The Acute Effects of Self-Myofascial Release on Range of Motion and Fatigue Rate in the Lower Extremities

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ABSTRACT

There has been a growing popularity in a technique similar to a massage that is easily accessible known as self-myofascial release, or more commonly as "foam rolling". While research has been conducted to examine the effects on a smooth foam roller, little research has been conducted regarding a more aggressive form of deep tissue self-myofascial release on muscular strength and fatigability. PURPOSE: To examine the acute effect of deep tissue self-myofascial release on hip range of motion and fatigue rate of the quadriceps in uninjured individuals. METHODS: Nineteen males, ages 20-35, with no prior knee surgery/injury on their preferred leg regardless of current functional status were recruited. Subjects were allowed familiarity trials for goniometry of hip flexion/extension, self-myofascial release, and the isokinetic strength/fatigability test prior to exercise testing. All subjects underwent three experimental trials [self-myofascial release (SMR), static stretching (STS), no additional warm-up control (CON)] in a balanced crossover design. During the treatment trials, subjects were required to perform a 10 minute warm-up on a stationary rate independent cycle ergometer (50 W) followed by one of the treatments applied to the hamstrings and quadriceps of the preferred leg; SMR (1 set; 2 min), STS (4 sets; 30 secs). Subjects were required to perform the Thorstensson test, using a single-chair isokinetic dynamometer, which consisted of 50 voluntary maximal isokinetic leg extensions on their preferred leg where the rate of force production was controlled as $180°\cdot sec^{-1}$. Measurement of hip flexion (HF) and extension (HE), absolute peak quadriceps force production (AF), relative peak quadriceps force production (RF), quadriceps fatigue rate (FR), and perceived local leg fatigue (PF) were recorded. One-way ANOVA with repeated measures was used to analyze for differences between trials (STS, SMR, CON), except for FR where a Friedman ANOVA was used, α=0.05. RESULTS: HF did differ significantly between the treatments (p<0.05) where SMR (113.7±4.8°) and STS (114.7±4.9°) > CON (106.2±5.0°). The treatments also differed significantly (p<0.05) in HE, where SMR (19.7±3.3°) and STS (18.2±4.3°) > CON (13.2±3.6°). AF did not differ significantly (p>0.05) between the treatments (SMR=175.2±32.1 Nm, STS=180.9±35.6 Nm, CON=177.2±38.3 Nm), nor did RF (SMR=1.9±0.4 Nm/kg, STS=1.9±0.4 Nm/kg, CON=1.9±0.4 Nm/kg). FR also did not differ (p>0.05) between treatments (SMR=59.7±9.4%, STS=61.3±11.0%, CON=61.5±8.8%). PF was seen to be more frequently greater with most subjects in CON, but there were no significant difference (p>0.05) between trials. CONCLUSION: While SMR had no effect on muscular strength and fatigability, SMR did have similar significant effect as static stretching on hip range of motion.

INTRODUCTION

For many years, massages have been a significant aspect in sports performance and health fitness due to the optimal physiological enhancements and recuperation benefits on the human body[1]. Recently, there has been a growing popularity in a technique similar to a massage that is easily accessible known as self-myofascial release, or more commonly as "foam rolling". RumbleRoller® is a deep tissue foam roller that has aggressive ridges compared to the ordinary smooth foam roller to apply a greater pressure per unit area to stimulate deeper muscles, and fully stretch connective tissue[2]. The premises of increasing range of motion through foam rolling is constructed by pressure and friction applied to the connective tissue (fascia) allows it to become less dense for a greater length-tension relationship[3]. Additionally, self-myofascial release has a hyperemia effect by increasing the blood flow to the area that is being treated[3]. The increase of blood flow to the muscles allows nutrients such as oxygen and nitric oxide to efficiently reach the area, which in turn causes vasodilation of the arteries[3]. Lastly, while the effect of self-myofascial release on muscular power has been investigated using a smooth foam roller, little research has been conducted regarding deep tissue self-myofascial release on muscular strength and fatigability.

PURPOSE

The purpose of the study was to examine the acute effect of deep tissue self-myofascial release on hip range of motion and fatigue rate of the quadriceps in uninjured individuals.

METHODS

IRB Approval. The study was approved by the Institutional Review Board (Human Subjects) at Texas A&M University-Kingsville.

Subjects. All subjects were provided informed consent prior to testing. Nineteen male subjects (N=19) were recruited from the student population at Texas A&M University-Kingsville.

Pre-participation Screening/Testing. All subjects underwent a health screening according to the American College of Sports Medicine's guidelines for exercise testing and prescription.[5] Only subjects classified as low or moderate risk for untoward events during exercise based on these guidelines were allowed to participate. Additionally, subjects who have undergone any sort of knee surgery/injury on their preferred leg were not allowed to participate regardless of their current functional status. The following measurements were made pre-exercise testing: body mass utilizing a standard physician's scale and body stature utilizing a stadiometer. Furthermore, subjects performed familiarization trials of the proper usage of self-myofascial release technique, static stretches, and the Thorstensson Test.

Experimental Design. A balanced cross-over design was used. Each subject underwent three experimental trials [static stretching treatment (STS), self-myofascial release treatment (SMR), and controlled treatment (CON)] on separate days within 2-7 days apart. During the three trials, the subjects were required, after receiving the corresponding treatment for that trial, to perform the Thorstensson Test for strength/fatigability.

METHODS, cont.

Treatments. The pre-Thorstensson Test treatments used during the experimental trials were as follows:

Static Stretching (STS) – Following a 10 minute warm-up was on a stationary rate-independent cycle ergometer at a power output of 50 W, subjects self-administered a supine hamstring stretch and side lying quadriceps stretch on their preferred leg. The stretches were actively held at the point of slight discomfort for 30 seconds per repetition. Four repetitions were performed for each muscle group with a 15 second rest interval between repetitions.

Self-Myofascial Release (SMR) – Following a 10 minute warm-up was on a stationary-rate independent cycle ergometer at a power output of 50 W, the SMR treatment consisted of a long duration of repetition of 2 minutes on the hamstrings and quadriceps. The subjects gradually externally and internally rotated their femur at a specific area over a foam roller (RumbleRoller®) while maintaining a relaxation of the muscle group. At 20 second intervals the treatment was moved superiorly and/or inferiorly to cover the entire muscle group.

Control (CON) – A 10 minute warm-up was on a stationary-rate independent cycle ergometer was performed at a power output of 50 W.

Thorstensson Test. The Thorstensson Test[6] for strength/fatigability uses a single-chair isokinetic dynamometer (Biodex) and consisted of 50 voluntary maximal isokinetic leg extensions on the subject's preferred leg where the rate of force production was controlled as $180°\cdot sec^{-1}$.

Measurements. During each experimental trial, the following measurements were made or derived:

Hip Range of Motion (°) – Goniometry was used to assess the range of motion of the preferred hip joint. Specifically, hip flexion and extension were measured.

Absolute/Relative Quadriceps Strength (Nm, $Nm\cdot kg^{-1}$) – Peak torque output was used to measure strength and taken as the mean of the first three maximal repetitions of the Torstensson Test. Relative strength was derived using absolute strength divided by the subject's body mass.

Quadriceps Fatigue Index (%) – The ratio of difference between the first three repetitions (peak torque) and the last three repetitions (least torque) to the peak torque during the Thorstensson test was calculated to reflect fatigue.

Perceived Local Leg Fatigue (0-10) – Subjects were asked to rate their perceived local fatigue of the tested quadriceps immediately following the isokinetic exercise bout using the numeric pain distress scale.

Statistical Analysis. One-way (treatment) ANOVA with repeated measures was used to analyze for differences between trials (STS, SMR, CON) in hip range of motion, absolute/relative peak torque development, and fatigue rate. Friedman ANOVA was used to analyze for differences between trials (STS, SMR, CON) in perceived fatigue. If needed, appropriate post-hoc tests were used to make all pairwise comparisons for specific differences across the three experimental trials or time points. The experimentwise error rate (α=0.05) was maintained throughout all post-hoc tests for specific differences.

RESULTS

Table 1: Subject Demographics

Variable	Mean	SD	Range
Age (yr)	24.3	4.7	20.0-35.0
Body Mass (kg)	96.6	20.4	64.9-138.0
Body Stature (cm)	176.9	8.9	165.1-203.2
BMI ($kg\cdot m^{-2}$)	30.9	6.1	21.1-45.2

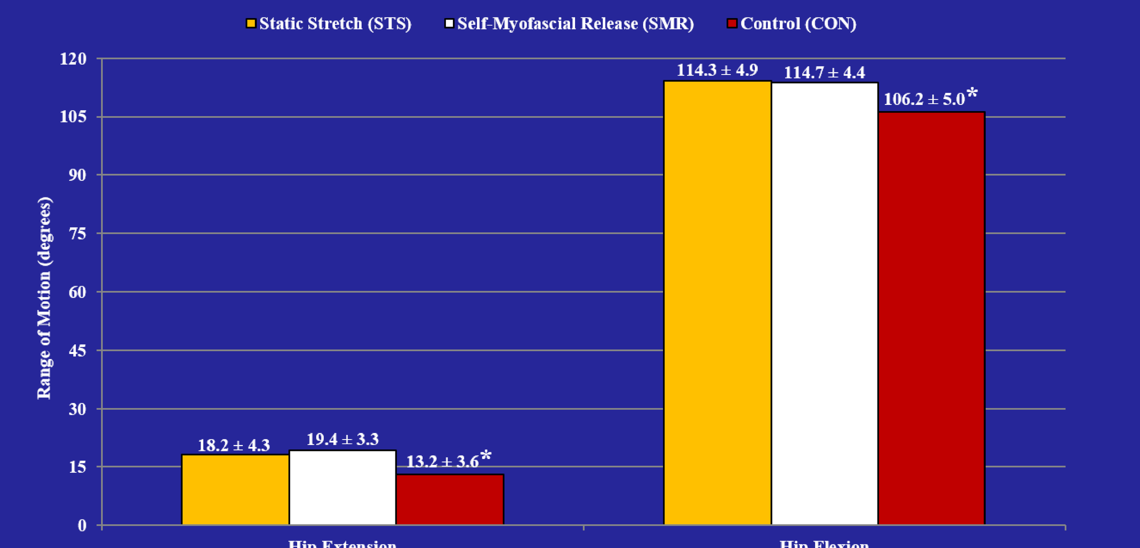

Figure 1: Treatment effect on hip range of motion. Hip extension (*p<0.0001) and hip flexion (*p<0.0001) differed significantly between treatments, specifically CON < STS and SMR.

RESULTS, cont.

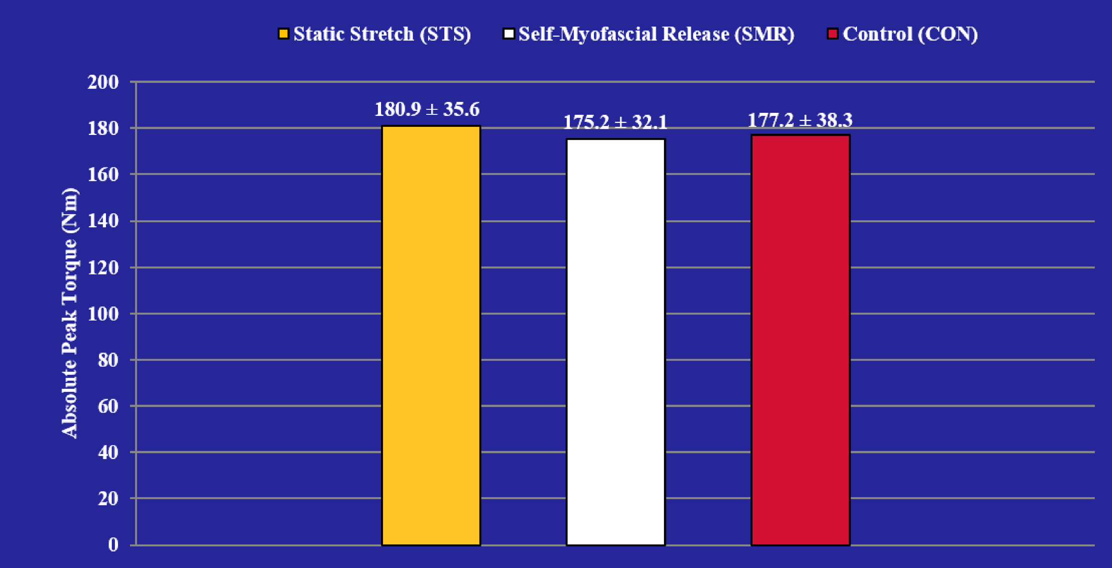

Figure 2: Treatment effect on absolute peak force development. Absolute isokinetic peak force did not differ significantly between the treatments (p=0.3850).

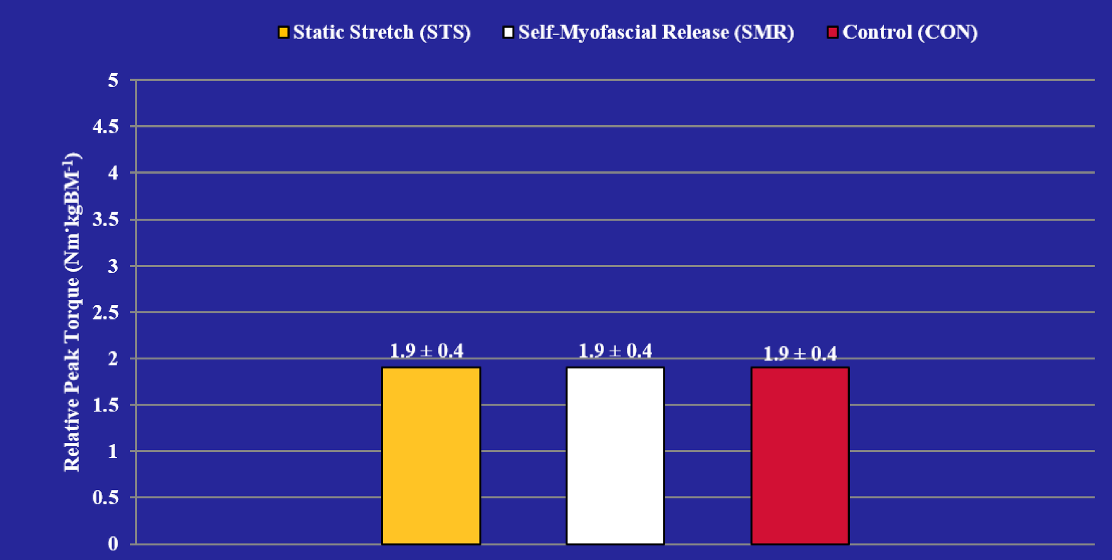

Figure 3: Treatment effect on relative peak force development. Relative isokinetic peak force did not differ significantly between the treatments (p=0.5340).

Table 2: Treatment Effect on Fatigue Rate and Perceived Fatigue

Variable	STS	SMR	CON
Fatigue Rate (%)	61.3 ± 11	59.7 ± 9.4	61.5 ± 8.8
Perceived Fatigue (0-10)	36.3 ± 0.5	36.1 ± 0.4	36.4 ± 0.3

Mean ± SD

There was no significant difference between the treatments on fatigue rate (p=0.5820) and perceived fatigue (p=0.6330).

CONCLUSIONS

Self-myofascial release is typically used as a recuperation modality for athletes to allow their body to endure vigorous training regimens. However, this technique is becoming more commonly used as a warm-up protocol prior to an exercise bout. While quadriceps strength, fatigue, and perceived fatigue did not differ between the treatments, the results of the study indicated that deep tissue SMR had a significant impact on hip flexion and extension over the control treatment (CON), but did not differentiate over the STS treatment. Additionally, with the results of this study and other studies, self-myofascial may be used as a form of pre-exercise warm-up without detrimental effect on athletic performance, and beneficial in activities that require optimal range of motion[2,7,8]. Further investigation is warranted to examine the long term effects of self-myofascial release on range of motion of a joint compared to the traditional static stretching.

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