and Reach Box (Baseline Evaluation Instruments, White Plains, NY) for both groups. The 1RM hamstring strength was determined for both groups by use of the Iso-Lateral Kneeling Leg Curl Machine (Hammer Strength, Rosemont, IL). The Static Stretching Group also cycled for five minutes using the Life Fitness Stationary Bike (Rosemont, IL). The Static Stretching Group and the Foam Rolling Group were asked to walk for five minutes around the gym to warm up. Both groups removed their shoes prior to the range of motion test using the

sit-and reach box. Both groups placed their backs firmly against the wall and stretched their hands out to determine the starting point for the sit and reach test. Participants for both groups pushed as far as they could reach and the measurements were recorded. Next, both groups performed a 1RM standing leg curl and the data were recorded. Both groups rested for five minutes until the second part of the testing began. The Static Stretching Group stretched both legs by sitting on the floor and tucking the alternate leg in. The Static Stretching Group stretched for five minutes, alternating legs every fifteen seconds. Next, the Static Stretching Group cycled on the stationary bike for five minutes. Upon completion of both protocols, the Static Stretching Group rested for five minutes and both the sit and reach test and the standing leg curl 1RM were retested and the data recorded. The Foam Rolling Group used a foam roller to loosen up the fascia of their hamstring muscles. Upon completion of the five minute rest period, the Foam Rolling Group used a foam roller for a total of five minutes. They foam rolled both their hamstrings for three minutes by sitting on the foam roller and placing their hands on the floor. After three minutes of foam rolling, the participants alternated foam rolling each leg individually for one minute. Upon completion of the five minutes of foam rolling, the Foam Rolling Group rested for five minutes. After resting, the sit and reach and standing leg curl 1RM were retested and the data recorded.

Independent variables

The independent variable for the Foam Rolling Group was the five minutes of foam rolling. The independent variable for the Static Stretching Group was the five minutes of static stretching and the five minutes of stationary bicycle riding.

Dependent variable

The dependent variables for both the Foam Rolling Group and the Static Stretching Group were the flexibility and the isotonic strength of both groups.

Statistical analysis

The data were analyzed with SuperANOVA (Abacus Concepts. Inc., Berkley, Ca) with a group by time analysis of variance.

RESULTS

The mean pretest and posttest for the group by time analysis of variance for the 1RM hamstring strength for the Static Stretching Group and the Foam Rolling Group are presented in Table One. The pretest 1RM hamstring strength mean was 45.90 (9.84) kg for the Static Stretching Group and 46.36 (11.85) kg for the Foam Rolling Group. The posttest mean for the Static Stretching Group was 46.80 (10.00) kg and 46.36 (11.85) kg for the Foam Rolling Group. The Group by Time ANOVA indicated no significant Group ($p = .9989$, F (1, 8) = 2.097 E – 6), Time ($p = .1413$, F (1, 8) = 2.664), or Group by Time interaction ($p = .1413$, F (1, 8) = 2.664).

The mean pretest and posttest for the group by time analysis of variance for range of motion are presented in Table Two. The pretest mean for the Static Stretching Group was 44.28 (8.07) cm and 39. 96 (3.39) cm for the Foam Rolling Group. The posttest mean for the Static Stretching Group was 50.16 (8.92) cm and 42.98 (2.93) cm for the Foam Rolling Group. The Group by Time ANOVA indicated no significant Group ($p = .2104$, F (1, 8) = 2.150) or Group by Time interaction ($p = .2104$), F (1, 8) = 1.854). A significant Time effect ($p = .0028$, F (1, 8) = 17.958) was found.

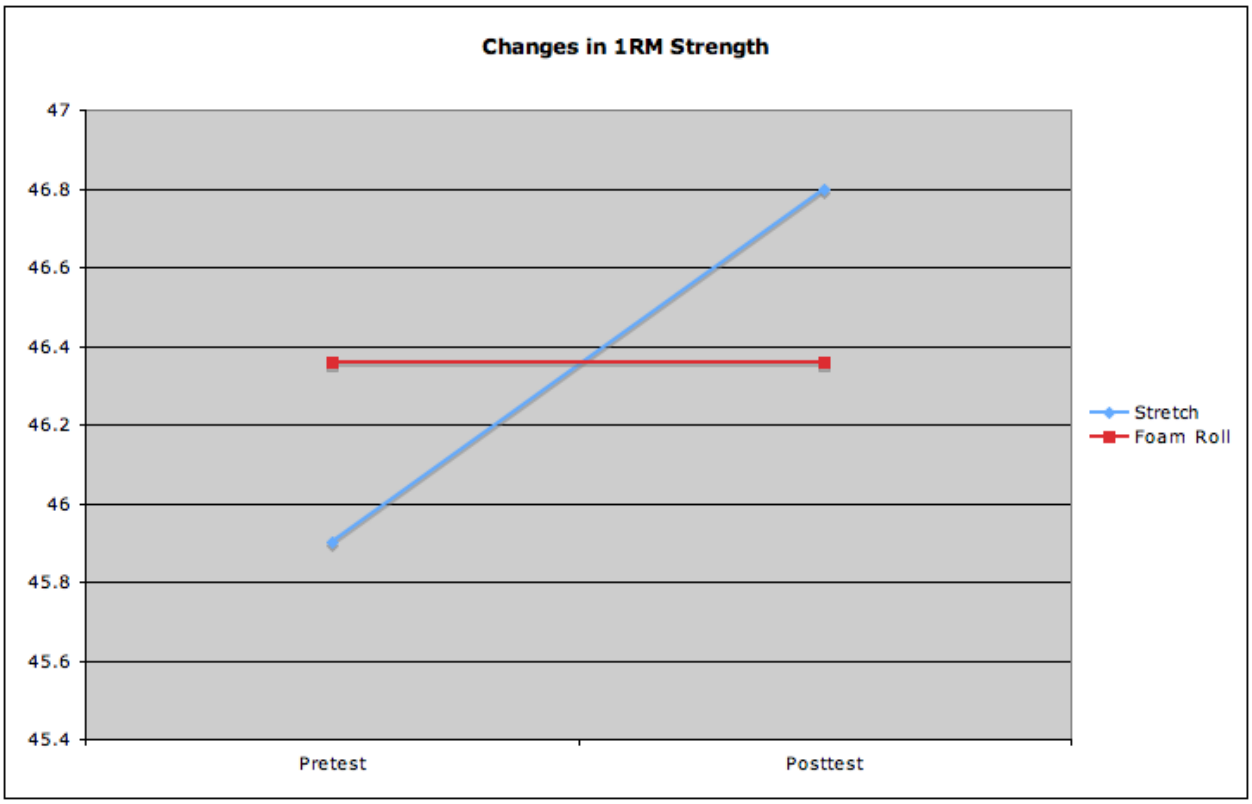

Figure 1. Group by time interaction for 1RM hamstring strength

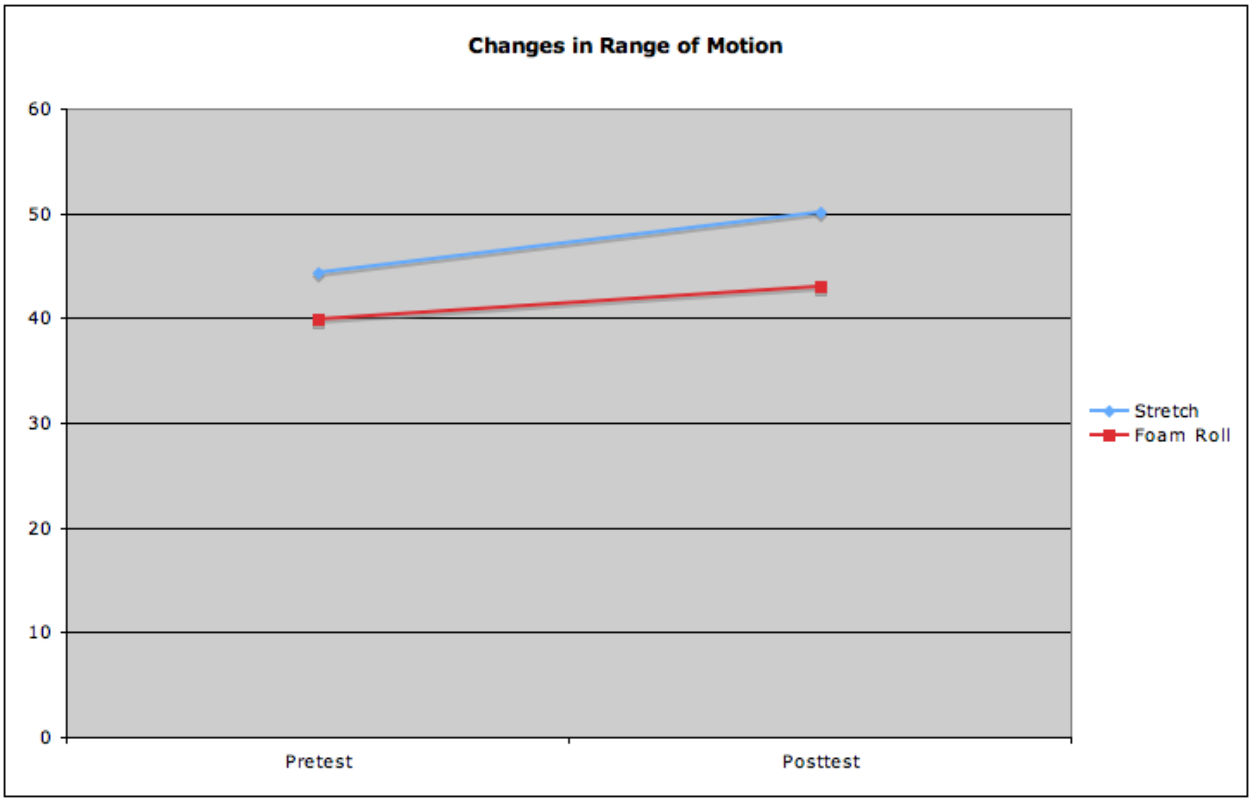

Figure 2. Group by time interaction for range of motion

DISCUSSION

The purpose of this study was to examine the acute effects of static stretching or foam rolling on range of motion and 1RM hamstring strength. The major finding of this study was that there were no differences in the acute effects of static stretching or foam rolling on range of motion. Both the Static Stretching Group and Foam Rolling Group made the same improvements in range of motion. The second major finding was that there were no differences between groups for 1RM hamstring strength. There was no change in 1RM hamstring strength for either group.

There have been previous studies that have examined acute effects of self-myo fascial release as it pertains to increasing range of motion without decreasing muscular strength (MacDonald, et al. 2013). In this study they examined the acute effects of self-induced myo-fascial release (foam rolling) of the quadriceps muscles on range of motion, maximum voluntary force, muscle activation, tetanic force twitch force and half relaxation time, and rate of force development. Results from this study show that an acute bout of foam rolling significantly improves joint range of motion with no decreasing effects on muscular strength (MacDonald et al., 2013). Other studies have shown that static stretching has similar increases in range of motion (Behm, Bambury, Cahill, & Power, 2004), but after static stretching there will be a loss in muscular strength (Behm, et al. 2001). One study conducted with roller massagers applied to the hamstrings found that sit and reach hamstring range of motion was improved within five to ten seconds without any performance impairments (Sullivan, Silvey, Button, & Behm, 2013). Another study examined the acute effects of foam rolling on flexibility, isokinetic and isometric strength (Li, 2015). The results of this study showed that two minutes of

foam rolling the quadriceps significantly increased the knee joint range of motion and there was no change in isometric or isokinetic peak force.

The previous studies have shown that range of motion will increase similarly by static stretching or foam rolling. These studies have also shown that muscular strength will decrease as a result of static stretching and muscular strength will not decrease as a result of foam rolling. However, these studies only tested isometric and isokinetic and not isotonic muscular strength. This study is the first study to examine changes in isotonic muscular strength and range of motion. Isotonic muscular strength was unaffected by acute static stretching or foam rolling.

CONCLUSION

In conclusion, these findings suggest that there were no significant differences between the Static Stretching Group and the Foam Rolling Group for flexibility or isotonic muscular strength.

REFERENCES

Barnes, MF. (1997). The basic science of myofascial release: Morphologic change in connective tissue. *Journal of Bodywork and Movement Therapies.1,* 231-238.

Behm, D.G., Button, D.C., & Butt, JC. (2001). Factors affecting force loss with prolonged stretching. *Canadian Journal of Applied Physiology 26,* 261-272.

Behm, D.G., Bambury, A., Cahill, F., & Power, K. (2004). Effect of acute static stretching on force, balance, reaction time, and movement time. *Medicine & Science in Sports & Exercise 36,* 1397-1402.

Boyle, M. (2009). Using foam rollers. Retrieved from: http:// *www.PerformBetter.com*.

Clark, M. & Russell, A. (2009). Self-myofascial release techniques. Retrieved from: http:// *www.PerformBetter.com*.

MacDonald, Z. G., Button, C. D., Drinkwater, J. E., & Behm, G. D. (2013). Foam rolling as a recovery tool after an intense bout of physical activity. *Medicine & Science in Sports & Exercise.*131-142.

MacDonald, Z. G., Penney, D.H. M., Mullaley, E. M., Cuconato, L. A., Drake, D.J. C., Behm, G. D., & Button, C. D. (2013). An acute bout of self-myofascial release increases range of motion without a subsequent decrease in muscle activation or force. *Journal of Strength & Conditioning Research. 27*(3) 812-821.

Li, Z. (2015). Acute effects of foam rolling on flexibility, isokinetic and isometric strength. *Graduate School Research Paper* Southern Illinois University, Carbondale.

Sullivan, K., Silvey, D., Button, D., & Behm, D. (2013). Roller-massager application to the hamstrings increases sit-and-reach range of motion within five to ten

seconds without performance impairments. *International Journal of Sports Physical Therapy.8,* 228-236.

APPENDIX A

Table 1. Group by time and analysis of variance for 1RM hamstring strength

Type III Sums of Squares

Source	df	Sum of Squares	Mean Square	F-Value	P-Value	G-G	H-F
group	1	.001	.001	2.097E-6	.9989		
Subject(Group)	8	1907.664	238.458				
Time	1	1.013	1.013	2.664	.1413	.1413	.1413
Time * group	1	1.013	1.013	2.664	.1413	.1413	.1413
Time * Subject(...	8	3.040	.380				

Dependent: One RM

Table of Epsilon Factors for df Adjustment
Dependent: One RM

	G-G Epsilon	H-F Epsilon
Time	1.000	1.143

NOTE: Probabilities are not corrected for values of epsilon greater than 1.

Means Table
Effect: Time * group
Dependent: One RM

	Count	Mean	Std. Dev.	Std. Error
Pretest, Stretch	5	45.900	9.840	4.400
Pretest, Foam Roll	5	46.360	11.851	5.300
Posttest, Stretch	5	46.800	9.998	4.471
Posttest, Foam Roll	5	46.360	11.851	5.300

Table 2 Group by time analysis of variance for range of motion

Type III Sums of Squares

Source	df	Sum of Squares	Mean Square	F-Value	P-Value	G-G	H-F
group	1	165.312	165.312	2.150	.1807		
Subject(Group)	8	615.052	76.881				
Time	1	99.012	99.012	17.958	.0028	.0028	.0028
Time * group	1	10.225	10.225	1.854	.2104	.2104	.2104
Time * Subject(...	8	44.108	5.514				

Dependent: ROM

Table of Epsilon Factors for df Adjustment
Dependent: ROM

	G-G Epsilon	H-F Epsilon
Time	1.000	1.143

NOTE: Probabilities are not corrected for values of epsilon greater than 1.

Means Table
Effect: Time * group
Dependent: ROM

	Count	Mean	Std. Dev.	Std. Error
Pretest, Stretch	5	44.280	8.072	3.610
Pretest, Foam Roll	5	39.960	3.390	1.516
Posttest, Stretch	5	50.160	8.920	3.989
Posttest, Foam Roll	5	42.980	2.930	1.310

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