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Original Research

An Acute Bout of Self-Myofascial Release in the Form of Foam Rolling Improves Performance Testing

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ABSTRACT

International Journal of Exercise Science 7(3) : 202-211, 2014. Recent developments in the strength and conditioning field have shown the incorporation of foam rolling self-myofascial release in adjunct with a dynamic warm-up. This is thought to improve overall training performance; however, minimal research exists supporting this theory. Therefore, determining if an acute bout of foam rolling self-myofascial release in addition to a dynamic warm-up could influence performance is of importance. In order to do so, eleven athletically trained male subjects participated in a two condition, counterbalanced, crossover within-subjects study comparing two particular warm-up routines. The two warm-up routines compared were a total-body dynamic warm-up (DYN) and a total-body dynamic warm-up in adjunct with a self-myofascial release, total-body foam rolling session (SMR). Following each warm-up condition, subjects performed tests of flexibility, power, agility, strength, and speed. Paired samples T-tests were utilized to determine if there were any significant differences in test results between conditions (DYN vs. SMR). The data indicated that SMR was effective at improving power, agility, strength, and speed when compared to DYN ($P \leq 0.024$). A warm-up routine consisting of both a dynamic warm-up and a self-myofascial release, total-body foam rolling session resulted in overall improvements in athletic performance testing.

KEY WORDS: Warm-up routines, strength, conditioning, athletics

INTRODUCTION

Myofascial release has been commonly regarded as a therapeutic, post-exercise technique aimed towards repair and recovery (1, 2, 18, 22). More recently, myofascial release has been regarded as a performance enhancing, pre-exercise technique within the athletic population (19, 24). This current pre-exercise myofascial release technique has been seen in the form of total-body foam rolling. This is a technique of self-myofascial release in which the targeted musculature is rolled and compressed utilizing a foam rolling device (6, 13, 24). The trend has emerged and is highly regarded within the strength and conditioning field.

Before the emergence of myofascial release as a pre-exercise technique, rehabilitation practitioners frequently explored the technique in alleviating pain and aiding in the recovery of physical activity. Pain and fatigue are often associated with particular trigger point tissue damage (18). One of the more commonly researched therapeutic approaches to pain and recovery has been trigger point soft tissue massage therapies (i.e., myofascial release techniques). Myofascial release research has shown to be effective in pain alleviation due to a series of physiological responses (1, 2). The most common of these responses is an increase in the dilation of the arterial system (22). The vasodilation response is responsible for increased blood flow to the myofascial release sites. Other common responses associated with myofascial release include restoration of soft-tissue, increased nitrogen dioxide (NO_2), and improved vascular plasticity (22). All of these responses have demonstrated a positive therapeutic effect on pain and recovery.

Osteopathic physicians have reported increases in prescribed myofascial release therapy for patient rehabilitation. This rehabilitation has been particular to somatic system dysfunction and somatic system disorders (9, 26). To improve these somatic deficits, physicians commonly prescribe the compressive form of self-myofascial release technique of foam rolling.

Compression has previously demonstrated recovery capabilities; therefore, the compressive nature of foam rolling has also been researched for its recovery capabilities (16). An acute bout of foam rolling self-myofascial release following physical activity has demonstrated improved recovery in multiple cardiovascular variables including heart rate variability and diastolic blood pressure (3). Until recently, foam rolling self-myofascial release has been used as a post-performance recovery and rehabilitation therapy. With the evolution of the strength and conditioning field, foam rolling self-myofascial release has emerged as an additional component to an athlete's warm-up.

In the strength and conditioning field, a diverse range of warm-up techniques have formerly been investigated. Recent strength and conditioning research has demonstrated that static stretching during the warm-up decreases force production and muscular performance (11, 28). Although foam rolling in adjunct with static stretching has demonstrated slight improvements in physical performance, it is not ideal for strength and conditioning coaches (24). It's not ideal because it has been demonstrated and well documented that an active dynamic warm-up improves many aspects of athletic performance such as speed, balance and power (5, 23, 28). Athletic gains in speed, balance, and power can directly translate to agility improvements as well (25). Therefore, strength and conditioning practitioners use a dynamic warm-up as a method to potentially improve an athlete's performance.

As recently discussed, self-myofascial release in the form of foam rolling has demonstrated multiple positive therapeutic effects (e.g., vascular plasticity and soft tissue restoration) on performance and recovery (1, 2, 3, 9, 16, 26). The existing research has suggested an increase of myogenic and endothelial dilation, as well as an increase in NO_2 as a response to foam rolling self-myofascial release (22). As a result, many strength and conditioning coaches now incorporate foam rolling self-myofascial release in adjunct with dynamic warm-ups to improve overall performance; however, there is little research to support beneficial effects. Therefore, the purpose of the current study was to determine if an acute bout of foam rolling self-myofascial release in addition to a dynamic warm-up will improve performance. Based on the current research, it was hypothesized that an acute bout of foam rolling in adjunct with a dynamic warm-up will improve performance testing when compared to an acute dynamic warm-up without foam rolling.

METHODS

The study was a counterbalanced, crossover within-subjects design in which subjects participated in a control condition that consisted of a standard 5-minute general warm-up followed by a 5-minute dynamic warm-up (DYN) and an experimental condition that consisted of the same standard 5-minute general warm-up followed by the same 5-minute dynamic warm-up with the addition of a bout of total body foam rolling (SMR). Measures of non-fatiguing exercise performance, agility, muscular strength, and speed were administered following each warm-up. The Nova Southeastern University Institutional Review Board approved the human subjects study.

Participants

Eleven physically active, athletic healthy males (Table 1) agreed to participate in the study. The population included subjects whom previously competed or currently compete in professional, collegiate division I, and collegiate division II athletics. The spectrum of sports includes football, baseball, soccer, and track-n-field. The population also included exercise and sports science majors and minors. Subjects were asked to maintain a normal diet throughout the duration of the study. Also, subjects were asked to refrain from physical activity, alcohol, and caffeine 24 hours prior to testing. Health history questionnaires were administered to detect medical contraindications for physical activity. Subjects read and signed an informed consent form prior to participation in the study.

Table 1. Subject characteristics.

Subjects	Age	Height (cm)	Weight (kg)	BMI	Body Fat %
N = 11	22.18 ± 2.18	176.76 ± 7.25	77.64 ± 9.70	24.76 ± 2.34	10.36 ± 2.30

Following consent, subjects reported to the Nova Southeastern Exercise and Sports Science Laboratory for all testing. Subjects were measured for physical characteristics including body weight, height, and body composition. Height and weight were assessed using a stadiometer and balance beam scale, respectively. Seven-site skin fold measurements were taken using Lange skin fold calipers (Beta Technology, Inc., Santa Cruz, California). The seven sites were marked and included the thigh, abdomen, suprailiac, midaxillary, chest, triceps, and subscapular skin fold (15). Two measurements were taken at each individual site to improve accuracy. If measurements varied by 2 mm, a third measurement was taken. Body density was calculated from the sum of the seven skin fold sites and then entered in to the Jackson and Pollock equation to extrapolate body fat percent (4). BMI was also calculated as weight (kg) divided by height squared (m^2).

Protocol

Subjects participated in two separate experimental trial conditions (DYN, SMR) separated by a 7-day recovery period. The order of experimental trial conditions was counterbalanced within-subjects. The experimental trial condition DYN began with a 5-minute general warm-up in which subjects jogged at a self-selected pace for 1000 meters. Following the general warm-up, subjects were instructed through a variety of mobility and full range of motion dynamic warm-up techniques that included arm circles, body weight squats, and body weight squat jumps. Flow maneuvers were followed with sprinting high knees, sprinting butt kickers, alternating lunge jumps, alternating log jumps, scapular push-ups, thoracic rotations, and clapping push-ups. Each technique followed a 2 x 10 scheme indicating each technique was performed for two sets of ten (repetitions or meters) in the same order by all subjects. Following DYN, the subjects were tested on a battery of performance tests that included a flexibility and power measures (sit-and-reach, vertical jump, and standing long jump), an agility measure (18.3 m pro-agility test), a maximum strength measure (indirect 1-RM bench press), and finally a sprint measure (37 m sprint) (4). 4 minute rest intervals were used between measures. The experimental trial condition SMR also began with the 5-minute general warm-up in which subjects jogged at the same self-selected pace for 1000 meters. Following the general warm-up, subjects were instructed through a variety of self-myofascial release techniques utilizing a conventional foam roller (Black Molded Foam Roller - 6" x 12" Round, Perform Better, Cranston, RI). The conventional foam roller has previously proved effective in its ability to cover the greatest amount of muscular surface area (6). The rolling progression (Figure 1) targeted the thoracic/lumbar regions (erector spinae, multifidis), the gluteal region (gluteus maximus, gluteus medius, gluteus minimus), the hamstring region (semitendinosus, semimembranosus, biceps femoris), the calf region (gastrocnemius, soleus) from the supine body position. The progression continued with the quadriceps/flexor region, (rectus femoris, sartorius, psoas major, iliacus) and finally the pectoral region (pectoralis major, pectoralis minor) from the prone body position. Each group of muscles was rolled over their entire surface area, and was applied at 5 strokes per 30 seconds. Each technique was performed bi-laterally.

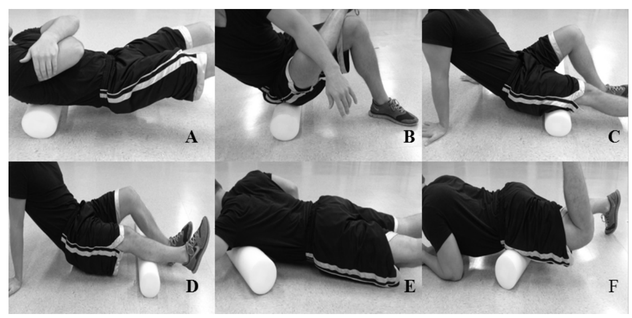

Figure 1. SMR full body foam rolling progression order includes (A) thoracic/lumbar, (B) gluteal, (C) hamstring, (D) calf, (E) pectoral, (F) quadriceps/flexor regions. *Figure 1 taken for rolling demonstration purposes only.

Following the self-myofascial release techniques, subjects were then instructed through the same variety of mobility and full range of motion dynamic warm-up techniques as DYN. These again included a 2 x 10 scheme of arm circles, body weight squats, and body weight squat jumps. Flow maneuvers were followed with sprinting high knees, sprinting butt kickers, alternating lunge jumps, alternating log jumps, scapular push-ups, thoracic rotations, and clapping push-ups. Following the warm-up, the same battery of performance tests including flexibility and power measures, an agility measure, a maximum strength measure, and a sprint measure were tested utilizing the same rest intervals.

All sit-and-reach measures were recorded using a standard sit-and-reach box (Baseline Evaluation Instruments, White Plains, NY). Each measure was recorded to the nearest cm. The subjects sat shoeless with their feet placed 30 cm apart, and touching the standard box. The subjects leaned forward slowly reaching as far as possible while keeping their hands adjacent with one another. The best of three trials following an initial guided trial was recorded to indicate hamstring and lower back flexibility.

As a measure of maximum muscular power (high-speed strength), the subjects performed the vertical jump using a commercial vertec device (Sports Imports, Columbus, OH). After using the stack of adjustable horizontal vanes to determine the subjects' flat-footed standing touch height, the stack of vanes was raised to an estimated height so that the athlete was capable of reaching the lowest set of vanes, but incapable of reaching the highest vane. The subject was then informed that the best of three trials would be recorded as highest point in jump (The difference in flat-footed standing touch height and highest point in jump was used as the vertical jump measure). The subject began each trial with a countermovement in which both flexion of the hips and knees occurred. Following the countermovement, the athlete then generated muscular power while extending at both the knees and hips reaching as high as they could while in air with their dominant hand. The subject tapped the set of vanes; the highest vane tapped indicated the highest point in the jump

As another measure of maximum muscular power (high-speed strength), the subjects performed the standing long jump. The subjects began each trial with both feet behind a designated starting line. Once in place, the subjects performed a countermovement and jumped horizontally as far as possible. A mark was placed at the subject's heel, and a measurement was made with a tape measure. It is important to note that if the subject did not stick their landing, the trial was repeated. The best of three trials was recorded as longest jump.

As a measure of agility, the subjects performed the 18.3 m pro-agility test. A subject began the test in a three-point stance, while straddling a center line. The subject then sprinted 4.6 m to a line left of the center line. The foot of the subject must come in contact with the line (monitored by a line judge). Once contact was made, the subject then turned and sprinted to a line 9.1 m to the right (4.6 m to the right of the center line) and again makes contact with the foot. Once contact is made with the right line, the subject then turned and sprinted to the left another 4.6 m through the center line. The best time of two trials was recorded as agility speed.

As a measure of muscular strength (low-speed strength), the subjects performed an Indirect 1-RM bench press. The procedure started with a subject completing a warm-up set at 60% of estimated 1-RM for 10 repetitions followed by an additional warm-up set at 80% of estimated 1-RM for 3 repetitions. After a three minute rest, the subjects performed a rep out max at 90% of estimated 1-RM. Utilizing the Adam's equation [kg / (1-(0.02 x number of repetitions))], an indirect 1-RM bench press value was determined (12).

As a measure of speed, the subjects performed the 37 m sprint. Following two build-up practice runs at submaximal speeds, the subjects were measured for speed twice. The faster of the two trials indicated speed to the nearest .1 second. The test started with the subject in a three-point stance with the entire body positioned behind the starting line. The subject then sprinted the entire distance at maximum speed. An 18 m area following the finish line was available for proper deceleration.

Statistical Analysis

Means and measures of variability were calculated for all subject and performance data. Following Shapiro-Wilk normality testing, Paired samples T-tests were utilized to determine if there were any significant differences on performance variables (sit-and-reach [cm], vertical jump [cm], standing long jump [cm],18.3 m pro-agility [sec], indirect 1-RM bench press [kg], and 37 m sprint [sec]) between conditions (DYN vs. SMR). All statistical analyses were performed using SPSS for Windows (version 17.0, SPSS Inc., Evanston, IL).

RESULTS

The performance testing measures are listed in Table 2. The data indicated differences in maximum muscular power and revealed that there were significantly greater performance scores for both the vertical jump (P = 0.012) and the standing long jump (P = 0.007) after the SMR warm-up, relative to the DYN warm-up protocol. The analysis also revealed significantly greater performance scores for the 18.3 m pro-agility test (P = 0.001) and the 37 m sprint (P = 0.002) following SMR. Finally, the data demonstrated a significantly greater indirect 1-RM bench press (P = 0.024) following SMR. There was no difference in sit and reach performance scores between DYN and SMR conditions (P = 0.833)

Table 2. Performance test battery results.

Performance Variable	DYN	SMR
Sit-And-Reach (cm)	34.18 ± 5.21	34.32 ± 5.70
Vertical Jump (cm)	67.66 ± 9.79	72.97 ± 10.60 *
Standing Long Jump (cm)	228.60 ± 25.25	237.84 ± 25.45 *
18.3 M Pro-Agility (sec)	4.97 ± 0.24	4.80 ± 0.16 *
Indirect 1-RM Bench Press (kg)	99.92 ± 19.56	103.68 ± 20.47 *
37 M Sprint (sec)	5.11 ± 0.29	4.95 ± 0.21 *

DISCUSSION

It was hypothesized that an acute bout of foam rolling in adjunct with a dynamic warm-up will improve performance when compared to an acute dynamic warm-up without foam rolling. Recent trends in strength and conditioning have incorporated the use of foam rolling in addition to a traditional dynamic warm-up; however, there has been a lack of evidence supporting this trend. Consequently, the purpose was to investigate this topic by comparing SMR to DYN in regards to acute performance. This study is the first to compare SMR to DYN; however, it is not the first to investigate foam rolling. The current results suggest that a warm-up combined with a series of foam rolling techniques has the potential to improve power, speed and agility performance test results.

Recently, it was determined that an acute bout of foam rolling is an effective method of increasing range of motion, particularly to the knee joint (19). It was also recently studied that direct application of rolling techniques on the hamstrings promoted improved sit-and-reach results without impairing performance (27). Contrary to previous findings (27), the results suggest that a warm-up with the addition of certain foam rolling exercises was unsuccessful at improving flexibility as measured via the standard sit-and-reach. The physiological effects of arterial dilation (22) may explain these differences, as the other studies only applied direct tissue rolling prior to testing. Therefore, an increase of blood flow to the targeted muscle group would be even more advantageous when compared to the full body rolling application in the current study. SMR is a full body warm-up technique, and blood flow may be circulated and distributed differently to other targeted regions.

It is the strength and conditioning professional's role to improve performance. This can be achieved by improving many aspects of power production including force and velocity. Improving the ability to generate force at a rapid pace has been established as a requisite ability for all athletic performance and ability (8). Techniques of power production have been measured through a series of performance tests including the vertical jump or the standing long jump. The most common of these to be tested in performance research is the vertical jump (7, 10, 16, 17, 20, 23, 28). Because of the nonfatiguing manner of the tests, both were tested as indicators of horizontal and vertical power performance. Recently, it was determined that SMR was not responsible for improvements in vertical lower body power and agility when compared to planking (13). Contrary to these previous findings, the results revealed that SMR did improve lower body power performance in the vertical jump, broad jump, and pro-agility when compared to DYN. This can be explained in part to the physiological improvements of movement and fiber pattern recruitment associated with myofascial release. This was previously explored in movement disorder research (26). Therefore, in the case of improving power production, SMR may have increased recruitment patterning or firing rate associated with the neural stimulation associated with foam rolling.

The ability of increasing strength, especially when compared to body mass, has been established as a major component to performance. (21). Therefore, examining acute strength effects as another marker of performance is relevant. Previous literature has suggested that SMR warm-up can maintain muscle performance (19). The data differs in it suggests SMR is successful warm-up for improving muscle performance when compared the DYN. This may be in part to the sample population, as the sample population used in the particular study was highly trained and familiar with all testing procedures. The data demonstrated increases in acute measures of the indirect 1-RM bench press values and the 37-m sprint times as a result of SMR compared to DYN.

While this was the first study to assess the effect of foam rolling and non-foam rolling warm-up, it is not without limitations. To avoid injury, a warm-up for each condition was utilized. Therefore, the present study lacks a true control condition, that is, a condition that is completed with no warm-up. It is important to note that no injuries were recorded during either condition. Also, sample size was believed as a minor limitation. It may be beneficial in the future to include a greater sample size; however, significance was still meant utilizing within-subjects analysis.

In conclusion, an acute warm-up bout of foam rolling in addition to a dynamic warm-up improved performance testing results when compared to an acute dynamic warm-up without foam rolling. In terms of the testing battery, the inclusion of foam rolling improved power, agility, strength, and speed when compared to the absence of foam rolling. SMR in combination with DYN demonstrated acute improvements of performance between 4-7%. Therefore, the inclusion of foam rolling with a dynamic warm-up may be a beneficial method to improve physical performance. Foam rolling could be considered when implementing the most efficient training routines. Future studies are currently underway monitoring weight, rolling techniques and performance. Often times, increasing body mass is associated with a decrease in athletic performance (14). Although, it is unknown, the data suggests that implementing SMR prior to training could contest this performance deficit. In fact, the combination of weight gain with SMR could result in overall increased athletic performance.

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