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THE IMPACT OF FOAM ROLLING ON MUSCLE RECOVERY AND PAIN RELIEF – A REVIEW ARTICLE

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ABSTRACT

The present review evaluates the impact of foam rolling on muscle recovery, with a particular focus on muscle strength, lactate clearance, range of motion, and delayed onset muscle soreness (DOMS). The analysis synthesizes findings from multiple studies, indicating that foam rolling may preserve muscle strength, reduce lactate accumulation, and alleviate DOMS following intense physical exertion. Evidence from various athletic populations suggests that foam rolling effectively minimizes the decline in isometric and explosive strength post-exercise, particularly in the lower limbs, while also decreasing subjective fatigue and improving proprioception. The application of vibration during foam rolling may further enhance perfusion, promoting metabolic clearance, though these effects are transient. Additionally, foam rolling appears to reduce muscle soreness at 24, 48, and 72 hours post-exercise, with some studies suggesting comparable efficacy to active recovery methods. However, inconsistencies in study design, intervention duration, and roller type limit the generalization of findings. Consequently, while foam rolling shows promise as a supplementary recovery tool, further research is warranted to standardize protocols and elucidate its long-term efficacy.

KEYWORDS

Foam Rolling, Muscle Recovery, DOMS, Pain Reduction, Muscle Strength, Myofascial Release

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Introduction.

Skeletal muscle regeneration is a complex biological process which is initiated in response to exercise-induced muscle damage. It is characterized by structural disruptions at the myofibrillar level and is associated with symptoms such as delayed onset muscle soreness (DOMS), reduced force production, and localized inflammation. The muscle repair process involves coordinated phases: immune cells clear debris and release cytokines, activating quiescent satellite cells. These cells proliferate, differentiate into myoblasts, and fuse to form or repair myofibers. Autophagy degrades damaged components, maintaining cellular homeostasis and supporting regeneration. The extent and rate of muscle recovery post-exercise are influenced by several factors. Eccentric exercises typically induce greater muscle damage compared to concentric or isometric activities. The intensity and duration of exercise also play significant roles; higher intensity and longer duration can lead to more substantial muscle damage. Individual factors such as age, sex, nutrition, fitness level, genetics, and familiarity with the exercise task can influence the magnitude of performance decrement and the time course of recovery following exercise-induced muscle damage (Markus et al., 2021).

Foam rolling, a form of self-myofascial release, involves applying pressure to soft tissues using a cylindrical tool to alleviate muscle tightness and enhance flexibility. This technique targets the fascia, the connective tissue enveloping muscles, which can become restricted due to overuse or injury. By rolling over specific muscle groups, individuals can promote blood flow, reduce DOMS, and improve range of motion without adversely affecting muscle performance. The physiological benefits of foam rolling are attributed to several mechanisms. These include the stimulation of mechanoreceptors that modulate pain perception, the breakdown of adhesions within the fascial network, and the enhancement of lymphatic drainage. Additionally, the thixotropic properties of fascia – where tissue viscosity decreases with movement – facilitate improved tissue pliability and mobility. Foam rollers vary in density and texture, ranging from soft to firm, and may feature smooth or textured surfaces. The choice of roller depends on the user's experience and therapeutic goals; firmer rollers provide deeper pressure, while softer ones are suitable for beginners or sensitive areas. Incorporating foam rolling into warm-up or cool-down routines can be an effective strategy for enhancing muscle recovery and performance.

Foam rolling has become a prevalent modality in clinical practice, particularly among physical therapists and sports medicine professionals. Despite its widespread use, there is a recognized need for standardized protocols and clinical guidelines for foam rolling. A significant proportion of professionals acknowledge a gap in research regarding the optimal application of foam rolling techniques. This underscores the necessity for further studies to establish evidence-based practices and to determine the most effective parameters for foam rolling interventions (Cheatham, 2019).

In summary, muscle regeneration following exercise-induced damage involves a multifaceted repair process mediated by immune cells, satellite cells, and autophagy, with recovery influenced by exercise modality and individual factors. Foam rolling, widely utilized for its potential to reduce DOMS and enhance tissue pliability, targets fascial restrictions through self-myofascial release techniques. Despite its clinical popularity, a lack of standardized protocols underscores the need for further investigation into its optimal application. This review aims to critically evaluate the impact of foam rolling on muscle regeneration, examining current evidence and identifying gaps to inform evidence-based practice.

Methodology

This review article was conducted to assess the impact of foam rolling on muscle regeneration with a particular focus on its effects on pain relief and recovery post-exercise. The research was carried out in May 2025 using the PubMed database as the primary source of literature. The search strategy employed the keywords "foam rolling AND (muscle recovery OR muscle regeneration OR regeneration)," yielding a total of 70 articles which were screened for relevance. Inclusion criteria were based on the relevance of the article's title and abstract, focusing on studies that specifically addressed the application of foam rolling and its impact on muscle recovery, including aspects related to delayed onset muscle soreness (DOMS), range of motion, and tissue repair.

A total of 28 studies met the inclusion criteria and were subjected to critical analysis. The synthesis aimed to provide an objective evaluation of the potential impact of foam rolling on muscle regeneration and recovery.

Results

The effect of using a foam roller on muscle recovery has been the subject of many studies, but the results obtained are not entirely conclusive. Some studies indicate its potential benefits in restoring muscle function following intense physical exertion. In a study conducted by Naderi et al. (Naderi et al., 2020), the use of a foam roller significantly reduced the decline in isometric strength compared to passive rest. Similar results were observed in studies involving futsal players (Rahimi et al., 2020) and professional football players (Rey et al., 2019), where foam rolling reduced the decline in explosive strength of the lower limbs after intense physical exercise and also reduced the subjective sensation of fatigue while minimizing the decrease in agility. This suggests its potential role as a tool to aid regeneration. In addition, the use of a foam roller can also have beneficial effects on proprioception and motor control (Naderi et al., 2020).

Due to its effect on muscle perfusion and lactate metabolism, the foam roller may serve as an effective tool in accelerating recovery processes. An MRI study demonstrated that foam rolling applied immediately after a half-marathon reduced inflammatory swelling in muscles and improved perfusion (Shu et al., 2021). However, these effects were transient and lasted up to 60 minutes post-intervention. Another study by Romero-Moraleda et al. (Romero-Moraleda et al., 2019) evaluated the effects of a foam roller with a vibration function on muscle perfusion and showed that adding vibration more effectively increases perfusion than standard foam rolling, which may be important in terms of improving local blood supply and accelerating muscle recovery. Meanwhile, a study involving futsal players indicated that foam rolling accelerated lactate clearance after an intense tournament, potentially enhancing the aerobic performance of the athletes (Rahimi et al., 2020).

Foam rolling can also affect range of motion and muscle flexibility, but the results of studies in this area are inconclusive. In the study by Laffaye et al. (Laffaye et al., 2019), only a slight positive effect of foam roller application after a high-intensity interval training session on hip joint range of motion was observed (an improvement of 4.2%), with no statistically significant impact on other joints. However, a significant reduction in delayed onset muscle soreness (DOMS) was noted. The findings suggest that foam rolling may be effective in reducing DOMS after intense exercise, but its impact on recovery of physical performance remains limited. In contrast, a meta-analysis involving 21 studies (Wiewelhove et al., 2019) found that the use of a foam roller after exercise can slightly increase muscle flexibility (4.0% improvement), but these effects were more pronounced in competitive athletes than recreational athletes.

Reducing the perception of muscle soreness, commonly referred to as DOMS, after intense physical activity is one of the primary applications of foam rolling. In a study conducted by Arbiza et al. (Arbiza et al., 2024), an intervention involving foam roller use compared to passive rest after intense physical exercise reduced muscle soreness by 22.8% after 24 hours, 39.2% after 48 hours, and 59.7% after 72 hours. It is noteworthy that the effects of the above intervention on pain reduction were comparable to those of active recovery performed on a cycle ergometer. Similar findings concerning pain reduction (particularly 2-4 days post-intervention) were also observed in a study made by D'Amico et al. (D'Amico et al., 2020). Furthermore, a study involving members of the Chinese national volleyball team (Zhang et al., 2024) demonstrated the effectiveness of foam rolling in reducing muscle soreness after eccentric exercise. The muscle pain intensity assessed on the VAS scale was significantly lower 96 hours post-exercise in the foam roller group compared to the control group. Another study by Romero-Moraleda et al. (Romero-Moraleda et al., 2017) also supports the positive impact of foam rolling on muscle soreness reduction after intense exercise (pain reduction measured on the NPRS scale was up to 45%). Foam roller application immediately post-exercise and every 24 hours effectively decreased DOMS and mitigated declines in dynamic power (Pearcey et al., 2015). In a study by Zhang et al. (Zhang et al., 2025), foam roller use was associated with a significant reduction in muscle soreness, lower CK levels, and accelerated lactate clearance after intense exercise in elite volleyball players, achieving effects comparable to active recovery, especially in the 48-96 hour post-exercise period. Additionally, both foam rolling and active recovery provided better muscle perfusion compared to passive rest.

In the study made by Lee et al. (Lee et al., 2020), foam rolling effectively reduced the perception of active muscle pain, assessed using the VAS scale, compared to compression tights. The greatest effect was observed at 48 hours post-intervention. However, it is worth noting that differences in passive pain levels were not statistically significant, suggesting that foam rolling may mainly affect pain perception during physical activity, not necessarily in a resting state.

The rolling duration plays also a key role. As shown by Hughes et al. (Hughes & Ramer, 2019), foam rolling applied for 90 seconds per muscle group can effectively reduce muscle soreness. Extending the intervention duration beyond 90 seconds does not provide additional benefits and may even impair muscle performance. The type or texture of the foam roller is also another factor that has been studied for its effectiveness. Some studies indicate that foam rolling, regardless of roller texture and hardness, effectively reduces muscle soreness and accelerates lactate clearance after intense exercise. However, the duration of the intervention (120 s per muscle group) may be a key factor determining foam rolling effectiveness, while the roller structure does not significantly impact recovery efficacy (Michalak et al., 2024). Other studies contradict these findings, showing that the structure and type of roller used may influence the degree of muscle tissue compression and thus the intensity of mechanical stimuli acting on pain receptors. A study by Adamczyk et al. (Adamczyk et al., 2020) demonstrated that foam rolling using a GRID-type roller resulted in greater muscle soreness reduction compared to a traditional, smooth roller. However, these differences were not evident regarding the rate of muscle recovery. The application of a vibrating roller also has a positive effect on reducing the perception of muscle soreness after exercise (Romero-Moraleda et al., 2019). Both vibration and non-vibration foam rolling effectively decrease muscle oxygen demand, but adding vibration does not provide additional benefits in this aspect (Huang et al., 2024).

Several studies, however, indicate a lack of significant positive effects of foam roller use. It may have limited efficacy as a recovery tool but may support recovery after intense eccentric exercises by reducing DOMS and enhancing dynamic power (Drinkwater et al., 2019). In a study made by Junker et al. (Junker & Stoggl, 2019), no significant improvement in muscle strength, endurance, or balance was noted in the foam roller group compared to the control group, despite twice-weekly application. The only parameter that showed significant changes was the range of motion in the stand and reach test. The authors suggest that foam rolling may affect flexibility, but its efficacy in improving muscle strength and functional recovery is limited. Similar results were also obtained by D'Amico et al. (D'Amico & Gillis, 2019). Moreover, a study by De Oliveira et al. (De Oliveira et al., 2023) suggests the lack of significant effects of foam rolling in restoring muscle power, agility, and flexibility within 24 hours post-exercise.

Studies assessing the impact of foam rolling on muscle pain perception and recovery after eccentric exercise, both in military tasks (Scudamore et al., 2021) and after intense loaded squats (Beier et al., 2019), did not observe significant differences in pain levels, muscle activation (measured using EMG), or range of motion compared to passive rest or dynamic warm-up. These findings suggest that foam rolling may have limited efficacy in enhancing muscle recovery in dynamic and strength tasks. In a study made by Vatovec et al. (Vatovec et al., 2024), performing two sets of 1-minute foam rolling had no significant impact on muscle stiffness in both uninjured and muscle-damaged states induced by eccentric contractions.

A study involving ten healthy professional athletes, aiming to assess the impact of foam rolling on muscle perfusion using contrast ultrasound, also did not demonstrate significant intervention effects (Schroeter et al., 2023). The authors suggest that foam rolling may not affect microcirculation in deeper muscle layers, which may limit its efficacy in enhancing perfusion.

Discussion

Foam rolling has become a widely discussed method for enhancing muscle recovery, yet the scientific evidence remains inconclusive. The present analysis aimed to evaluate the impact of foam rolling on muscle regeneration, focusing on its effects on muscle strength, lactate clearance, range of motion, and delayed onset muscle soreness. The findings demonstrate that foam rolling can offer potential benefits in preserving muscle strength, reducing lactate accumulation, improving flexibility, and alleviating DOMS; however, the efficacy and consistency of these outcomes vary across studies.

One of the most notable benefits of foam rolling is its impact on muscle strength, particularly following intense physical exertion. Several studies suggest that foam rolling significantly reduces the decline in isometric strength compared to passive rest. For instance, interventions involving futsal and professional football players demonstrated a preservation of explosive strength in the lower limbs post-exercise, along with decreased subjective fatigue and minimized agility loss. These results suggest that foam rolling may be a valuable tool in maintaining muscle performance after strenuous activities. Additionally, the incorporation of vibration in foam rolling appears to enhance local blood flow and perfusion, as indicated by an increase in muscle perfusion when compared to standard foam rolling. This physiological effect may facilitate the clearance of metabolic by-products, such as lactate, thereby accelerating muscle recovery. Notably, foam rolling applied immediately after prolonged efforts, such as a half-marathon, demonstrated a reduction in inflammatory swelling and improved muscle perfusion. However, the transitory nature of these effects, lasting approximately 60 minutes post-intervention, warrants further exploration to establish long-term benefits.

In addition to strength preservation, foam rolling may aid in reducing DOMS, which is a critical component of post-exercise recovery. Numerous studies have shown that foam rolling decreases perceived muscle soreness when compared to passive recovery. Notably, reductions in muscle pain were observed at 24, 48, and 72 hours post-intervention, with some studies suggesting that the efficacy is comparable to active recovery methods such as cycling on a cycle ergometer. The consistency of pain reduction was also observed across different athletic populations, including elite volleyball players and military personnel, where foam rolling contributed to lowering soreness, enhancing comfort, and facilitating the continuation of training routines. While foam rolling's efficacy in reducing muscle soreness is well supported, there is some variability in outcomes depending on the type of roller used. Specifically, textured or vibrating rollers may offer more pronounced relief compared to smooth rollers, though the evidence remains inconclusive regarding their impact on long-term muscle performance recovery.

Despite the promising results, several inconsistencies and methodological challenges limit the generalization of findings. Some studies report negligible effects of foam rolling on muscle strength, flexibility, and performance, particularly in non-elite populations or when the intervention duration exceeds 90 seconds per muscle group. Moreover, differences in study design, population characteristics, and the specificity of the exercise protocols may contribute to the observed variability. The lack of a standardized protocol for foam rolling application, including factors such as duration, frequency, and pressure, complicates the comparison of results and the formulation of clear clinical recommendations. Furthermore, some studies indicate that foam rolling does not significantly influence muscle perfusion in deeper muscle layers, suggesting that its primary benefits might be limited to superficial muscular structures. Additionally, the presence of short-term benefits without sustained recovery improvements challenges the notion of foam rolling as a standalone recovery intervention.

Considering the current evidence, foam rolling should be regarded as a supplementary method rather than a primary recovery strategy. While it may aid in reducing muscle soreness and preserving performance in the short term, its efficacy varies based on application parameters and individual responses. Future research should aim to establish more standardized protocols, investigate the physiological mechanisms underlying foam rolling, and explore its long-term effects on muscle recovery and athletic performance. Comparing foam rolling with other established recovery modalities, such as dynamic stretching or active recovery, would also provide valuable insights into its relative effectiveness. By addressing these gaps, future studies could better define the role of foam rolling within the context of sports recovery practices.

Conclusions

Foam rolling has emerged as a widely utilized recovery tool in athletic and rehabilitation settings, yet the findings regarding its efficacy remain mixed. The present analysis indicates that foam rolling can be beneficial in certain aspects of muscle recovery, particularly in reducing the decline in isometric and explosive strength following intense physical exertion. Multiple studies demonstrated its potential to alleviate delayed onset muscle soreness, with reductions in pain intensity observed at 24, 48, and 72 hours post-intervention, suggesting that foam rolling may serve as a valuable adjunct to recovery protocols, especially in high-intensity sports settings. Additionally, evidence points to its role in enhancing lactate clearance, which may contribute to more efficient muscle recovery and the maintenance of aerobic performance. However, the effects on flexibility and range of motion appear limited and inconsistent, with minor improvements reported in select populations and no statistically significant impact in others. The use of textured or vibrating rollers showed some potential in further amplifying these benefits, though findings remain inconclusive.

Despite the promising outcomes, several limitations and inconsistencies were noted across the reviewed studies. Methodological variability, including differences in study design, participant characteristics, and intervention parameters, complicates direct comparison of findings and hinders the establishment of clear clinical guidelines. The lack of standardized protocols concerning foam rolling duration, pressure, and frequency further limits the generalizability of results. Moreover, the transient nature of observed effects, particularly regarding muscle perfusion and inflammatory response, raises questions about the long-term efficacy of foam rolling as a recovery intervention. Certain studies reported negligible effects on muscle strength and recovery, particularly in non-elite or recreational athletes, underscoring the need for more targeted and individualized approaches.

Future research should focus on developing standardized foam rolling protocols that clearly define optimal application parameters, including duration, pressure, and frequency. Additionally, more rigorous studies are needed to assess the long-term effects of foam rolling on muscle recovery and athletic performance, particularly in comparison to other established recovery modalities such as dynamic stretching, active recovery, and compression therapy. Investigating the underlying physiological mechanisms of foam rolling, particularly its impact on deeper muscle layers and microcirculation, could also provide valuable insights into its therapeutic potential. Addressing these gaps will be crucial in determining the precise role of foam rolling within comprehensive recovery frameworks and in establishing evidence-based recommendations for its practical application.

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All authors have read and approved the final version of the manuscript.

Conflict of Interest Statement

The authors declare no conflicts of interest.

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