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Original

The effect of self myofascial release and static stretching on the antagonist muscles before agonist performance

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ABSTRACT

Objective: The aim of this study was to compare differences in volume load, total repetition performed and rating of perceived exertion between static stretching and self-myofascial release on antagonist muscles.
Methods: Eighteen recreationally trained men (23.4 ± 3.3 years; 80.7 ± 11.1 kg; 1.76 ± 0.06 cm) performed 10 repetitions maximum test and retest in the leg extension exercise on the first two visits. Then, three experimental sessions were conducted in a random order, in which two consisted of self-myofascial release and static stretching on hamstrings, and the other was used as a control.
Results: Significant higher repetitions were performed in the third set of static stretching when compared to control protocol. Additionally, significant reductions in total repetitions performed were observed only in the control session. No significant differences were noticed in the volume load of leg extension and rating of perceived exertion between protocols.
Conclusion: Self-myofascial release and static stretching performed before a session in the antagonist muscles can maintain repetitions performance by optimizing recovery between sets and reducing fatigue of agonist muscle.
Keywords: Resistance training; Static stretching; Lower extremity; Athletic performance.

Efecto de la autoliberación miofascial y el estiramiento estático previos de la musculatura antagonista en el rendimento de la musculatura agonista

RESUMEN

Objetivo: El objetivo de este estudio fue comparar las diferencias entre el volumen de la carga, el número total de repeticiones y la percepción subjetiva del esfuerzo, de la musculatura agonista, tras estiramiento estático y liberación miofascial de los músculos antagonistas.
Método: Dieciocho hombres entrenados recreativamente (23.4 ± 3.3 años; 80.7 ± 11.1 kg; 1.76 ± 0.06 cm) realizaron un test retest de 10 repeticiones máximas de extensión de rodilla en las dos primeras visitas. A continuación, se llevaron a cabo tres series en orden aleatorio que consistieron dos en autoliberación miofascial y estiramiento estático de los isquiosurales, y la otra se usó como control.
Resultados: En la tercera serie se obtuvo un mayor número de repeticiones tras estiramientos estáticos en comparación con el control. Además, se encontraron reducciones significativas en las repeticiones solo en la serie control. Entre los protocolos, no hubo diferencias en el volumen de rendimiento y la percepción subjetiva del esfuerzo.
Conclusión: La liberación miofascial y el estiramiento estático de los músculos antagonistas, realizados antes de la sesión pueden mantener el rendimento en repeticiones a lo largo de las series, al optimizar la recuperación entre series y reducir la fatiga del músculo agonista.
Palabras clave: Entrenamiento fuerza; Estiramiento estático; Miembros inferiores; Rendimiento.

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Efeito da auto-liberação miofascial e alongamento estático no músculo antagonista antes do desempenho agonista

RESUMO

Objetivo: O objetivo deste estudo foi comparar diferenças no volume de treinamento, repetições totais e percepção subjetiva de esforço entre alongamento estático e auto-liberação miofascial nos músculos antagonistas.

Método: Dezoito homens recreacionalmente treinados (23.4 ± 3.3 anos; 80.7 ± 11,1 kg; 1.76 ± 0.06 cm) realizaram teste e reteste de 10 repetições máximas na cadeira extensora nas primeiras duas visitas. Em seguida, foram realizadas três sessões de ordem aleatória, onde duas consistiram de auto-liberação miofascial e alongamento estático, e outra foi usada como controle.

Resultados: A terceira série apresentou maior número de repetições no alongamento estático em comparação ao controle. Além disso, foram verificadas reduções significativas de repetições somente no controle. Entre protocolos, não foram verificadas diferenças no volume de treinamento e percepção subjetiva de esforço.

Conclusão: Auto-liberação miofascial e alongamento estático realizados nos músculos antagonistas antes de uma sessão podem manter o desempenho de repetições ao longo das séries a partir de uma recuperação entre séries e redução da fadiga nos músculos agonistas.

Palavras-chaves: Treinamento força; Alongamento estático; Membros inferiores; Desempenho.

Introduction

Resistance training (RT) is commonly prescribed for athletes who want to develop sports performance because of the benefits that this exercise modality brings, especially the increase in strength and power.[1] Different strategies are used to develop acute performance in RT aiming improvement of the adaptive responses which can elevate the physical capacity of its practioneers.[2] A well-known and widely used strategy is the activation of the antagonist musculature before the activity of agonist muscles, known to improve the volume load.[3]

The use of static stretching (SS) as an antagonist activation has been described as an effective method for antagonist muscle pre-load and to improve acute performance.[4,5] In order to examine the effects of the SS on antagonist muscles and RT performance, and muscle activation, Paz et al.[5] investigated 15 recreationally trained men performing wide seated row (WSR) with different experimental protocols. In a counterbalanced and randomized order, three protocols were applied in the pectoralis major before the SR: SS consisted of a set of 40 seconds; proprioceptive neuromuscular facilitation involved 20 seconds of isometric tension followed by 20 seconds of 20 stretching; and dynamic RT performed on the bench press consisted of one set to muscular failure with 10 repetitions maximum (RM) load. The results showed a significant improvement in SR performance by the number of repetitions found in the SS and dynamic RT protocols when compared to the traditional protocols. Also, a higher muscle activation by electromyographic (EMG) measures was found in the agonist muscle used in the SR which may justify better performance.

Recently, another intervention that has been well studied is the self-myofascial release (SMR), commonly applied before training session in order to improve performance[6,7]. The SMR is based on massages and other similar techniques used to reduce the fibrous adhesions resulted of muscle damages of subsequent high intensity exercises.[8-10] The SMR is recognized to improve flexibility and mobility, which results in a higher range of motion (ROM) of joints and can bring better neural adjustment during dynamic movements, providing better performance.[6] Besides that, the SMR has an analgesic effect, reducing muscle soreness and fatigue perception that can improve recovery after high intensity session and even reduce the incidence of injuries.[11,12] However, studies lack in presenting improvement of strength, power, or other skills after a SMR protocol, and the absence of evidence regarding the prescription in the method may be one reason.[12-14]

However, there is no evidence of investigating acute effects of SMR before dynamic RT regarding improvement of performance from the volume load. Besides that, all protocols used in SMR were investigated when applied in the agonist muscle of the movement. As it is recognized that interventions in the antagonist muscle can improve the agonist performance, as shown by SS, the use of SMR may have similar effects. Moreover, SMR is easier to use as the practitioner can do it by himself. Among other benefits, SMR presents lower costs compared to massage sessions, when the goal is to mitigate the effects of high intensity sessions. Because of these facts, the purpose of the present study was to evaluate acute effects of leg extension (LE) exercise performance measured by the volume load (sets x repetitions x load), and rating of perceived exertion (RPE) after SMR and SS protocols in the hamstrings.

Methods

Subjects

Eighteen recreationally trained men participated in the study (23.4 ± 3.3 years; 80.7 ± 11.1 kg; 1.76 ± 0.06 cm). The sample size was estimated by the software G*Power (version 3.1.9.2. Dusseldorf, DEU) based on volume load variable, with an effect size of 0.25, an α error of 0.05 and the power (1 - β) of 0.80, resulting in a total sample calculation of 28 subjects. Based on sample size calculation and the reduced number of subjects recruited, this study has interval validity and should be considered for a sample size with similar characteristics used in this study. Subjects recruited for this study were physical education students from the University, and to be included, they had to be physically active for at least six months in RT with a regularity of three sessions per week. All participants recruited in this study were experienced with lower limb resistance exercises. Also, they should not present any kind of injury and not use any sort of ergogenic aids that can improve performance. Before starting the experimental procedures, the participants completed the Physical Activity Readiness Questionnarie (PAR-Q) and if one item had an affirmative answer, they would be excluded from the study. During the investigation, the participants were told not to do any kind of physical activity 48 hours before the protocols.

The participants were aware of all procedures to be adopted and the potential risks involved. As well as required to sign an informed consent form. This study is in accordance to the Declaration of Helsinki in relation to ethical procedures.

Procedures

Participants visited the laboratory in a total of five occasions, with an interval of 48 to 72 hours. All procedures were performed at the same time of the day for all participants. In the first session, the 10 repetition maximum (RM) test was performed to identify the load that would be used in the protocols. The second time, the test was performed again to have a greater accuracy of ideal load for 10 RM. In the third, fourth and fifth sessions, the experimental protocols were applied in a counterbalanced way in which all participants had to perform the three protocols in a randomized crossover design.

During the first two sessions, participants underwent to a 10 RM testing and retesting to determine the training load in the LE.

There were two days with 48-72 hours interval between them. The 10 RM testing protocol was adapted to Beachle and Earle[15] procedures. The initial load was estimated based on the weight that the volunteers frequently use on their training sessions. Before starting the test, one set was done as a warm-up in the first exercise with 50% of the estimated load. During the test, rest intervals between trials ranged between three to five minutes. Each participant performed three attempts for each exercise. On the second day, the same protocol was followed to optimize the accuracy of the load achieved for 10 RM. The test was discontinued immediately after the participant showed a technique failure or a concentric failure. The higher load obtained on both days were used in the experimental sessions.

Strategies were adopted in order to optimize results and reduce the margin error in testing: 1) the explanation of the testing methodology; 2) standardization and guidance of the exercise execution; 3) the researcher carefully monitored the exercise execution; 4) verbal stimulus to motivate volunteers. The LE was performed in a seated position with the hip flexed to approximately 90º and the knee started flexed near to 90º. The participant should do a leg extension during the concentric phase and back to the started position during the eccentric phase.

In sessions three, four and five; three distinct protocols were performed in counterbalanced design.

The SS protocol was performed in a passively way, where the researcher manipulated the leg. The movement of hip flexion with extended leg was used to stretch the hamstring while the opposite leg remained extended. The low back curvature was maintained during the movement. Three sets of 30 seconds were performed on each leg (Figure 1).

Figure 1. Illustration of the static stretching performed in the hamstring

In the SMR, it was used a foam roller Brasil (Brazil) made with expanded polypropylene with the dimensions 30 cm x 15 cm and 250 grams. The subject needed to slip the leg over the foam roller slowly. Three sets of 30 seconds were performed on each leg (Figure 2).

After each protocol, three sets until failure were performed in the LE using the 10 RM load. The control protocol was carried out without SS and SMR. Only a specific warm-up in the LE with 50% of the 10 RM load and 15 repetitions was performed.

Statistical Analysis

The statistical treatment was achieved using software SigmaPlot version 11.0 (Oregon, USA). All variables showed normal distribution and homoscedasticity according to Shapiro-Wilk normality test. The intra class coefficient correlation was calculated to verify the reproducibility of the 10 RM test and retest. The two-way ANOVA [protocol (3) x sets (3)] for repeated measures test was applied to determine if there was interaction for repetition performance between protocols and sets (1-3). The one-way ANOVA for repeated measures was used to determine if there were interaction among protocols for VL an RPE. The Bonferroni post hoc was used with the value $p \leq 0.05$ adopted for all interferential analysis. In addition, Cohen's d effect size (ES) and 95% confidence interval (CI) was used, consisted of the difference between two means divided by pooled standard deviation, and rated according to the magnitude of < 0.20 trivial; 0.20-0.49 small; 0.50-0.79 moderate; and > 0.80 large.[16]

Results

The average load used in the LE exercise was 69 ± 14. The ICC of 10 RM testing and retesting was 0.97. The anthropometric measures of the sample are shown in Table 1.

Table 1. Anthropometric measures of the sample

	Age (years)	Height (cm)	Weight (kg)	BMI
Mean ± SD	23.4 ± 3.3	176 ± 0.1 cm	80.7 ± 11.1	25.8 ± 2.1

SD: Standard Deviation; BMI: Bodymass Index.

Considering the number of repetitions throughout the sets (Figure 3), the third set of the SS protocol was significantly higher than the control (p = 0.041). For the control protocol, the third set reduced expressively when compared to the first set (p = 0.003).

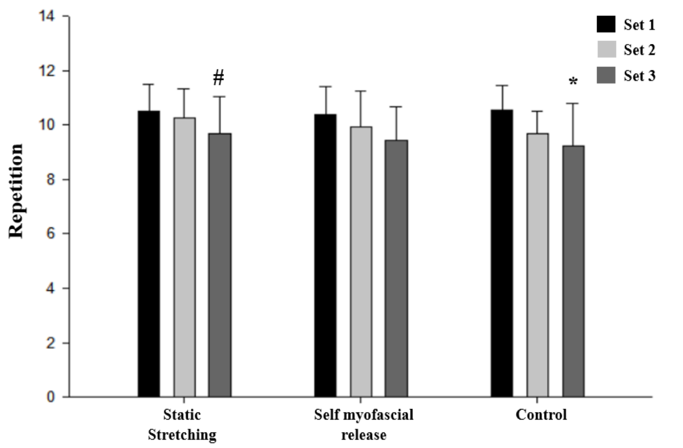

Figure 3. Repetitions performed on each set in the protocol

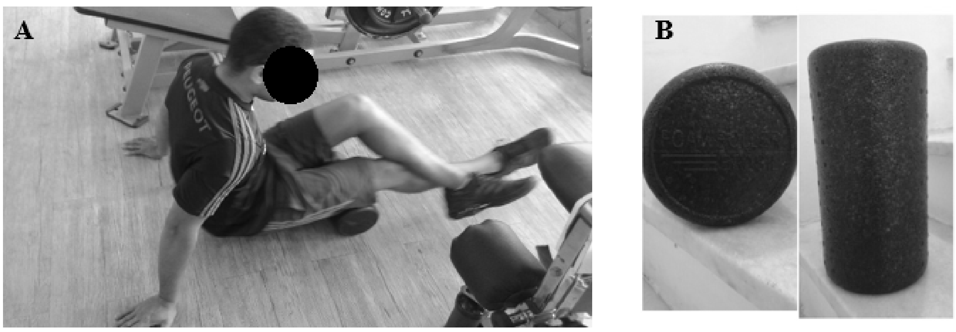

Figure 2. Illustration of the self-myofascial release performed in the hamstring (A) and the foam roller used in the protocols (B).

Table 2. Volume load performance of different protocols.

	SMR	SS	CON	SMR vs. CON		SS vs. CON		SMR vs. SST	
	Mean ± SD	Mean ± SD	Mean ± SD	ES (90% CI)	Rating	ES (90% CI)	Rating	ES (90% CI)	Rating
Volume Load (kg)	2222 ± 503	2247 ± 375	2183 ± 419	0.08 (0.02; 0.19)	Trivial	0.16 (0.05; 0.27)	Trivial	0.06 (0.05; 0.17)	Trivial

Legend: SMR: Self-myofascial release; SS: Static Stretching; COM: control; ES: effect size; CI: confidence interval.

Considering the volume load of the LE after each protocol (Table 2), there were no significant differences among them (p = 0.092). In relation to the RPE, no significant differences were observed among conditions (p = 0.104).

Discussion

The main discovery of the present study was that the SS and SMR protocols were able to maintain the performance of repetitions throughout the sets better than the control session. Besides that, the SS protocol showed significantly higher repetitions in the third set when compared to the control. To our knowledge, this is the first study investigating the effect of SMR in antagonist muscle before performing an agonist training session.

This study corroborates with previous studies showing that SS in the antagonist muscle can improve acute performance in the subsequent agonist.[4,5] In this study, the SS protocol had smaller reduction in repetitions performance along sets when compared to the control protocol, indicating better recovery between sets and less fatigue sensation. In order to understand the mechanisms of stretching the antagonist muscles in acute RT performance, Miranda et al.[4] investigated their effects when performed between sets in a WSR in 10 men recreationally active. The two experimental protocols used were: passive recovery (PR) which included three sets with 10 RM load tested previously to failure with two minutes rest interval between sets; and antagonist passive static stretching (AS) which consisted of the same protocol as PR, but a SS in the pectoralis major were performed lasting 40 seconds before the ending rest interval between sets. In agreement with the present study, higher reductions in repetitions along sets were observed in the PR when compared to the AS. Besides that, greater volume load was seen in the AS and higher muscle activation of agonist muscles used in the WSR were observed by EMG. This study used the SS protocol only before all multiple sets showing a positive effect, but apparently its application between sets can optimize the performance results.

Since there were not significant reductions when comparing sets, the SMR protocol was able to maintain the performance along them, but had no effect on performance improvement. The SMR protocol was performed in the antagonist muscle, but the results corroborate with previous studies that investigated the acute effect of SMR before RT session and showed no significant differences.[8,12-14,17] However, it is possible to affirm that less fatigue sensation was observed in the SMR protocol, since there were not significant reductions along the sets for this protocol, and in the control protocol the last set had a worse performance than the first. A similar result was verified by Healey et al.[12] who investigated a SMR protocol in 13 men and 13 women recreationally trained performing in different muscles for lower limbs. When analyzing the performance in vertical jump height and power, isometric force and agility test, no significant differences were determined regarding to the control protocol. However, lower rates of fatigue measured by a scale from 0 to 10 were observed for the SMR protocol in the post exercise moment, indicating that this protocol can promote a movement economy with same performance, as well as less effort.

In relation to the application of SS and SMR, it is important to highlight there was no deleterious effect of its application on acute performance before a RT session. This finding suggests that both can be used as a strategy for flexibility improvement in the same session when applied in the antagonist muscle. Another important aspect is the fact that previous studies showed that SMR can acutely improve the range of motion (ROM) and has no negative effects on strength performance when performed in the agonist muscle.[12-14,18,19] For sports performance, this could be an important consideration since training sessions generally combine strength and power exercises. Although there is a lack of evidence showing increased performance of SMR as a warm-up strategy, no deleterious effects were previously reported.[20]

In order to investigate a short-term effect of four weeks training with foam rollers for flexibility, Junker et al.[21] recruited 47 men recreationally active. They were divided into three groups: the first group used the foam roller (FOAM, n = 13) performing three sets for hamstring on each leg in a total duration of 30-40 seconds; a second group used contract-relax proprioceptive neuromuscular facilitation (CRPNF, n = 14) consisted of three times of six seconds of isometric contraction and 10 seconds stretching, in a total of three sets; and the last one was a control group (n = 13). Both interventions were effective in increasing the hamstring in the stand-and-reach test when compared to the control group and without significant differences between them. This indicates that the improvement in ROM evidenced by previous studies for SMR may have chronic benefits in flexibility.[22,23]

The present study concluded that SMR and SS can optimize the recovery and reduce fatigue when performed in the antagonist muscles. Both protocols had better performance response than the control session that presented greater repetition reductions along the sets. Self-myofascial release can be a good alternative to be included in an athlete's training prescription in order to improve flexibility without any harmful effects on muscular performance.

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