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# AN ACUTE BOUT OF SELF-MYOFASCIAL RELEASE INCREASES FLEXIBILITY WITHOUT A CONCOMITANT DEFICIT IN MUSCLE PERFORMANCE IN FOOTBALL PLAYERS

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## ABSTRACT

***Background:*** Football training reduces the flexibility of players. Lower flexibility in the knee and hip flexors may increase the risk of muscle strain injury. A method which increases the flexibility without a concomitant deficit in muscle performance will be meaningful for athletic performance and injury prevention for football players. The purpose of the current study was to investigate the acute effects of self-myofascial release via a foam roller on vertical jumps, speed, agility and flexibility of football players.

***Methods:*** It was a randomized, nonexperimental and comparative design. Participants were forty-two amateur football players (age: 24.3 ± 5.5 yr., height: 175.24± 4.3 cm, weight 69.03± 5.56 kg). They were divided randomly into four groups as control (CON), static stretching (SS), dynamic stretching (DS) and foam roller (FR). The CON performed five minutes jogging and seven and a half minute rest, the SS performed five minutes jogging and seven and a half minutes of static stretching, the DS performed five minutes jogging, and seven and a half minutes dynamic stretching, and the FRG performed five minutes jogging and seven and a half minutes foam roller intervention. Outcome measurements: After the stretching protocols, all groups performed vertical jumps (countermovement jump, squat jump, and horizontal jump), speed (10 and 30 m.), and agility (t-test) tests. One way ANOVA test was used for comparing results of the groups.

***Results:*** The FR and DS protocols were significantly better in speed, agility, and vertical jumps test when compared with the SS (P<0.01). Moreover, the FR and SS had significantly better flexibility than the DS and CON (P<0.01).

***Conclusion:*** According to the results of the present study, the acute effect of foam roller intervention is more appropriate for improving flexibility without a concomitant deficit in muscle performance than static and dynamic stretching protocols.

***Keyword:*** self-myofascial release, foam roller, flexibility, anaerobic performance.

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## INTRODUCTION

Football is often defined as a non-interrupted, interval and a high-intensity exercise [1]. Most part of football is played at maximum speed. Acceleration, deceleration, cutting, jumping, spinning, kicking the ball and pivoting are various explosive ballistic motions [2]. Beside of football popularity and benefits, a huge number of injuries occur during football activities. It has been reported that football injuries are mainly located in the lower extremities [3,4]. Majority of the injuries mainly occur in the hip adductor and flexor and extensor of the knee [5,6]. In football players, especially hamstring injuries are common [7,8] and characterized by a high re-injury rate. Moreover, a football player cannot participate in the match for up to 90 days due to hamstring injuries [8,9].

The risk factors in football injuries are divided as intrinsic and extrinsic ones [10], and the lack of muscle flexibility is generally accepted as an intrinsic risk factor due to leading to the development of muscle strains [6,8]. It has been determined that football training reduces the flexibility of players [11], and non-players have a higher range of motion (ROM) than the football players [12,13]. Moreover, it has been found that a lower ROM in the knee and hip flexors may increase the risk of muscle strain injury [14,15]. Dadebo et al., (2004) have determined that hamstring stretching protocols were the most significant training factors related to hamstring strain rates [16].

Generally, static stretching has been suggested as an efficient method for increasing ROM [17]. However, some authors have demonstrated the negative effect of static stretching on muscular performance [18,19]. Therefore, dynamic stretching has been advised to enhance athletic performance [20]. As a result, a method which increases flexibility without a concomitant deficit in muscle performance will be meaningful for athletic performance and hamstring injuries prevention.

In the recent years, self-myofascial release (SMR) has become a much more popular technique in strength and conditioning fields and commercial gyms [21]. This new technique is applied by using a foam rolling (FR) device. The targeted musculature is compressed and rolled with the FR device. Individuals place their own body on the device to exert pressure on the affected soft tissues known as fascia by varying body position [22,23]. These muscle groups mostly include the knee extensors and flexors, hip adductors, gluteal muscles, calf muscles and trapezius [20], and they are surrounded by the fascia which influences flexibility and ROM. It is has been reported that using a foam roller makes the fascia more flexible and breaks down scar tissue and adhesions [24]. Moreover, the FR leads to a rise of endothelial and myogenic dilation [25].

Consequently, we hypothesized that the FR intervention might increase flexibility without a concomitant deficit in muscle performance. The aim of the current study was to determine the effects of the pre-exercise FR intervention on anaerobic performance and flexibility.

## METHODOLOGY

### Study design

It was a randomized, nonexperimental and comparative design to investigate the acute effects of self-myofascial release via a foam roller on vertical jumps, speed, agility and flexibility of football players. Participants were divided randomly into four groups as control (CON), static stretching (SS), dynamic stretching (DS) and foam roller (FR). The SS performed static stretching, the DS performed dynamic stretching, and the FR performed foam roller intervention to warm-up. The CON did not have any intervention for stretching and rest during seven min and a half. After 1-min from stretching protocol, the participants performed jump tests [counter movement jump (CMJ), squat jump (SJ), and standing long jump (SLJ)], agility test (t-test), and speed test (10 and 30 m) to determine anaerobic performance at 5-min intervals. After the anaerobic performance tests, they were asked to perform the sit and reach test to determine flexibility. One way ANOVA test was used for comparing results of the groups.

### Participants

Forty-two amateur football players (Age: 24.3 ± 5.5 yr., Height: 175.24± 4.3 cm, Weight 69.03± 5.56 kg) participated in this study. All the players had no sports injuries for at least one month, and they had similar training regime volume (3-4 day in a week/1-2 hour in duration). The study was conducted in a competition season. The descriptive statistics of participants are presented in Table 1. The study was approved by the Clinical Research Ethics Committee of Afyon Kocatepe University according to the Declaration of Helsinki

### Procedure

The study was conducted in competition season. The procedures took place in the same indoor gym between 10:30-12:30 am. First, descriptive statistics of participants were taken. Then they were familiarized with test measurements. The FR group also familiarized with foam rolling intervention. After the familiarization applications, each group performed 5-min jogging and the stretching protocol. After the stretching protocol, the participants performed jumps, speed, and agility tests. Four protocols were administered with two days interval. A similar method was used by Chatzopoulos et al. (2014) [26]. We used the most common test items with high discriminating power ability capacity that related to football performance [27] and related to hip and hamstring flexibility. Details of the stretching protocols and tests were described below. The same tester administered the stretching protocols and tests for all participants. All participants were asked to avoid alcohol, physical activity, and caffeine intake and to follow a similar diet program during one day before the study.

### Interventions

After 5-min jogging, three stretching protocols were performed: SS, DS, and FR. CON group did not carry out any stretching protocol. The SS, DS, and FR consisted of 7-min 30 sec.

The control group rested for 7-min and 30 sec. The protocols were performed for 30 sec with a 15-sec recovery period between each muscle group, and each technique was performed bi-laterally with 30-sec rest period when changing the limb. The protocols consisted of lower-extremity muscle groups (gluteals, hip flexors, adductors, quadriceps, hamstrings, and gastrocnemius). The dynamic stretching exercises used were described by Chaouach et al., (2010) [28]. The FR protocol also consisted of a variety of 7-min 30 sec a deep tissue foam roller techniques (Trigger point, USA). Similar to the static and dynamic stretching protocols, the rolling process targeted the lower-extremity muscle groups which included gluteal region, the hamstring region, and finally, the calf region in the supine body position. The protocol followed with the quadriceps/flexor region from the prone body position.

**Outcome measurements:**

Speed (10 and 30 m sprint), jump ( CMJ, squat and horizontal) and agility (t-test) tests were used to determine functional anaerobic performance. Sit and reach test was used to determine the flexibility of gluteal and hamstring muscle groups.

***10 and 30m speed:*** The speed time was measured with a photocell system (Fit speed, Turkey). The participants started from a standing position. Their forward foot was behind the starting line. They completed a 30-m sprint. The timer triggered when the participant passed the eye of the start photocell. The photocell gates placed at 10 and 30-m from the starting line. The height of the photocells was 100 cm. The participants performed three trials with a 3-min active recovery interval. Their best result of 30-m and the associated 10-m sprint time were determined.

***Jump tests:*** Vertical jumps (SJ, CMJ) were measured using an electronic jump mat (Newtest Power- 83 Timer Testing System, Ele-Products Oy, Finland). This system measures vertical jump height by calculating flight time (Bosco protocol). All participants positioned on the mat. They kept their hands on their hips. They jumped as high as possible whenever they would be ready. For the SJ, the participants were instructed to flex their knee like jumping position, hold for 4 sec, and jump as high as possible. After the CMJ and SJ, the participants performed the SLJ. Their feet were behind the starting line. They kept their hands on their hips and jumped as far as possible whenever ready. The distance between the first contact of the back side of the toes and the starting line was measured with a meter (Stabile, Germany). The participants performed three trials for SJ, CMJ, and SLJ with 30–45-s recovery within each jump and 3-min recovery between jump tests. The best results in each type of jumps were recorded for statistical analysis.

***Agility (t-test):*** The t-test protocol was carried out to determine agility of the participants. Test completion time was measured with Newtest power timer Photocell system (Newtest Power- 83 Timer Testing System, Ele-Products Oy, Finland). The photocell system was set up on the starting line. The participants were positioned just behind the starting line to perform the test. They started the test when they felt ready. The timer was triggered when they crossed in front of the photocell. And the timer was stopped when they crossed in front of the photocell for the second time upon turning back to the start line. The participants performed three trials with 3-min recovery interval. The best of three measurements was recorded.

***Flexibility:*** Sit and reach test was used to determine the flexibility of gluteal and hamstring muscle groups. The participants sat with their feet against the testing box. They extended their knees fully. To ensure the full extension of the knees during the test, the examiner pushed down with his both hand. They were instructed to reach and push the sliding apparatus as far as possible. The best of three measurements were recorded for statistical analysis.

**Statistical Analyses**

Mean, and standard deviation (SD) were used to describe variables. Kolmogorov-Smirnov test was used before using parametric tests to examine the assumption of normality. After the determination of data was normally distributed, One-way ANOVA test was carried out to compare differences among four groups. The alpha level was 0.05 for statistically significant.

## RESULTS

Table 1 presents descriptive statistics of four groups. There are no statistical differences between the groups for age, height, weight, and BFP.

Table 2 outlines that the FR and DS protocols are significantly better in speed, agility, and vertical jumps tests when compared with SS and CON. Moreover, the FR and SS perform significantly better flexibility than the DS and CON according to this table.

**Table 1:** Descriptive statistics of the participants

| | SS | DS | FR | CON |
|---|---|---|---|---|
| Age (year) | 23.60±3.13 | 23.43±3.24 | 22.64±2.06 | 23.10±3.54 |
| Height (cm) | 175.20±5.51 | 175.90±6.24 | 176.36±7.85 | 176.10±4.91 |
| Weight (kg) | 68.24±5.58 | 68.82±6.55 | 67.91±7.51 | 69.74±6.20 |
| BFP (%) | 9.09±2.55 | 10.68±4.22 | 11.82±3.16 | 11.40±3.91 |

SS: Static Stretching, DS: Dynamic Stretching, FR: Foam Roller, CON: Control, BFP: Body Fat Percentage

**Table 2:** Comparison of SS, DS, FR, and CON groups' vertical jumps, speed, agility, and flexibility results

| | SS | DS | FR | CON | Statistical difference | Post hoc (boferroni) |
|---|---|---|---|---|---|---|
| 10 m (sec) | 1.86±0.08 | 1.70±0.06 | 1.71±0.10 | 1.83±0.08 | P<0.001 | DS<SS,DS<CON FR<SS,FR<CON |
| 30 m (sec) | 4.52±0.13 | 4.32±0.06 | 4.34±0.08 | 4.62±0.21 | P<0.002 | DS<SS,DS<CON FR<SS,FR<CON |
| CMJ (cm) | 34.55±2.06 | 38.40±2.88 | 38.46±3.58 | 35.10±2.18 | P<0.003 | DS>SS,DS>CON FR>SS,FR>CON |
| SJ (cm) | 33.26±1.92 | 37.30±2.36 | 36.77±3.53 | 35.05±1.79 | P<0.001 | DS>SS,DS>CON FR>SS,FR>CON |
| SLJ (cm) | 174.80±10.24 | 189.09±8.42 | 198..00±12.58 | 183.20±6.56 | P<0.001 | DS>SS,DS>CON FR>SS,FR>CON |
| T test (sec) | 10.20±0.29 | 9.84±0.30 | 9.73±0.34 | 10.23±0.33 | P<0.001 | DS<SS,DS<CON FR<SS,FR<CON |
| Flexibility (cm) | 34.80±3.22 | 29.18±3.60 | 35.90±2.63 | 24.30±5.17 | P<0.001 | SS>DS, SS>CON FR>DS, FR>CON |

SS: Static Stretching, DS: Dynamic Stretching, FR: Foam Roller, CON: Control, CMJ: Counter Movement Jump, SJ: Squat Jump, SLJ: Standing Long Jump

## DISCUSSION

The purpose of the current study was to investigate the acute effects of self-myofascial release via a foam roller on vertical jumps, speed, agility and flexibility of football players. To the best of our knowledge, the present investigation has been the first study to examine the effects of the acute foam roller intervention on anaerobic performance and flexibility in football players in the related literature.

In the current study, we found that the FR and DS protocols were significantly better in speed, agility and vertical jump tests when compared with SS and CON. Moreover, the FR and SS performed significantly better flexibility than the DS and CON. According to the results of the study, the acute effect of foam roller intervention was more appropriate for improving the flexibility without a concomitant deficit in muscle performance than static and dynamic stretching protocols.

Many researchers have examined the effects of pre-exercise FR intervention on anaerobic performance and flexibility. Similar to the current study, a lot of studies found an increase in flexibility without a concomitant deficit in various types of muscle performance [22,29,30,31]. Mac Donald et al (2013) investigated the use of a foam roller before knee ROM and extensor force on eleven individuals. They did not find any significant differences between the control and foam roller measurements. However, knee ROM increased after the foam roller intervention [29]. Sullivan et al. (2013) determined no significant differences in maximal voluntary contraction (MVC), while an increase was detected in hamstring ROM after the foam rolling intervention [30]. In another study, Halperin et al. (2014) determined that foam rolling intervention increased and static stretching decreased maximal force output in the post-tests. However, both the static stretching and roller massage increased the flexibility of plantar flexor muscles immediately and 10-min after the interventions [31]. Mohr et al. (2014) investigated the combination of static stretching and foam roller influence on flexibility of hip flexion. They found that the combination of the foam roll and static stretch more effective than using foam-rolling alone [32]. Sherer et al. (2013) investigated the effects of the foam rolling on hamstring flexibility in a weight training athletes for a long term. They determined that hamstring flexibility significantly increased in the foam rolling while there was no change detected in the control group [33]. In contrast to the current investigation, only Jay et al. (2014) determined no change in ROM of hamstring in healthy untrained individuals. They used 10-min of foam roller protocol on the hamstrings [34]. However, all other studies employed foam roller intervention with a maximum of 1-min for per muscle group [22,29,30,31]. Similarly, we used the foam roller on a muscle group for 30 sec. Therefore, there may be an effective duration for foam roller intervention to improve flexibility. The results of the studies in the literature have suggested that the acute effect of foam roller intervention is more appropriate for improving of flexibility without concomitant deficit in muscle performance.

An explanation of the hamstring flexibility increment after foam roller intervention may be attributed to a change in the thixotropic property of the myofascial [35]. Fascia softens and becomes a more gel-like when exposed to heat and mechanical stress. However, when it is not disturbed, it becomes thicker and more viscous, and it gets a more solid form [36]. Overuse or inactivity of muscles can cause the formation of scar tissue in the fascia because of repeated stress occurred on the soft-tissue of the body. These scar tissues may reduce ROM of a joint. It is well known that using the SMR via a foam roller makes the fascia more flexible and breaks down scar tissue and adhesions [24] by increasing body temperature [37]. This situation may remobilize the fascia back to the gel-like situation [38]. Therefore, larger ROM may be obtained when the fascia becomes more gel-like state due to increased soft-tissue compliance [39]. The increase of soft-tissue compliance depends on the mechanical stress duration and force. In the current study, the participants used their body mass (67.91±7.51kg) on the device to exert pressure on their targeted muscle soft tissues. Threlkeld (1992) determined that 24–115 kg mechanical stress application forces were enough to induce gel-like state. Therefore, we thought that SMR via foam roller might increase soft-tissue compliance and this situation leads higher hamstring ROM [40].

In the current study, we found that flexibility of the hamstring was similar in a foam roller and static stretching groups. However anaerobic muscle performance was better in the foam roller group. A huge number of studies demonstrated that static stretching had negative effects on muscular performance [18,19]. Reduced muscular performance after static stretching may be associated with sarcomere damage because of the potential static stretching effect and this subsequently reduces muscle force. Enhanced ROM after SMR and static stretching is very different from each other. During the static stretching, the pressure is placed on the insertion and origin points of the muscle. However, larger ROM may be obtained when the fascia becomes more gel-like state due to increased soft-tissue compliance during the foam roller application [29]. Therefore, it is thought that foam roller application increases ROM without inducing any detriment to the cross-bridges and sarcomeres of the muscles.

## CONCLUSION

The lack of muscle flexibility is generally accepted as an intrinsic risk factor because of leading the development of muscle strains. It has been determined that football training reduces the flexibility of players. The non-players have a higher ROM than the football players. Moreover, it has been found that a lower ROM in the knee and hip flexors may increase the risk of muscle strain injury. A method which increases the flexibility without a concomitant deficit in muscle performance will be meaningful for athletic performance and injury prevention for football players. The acute effect of foam roller intervention is more appropriate for improving the flexibility without a concomitant deficit in muscle performance than static and dynamic stretching protocols. The foam roller should be used to support the traditional stretching exercises to increase ROM in football players. Despite of no concomitant deficit in muscle performance, the increment in ROM may be clinically valuable for injury prevention in football players.

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