EFFECT OF SINGLE AND MULTIPLE SESSIONS OF SELF-MYOFASCIAL RELEASE: SYSTEMATIC REVIEW

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Revisão Sistemática
Revisión Sistemática

EFEITO DE UMA SESSÃO E DE MÚLTIPLAS SESSÕES DE AUTOLIBERAÇÃO MIOFASCIAL: REVISÃO SISTEMÁTICA

EFECTO DE UNA SESIÓN Y DE MÚLTIPLES SESIONES DE AUTOLIBERACIÓN MIOFASCIAL: REVISIÓN SISTEMÁTICA

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ABSTRACT

Self-myofascial release with a roller has been used as a tool to accelerate recovery. The objective of this systematic review was to investigate how one session or multiple sessions of self-myofascial release with a roller affect the recovery of an athlete´s performance. The research was conducted in the PubMed, Scopus, Cochrane Library, BVS, Embase, SPORTDiscus, ScienceDirect, and Google Scholar databases using the terms: foam rolling, foam roller, and self-myofascial release combined with recovery, exercise, fatigue, and sport and acute effects, chronic effects and performance, resulting in 12,020 articles. After checking the inclusion criteria, 40 studies were selected and analyzed. It was concluded that multiple sessions of self-myofascial release with a roller are more effective in recovering lower limb power and speed performance than just one session. A single session is more effective for recovering strength performance than multiple sessions. Moreover, both single and multiple sessions showed similar results in the recovery of agility, pain, flexibility, blood lactate removal, and perception of recovery. Finally, multiple sessions between sets of resistance exercise seem to reduce performance, decreasing the number of repetitions and resistance to fatigue, while a single session did not produce a significant effect. Self-myofascial release with a roller demonstrates potential for speeding up the recovery process of athletes. Future studies should evaluate the effect of the regular use of self-myofascial release with a roller on performance recovery. ***Level of evidence II; Systematic review.***

Keywords: Manipulation therapy; Recovery of function; Physical performance.

RESUMO

A autoliberação miofascial com rolo vem sendo utilizada como estratégia para acelerar o processo de recuperação. Esta revisão sistemática teve como objetivo investigar como uma sessão ou múltiplas sessões de autoliberação miofascial com rolo afetam a recuperação do desempenho dos atletas. A pesquisa foi realizada nas bases de dados PubMed, Scopus, Cochrane Library, BVS, Embase, SPORTDiscus, ScienceDirect e Google Scholar usando os termos: "foam rolling"; "foam roller"; "self-myofascial release" combinados com "recovery", "exercise", "fatigue", "sport" e "acute effects", "chronic effects", "performance", resultando em 12.020 artigos. Depois da verificação dos critérios de inclusão, 40 estudos foram selecionados e analisados. Verificou-se que múltiplas sessões de autoliberação miofascial com rolo são mais efetivas para recuperar o desempenho de potência dos membros inferiores e velocidade do que apenas uma sessão. Uma sessão é mais efetiva para a recuperação do desempenho de força do que múltiplas sessões. Além disso, uma sessão e múltiplas sessões mostraram resultados similares na recuperação de agilidade, dor, flexibilidade, remoção de lactato sanguíneo e percepção de recuperação. Por fim, múltiplas sessões entre séries de exercício resistido parecem reduzir o desempenho, diminuindo o número de repetições e a resistência à fadiga, enquanto uma só sessão não provocou efeito significativo. A autoliberação miofascial com rolo demonstra potencial para acelerar o processo de recuperação de atletas. Estudos futuros devem avaliar o efeito do uso crônico da autoliberação miofascial com rolo na recuperação do desempenho. ***Nível de evidência II; Revisão Sistemática.***

Descritores: *Liberação miofascial; Recuperação de função fisiológica; Desempenho físico.*

RESUMEN

La autoliberación miofascial con foam roller *se ha utilizado como estrategia para acelerar el proceso de recuperación. Esta revisión sistemática tuvo como objetivo investigar cómo una o varias sesiones de autoliberación miofascial con* foam roller *afectan la recuperación del desempeño de los atletas. La investigación se llevó a cabo en las bases de datos PubMed, Scopus, Cochrane Library, BVS, Embase, SPORTDiscus, ScienceDirect y Google Scholar utilizando los términos: "foam rolling"; "foam roller"; "self-myofascial release" combinados con "recovery", "exercise", "fatigue", "sport"; y "acute effects", "chronic effects", "performance", que dan como resultado 12.020 artículos. Tras verificar los criterios de inclusión, se seleccionaron y analizaron 40 estudios. Se concluyó que las sesiones múltiples de autoliberación miofascial con* foam roller *son más efectivas para recuperar el desempeño de potencia de las extremidades inferiores y velocidad que una sola sesión. Una sesión es más efectiva para recuperar el desempeño de fuerza que múltiples sesiones. Además, una sesión y varias sesiones demostraron resultados similares en la recuperación de la agilidad,* *el dolor, la flexibilidad, la eliminación del lactato en sangre y la percepción de recuperación. Por último, las sesiones múltiples entre series de ejercicios de resistencia parecen reducir el desempeño, al disminuir el número de repeticiones y la resistencia a la fatiga, mientras que una sola sesión no causó un efecto significativo. La autoliberación miofascial con* foam roller *demuestra su potencial de acelerar el proceso de recuperación de los atletas. Estudios futuros deberán evaluar el efecto del uso crónico de la autoliberación miofascial con* foam roller *en la recuperación del desempeño.* ***Nivel de evidencia II; Revisión sistemática.***

Descriptores*: Terapia por manipulación; Recuperación de la función; Desempeño físico.*

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INTRODUCTION

High-intensity physical exercise causes disturbances in various physiological systems, resulting in an increased perception of fatigue, muscle damage, late-onset muscle pain, decreased muscle strength, and reduced performance.[1] The relatively short period between competitive sports events makes full recovery impossible for the athletes, creating the need for recovery strategies to maintain adequate performance.[2]

Self-myofascial release (SMFR) has been used as a strategy to increase pre-training performance and speed up the recovery process.[3] SMFR seems to improve performance and power recovery of the lower limbs, speed, agility, and flexibility, as well as better muscle activation, reduced late muscle pain, and improved vascular endothelial function.[1,4-9]

In this context, SMFR stands out as a strategy to accelerate the process of muscle damage recovery, reduce the sensation of fatigue and muscle pain, increase flexibility, and help maintain the physical performance of athletes.[4] Although it is widely used in practice, more scientific support is needed so practitioners, athletes, coaches, physicians, and sports scientists can apply evidence-based SMFR.

Because there are different protocols for using SMFR, what effect a single session of SMFR has on the performance and recovery of athletes and whether multiple sessions could generate better results must be understood, since the most effective type of session for speeding up the recovery process is still unknown. Therefore, the objective of this systematic review was to investigate how one session or multiple sessions of SMFR affect physical performance recovery.

METHODS

Data sources and bibliographical research strategy

This study was conducted through a systematic review of the literature covering the use of SMFR, following the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) guidelines.[10] The search was performed against the PubMed, Scopus, Cochrane Library, BVS, Embase, SPORTDiscus, and Google Scholar databases using the following terms: (foam rolling OR foam roller OR self-myofascial release) AND (recovery OR exercise OR fatigue OR sport) AND (acute effects OR chronic effects OR performance). In the ScienceDirect database, the search strategy covered the following terms: (foam rolling OR foam roller OR self-myofascial release) AND (recovery OR exercise OR fatigue) AND (acute effects OR chronic effects OR performance). The search was conducted in June 2020 and updated in February 2021.

Study eligibility and selection criteria

The study inclusion criteria were: 1) healthy adult participants; 2) use of single or multiple sessions of SMFR before, during, or after a training protocol that induced muscle fatigue/damage; 3) participants were their own controls or were randomly divided into a control and/or intervention group; 4) results presented with evaluation of measurements of physical performance, muscle pain, or flexibility; 5) publication in English. The following types of articles were excluded from this review: conference abstracts, case reports, systematic reviews, meta-analyses, dissertations, course conclusion papers, theses, book chapters, and textbooks.

Two reviewers (RFO and GFAB) conducted the search independently, sorting the titles and abstracts by relevance and evaluating the articles found to determine which of them met the inclusion criteria. Duplicate articles were identified and excluded from the study using the Zotero program. The two reviewers had access to the full text of the articles for the eligibility assessment. Finally, the articles that met the inclusion criteria were registered and included in the qualitative analysis. More details about the process of article identification, selection, eligibility, and inclusion are shown in Figure 1.

Quality assessment of the studies

Included articles were evaluated by two independent reviewers (RFO and GFAB) in accordance with PRISMA-P recommendations.[10] A blind review was conducted, with the names of the authors and journals masked to avoid any potential bias or conflict of interest. Subsequently, the PEDro scale was used to verify methodological quality.[11] Studies with PEDro scores from 6 to 10 points were considered of high quality, of 4 or 5 points of moderate quality, and from 0 to 3 points of low quality. All disagreements related to PEDro-score classification were resolved by discussion and consensus between the two reviewers.

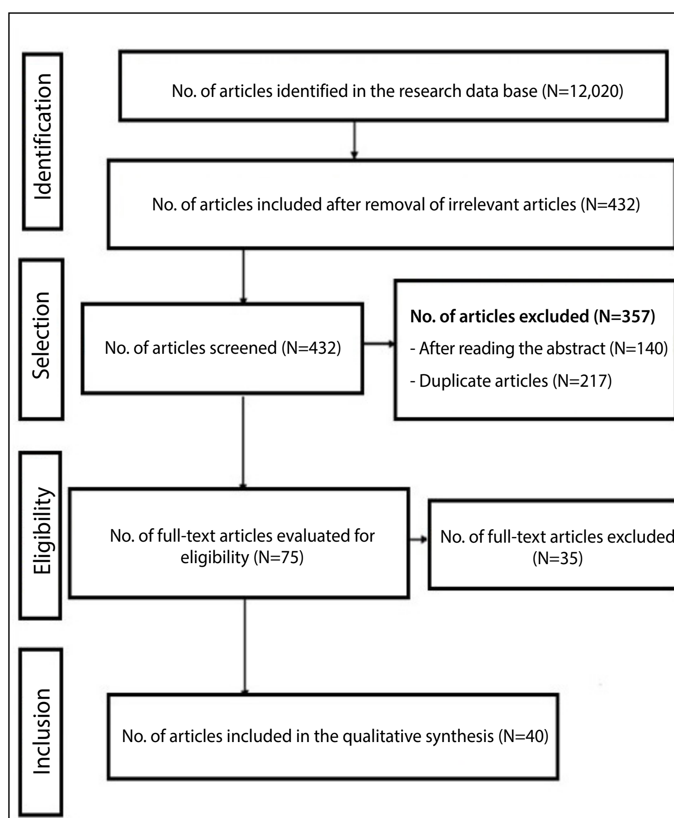

Figure 1. Flowchart for article identification, selection, and inclusion.

Data extraction and synthesis

The data from the included articles were extracted by one of the two reviewers (RFO) and checked by another author who was not involved in the extraction process (JES), and were adjusted as necessary. The studies were classified into two categories defined as follows: "Single SMFR Session" and "Multiple SMFR Sessions". After classification, relevant data, including participant characteristics, measured variables, exercise/training protocols, materials, intervention moments, muscle groups treated using SMFR, and significant results, were extracted from each study and summarized. After data extraction, the findings were qualitatively synthesized according to the study objective.

RESULTS

A total of 40 studies met the inclusion criteria and were included. The articles were heterogeneous, with significant limitations in relation to the different population characteristics and different moments and duration times of the SMFR protocol.

The mean PEDro scale score for the included studies was 5.55 ± 1.10 points (ranging from 2 to 8 points), indicating moderate quality. Most of the studies (24 out of 40) had high methodological quality and low risk of bias. A reasonable number (14 out of 40) had moderate quality with moderate risk of bias and only two articles had low quality with high risk of bias.

Single SMFR session

Table 1 summarizes the 23 studies that examined the effects of just one session of SMFR on performance recovery. Nineteen of the 23 studies evaluated showed some positive effect on some performance recovery parameter (82%). Eight studies reported a positive impact on flexibility (8 out of 11), seven on recovery from pain (7 of 10), five on removal of serum lactate (5 of 7), three on strength performance recovery (3 out of 5) and the perception of recovery (3 out of 3), two on the recovery of lower limb power (2 out of 6), one on the subjective perception of strength (1 out of 4), one on the recovery of agility performance (1 out of 3), and one of skin temperature recovery (1 out of 1). No positive effects on speed recovery (0 out of 2), serum CK concentration (0 of 2), or number of resistance exercise repetitions (0 out of 1) were observed (Table 1).

Multiple SMFR sessions

Table 2 summarizes the 17 studies that examined the effects of multiple SMFR sessions on performance recovery. Thirteen of the 17 studies evaluated reported some positive effect on some performance recovery parameter (76%). Six studies observed a positive effect on flexibility (6 out of 9), five on recovery from pain (5 out of 6), four on the recovery of power in the lower limbs (4 out of 8), two on the recovery of strength performance (2 out of 6), one each on the recovery of agility performance (1 out of 4), speed (1 out of 1), removal of blood lactate (1 out of 1), and sensation of recovery (1 out of 1). However, no positive effects were observed on the recovery of anaerobic power (0 out of 1), aerobic capacity (0 out of 1), the number of repetitions (0 out of 2), or the fatigue index (0 out of 2) (Table 2).

DISCUSSION

SMFR and physical performance

Overall, multiple SMFR sessions were more effective than one session in accelerating recovery of lower limb power. This suggests that there are chronic effects or that the tissues stimulated by SMFR, especially the myofascial tissue, need more time for positive adaptation.

Four studies did not verify the effects of a single SMFR session on height, maximum power, and reaction strength index in the countermovement vertical jump or the squat jump after a training session.[19,21-22,30] However, one study observed an increase in jump height[24] and another reported increases in the velocity, power, and peak power of the jump.[23] In relation to multiple SMFR sessions, less of a decline in jump distance and an increase in the height of the countermovement vertical jump were confirmed in time periods from 24 to 72 hours.[1,9,36,37]

Multiple sessions were shown to accelerate the recovery of speed performance.[8] It was found that multiple sessions (immediately, 24, and 48 hours after training) generated less of an increase in sprint time in periods from 24 to 72 hours.[8] On the other hand, a single session of SMFR did not produce any positive effect on post-training sprint time.[15,21,32] Thus, the results indicated that multiple sessions are also more effective in accelerating speed performance recovery.[8,15,21,32]

As for agility, one study with only a single SMFR session reported effective results in the t test,[21] while two studies showed no influence on either dynamic reaction time or in the t test.[15,23] Controversial results were observed for multiple SMFR sessions with several studies reporting negative impact on agility recovery over a prolonged period[8,44,46] and one study demonstrating better recovery of the same.[6] It is important to highlight that the studies used different intervention protocols.[6,8,15,21,23,44,46] Overall, the results suggest similar effects on agility recovery from both a single and multiple sessions of SMFR.

Regarding strength recovery, most studies indicate that neither one session nor multiple SMFR sessions accelerate the recovery process.[1,26,31,36-37,45] One SMFR session immediately following different training protocols did not cause any significant change in maximum voluntary isometric action when compared to the control group, but it decreased squat resistance when compared to active recovery and electric neuromuscular stimulation.[26,31] On the other hand, three studies observed positive effects from one SMFR session, both immediately and 48 hours after the training protocol, demonstrating less reduction and a subsequent increase in isometric and maximum voluntary concentric contractions.[14,22,25] In relation to the use of multiple SMFR series, only two studies had positive results, indicating that its use immediately and 24, 48, and 72 hours after different training protocols caused greater endurance and muscle strength than in the control group in the period of 24 to 48 hours.[8,35] In this context, studies have indicated that a single session is more effective for recovering strength performance than multiple sessions.

SMFR and late-onset muscle pain

Regarding late-onset muscle pain, several studies indicated that one session of SMFR after exercise and multiple SMFR session immediately, and 24, 48, 72, and 96 hours after a sprint protocol, did not significantly reduce pain.[6,13,22,26] However, only these four studies had non-significant results,[6,13,22,26] while most of the studies reported a reduction in the perception of pain and a higher pressure pain threshold, observing maintenance of and subsequent decrease in the level of late-onset muscle pain during the period from 24 to 48 hours after the training protocol.[1,8,14,17,19,21,24,25,27,34-36] Thus, both the use of one session and the use of multiple sessions of SMFR produced similar results and are indicated for the reduction of late-onset muscle pain.

SMFR and flexibility

Only six studies did not demonstrate increased flexibility after the use of one[19,21,20] or multiple SMFR sessions.[6,36,37] Most of the studies reported increased flexibility after the use of one or multiple (from 2 to 24) SMFR sessions, even when different intervention protocols were used.[1,12-14,18,24,26,32,33,36,40,41,44,45,47] Thus, the use of a single session or multiple sessions of SMFR after a training protocol produced similar results, both being indicated for flexibility recovery.

Table 1. Summary of studies examining the effects of a Self-myofascial release (SMR) session on performance recovery.

Author	Objective	Sample	Outline	Training Protocol	SMR Protocol	Muscle Group Treated	Evaluation of Variables	Outcome
MANIATAKIS et al.,[12] 2020	Investigate the effectiveness of IASTM, SMR and EB at ROM shoulder and throwing performance in volleyball players	15 elite volleyball players (Age= 24 ± 4,54 years old)	Crossover trial: SMR, IASTM or EB	Daily volleyball training sessions	-Total: 10 min - 9 x 60 s - Pressure BW - Before the volleyball training session -Roller	-Shoulders	-IM after RP	> ROM in the external rotation of the shoulder in SMR and IASTM compared EB pre to post > ROM in the shoulder flexion in SMR and IASTM compared EB pre to post
YANAOKA et al.,[13] 2020	Compare the effect of different SMR rolls on ROM	10 active participants (Age= 22,1 ± 1,4 years old)	Crossover trial: medium dens SMR or high dens SMR with contralateral lower limb as control	LIST -loughborough intermittent shuttle test	Total: 2 min SMR -2 x 60 s unilateral rest 30 s -IM after TP - Medium and High Dens Roll - Pressure force from 45% to 55% of body weight	-Hamstrings	-IM after TP -IM after RP -20 min RP -60 min RP -24 h after RP -48 h after RP	> ROM hip SMR (0, 20, 60 min e 24, 48 h) compared CON No significant difference in PS and CK
NAKAMURA et al.,[14] 2021	Detect the acute effect of 90 s of SMR on soreness and muscle function of the quadriceps	17 healthy and sedentary men (Age= 21,1 ± 0,5 years old)	Pre and post test	6 x 10 maximum repetitions of knee extension (eccentric exercise)	Total: 90 s SMR -3 x 30 s unilateral rest 30 s -48 h after TP - Plastic core roller -Pressure BW with 7 out of 10 on the numerical rating scale (0 to 10)	-Quadriceps	-48 h after TP -IM after RP	> MVCC, MVIC and ROM knee pre to post SMR < PS on palpation, contraction and stretching (-22.5 mm) pre to post SMR
PELANA et al.,[15] 2021	Evaluate the use of SMR in performance recovery and lactate reduction in futsal athletes	30 futsal athletes (Age= 20 a 23 years old)	controlled trial: SMR or AR	Sprint 20 m and agility T-Test	Total: 10 min SMR -1 x 60 s each muscle group of each leg rest 15 s -IM after TP -Non-smooth high-dens roller -Pressure BW	-Quadriceps -Hamstrings -Adductors -Gluteus -Gastrocnemius	-IM after RP -24 h after RP	↑ lactate removal SMR compared to AR No significant difference in agility and sprint
WATTIMENA; WINATA,[16] 2020	Compare HWI and SMR in the recovery of Sepak takraw athletes	18 sepak takraw athletes (Age= 18 a 20 years old)	controlled trial: HWI or SMR or PR	Takraw sepak game	-Total: 10 min SMR -1 x 60 s each muscle group of each leg rest 30 s -IM after TP -Non-smooth roll -Pressure BW	-Quadriceps -Hamstrings -Abductors -Gluteus -Gastrocnemius	-IM after TP -15 min after RP	↑ Lactate removal HWI and SMR compared to PR > SPR HWI and SMR compared to PR
ADAMCZYK et al.,[17] 2020	Determine which type of SMR roller is effective in lactate removal and DOMS prevention	33 participants untrained and healthy males (Age= 19 a 25 years old)	Controlled trial: PR or Smooth SMR or Non-smooth SMR	Squats with full effort jumps in 1 min	-Total: 12 min SMR -1 x 60 s each muscle group of each leg. -IM after TP - Smooth and non-smooth rolls -Pressure BW	-Quadriceps -Hamstrings -Adductors -Gluteus -Gastrocnemius -Iliotibial tract	-IM after RP -24 h after RP -48 h after RP -72 h after RP -96 h after RP	↑ removal lactate non-smooth SMR and smooth SMR compared to PR > skin temperature in smooth and non-smooth SMR compared to PR after 30 min of SMR < PS Smooth (48 h to 96 h) and non-smooth (24 h to 96 h) SMR compared to PR
DE BENITO; VALLDECABRES,[18] 2019	Determine the effects of SMR with and without vibration after a fatigue-inducing protocol	24 active and healthy participants (Age= 18 a 28 years old)	Crossover trial: SMR with or without vibration	30 Reps lunges for min until voluntary fatigue	-Total: 4 min SMR -2 x 60 s each muscle group rest 30 s -IM after TP -Dense roll -Pressure BW	-Quadriceps -Hamstrings	-IM após FP -IM after RP	↑Flex ankle and hamstrings
KALÉN et al.,[7] 2017	Compare the effectiveness of RP, RA or SMR in removing lactate after an aquatic rescue.	12 lifeguard (Age= 24 ± 4,9 years old)	Crossover trial: AR, PR or SMR	100 m aquatic rescue	-Total: 20 min SMR -1 min each leg -IM after aquatic rescue -High dens roll -Pressure BW	-Quadriceps -Hamstrings -Adductors -Gluteus -Iliotibial tract	-IM after FP -IM after RP	< lactate concentration in SMR and AR compared to PR No significant difference RPE

LAFFAYE et al.,[19] 2019	Assess the impact of SMR on a lower limb immediately after HIIT	20 healthy participants (Age= 24,45 ± 3,35 years old)	Contralateral lower limb as control	8 x 20 s squat 10 s of rest	- Total: 4 min SMR -2 x 60 s each muscle group of the dominant leg -IM after TP - Non-smooth high dens roller -Pressure BW	-FLT -Rectus femoris and sartorius	-IM after RP -24 h after RP -48 h after RP	No significant difference VJ and ROM < PS after 24 h SMR leg compared to control leg
D'AMICO; PAOLONE,[20] 2017	Examine SMR impact on recovery between two 800 m runs	16 trained participants (Age= 20,5 ± 0,5 years old)	Crossover trial: PR or SMR	800m treadmill run	-Total: 10 min SMR -30 s each muscle group. -IM after run -EVA roll -Pressure BW	-Hip flexors -Quadriceps -Iliotibial tract -Adductors -Gluteus -Gastrocnemius	-IM after first run e IM before RP -IM after second run	No significant difference in lactate removal, running hip extension and running time
REY et al.,[21] 2019	Examine the effectiveness of SMR and PR interventions performed immediately after a training session	18 professional soccer players (Age= 26,6 ± 3,3 years old)	Controlled trial: PR or SMR	standardized soccer training	-Total: 20 min SMR -2 x 45 s rest 15 s each muscle group each leg. -IM after TP -High dens roll -Pressure BW	-Quadriceps -Hamstrings -Adductors -Gluteus -Gastrocnemius	-24 h after RP	SPR Maintenance, PS maintenance, Maintenance agility after 24 h No significant difference VJ, Sprint and Flex
FLECKENSTEIN et al.,[22] 2017	To compare the effects of a single preventive or regenerative SMR session on exercise-induced neuromuscular exhaustion	44 healthy and physically active participants (23 men age = 24.8 ± 2.3 years old and 22 women age = 25 ± 2 years old)	Controlled trial: PR, SMR antes FP or SMR after FP	Functional agility short-term fatigue protocol (FAST-FP)	-Total: 5 min SMR -30 s each muscle group, in both legs-IM após PF -Roll -Pressure BW	-Quadriceps -Hamstrings -Adductors -Iliotibial tract -Gastrocnemius	-IM after FP and 5 min after FP or IM after RP and 5 min after RP	< MVIC reduction IM after FP and 5 min after FP No significant difference PS and VJ
JO et al.,[23] 2018	Examine the effects of SMR IM after strenuous activity on fatigue-related muscle performance	25 healthy individuals (Age = 18 to 25 years old)	Crossover trial: PR or SMR	Treadmill maximal effort protocol and 3 x 10 reps of deep jumps	-Total: 10 min SMR -2 x 30 s each muscle group -IM after maximum effort protocol -High dens plastic core roller -Pressure BW	-Hamstrings -Quadriceps -Adductors -Iliotibial tract -Gastrocnemius	-IM after RP	< Velocity decline, power and peak power in VJ No significant difference in dynamic reaction
ROMERO-MORALEDA et al.,[24] 2019	Compare the effects between SMR without and with vibration after causing muscle damage	38 healthy participants (Age = 22.2±3.2 years old)	Controlled trial: SMR without or with vibration	10 x 10 reps of eccentric squats	-Total: 10 min SMR -5 x 60 s rest for 30 s, on both legs. -48 h after TP -Polystyrene roller -Pressure BW	-Quadriceps	-48 h after TP e IM after RP	< PS, > VJ height and ROM hip (active and passive) and knee (active) > Passive PS and lower pain threshold in SMR compared to vibrating roller
ROMERO-MORALEDA et al.,[25] 2017	Compare the immediate effects of a Neurodynamic Mobilization or SMR treatment after DOMS	32 healthy participants (Age= 22.6 ± 2.2 years old)	Controlled trial: Neurodynamic Mobilization or SMR	5 x 20 reps in box jumps (0.5m) 2 min rest between sets	-Total: 10 min SMR -5 x 60 s rest for 30 s on both legs -48 h after PT -Polystyrene roller -Pressure BW	-Quadriceps	-48 h after TP e IM after RP	< PS SMR and Neurodynamic Mobilization group compared to pre TP ↑ of leg strength ↑ MVIC of the rectus femoris SMR
AKINCI et al.,[26] 2020	Compare AR, neuromuscular electrical stimulation and SMR in healthy young people	45 healthy young participants (Age= 20 a 25 years old)	Controlled trial: SMR ou AR ou neuromuscular electrical stimulation	Circuit based on high intensity training	-Total: 15 min SMR -90 s each muscle group in both legs. -IM after circuit -Polyurethane and polypropylene roller -Pressure BW	-Quadriceps - Hamstrings -Adductors -Gluteus -Iliotibial tract	-IM after RP (Flex, strength and resistance) -5 and 20 min after RP (Lactate) -IM, 24 and 48 h after RP (PS)	< Flex, hamstring strength and squat resistance SMR compared to neuromuscular electrical stimulation and RA No significant difference PS and lactate
LEE et al.,[27] 2020	Determine the influence of SMR on pain and running performance compared to the simulation of compression tights	8 runners (Age=31 ± 7 years old)	Crossover trial: SMR or placebo (compression tights)	30 min downhill run at 75% speed of 5 km run	-Total: 16 min SMR -2 x 1 min muscle group in both legs -IM after run -Dense roller	- Quadriceps - Hamstrings -Gluteus -Iliotibial tract	-IM after running (IM before RP) and 48 h after RP	< PS active SMR pre to post compared compression tights No significant difference RPE, CK and time on 3km counter
DA SILVA; et al. et al.,[28] 2019	To investigate the effect of SMR during rest between sets on rep number	10 men trained in resistance training (Age: 27.3 ± 5.1 years old)	Crossover trial: SMR e PR	2 x 70% of a 1 RM to concentric failure	-Total: 60 s SMR -Between knee extension sets -Inner hard core EVA roller -Pressure BW	-Quadriceps	-IM after RP	No significant difference in the number of repetitions between PR and SMR group

ÖZSU et al.,[29] 2018	Compare the effects of PR, AR and SMR on the removal of lactate and SPR 22 well-trained team sports athletes	22 well-trained team sports athletes (Age= 22.6 ± 2.9 years old)	Crossover trial: SMR, PR e AR	Wingate anaerobic test	-Total:15 min SMR -3 x 30 s, 10-30 s rest on both legs. -IM after FP -Trigger point roller -Max BW pressure	-Hamstrings -Quadriceps -Hip -Iliotibial tract -Gastrocnemius -Anterior tibial	-IM after RP	> SPR SMR compared to PR and AR < RPE SMR compared to PR and AR > lactate removal SMR and AR compared to PR No significant difference in anaerobic power
GIOVANELLI et al.,[30] 2018	Assessing the effects of SMR on the Running Economy	13 students practicing sports (Age= 26.3±5.3 years old)	Crossover trial: SMR or PR	10 min treadmill run	Total: 16 min SMR -1 x 1 min each muscle group in both legs. -After the run protocol -Roll -Max BW pressure	-Plantar fascia -Gastrocnemius -Tibial anterior -Quadriceps -Hamstrings -Gluteus -FLT	-IM and 3 h after RP	No significant difference VJ and RPE
ZORKO et al.,[31] 2016	Provide data on the effects of SMR on the recovery of muscle contractile function	10 active university students (Age= 18 to 24 years old)	Contralateral lower limb as control	3 x 15 rep knee extension with 70% of 1 RM	-Total: 90 s SMR in the dominant leg. -After FP -Trigger point roller -Pressure BW	-Quadriceps	-IM after FP and IM after RP	No significant difference MVIC
MILLER et al.,[32] 2019	Examine the effects of SMR on peak sprint performance and ROM in recreational athletes	22 physically active participants (11 men age = 22.16 years old and 11 women age = 21.7 years old)	Crossover trial: SMR or PR	Sprint protocol	-Total: 12 min SMR -3 x 30 s, 10 s of rest each muscle group in both legs. -IM after sprint protocol -High density polyethylene roller -Max BW pressure	-Gastrocnemius -Quadriceps -Gluteus -Hamstrings	-IM after RP	↑ ankle, knee and hip ROM SMR compared to RP No significant difference speed
POŻAROWSZCZYK et al.,[33] 2018	Understand the effectiveness of SMR on muscle stiffness, flexibility and tone in swimmers	12 adolescent swimmers (Age= 14 ± 2 years old)	Pre-Post test	Aerobic swim training with 4 km and 75 min duration	Total: 15 min SMR -8 to 10 reps each muscle group. -IM after swimming training -Roll -Max BW pressure	-Back -Legs (posterior) -Neck	-IM after TP and IM after SMR	↑ Flex postural muscles, pre to after SMR

Source: Elaborated by the author, 2021. IASTM = instrument assisted soft tissue mobilization, SMR = self-myofascial release, EB = elastic band, ROM = range of motion, BW = body weight, IM = immediately, RP = recovery protocol, > larger, TP = training protocol, dens = density, CON = control, PS = perception of soreness, CK = creatine kinase, MVCC = maximal voluntary concentric contraction, MVIC = maximal voluntary isometric contraction, < less, AR = active recovery, ↑ = increase, HWI = hot water immersion, , PR = passive recovery, DOMS = delayed onset muscle soreness, Reps = repetitions, FP = fatigue protocol, Flex = flexibility, RPE = rating of perceived exertion, FLT = fascia lata tensor, VJ = Vertical jump, SPR = subjective perception of recovery, RM = repetition maximum

SMFR and other results

One study found that multiple SMFR sessions increased the removal of blood lactate and the sensation of recovery.[46] Five studies with one post-exercise SMFR session also observed faster lactate removal,[7,15-17,29] but two studies did not observe this effect.[20,26] These results highlight that both one session and multiple sessions of SMFR have the potential to accelerate lactate removal. It was not possible to determine the effect of SMFR on aerobic power or aerobic capacity due to a lack of studies.

The use of multiple SMFR sessions between sets of exercise reduced the number of repetitions and resistance to fatigue.[38,39,42,43] The studies used multiple sessions of SMFR with intervention times of 60, 90, and 120 seconds between sets of knee extensions to eccentric failure.[38,39,42,43] The longer the duration of the SMFR session, the greater the decrease in performance. Using One SMFR session between two exercise sets had no positive effect nor did it reduce the number of repetitions.[28] The results indicate that multiple SMFR sessions between sets of resistance exercises should be avoided because they hinder performance recovery.

The use of a single SMFR session after the training protocol did not influence either serum CK concentration or the perception of exertion, but it produced a greater perception of recovery and an increase in skin temperature.[7,13,16,17,21,27,29,30] It was also associated with a lower perception of exertion after the Wingate test when compared to passive recovery.[18] In addition, one study with multiple SMFR sessions reported similar positive sensation of recovery results after futsal matches.[46] A single session and multiple sessions of SMFR both demonstrated similar positive results for the perception of recovery. One SMFR session can have a positive effect on recovery of the perception of exertion.

CONCLUSION

Although both a single session and multiple sessions have similar effects on the recovery of agility, the reduction in late-onset muscle pain, lactate removal, increased flexibility, and perceived recovery, the two strategies produced different effects on the recovery of lower limb power, speed, and strength. While a single SMFR session appears to be more effective in recovering strength performance, multiple sessions are more effective restoring the power of the lower limbs and speed. Additionally, there is evidence that multiple sessions during rest periods between sets of resistance exercises reduce performance. Effects experienced after using this SMFR strategy point to a smaller decrease in performance and may be beneficial to athletes who train and compete repeatedly. So, it is important to evaluate the individual responses within the practical context. Further studies should assess the chronic use of SMFR in performance recovery and identify potential mechanisms involved in the process.

All authors declare no potential conflict of interest related to this article

Table 2. Synthesis of studies examining the effects of multiple SMR sessions on performance recovery.

Author	Objective	Sample	Outline	Training Protocol	SMR Protocol	Muscle Group Treated	Evaluation of Variables	Outcome
D'AMICO et al.,[34] 2020	Evaluate the influence of SMR on physical performance and autonomic function after EIMD	40 healthy adults (Age=19 to 38 years old)	Controlled trial: SMR or CON	40 x 15 m Sprint	Total: 25 min SMR -60 s each muscle group of each leg - IM, 24, 48, 72, 96 h after TP -High density roller -Pressure BW	-Quadriceps -Iliotibial tract -Hamstrings -Adductors -Gluteus -Gastrocnemius	-IM after RP	< PS SMR 24, 48, 72, 96 h after TP compared to CON
D'AMICO; GILLIS,[6] 2019	Examine the impact of SMR on recovery from EIMD	37 healthy participants (SMR age = 22.4 ± 2.0 years old and CON age = 23.2 ± 3.2 years old)	Controlled trial: SMR or PR	40 Sprints de 15 m	-Total: 24 min SMR -2 x 60 s each muscle group in both legs. -Pressure BW -IM, 24 h, 48 h, 72 h, 96 h after sprints -High density roller	-Quadriceps -Hamstrings -Adductors -Iliotibial tract -Maximum gluteus -Gastrocnemius	-IM after RP	> agility SMR compared to PR No significant difference ROM, VJ, PS
NADERI et al.,[35] 2020	To examine the effects of SMR on muscle and joint proprioception after an intense exercise protocol	80 healthy and physically active students (Age= 22.8 ± 3.3 years old)	Controlled trial: SMR or PR	4 x 25 reps maximal eccentric voluntary contractions 2 min rest between sets	-Total: 2 min SMR -Max BW pressure -1 h, 24 h, 48 h, 72 h after TP -Polypropylene roller	-Quadriceps	-IM after RP	< PS SMR > pain threshold SMR > strength with 60° and 120° SMR 24 h after TP > pain threshold SMR > strength with 60° and 120° SMR 48 h after TP > força com 60° e 120° SMR 24 h após TP
MACDONALD et al.,[1] 2014	Understand the effectiveness of SMR as a recovery tool after EIMD	20 active participants with experience in strength training (Age= 25.1 ± 3.6 years old)	Controlled trial: SMR or PR	10 x 10 reps squat, 2 min rest between sets	-Total: 20 min SMR -60 s in each muscle group. -Pressure BW -IM, 24 h, 48 h after TP -Roller	-Quadriceps -Hamstrings -Adductors -Iliotibial tract -Gluteus	-24 h after RP	< PS 24, 48 and 72 h after TP compared to PR Maintenance and ↑ height VJ SMR 24 and 48 h after TP compared to PR no significant difference strength maintenance and ↑ Hamstring ROM active 24 h, passive 72 h and passive quadriceps 48 h and 72 h SMR after TP compared to PR
DRINKWATER et al.,[36] 2019	Investigating the effects of acute SMR use after a single bout of eccentric exercise	11 healthy participants (Age= 24.0 ± 0.7 years old)	Crossover trial: SMR or PR	6 x 25 reps eccentric contraction in knee extension with 60 s rest between sets	-Total: 15 min SMR -3 min right leg muscle group. -Max BW pressure -IM, 24, 48, 72 h after TP -Roller	Quadriceps -Adductors -Iliotibial tract -Gluteus -Hamstrings	-IM after RP	↑ height VJ SMR at 48 and 72 h after TP No significant difference ROM and MVIC > pain threshold SMR 48 h after TP
PEARCEY et al.,[8] 2015	Examine the effects of SMR as a recovery tool after an intense exercise protocol	8 healthy and physically active participants (men) (Age = 22.1 ± 2.5 years old)	Crossover trial: SMR or PR	Squat with 10 x 10 reps	-Total: 20 min SMR -2 x 45 s muscle group, rest 15 s -Max BW pressure -IM, 24, 48 h after TP - PVC and Neoprene roller	-Quadriceps -Adductors -Iliotibial tract -Gluteus -Hamstrings	-24 h after RP	> pain threshold SMR after TP < increase sprint time 24 h and 72 h SMR after TP < jump distance decline 24 h and 72 h SMR after TP compared to PR > resistance 48 h SMR after TP No significant difference agility
AUNE et al.,[37] 2019	Compare the acute and chronic effects of eccentric training and SMR on ankle dorsiflexion	23 base football players (Age= 18 ± 1 years old)	Controlled trial: SMR or eccentric training	Daily Football Training Sessions	-Total: 4 weeks SMR -3 x 60 s, 30 s rest dominant leg -Max BW pressure -Before the daily football training sessions -Roll	-Gastrocnemius	-30 min, 24 h after SMR -After 4 weeks using SMR	No significant difference in ROM and plantar flexion torque ↑ reactive force after 4 weeks of SMR

MONTEIRO et al.,[38] 2017	Investigate how different SMR durations during rest periods between sets affect the number of reps	25 active women (Age= 27.8 ±3.6 years old)	Crossover trial: SMR 60 s, SMR90 s, SMR 120 s or PR	4 x knee extension (load 10 RM) until concentric failure, 4 min rest between sets	-3 x 60 s (Total: 3 min SMR) -3 x 90 s (Total: 4 min and 30 s SMR) -3 x 120 s (Total: 6 min SMR) -On both legs together -Max BW pressure -Between the series -EVA roll (trigger point)	-Quadriceps	-IM after RP	< number of reps SMR120, SMR90 and SMR60 compared to PR > number of SMR60 and SMR90 reps compared to SMR120 No significant difference SMR60 and SMR90
MONTEIRO; NETO,[39] 2016	To analyze the effect of different durations of SMR on fatigue of knee extensors	25 active women (age 27.7 ± 3.56 years old)	Crossover trial: SMR 60 s, SMR 90 s, SMR 120 s or PR	3 x knee extension (load 10 RM) until concentric failure, rest 4 min between sets	-2 x 60 s (Total: 2 min SMR) -2 x 90 s (Total: 3 min SMR) -2 x 120 s (Total: 4 min SMR) -On both legs together -Max BW pressure -Between the series -EVA roller (trigger point)	-Quadriceps	-IM after RP	> fatigue resistance for CON than SMR90 and SMR120 > SMR60 fatigue strength than SMR120 > SMR90 fatigue strength than SMR120
ALIN; AZAB,[40] 2019	To investigate the effects of SMR on ROM and on the performance level of individual routine in rhythmic gymnastics for female students	20 female college students (Age CON= 20.36 ± 0.4 years old, SMR = 20.55 ± 0.3 years old)	Controlled trial: SMR or without intervention	Individual rhythmic gymnastics training routine	-Total: 8 weeks SMR -3 x week -1 h - Roller	Unspecified	After 8 weeks using SMR	> Shoulder, Back and Knee ROM ↑ individual performance of SMR rhythmic gymnastics compared to CON
GUILLOT et al.,[41] 2019	Answer whether short and long SMR durations and elastic training improve ROM in rugby players	30 professional rugby players (Age = 18.85 ± 1.1 years old)	Controlled trial: SMR 40 s, SMR 20 s or PR and Controlled trial: SMR or elastic band training	Rugby Practice Routine	-Total: 6 weeks SMR (15 sessions) -On both legs. -SMR 40= 40 s muscle group -SMR 20= 20 s muscle group -Pressure BW -High dens roller	-Gluteus -Quadriceps -Hamstrings -Adductors -Gastrocnemius	-After 6 weeks using SMR	> ADM opening SMR20 and SMR40 compared to PR > ROM in hip flexion and extension SMR20 and SMR40 compared to PR No significant difference SMR20 and SMR40 No significant difference between knee and ankle ROM > Hamstring and Adductors ROM Elastic Training
MONTEIRO et al.,[42] 2017	To investigate the effects of different SMR durations on the hamstrings during the rest period between sets	25 active women (Age= 27.8 ± 3.6 years old)	Crossover trial: SMR 60 s, SMR 120 s or PR	3 x knee extension (10 RM load) to concentric failure, 4 min rest between sets	3 x knee extension (load 10 RM) until concentric failure. 4 min rest between sets -2 x 60s (Total: 2 min SMR) -2 x 120s (Total: 4 min SMR) -On both legs together. -Pressure BW -Between sets -EVA roll (Trigger Point)	-Hamstrings	-IM after RP	> number of reps PR compared to SMR60 and SMR120 > number of reps SMR60 compared to SMR120
MONTEIRO et al.,[43] 2019	Analyze the acute effects of different durations on fatigue of knee extensors	12 active women (Age= 27.58 ± 3.23 years old)	Crossover trial: SMR 60 s, SMR 120 s or PR	3 x maximum knee extension (load 10 RM) until concentric failure, rest 5 min between sets	-2 x 60 s (Total: 2 min SMR) -2 x 120 s (Total: 4 min SMR) -In the dominant leg -Pressure BW -Between series -EVA (Trigger Point) Roller	-Hamstrings	-IM after RP	> fatigue strength PR compared to SMR60 and SMR120 No significant difference SMR60 and SMR120

STOVERN et al.,[44] 2019	Evaluate the effects of SMR training on ROM, flexibility, agility and height VJ	34 active participants (Age= 20.8 years old)	Controlled trial: SMR ou without intervention	Recreational training routine	-Total: 6 weeks SMR (18 sessions, 3 sessions per week) -15 min -Session 3 x 20 s each muscle group. -Pressure BW -EVA Roller (Trigger Point)	-Lower back -Gluteus -Quadriceps -Hamstrings -Gastrocnemius -Iliotibial tract	-After 6 weeks using SMR	> ankle ROM SMR and CON Pre to post, no difference between groups. No significant difference knee ROM, agility and VJ ↑ Flex SMR compared to CON, Pre to post-test SMR More flexible and feel that could jump higher than CON
JUNKER; STÖGGL,[45] 2019	To examine the effect of an 8-week SMR intervention	40 active participants (SMR Age= 30.5 ± 10.2 years old, CORE= 28.2 ± 7.8 years old, CON= 29.1 ± 6.9 years old)	Controlled trial: SMR or CORE or without intervention	Routine of sports activities	-Total: 8 weeks SMR (2 sessions per week) -27 to 30 min per week -3 x 30 to 50 s -Pressure BW -Roller	-Gastrocnemius -Hamstrings -Quadriceps -Gluteus -Iliotibial tract	After 8 weeks using SMR	↑ CORE dorsal resistance compared to SMR and CON No significant difference jump ↑ Flex SMR compared to CON No significant difference between SMR and CORE
RAHIMI et al.,[46] 2020	To investigate the effectiveness of SMR recovery of futsal players in a simulated futsal tournament	16 young futsal players (Age= 19 ± 1.2 years old)	Controlled trial: SMR or PR	Futsal matches	-Total: 15 min SMR -3 x 40 s, 20 s rest on each muscle group. -on both legs -Pressure BW -5 min after futsal match (3 matches) -Non-smooth PVC roll and neoprene	-Gastrocnemius -Quadriceps -Hamstrings -Gluteus	-24 h after RP	No significant difference repeated sprint, agility, Yo-yo test and VJ SMR compared to PR > sensation recovery SMR second and third game < lactate 15 and 30 min SMR after third match
JUNKER; STÖGGL,[47] 2015	Determine the effect of a 4-week SMR training period on hamstring flexibility	40 active participants (SMR age = 31.0 ± 8.5 years old, PNF = 33.0 ± 10.5 years, CON = 30.0 ± 9.0 years old)	Controlled trial: SMR, Proprioceptive neuromuscular facilitation or without intervention	Routine of sports activities	-Total: 4 weeks SMR (3 sessions per week) -3 x 30 to 40 s -on both legs -Pressure BW -Roll	-Hamstrings	-After 4 weeks using SMR	↑ Flex SMR and proprioceptive neuromuscular facilitation than CON, Pre to post No significant difference in SMR and proprioceptive neuromuscular facilitation

Source: Elaborated by the author, 2021. SMR = self-myofascial release, EIMD = exercise-induced muscle damage, CON = control, IM = immediately, TP = training protocol, BW = body weight, RP = recovery protocol, < less, PS = perception of soreness, PR = passive recovery, dens = density, > larger, ROM = range of motion, VJ = Vertical jump, reps = repetitions ↑ increase, MVIC = maximal voluntary isometric contraction, FI = fatigue index, Flex = flexibility.

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