http://doi.org/10.22282/ojrs.2018.30

RESIDUAL EFFECT OF WARM-UPS INVOLVING STATIC OR SELF-MYOFASCIAL-RELEASE EXERCISES ON DYNAMIC POSTURAL CONTROL, FLEXIBILITY AND SPRINT PERFORMANCE IN ELITE MALE COMBAT ATHLETES

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Background: Self-myofascial releasing (SMR) exercises using foam roller equipment are thought to improve muscle performance. SMR exercises using Foam roller equipment are a technique that can be easily applied to reduce the tension on the soft tissue, fascia, tendons and muscles without decreasing the muscle performance, and to increase the range of motion of the joint.

Objective: The purpose of this study was to investigate the residual effects of lower body self-myofascial release on flexibility, balance and sprint performance in elite combat athletes.

Method: Thirteen elite male combat athletes (mean age: 20.2 ± 1.82 years, mean body mass: 69.1 ± 7.54 kg, mean body height: 176.2 ± 5.26 cm, BMI: 22.2 ± 1.93 kg/m2), who were medalists at national and/or international competitions, voluntarily participated in the study. The experimental design of this study was a Crossover Randomized Study. Each athlete participated in three different experimental conditions on separate visits to the sports hall with a 5 days' interval and each took place at the same time of day. During the familiarization session, anthropometric measurements were taken. One experimental day, athletes performed aerobic running and static stretching (AR+SS) followed by a series of athletic performance tests (flexibility, sprint, and dynamic postural control), and the other experimental day, participants performed aerobic running and self-myofascial-release (AR+SMR) followed by the same series of athletic performance tests. The speed (30 meter) was measured with a Newtest, Finland photocell stopwatch system. The sit-and-reach test (S&R) was applied to determine hip, back and posterior flexibility of the muscles of the lower limbs. Star Excursion Balance Test (SEBT) was used to determine dynamic postural control that is carried out on a grid of the 3 direction as anterior (ANT), posteromedial (PM), and posterolateral (PL) of athletes. The scores were then averaged together to find a composite (COMP) score. After each experimental season, the athletes performed the S&R, 30-m sprint and SEBT tests with 30-s of rest between the test after the warm-up period (pre-test) and at the 15th minute (post-test) during recovery period. The data were analysed with IBM SPSS (Version 23) analysis program. Wilcoxon Signed-Rank Test was used to determine the performance change.

Results: In the sprint test, no statically significant differences was found in the recovery time in the 15th minute for the both seasons (p> 0.05). Flexibility after AR+SMR season was significantly increase than after the athletes performed static stretching at the recovery time in the 15th minute (p= 0.00). There were significant increases from pre to recovery time in the 15th minute during AR+SS and AR+SMR for COMP scores, (p=0.03) and (p=0.01), respectively. The COMP score increase was found higher in the AR+SMR season than AR+SS season.

Conclusion: The results show that the 30-second AR+SS and AR+SMR exercises applied to each lower extremity had no effect on sprint performance, had the same effect on dynamic postural control, and that self-myofascial release exercises provided a significant increase in flexibility performance over static stretching.

Key Words: Self-Myofascial-Release, static stretching, flexibility, Star Excursion Balance Test, speed, combat athletes.

INTRODUCTION

The correct warm-up strategy is essential to optimise athletic performance (Cunniffe, Brian, et al, 2017). With an effective warm-up routine, an athlete can improve athletic performance, activate the body, reduce muscle soreness, and aid in the prevention of injuries (Galazoulas et al. 2012). Though previous researches have suggested that an active warm-up appears to be more beneficial than a passive warm-up for athletic performance (Woods et al. 2007; Behm and Chaouachi, 2011), static stretching was considered an essential component of a warm-up for decades. Static stretching involves moving a limb to its end range of motion (ROM) sustaining this stretch position for a period of time (Young and Behm, 2002). Effectiveness of static stretching on ROM have been well established in previous studies (Marek et al., 2005). However, the recent researches has shown that static stretching during warm-up have found detrimental impact on performance (Gelen 2010; Little and Williams 2006).

Pre-activity static stretching can impair strength, power, speed, balance, and vertical jump performance (Behm and Chaouachi, 2011; Galazoulas, 2017). Alizadeh Ebadi and Çetin 82017) reported that according to the analyzes, it was observed that 5 min jogging and 15 s stretching exercises increased the isokinetic strength, whereas 30 and 45 s stretching exercises caused a decrease. Behm et al. (2004) reported that it appears that an acute bout of stretching impaired the warm-up effect achieved under control conditions with balance and reaction/movement time. Costa et al. (2009) indicated that the 45-second stretching protocol did not significantly alter balance scores. Conversely, the 15-second stretching protocol significantly improved balance scores by 18.0%.

Combat sport is a competitive contact sport with one-on-one combat (Morel et al. 2017) and frequently involve striking, throwing, or immobilizing the opponent. Due to all these there is a high risk of injury and individuals with decreased strength, balance, proprioception, and neuromuscular control are also increase risk for injury (Leetun et al. 2004; Willems et al. 2005). In an effort to decrease the number of serious injuries, many measures have been taken in these branches (Pappas, 2007). Therefore, optimization of warm-up strategies seems pertinent for these sport.

More recently, in the athletic population, self-myofascial release (SMR) has been regarded as a performance enhancing, pre-exercise technique (MacDonald et al. 2013; Okamoto et al. 2013; Renan-Ordine et al. 2011).

It is known that myofascial release has effects such as regulating imbalance in the muscles, increasing ROM, decreasing muscular aches and joint stiffness, decreasing neuromuscularly increased tone, increasing flexibility in musculotendinous compound, increasing neuromuscular activity and providing normal functional muscle length. However, this technique is costly, time consuming and require a skilled clinician (Robertson, 2008). Therefore, a SMR is a beneficial alternative for athletes. Researches claim that the SMR application before a workout can enhance athletic performance by the way of myofascial release, leading to increased mobility and neuromuscular efficiency (Castiglione, 2010). Similar to massage, foam rolling before a workout has been said to help restore muscle length–tension relationships and allow for better warm-up (Depino et al. 2000.). Some of these effects have been proven, but the relevant literature is not comprehensive enough.

With respect to the lack of scientific evidence existing in sport and therapy, Schroeder and Best (2015) showed that the effects of Foamrolling exercises as a pre-exercise or recovery strategy are neither homogeneous nor evident. Beardsley and Skarabot (2015) showed contradictory results of foam-rolling exercises on flexibility, force-production, athletic performance, and delayed onset of muscle soreness. Further studies are needed to determine optimal foam roller protocols and variable combinations for elite/well trained athletes to enhance performance. However, there is limited evidence related to foam rolling. Therefore, the purpose of this study was to investigate the effects of self-myofascial-releasing exercises on the sit and reach (S&R), sprint performance, and dynamic postural control in elite male combat athletes.

MATERIALS AND METHODS

Participants

Thirteen international level male combat athletes (mean age: 20.2 ± 1.82 years, mean body mass: 69.1 ± 7.54 kg, mean body height: 176.2 ± 5.26 cm, BMI: 22.2 ± 1.93 kg/m^2), who were competing in taekwondo, kickboxing, and wushu, voluntarily participated in this study. Inclusion criteria required physically active athletes with no history of musculoskeletal injury at the lower extremities for at least six months and no health problems before the trial. At the beginning of the study, participant athletes were informed about research protocols and signed a consent form of voluntary participation. All atheletes were banned from eating and drinking alcoholic beverages and strenuous physical activities at least 24 hours before the test sessions.

Procedures

The experimental design of this study was a Crossover Randomized Study. Each volunteer participated in three different experimental conditions on separate visits to the sports hall with a 5 days' interval and each took place at the same time of day (13:00–15:00) to avoid any effect of circadian rhythms.

During the familiarization session, anthropometric measurements were taken, body mass index was calculated. One experimental day consisted of a static stretching exercises (SS) followed by a series of athletic performance tests. On the other experimental day, participants performed a self-myofascial release (SMR) bout using vibrating foam rollers (VYPER) followed by the same series of athletic performance tests. The order of testing was designed in such a way that one test would not adversely affect the performance of another test, their order being as follows; flexibility, sprint measurements, and dynamic postural control.

Performance assessment procedures for dependent variables

At the beginning of each experimental session, athletes performed a standard aerobic warm-up that lasted about a 5-minute treadmill run (HP COSMOS, Germany) at 7 km/h and 1% slope. After the aerobic warm-up, the athletes performed three submaximal 30-m sprints with a 10-second rest as a special warm-up. After the 2-minute of passive rest, to obtain pretest values, two flexibility, two 30-m sprints tests, and two Star Excursion Balance Test (SEBT) tests were performed. The best scores were recorded for statistical analysis. After the 1-minute passive rest session, SS and SMR sessions were applied. For the residual measurement, after each SS and SMR session, the tests were completed at the 15th minute of the recovery period in the same order. 15-second passive rest was given between the same test and 30-second passive rest was given between the different tests.

Static stretch: Athletes rested passively for 1-minute after the completion of the pre-tests and performed two sets of four static stretching exercises to the point of discomfort of 30-s each with 10-s rest periods including hamstring (seated unilateral hamstring stretch), quadriceps (prone unilateral quadriceps stretch), hip (seated unilateral gluteal stretch), and gastrocnemius muscles (standing unilateral calf stretch).

Self-Myofascial rolling exercises (SMR): SMR exercises were performed using a vibrating foam roller equipment (VYPER). The protocol consisted two sets of one 30-s bout with 10-s of passive rest for each side of four muscles: hamstrings, quadriceps, hip, and gastrocnemius. During foam roller exercises the vibrating foam roller equipment was kept open as highest level.

Sit and Reach (S&R) Test

The sit-and-reach test was conducted using a S&R testing box (Tartı Med, Turkey). For the SR test, the participant sat with their feet against the testing box and with their knees fully extended. In order, to ensure the full extension of the knees in the duration of the test, the examiner pushed down with his hand both knees. Afterward, the participant placed one hand over the other and slowly reached forward as far as they could by sliding their fingers along the measuring board.

Sprint Tests

Sprint speed (20-m) was measured on an indoor synthetic track with a photocell stopwatch system. In these tests, the photocell doors were placed at the start and finish distances. Athletes started from a standing position 0.3 m ahead of the starting line. Each athlete was given three trials every 2-minute, and the best rating was used.

Dynamic Postural Balance Test

The SEBT was designed as a lower-extremity reach test on 8 designated lines on the ground [Gray, 1995]. The test later was simplified as to include only 3 directions as anterior, posteromedial, and posterolateral [Grible et al. 2012]. Internal consistency reliability of this scale is (ICC: 0.86–0.9) [Grible et al. 2013]. Bilateral reach distance was measured by using a tape measure fixed on the ground, and the reached point was marked on the tape measure for each direction of SEBT. The tape measures were positioned in connection with each other with 135° angle opposite to the anterior points of posterior medial and posterior lateral areas. Anterior reach was measured from the toe tip at the center, posteromedial, and posterolateral were measured as the distance between the heel and the remotest point reached. The test requires the participants to be unshod in order to reach maximum distance with their free leg when their other leg is on the point of intersection of the star pattern on the floor. Before balance test, each participant was requested to kick the ball and the foot used to kick the ball was recorded as dominant leg. During the test process, the participants were required to keep their hands on iliac and keep their heels on the ground and to touch the remotest point with their toe tip. An experienced researcher made brief demonstration about the test before the measurement process, and the participants were asked to try to reach each direction at least 4 times [Robinson and Grible 2008]. When the participants put their body weights on their reaching legs during measurements, when they disconnected their stance heels from the ground, or ceased to touch their hips, the process was repeated after the participant was verbally warned. All reach distances were recorded in centimeters. The average of reach-out scores for each direction was taken and normalized in accordance with the leg length values [Grible and Hertel 2004]. Normalized scores are shown as a percentage of stance leg length (LL%). Normalized anterior, posteromedial, and posterolateral scores were averaged and combined score was found. Composite reach distance (COMP) was calculated by the sum of the three reaching direction by averaging the normalized anterior, posteromedial, and posterolateral scores. The average values of normalized anterior, posteromedial, posterolateral, and composite scores from the right limb and left limb were used for statistical analysis.

Statistical Analysis

Statistical analysis of the values obtained from the study was performed using the IBM SPSS (version 23) analysis program. Skewness and kurtosis were checked to determine whether the data were appropriate for normal distribution. First, the arithmetic mean, standard deviation values of the data were calculated. Wilcoxon was performed the effects of pre-post and intervention. The alpha value were accepted as significant (p <0,05).

RESULTS

Flexibility was increased significantly from pre-to post-test in the AR+SMR session *(p = 0.00)* while no significant differences was found in the AR+SS session *(p = 0.42)*. Both the AR+SS and AR+SMR treatment increased the dynamic postural control, respectively *(p = 0.03; p = 0.01).* No statically significant differences was found in the sprint performance both the AR+SS and AR+SMR treatment, respectively *(p = 0.64; p = 0.92).*

Table 1. Descriptive statistics of participants (n = 13).

Variables	Mean	SD
Age (year)	20.2	1.82
Height (cm)	176.2	5.26
Mass (kg)	69.1	7.54
BMI (kg/m^2)	22.2	1.93
Sport specific training age (year)	11	3.61
General training age (year)	12.8	4.21
Leg length (cm)	94.7	5.66

SD: standard deviation.

Table 1. Pretest, Posttest, and Gain Scores (in cm) of S&R for Each Group (n= 13)

	Pre-test	**Recovery moment (15th min.)**	**Gain (difference between pretest & posttest (CI 95%, Lower- Upper)**	***p***
Aerobic running+static stretching	29.7±8.71	30.8±8.13	1.23 (-0.84 - 3.3)	*0.42*
Aerobic running+self-myofascial rolling	28.4±8.62	30.2±8.57	1.77 (1.02 – 2.52)	0.00*

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Table 2. Pretest, Posttest, and Gain Scores (in second) of sprint for Each Group (n= 13)

	Pre-test	**Recovery moment (15th min.)**	**Gain (difference between pretest & posttest (CI 95%, Lower- Upper)**	***p***
Aerobic running+static stretching	3.02±0.09	3±0.09	-0.02 (-0.03 - 0.00)	*0.64*
Aerobic running+self-myofascial rolling	3.01±0.06	2.81±0.84	-0.2 (-0.07 – 0.3)	0.92

Table 3. Pretest, Posttest, and Gain Scores (in %) of SEBT-COMP for Each Group (n= 13)

	Pre-test	**Recovery moment (15th min.)**	**Gain (difference between pretest & posttest (CI 95%, Lower- Upper)**	***p***
Aerobic running+static stretching	96.2±3.52	98±5.04	1.55 (-0.04 - 3.14)	*0.03**
Aerobic running+self-myofascial rolling	86.7±4.52	88.8±4.34	2.17 (0.4 – 3.93)	0.01*

DISCUSSION

The purpose of this study was to investigate the residual effects of lower body foam rolling on flexibility, dynamic postural control and sprint performance in elite combat athletes. To our knowledge, this is the first study investigating the residual effects of SMR on dynamic postural control. The main findings showed that the addition of self-myofascial rolling with foam roller after an aerobic running had a significant performance-enhancing effect on S&R in recovery moment at the 15^{th} minute, while having no statistically significant effect on sprint performance. Furthermore, both the AR+SMR and AR+SS appeared to have an enhancing effects on COMP scores in elite combat athletes in recovery moment at the 15^{th} minute.

There are studies with the findings that static stretching increases the flexibility (Nelson and Kokkonen, 2001; Fowles et al. 2000). Similarly, previous research has shown that SMR can increase flexibility acutely in untrained, adult subjects with no SMR experience (Jay et al. 2014; Sullivan et al. 213). There are few studies compared the residual effect of SMR and

SS on S&R performance. In the present study, from pre-test to 15 minutes post-test, AR+SMR treatment significantly increased flexibility than AR+SS (p= 0.00). Parallel the present study, MaCDonald et al. (2013), which compared the residual effects of SMR and SS on S&R performance showed that after foam rolling, subjects' ROM significantly (p = 0.001) increased by 10^o and 8^o at 2 and 10 minutes, respectively. Skarabot et al. (2015) reported that post hoc testing revealed that foam rolling with static stretching was superior to foam rolling. All changes from the interventions lasted less than 10 minutes.

There are also other studies investigated the effects of SMR on S&R and ROM performance (Sullivan et al.2013; Grieve et al.2015). Mohr et al (2014), found that foam rolling combined with static stretching produced statistically significant increases (p=0.001, r=7.06) in hip flexion ROM. Also greater change in ROM was demonstrated when compared to static stretching (p=0.04, r=2.63) and foam rolling (p=0.006, r=1.81) alone. Sullivan et al measured the effects of a roller massager intervention on lower extremity ROM and neuromuscular activity. The use of a roller massager produced a 4.3% (p<0.0001) increase in sit and reach scores after the intervention periods of one and two sets of 5 seconds.

The research regarding effects of SMR on sprint performance and dynamic postural control is limited. The other finding of the present study was there was a decrease in sprint performance time both the AR+SMR and AR+SS treatments at the 15^{th} minute, respectively (p = 0.64; p = 0.92). also, both the AR+SMR and AR+SS appeared to have an enhancing effects on COMP scores in elite combat athletes in recovery moment at the 15^{th} minute. A number of studies have reported that SS is not suitable during warming up because of the limitation performance capacity (Shrier, 2004; Taylor et al. 2009). Linderoth (2015) showed no statistical significant difference between dynamic and foam Rolling warm-up routines on 20-m sprint time (p=0.54).

In conclusion, SMR is effectiveness method for improving flexibility and dynamic postural control in elite combat athletes. Further investigation is needed to better understand about the residual effects of SMR on these performance.

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