PEER REVIEW, Vol. 6, Nº 7, 2024
DOI: 10.53660/PRW-2059-3805
ISSN: 1541-1389

Morphofunctional characteristics of muscle fascia and the impact of its mobilization on the sports scene: an integrative review

Características morfofuncionais da fáscia muscular e o impacto de sua mobilização para o cenário esportivo: uma revisão integrativa

Francisco Camolesi Ide
ORCID: https://orcid.org/0000-0003-2825-4822
Universidade do Estado de Santa Catarina, Brasil
E-mail: franciscoide.02@gmail.com
Fernanda Aquino Costa
ORCID: https://orcid.org/0009-0000-1211-410X
Universidade do Estado de Santa Catarina, Brasil
Tamiris Beppler Martins
ORCID: https://orcid.org/0000-0001-6156-3454
Universidade do Estado de Santa Catarina, Brasil
E-mail: tamiris.martins@udesc.br
Raquel Fleig
ORCID: https://orcid.org/0000-0003-1934-6936
Universidade do Estado de Santa Catarina, Brasil
Gilmar Moraes Santos
ORCID: https://orcid.org/0000-0002-6322-9238
Universidade do Estado de Santa Catarina, Brasil
Iramar Baptistella do Nascimento
ORCID: https://orcid.org/0000-0003-1268-2777
Universidade do Estado de Santa Catarina, Brasil

ABSTRACT

The use of myofascial release has been the subject of study by scholars from different areas of health. Although there is a smaller number of researches, scientific findings point to a strong impact of its inclusion in protocols. Objective: to identify the morphofunctional characteristics of the muscular fascia and the impact of its mobilization in the sporting scenario. Method: the search was carried out in the LILACS, MEDLINE, SciELO, SPORTDiscus and Embase databases, using the SPIDER strategy. Results: 40 studies were selected, which revealed the main aspects regarding energy transmissibility through the muscular fascia. Conclusion: it is important to strengthen the relationship between the inclusion of myofascial release in protocols and the professional's skills. This research suggests combining self-applied release with Foam rollin with other standard stretches over a period of at least 8 weeks for ROM and explosive strength, before or after warm-up, with the purpose of both performance and prevention for athletes.

Keywords: Musculoskeletal manipulations; Fascia; physical activity.

Recebido: 05/03/2024 | Aceito: 07/04/2024 | Publicado: 10/04/2024

RESUMO

A utilização da liberação miofascial tem sido objeto de estudo por estudiosos de diferentes áreas da saúde. Embora exista um número mais restrito de pesquisas, os achados científicos apontam um forte impacto de sua inserção junto aos protocolos. Objetivo: identificar as características morfofuncionais da fáscia muscular e o impacto de sua mobilização para o cenário esportivo. Método: a busca foi realizada nas bases de dados LILACS, MEDLINE, SciELO, SPORTDiscus e Embase, utilizando a estratégia SPI-DER. Resultados: foram selecionados 40 estudos que revelaram os principais aspectos referentes à transmissibilidade energética através da fascia muscular. Conclusão: torna-se relevante o fortalecimento das relações entre a inclusão da liberação miofascial em protocolos e a habilidade do profissional. Esta pesquisa sugere a combinação da liberação autoaplicada com Foam rollin a outros alongamentos pa-drão num período de no mínimo 8 semanas para ADM e força explosiva, antes ou após o aquecimento, com o propósito tanto para performance quanto para prevenção de lesão dos atletas.

Palavras-Chave: Manipulações musculoesqueléticas; Fáscia; Atividade física.

INTRODUCTION

The fascial system (FS) presents an anatomical organization that establishes tensions involving muscles, viscera, and endothelium (FEDE et al., 2021). The deep fascial structure, known as muscular fascia, collaborates among connective tissues, instituting a dynamic of movement and functionality (ADSTRUM et al., 2017). The properties of muscular fascia (MF) contain synoviocyte cells, receptors in fibroblasts, and myofibroblasts (STECCO; SCHLEIP, 2016; ADSTRUM et al., 2017; SCHLEIP et al., 2020).

The tensions slowly accumulated by soft tissues and joints tend to establish a progressive loss of muscular functionality (SCHLEIP et al., 2020; SCHLEIP; HEDLEY; YUCESOY, 2019). It has become evident in the scientific literature the pos-sibility of force transfer through the composition and properties of the muscular fascia (FM) (ADSTRUM et al., 2017). Receptors presence in fibroblasts, synoviocytes, and myofibroblasts are found in its histomorphological structure (ADSTRUM et al., 2017; SCHLEIP; HEDLEY; YUCESOY, 2019). Myofascial release (MFR) has been an innovative strategy for conditions inherent in sports performance (FRANÇA et al., 2020). Strategies for releasing and reorganizing the fascia suggest further elucidation due to the existence of variables to be investigated, such as the behavior of muscle mechanoreceptors, the influence of the central nervous system (CNS), and central modulation on pain perception (BEHM et al., 2013; VIGOTSKY et al., 2015).

Myofascial release (MFR) is categorized into two main types: therapist-applied MFR and self-applied MFR by the individual (FRANÇA et al., 2023). The primary

techniques utilizing MFR include instrumental myofascial release (IMR), also known as instrument-assisted soft tissue mobilization (IASTM), which involves the use of cups, needles, scrapers, or hooks. The therapist can also choose for the use of their own hands. The second form of self-myofascial release (SMFR), namely, self-myofascial release (SMR), is performed through self-applied release with foam rolling (SAFR), in which the individual uses a foam cylinder and lies on it to perform specific movements (ADSTRUM et al., 2017; SCHLEIP; HEDLEY; YUCESOY et al., 2019; FRANÇA et al., 2023).

In the sports scenario, the use of self-myofascial release (SMR) has become a proposal, which in turn, is a self-applied intervention used in both rehabilitation processes and physical conditioning (GRIEVE et al., 2015). In sports, athletes seek manual therapies with the purpose of improving sports performance (FRANÇA et al., 2020). However, some factors are essential for the preservation and achievement of sports performance, such as the reduction of muscular fatigue, intra-articular pressures, and loss of oxygenation (AMORIM et al., 2022; BASSETT; HOWLEY, 2000; FAUDE; KINDERMANN; MEYER, 2009). It is important to highlight the force transmission from the manipulation of the FS, which seems to stem from a sequence that is constituted by an interdependent functional action of muscle groups (STECCO; SCHLEIP, 2016). Similarly, the already evident outcomes regarding the benefits in balance and pain attenuation awaken a favorable prognosis with the use of self-applied and applied MFR in the sports scenario (ADSTRUM et al., 2017; SCHLEIP; HEDLEY; YUCESOY, 2019; FRANÇA et al., 2020).

The different techniques and methodologies using MFR can be an opportunity to transcend from motivational effects to clinical applications and feasible improvements in athletes' performance. This includes enhancements in countermovement jump height, jump power, agility tests, and even achieving greater isometric strength (SCHLEIP, 2020). Research on the strength derived from MFR at different periods with its applicability and the identification of relevant outcomes, as well as seeking results on athletes' adaptations to contemporary MFR strategies, can lead to contemplation in the sports scenario. Therefore, the aim of this study was to identify the morphofunctional characteristics of muscle fascia and the impact of its mobilization on the sports scene.

METHOD

The present research is an integrative review. For the preparation and development of this research, the following methodological steps were taken: definition of inclusion and exclusion criteria; definition of the information to be extracted from the selected studies; categorization of the studies; analysis and interpretation of the data; evaluation of the results included in the integrative review; and presentation of the review/synthesis of knowledge in the following manner: stages (1) identification of the problem; (2) literature review; (4) data analysis; and (5) presentation of results (WITTEMORE; KNALF, 2005). In stage (3) categorization of sources, eight categorization items contained in the data col-lection instrument were used (URSI; GAVÃO, 2005).

The literature search was conducted based on an initial list of indexing terms or descriptors, which were used to identify records in Portuguese and English languages, following the SPIDER strategy (METHLEY et al., 2014). The search was carried out in the following databases: Latin American and Caribbean Health Sciences Literature (LILACS), Medical Literature Analysis and Retrieval System Online / Virtual Health Library (MEDLINE/BVS), Scientific Electronic Library Online (SciELO), SPORTDiscus, and Embase. The search was conceived using the Health Sciences Descriptors of the Virtual Health Library Lilacs (DeCS) to obtain specific keywords. The following descriptors were selected: Musculoskeletal manipulations, Fascia, Physical activity, using the boolean operators "AND" and "OR". The full search strategy used is shown in Table 1.

Table 1 – Database search strategy

Data base	**Descriptors**
LILACS	((physical activity) OR (musculoskeletal manipulations) AND ((fascia) OR (physical activity) OR (musculoskeletal manipulations)).
PubMed/MEDLINE	((physical activity) OR (musculoskeletal manipulations) OR (fascia)); ((physical activity) OR (musculoskeletal manipulations) OR (fascia)).
SciELO	((musculoskeletal manipulation) OR (fascia) AND (physical activity)); (fascia) OR (physical activity) OR (musculoskeletal manipulations)).

SPORTDiscus	((musculoskeletal AND manipulation) OR (fascia) AND (physical AND activity); (performance) AND (physical AND activity) OR (musculoskeletal AND manipulation) AND (fascia)).
Embase	((physical activity)) AND (musculoskeletal manipulations) OR (fascia)); ((physical activity) OR (musculoskeletal manipulations) AND (fascia)).

Source: Elaborated by authors

The inclusion criteria for this study were articles published in Portuguese and English, available electronically in full, from January 2010 to December 2023. The criteria for including publications consisted of identifying the expressions used in searches in the title or keywords, or having explicit mention in the abstract that the text relates to the verification of methods and/or equipment used for MFR and verification of outcomes regarding athlete performance. Inclusion criteria encompassed experimental or observational studies published in the last 10 years, involving healthy sports individuals of both genders, over 15 years of age, who received strategies with MFR applied by a therapist and SMFR.

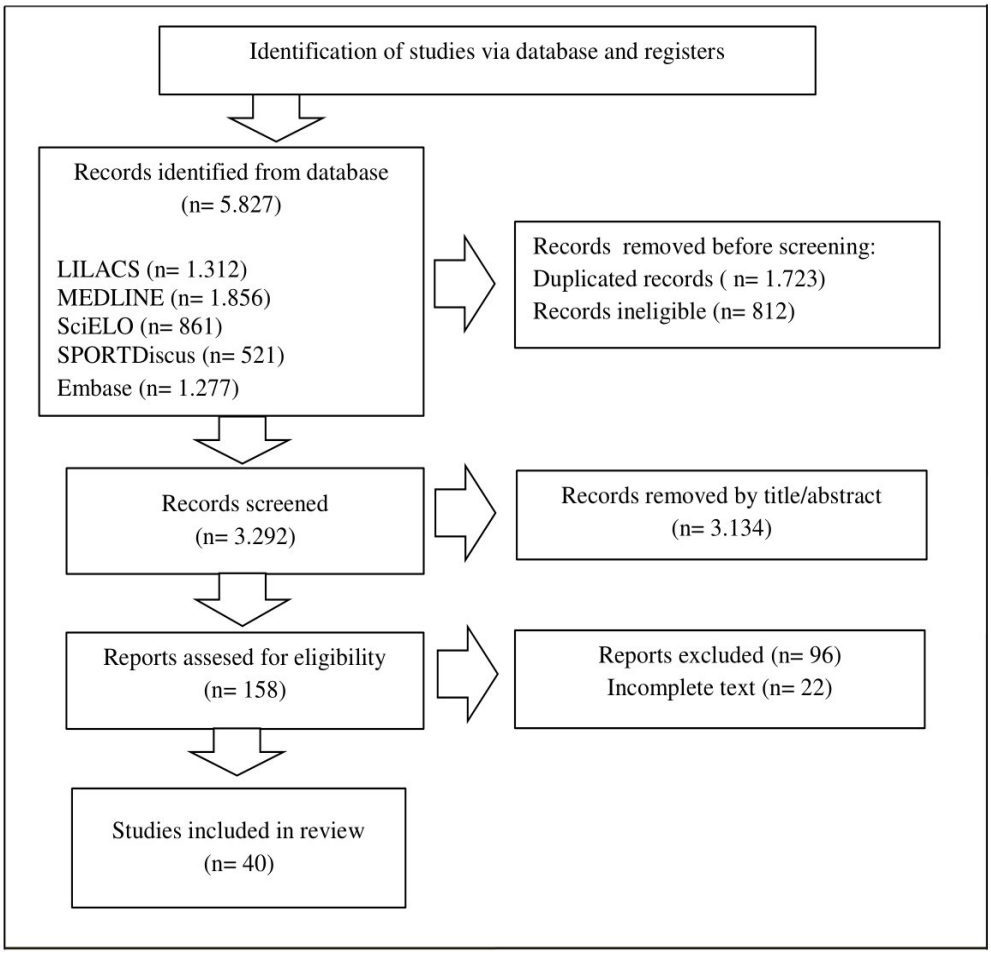
Themes of interest: aspects related to sports performance and characteristics of outcomes related to strength, speed, and range of motion (ROM) of the athlete. Subsequently, the manner in which MFR was conducted was assessed. Randomized controlled trials (RCT) and randomized crossover clinical trials (RCCT) were advocated. However, observational studies, laboratory research of high methodological relevance, review studies, and books were also considered. Exclusion criteria: studies that did not present aspects related to self-myofascial release techniques; different populations; methods and results not elucidated between strategies and factors related to sports performance were excluded. Likewise, studies of personal opinions, observational studies, laboratory studies, editorials, comments, letters, brochures, newspapers, and conference abstracts were not considered for this research.

RESULTS

The search yielded 5,207 references related to the physiological properties and morphofunctional mechanism of the muscular fascia. Subsequently, 1,723 duplicate articles and 812 articles of certain publication types (editorials, personal opinions,

comments, newspapers, letters, brochures, and conference abstracts) were removed, resulting in 3,292 articles for analysis in Portuguese, English, and Spanish. A comprehensive analysis of the topics was then conducted, leading to the elimination of 3,134 articles, resulting in 158 remaining. These articles were then considered, following the guidelines for conducting review studies based on the SPIDER strategy, which resulted in 40 scientific studies, as shown in Figure 1.

Figure 1 – Flow Diagram



Source: Elaborated by author (2023).

Regarding the analysis of the level of evidence, we found the following distribution: four scientific articles (10%) scored 1; three (7.5%) scored 2; seven (17.5%) scored 3; four (10%) scored 4; eight (20%) scored 5; five (12.5%) scored 6; and nine (22.5%) scored 7.

After the final selection of studies, basic content analysis techniques (BARDIN, 2000) were employed to analyze the data. Subthemes were established to compose the analysis framework and guide the text writing process. Additionally, for articles containing the relevant outcomes selected for this study, the scale developed by Zandonai et al. (2010) was used. Subsequently, the data collection phase of the studies identified in the selection phase was employed. It is worth noting that the use of a predetermined instrument was essential to ensure a better coverage of information. This guideline aimed to reduce the risk of transcription errors and ensure accuracy in information verification, also serving as a record. The data from the most relevant experimental studies for the present research, published in the last 10 years, were organized into two tables. The first table presents the first author, year of publication, study type, sample size, mean age (MA), gender, and country where the study was conducted. The second table presents the study objective, evaluated outcome, and treatment period.

DISCUSSION

MORPHOFUNCTIONAL PROPERTIES AND MECHANICAL BEHAVIOR OF DEEP FASCIA

The fascia seems to play a role in both proprioception and mechanics. Studies have demonstrated the presence of myofibroblasts and contractile properties in the fascia, indicating that it is not a passive structure. In the morphological composition of the deep fascia (muscular), two types of covering tissues are found: the first is the epimysial connective tissue that surrounds the musculature and extends into the tendons, while the second is the aponeurotic fascial tissue, which slides more easily along the muscular system and is located just below this membrane (WILKE et al., 2018; ADSTRUM et al., 2017). Therefore, the transmission of force from the surface of muscle fibers to the extracellular matrix tends to propagate synergistically to the muscular fasciae. During muscle contraction, the aponeurotic fascia expands to attenuate the transmitted force and establish a reduction in stress (ADSTRUM et al., 2017).

Thus, it is observed that the muscular system does not exert an isolated function, since proprioceptive and nociceptive functions, as well as meridians in the fascial

structure, can establish themselves as possible predictors for impairments in anatomical structure and painful problems (WILKE et al., 2018). Therefore, understanding the physiopathology of connective tissues, their relationship with pain, and other musculoskeletal pain conditions seems to be essential. A recent study highlighted the role of connective tissue innervation in the development of low back pain, demonstrating the presence of sensory nerve fiber terminations within the collagen matrix of nonspecialized connective tissue (SINHORIM et al., 2021).

A relevant factor is the alterations and adaptations of the fascia due to its mobilization, taking into consideration the mechanical behavior and resistance of the structures around it. Among others, the molecules contained in hyaluronic acid alongside the fascia, which, depending on the tissue's resting state or manipulation, can alter its viscoelastic properties (BEHM et al., 2019). Regarding the tension exerted, it is worth noting that at lower levels of shear stress, the high molecular weight hyaluronan chains tend to be more efficient in returning to their previous superstructure after the removal of a certain load. However, if the hyaluronan assumes a more compacted conformation, it will increase the density of loose connective tissue within the fasciae and, consequently, the behavior of the entire deep fascia may be compromised (YUCESOY et al., 2010).

The mechanical properties of hyaluronan also change with temperature (TØMMERAAS; MELANDER, 2008). pH alterations can modify the viscosity of hyaluronan, which becomes more viscous in an acidic solution. Authors have demonstrated that, after strenuous exercise, the pH can reach a value of 6.60 due to lactate accumulation, which can generate an approximate 20% increase in viscosity and increase the sensation of stiffness (JUEL et al., 2006).

Another variable is the stress-strain curves, where stress represents the force applied per area, while strain is the percentage of elongation beyond the resting length (KORHONEN; SAARAKKALA, 2011). Some studies have emphasized the stress-strain curves of many soft tissues, with tendon and muscle tissue properties being the most studied (ADSTRUM et al., 2017; STECCO et al., 2016). However, regarding stresses in the aponeurotic fascia, scientific data are still limited. It is known that the stress-strain curve of the fascia is not linear, due to the probable detachment of collagen fibers and the elasticity generated by elastin fibers resulting in high strain and low force (KORHONEN; SAARAKKALA, 2011). A study highlights that for each increasing increment of applied stress, the fascia responds with a corresponding increase in tension (STECCO et al.,

2020). When all collagen fibers are fully uncompressed and oriented in the direction of the load, the amount of stress is entirely governed by the cumulative behavior of tensioned collagen fibers (STECCO et al., 2020).

MFR STRATEGIES AND POSSIBLE OUTCOMES

Types of strategies and interventions have been increasingly investigated. Applied MFR is recognized as a type of treatment instrument involving techniques from manual therapy, using hands, fingers, forearms, elbows, and some specific instruments, including some osteopathic techniques for soft tissues, massage, trigger point release, and muscle energy techniques (SIMMONDS et al., 2012). In view of this, it is advocated for muscular relaxation through applied mechanical force that generates local ischemia, improving blood perfusion and consequently attenuating painful sensations and discomfort (SIMMONDS et al., 2012; CHEATHAM et al., 2015; OLIVEIRA et al., 2019; SINHORIM., 2019; GUO et al., 2023).

For orthopedic pain in sports, MFR strategies have been considered a safe treatment to assist in the management of acute inflammatory processes and have become a self-administered possibility, used in physical conditioning and rehabilitation processes (FRANÇA et al., 2020; AFANADOR-RESTREPO et al., 2023). Understanding the changes in the course of techniques with MFR requires more specific studies, since the physiological mechanism of the techniques is still being explored, as manipulation of the fascia and adjacent tissues can lead to different complications and effects (KRAUSE et al., 2017; ZUGEL et al., 2018). Therefore, the way fascial manipulation is applied and the interpretation of its effects during its execution will depend on the clinician's ability to recognize tissue changes and understand the subsequent biological effects of touch, which can make a difference in treatment efficacy (KIDD, 2009).

However, there is scientific evidence supporting that MFR may generate increased local blood perfusion and corticospinal excitability, promoting improvements during fascial gliding and increased oxygenation (ZUGEL et al., 2018; SINHORIM et al., 2019). It has become evident that the use of MFR technique in protocols involving pressures, stretches, and myofascial glides leads to improvements in tissue oxygenation levels (SINHORIM et al., 2019). Furthermore, the blood perfusion technique reduces stiffness and increases the elasticity properties of appendicular members (JĘDRZEJEWSKI, G. et al., 2020). In light of the scientific data, the different modalities of LMF can be applied

both in warming up and cooling down the body after physical activity, reinforcing that MFR (applied, IASTM) and MFR (self-applied, LAFR) can be effective interventions to improve joint range of motion and muscular performance (CHE-ATHAM et al., 2015).

There is a favorable assumption about the inclusion of MFR techniques in the training programs of athletes from various sports modalities, with the five main factors related to improvement in muscle response, explosive strength, flexibility, restoration of tissue elasticity, and reduction in stiffness (BEHARA et al., 2017; KALICHMAN et al., 2017; KIM AND YIM, 2018; FRANÇA et al., 2023; AFANA-DOR-RESTREPO et al., 2023). A significant example was the use of LAFR after dynamic stretching (DS), which revealed improvements in the vertical jump (VJ) of basketball players (RICHMAN et al., 2019).

The modalities of strategies with MFR included in the protocols seem to establish different outcomes. A 10-week protocol with LAFR was not sufficient to achieve significant values in female muscle strength (BOND et al., 2019). Another study with IASTM indicated higher isokinetic strength in the ankle, both in the increase of strength and in isokinetic power, as well as greater flexion and extension strength of the knee (RHYU; HAN; RHI, 2018). Therefore, there are still contrasting ideas about the use of applied or self-applied LMF, as it seems crucial to investigate the most suitable sport and the main purpose of its use.

Table 1 – Characteristics of the most recent studies

Author/Year of publication	**Study Type**	**(n) / MA / Gender**	**Country**
Afanador-Restrepo et al. (2023)	Experimental Study	(n=87) / MA (20,5 ± 2,3) / M. F.	Colombia
Behara et al. (2017	Experimental Study	(n= 28) / MA (20 ± 1,4) / M.	USA
Bond et al. (2019)	Experimental Study	(n=20) / MA (39,9 ± 8,7) / M.	Japan
Healey et al. (2014)	Experimental Study	(n=26) / MA / (21,56 ± 2,04) / M. F.	Iceland
Junker et al. (2019)	Experimental Study	(n= 34) / MA (29,26 ± 1,96) / M.	Australia
Kim e Yim (2018)	Experimental Study	(n= 40) / MA (16,3 ± 0,8) / M.	Corea

Krause et al. (2017)	Experimental Study	(n= 16) / MA (not reported) (20 to 40 years old) / M. F.	Germany
Rey et al. (2019)	Experimental Study	(n=18) / MA (26,6 ± 3,7) /M.	Spain
Richman et al. (2018)	Experimental Study	(n=14) / MA (19,8 ± 1,3) / F.	Colombia
Rhyu et al. (2018)	Experimental Study	(n= 40) / MA (17,24 ± 1,71) / M.	Corea
Seever et al. (2022)	Experimental Study	(n=42) / MA (24,3 ± 2,5) / M. F.	Germany
Sulowska-Daszyk et al. (2022)	Experimental Study	(n= 62) / MA (33,79 ± 7,56) / M. F.	Poland
Wilke et al. (2018)	Experimental Study	(n=16) / MA / (25±2) / M. F.	Germany

Source: Elaborated by author (2023). Abbreviation: USA – United States of America, n – sample number, MA – Mean Age, M – Masculine, F - Feminine

However, comparing fascial adaptations with strength gains can be challenging, as neural adaptations and muscle hypertrophy can obscure this relationship (BOND et al., 2019). Regarding the purpose of reducing the effects of pain, the findings were more categorical, revealing that therapies with MFR may be a relevant strategy compared to other standard treatments found in physiotherapy (RODRÍGUEZ-HUQUET et al., 2020).

Concerning the application time of techniques with MFR, the period of 2 minutes for each muscle group demonstrated an increase in muscle flexibility and ROM (SULOWS-KA et al., 2022). However, the use of the technique with LAFR indicated reduced results for lower limb (LL) flexibility (REY et al., 2019).

In accordance with these assumptions, when observing the effects of MFR using Manual Therapy Oriented (MTO) for combined with Foam Rolling (FR) on physical performance in university athletes, the MTO interventions did not exceed 15 minutes per subject and were applied to both lower limbs. Subjects in the intervention group (IG) received the same treatment with FR as the control group (CG), twice a week, and with MTO once a week on non-consecutive days, totaling 8 weeks and completing 24 sessions. It was evidenced that MFR combined with FR generated more and better effects in all evaluated ROM, jump height, and flight time, maximum repetition (MR), and mean propulsive velocity (MPV) tests (AFANADOR-RESTREPO et al., 2023). Similar to the

results of two other studies using FR for ankle dorsiflexion ROM ($p < 0.05$) (JUNKER; STÖGGL, 2019; SE-EVER; MASON; ZECH, 2022).

It is observed that regarding the quantity, duration, and speed of application of fascial release strategies, there are still gaps. Fascial viscoelasticity depends on the integration of architecture, composition, and water content of connective tissues. As connective tissue is highly adaptable and when regularly placed under increasing or constant tension, the tissue architecture is better equipped to meet new demands because fibroblasts adjust their matrix remodeling activity (BOND et al., 2019).

The principle of biological individuality is important in choosing the method. Studies have demonstrated the importance of the technique being performed and guided by a rehabilitation professional, in order to be effective in reducing the patient's perception of pain and increasing functional range of motion (ROM). Manual therapy applied (MTA) by a professional showed better effects related to pain relief, when compared to self-myofascial release techniques (SMRT) (OLIVEIRA et al., 2019; RODRÍGUEZ-HUGUET M. et al., 2020).

Table 2 – Objectives and main outcomes of experimental studies

Author/ Year of publication	**Study objective**	**Outcome / treatment period**
Afanador-Restrepo et al. (2023)	To compare the effects of myofascial release with OMT combined with FR versus FR alone on the physical performance of university athletes	ROM, VJ, strength and flexibility / 8 Weeks
Behara et al. (2017)	To verify the acute effects of deep foam rolling and dynamic stretching on muscle strength, power, and flexibility in soccer forwards.	MMII //strength, power, flexibility, CMJ (Quadriceps and hamstrings) / 8 min
Bond et al. (2019)	To assess the extent to which the fascial system can enhance women's health potential.	Muscular strength/ 10 weeks
Healey et al. (2014)	To verify if SMR with FR (SAFR) enhances acute athletic performance when compared to planks, a similar isometric exercise.	Power, VJ, strength and speed (hamstrings, quadriceps) / 48 hours
Junker et al. (2019)	To examine the effect of an 8-week resistance exercise intervention using FR on central "strength endurance," jump performance, dynamic balance, ROM and flexibility.	Strength, VJ, VJ performance, ROM, dynamic balance and flexibility/ 8 weeks
Kim e Yim (2018)	To examine the effects of a rehabilitation exercise combined with instrument-assisted soft tissue mobilization on isokinetic strength, muscle fatigue, and physical fitness in soccer players.	Flexibility, VJ height, MMII balance / 12 weeks
Krause et al. (2017)	To evaluate the acute effects of SMR on the passive stiffness of the anterior thigh muscles and on the sliding properties of the associated fasciae.	MMII flexibility/ 48 hours

Rey et al. (2019)	To assess the effects of foam rolling as a recovery tool in professional soccer players.	MMII flexibility/ 2 sessions of 20 min
Richman et al. (2018)	To investigate the combined effects of self-myofascial release and dynamic stretching on the range of motion, jump, running, and agility performance in basketball athletes.	Seat and reach, VJ and SMR (hamstring and quadriceps) / 2 sessions 5 min running
Rhyu et al. (2018)	To investigate the use of the IASTM technique in young basketball players.	ROM, strength (MMII), flexibility (hamstring, quadriceps) / 8 weeks
Seever et al. (2022)	To examine the chronic and residual effects of a two-week intervention with a massage roller on ankle dorsiflexion ROM and dynamic balance.	ROM, Balance (Hind leg muscles) / 2 weeks.
Sulowska-Daszyk et al. (2022)	To evaluate the acute effect of self-myofascial release on muscle flexibility in long-distance runners.	Muscular flexibility / 15 minutes
Wilk et al. (2018)	To investigate the effect of FR velocity on joint SMR and tissue stiffness.	Articular ROM and Tissue stiffness/ 1 week

Source: Elaborated by author (2023). Abbreviations**:** ROM – Range of motion, SMR – Self miofascial release, IASTM - instrument-assisted soft tissue mobilization, SAFR – Self-applied release with *Foam rolling*; MMII – Lower limbs, CMJ – Counter movement jump, VJ – Vertical jump, OMT- Outcome-Oriented Orthopedic Manual Therapy, FR – Foam Roller

It is consensus that physical exercises offer benefits to most populations and are safe activities for different age groups. Fascia, as well as connective and muscle tissues, are the most prone to injuries during physical exercise (MARTINS; PEREIRA; FELÍCIO, 2019). Thus, MFR can be preventive for various complications, such as traumatic, inflammatory, and degenerative processes (ZUGEL et al., 2018).

CONCLUSION

There is a process of energy transmissibility through the muscular fascia that requires more specific experimental investigation into its neurofunctional and mechanical properties. Understanding the effects of the fascia can enhance the strategies of MFR, as knowledge about the transmissibility from muscle fiber to fascia, tensions, and potential complications, is still a hurdle to be overcome. Similarly, strengthening the relationship between MFR techniques and the professional's ability to both perform them and incorporate them into training protocols, with the ideal purpose for the athlete and their respective sport, is essential. New studies are necessary for a better understanding of MFR and its implications in training practices. This research suggests combining SAFR with other standard stretches for a minimum period of 8 weeks for range of motion and

explosive strength, before or after warm-up, for both performance enhancement and athlete injury prevention.

REFERÊNCIAS

AFANADOR-RESTREPO DF, et al. Effects of Myofascial Release Using Finding-Oriented Manual Therapy Combined with Foam Roller on Physical Performance in University Athletes. A Randomized Controlled Study. **Int J Environ Res Public Health**, v. 20, n.2, p. 1364, 2023. https://doi.org/10.3390/ijerph20021364. PMID: 36674120.

ADSTRUM, S. et al. Defining the fascial system. **Journal of Bodywork and Movement Therapies**, v. 21, n. 1, p. 173–177, 2017. https://doi.org/10.1016/j.jbmt.2016.11.003

AMORIM, M. DOS S. et al. Acute effects of myofascial reorganization on trapezius muscle oxygenation in individuals with nonspecific neck pain. **Journal of Bodywork and Movement Therapies**, v. 29, p. 286–290, 2022. https://doi.org/10.1016/j.jbmt.2021.10.010

BASSETT, D. R.; HOWLEY, E. T. Limiting factors for maximum oxygen uptake and determinants of endurance performance. **Medicine and Science in Sports and Exercise**, v. 32, n. 1, p. 70–84, 2000. https://doi.org/ 10.1097/00005768-200001000-00012

BEHARA, B; JACOBSON, BH. Acute effects of deep tissue foam rolling and dynamic stretching on muscular strength, power, and flexibility in division I linemen. **J Strength Cond Res,** v. 3, n.4, p. 888-892, 2017. https://doi.org/10.1519/JSC.0000000000001051

BEHM, DG, et al. Massage and stretching reduce spinal reflex excitability without affecting twitch contractile properties. **J Electromyogr Kinesiol**, v.23, n. 5, p. 1215-21, 2013. https://doi.org/ 10.1016/j.jelekin.05.002.

BEHM. DG; WILKE. J. Do self-myofascial release devices release myofascia? Rolling mechanisms: a narrative review. **Sports Med**, v.49.n.8, p. 1173-1181, 2019. https://doi.org/ 10.1007/s40279-019-01149-y.

BOND, M. M. et al. Measurement of Strength Gains Using a Fascial System Exercise Program. **International journal of exercise science**, v. 12, n. 1, p. 825–838, 2019. PMID: 31523342; PMCID: PMC6719817.

CHEATHAM S.W. et al. The effects of self-myofascial release using a foam roll or roller massager on joint range of motion, muscle recovery, and performance: A systematic review. **Int. J. Sports Phys. Ther**, v. 10, n. 1, p. 827–838, 2019. PMID: 26618062; PMCID: PMC4637917.

FAUDE, O; KINDERMANN, W; MEYER, T. Lactate threshold concepts: how valid

are they? **Sports medicine** (Auckland, N.Z.), v. 39, n. 6, p. 469–90, 2009. https://doi.org/10.2165/00007256-200939060-00003.

FEDE, C. et al. Expression of the endocannabinoid receptors in human fascial tissue. **European Journal of Histochemistry**, v. 60, n. 2, p. 130–134, 2016.https://doi.org/ 10.4081/ejh.2016.2643.

FRANÇA, M.E.D, et al. Manipulation of the Fascial System Applied During Acute Inflammation of the Connective Tissue of the Thoracolumbar Region Affects Transforming Growth Factor-β1 and Interleukin-4 Levels: Experimental Study in Mice. **Frontiers in Physiology**. v. 11, p. 587373, 2020. https://doi.org/10.3389/fphys.2020.587373.

FRANÇA, M.E.D, et al. Myofascial release strategies and technique recommendations for athletic performance : A systematic review. **J Bodyw Mov Ther**,v.36, n. 1, p. 30-37, 2023. https://doi.org/10.1016/j.jbmt.2023.04.085.

GU0, Y; LV, X; ZHOU, Y, et al. Myofascial release for the treatment of pain and dysfunction in patients with chronic mechanical neck pain: Systematic review and meta-analysis of randomised controlled trials. **Clinical Rehabilitation, v.**37, n.4, p.478-493, 2023. https://doi.org/10.1177/02692155221136108.

JĘDRZEJEWSKI, G. et al. The Rolf Method of Structural Integration on Fascial Tissue Stiffness, Elasticity, and Superficial Blood Perfusion in Healthy Individuals: The Prospective. Interventional Study, **Frontiers in Physiology**, v. 11, 2020. https://doi.org/10.3389/fphys.2020.01062

JUNKER, D; STÖGGL, T. The Training Effects of Foam Rolling on Core Strength Endurance, Balance, Muscle Performance and Range of Motion: A Randomized Controlled Trial. **J Sports Sci Med**, v.18, n.2, p.229-238, 2019. PMID: 31191092; PMCID: PMC6543984.

KALICHMAN, L; BEN DAVID, C. Effect of self-myofascial release on myofascial pain, muscle flexibility, and strength: A narrative review. **J. Bodyw. Mov. Ther**, v.21,p.446–451, 2017.. https://doi.org/10.1016/j.jbmt.2016.11.006

KIDD, R. F. Why myofascial release will never be evidence-based. **International Musculoskeletal Medicine**, v.31, n. 2, p. 55-56, 2009. https://doi.org/10.1179/175361409X412575

KIM, J; YIM, J. Instrument-assisted Soft Tissue Mobilization Improves Physical Performance of Young Male Soccer Players. **International Journal of Sports Medicine**. v.39, n. 12, p. 936–943, 2018. https://doi.org/ 10.1055/a-0649-1074.

KORHONEN, R K.; SAARAKKALA, **S. Biomechanics and modeling of skeletal soft tissues**. v. 6, p.113-132, 2011. https://www.intechopen.com/chapters/22189

KRAUSE, F; WIKE, J. et al. Acute effects of foam rolling on passive tissue stiffness and fascial sliding: study protocol for a randomized controlled trial. **Trials**, v.18, n.1, p.114, 2017. https://doi.org/10.1186/s13063-017-1866-y.

METHLEY, A M. et al. PICO, PICOS and SPIDER: a comparison study of specificity and sensitivity in three search tools for qualitative systematic reviews. **BMC health services research**, v. 14, n. 1, p. 1-10, 2014. https://doi.org/10.1186/s12913-014-0579-0.

OLIVEIRA, APM; PREREIRA KP; FELICIO LR. Evidências da técnica de liberação miofascial no tratamento fisioterapêutico: revisão sistemática**. Arquivos de Ciências do Esporte**, v. 7, n. 1, p. 1-17, 2019. https://doi.org/10.17648/aces.v7n1.3504

REY, E. et al. Effects of foam rolling as a recovery tool in professional soccer players. **J. Strength Condit Res**, v. 33, n.8, p. 2194-2201, 2019. https://doi.org/10.1519/JSC.0000000000002277.

RHYU, H.S; HAN, H.G; RHI, S.Y. The effects of instrument-assisted soft tissue mobilization on active range of motion, functional fitness, flexibility, and isokinetic strength in high school basketball players. **Technol. Health Care, v.** 26, n.5, p. 833–842, 2018. https://doi.org/10.3233/THC-181384.

RICHMAN, ED; TYO, BM; NICKS, CR. Combined Effects of Self-Myofascial Release and Dynamic Stretching on Range of Motion, Jump, Sprint, and Agility Performance. **J Strength Cond Res**, v.33, n.7, p.1795-1803, 2019. https://doi.org/10.1519/JSC.0000000000002676.

RODRIGUEZ-HUGUET, M, et al. Treatment of Neck Pain With Myofascial Therapies: A Single Blind Randomized Controlled Trial. **J Manipulative Physiol Ther**, v.43, n.2, p. 160-170, 2020. https://doi.org/ 10.1016/j.jmpt.2019.12.001

SEEVER, TC; MASON, J; ZECH, A. Chronic and Residual Effects of a Two-Week Foam Rolling Intervention on Ankle Flexibility and Dynamic Balance. **Front Sports Act Living**, v.15, n.4, p.799985, 2022. https://doi.org/10.3389/fspor.2022.799985.

SCHLEIP, R. **Fáscia no Esporte e no Movimento**. 1. ed. Barueri, SP: Manole, 2020.

SCHLEIP, R.; HEDLEY, G.; YUCESOY, C. A. Fascial nomenclature: Update on related consensus process. **Clinical anatomy (New York, N.Y.)**, v. 32, n. 7, p. 929–933, 2019. https://doi.org/10.1002/ca.23423

SIMMONDS, N; MILLER, P; GEMMELL, H. A theoretical framework for the role of fascia in manual therapy. **J. Bodyw. Mov,** v.16, n.1, p. 83–93, 2012. https://doi.org/10.1016/j.jbmt.2010.08.001.

SINHORIM, L. et al. Acute effect of myofascial reorganization of the trapezius muscle in peripheral muscle oxygenation in asympomatic subjects – a case series. **Manual Therapy, Posturology & Rehabilitation Journal**, v.1, n.1, p. 1–7, 2019.https://doi.org/10.17784/mtprehabjournal.2019.17.739

SINHORIM, L. et al. Potential nociceptive role of the thoracolumbar fascia: A scope review involving in vivo and ex vivo studies. **Journal of Clinical Medicine**, v. 10, n. 19, p. 4342, 2021. https://doi.org/10.3390/jcm10194342

STECCO, C.; SCHLEIP, R. A fascia and the fascial system. **Journal of Bodywork and Movement Therapies**, v. 20, n. 1, p. 139–140, 2016.

https://doi.org/10.1016/j.jbmt.2015.11.012

SULOWSKA-DASZYK, I; SKIBA, A. The Influence of Self-Myofascial Release on Muscle Flexibility in Long-Distance Runners. **Int J Environ Res Public Health**, v.19, n.1, p. 457, 2022. https://doi.org/10.3390/ijerph19010457.

TØMMERAAS, K; MELANDER, C. Kinetics of hyaluronan hydrolysis in acidic solution at various pH values. **Biomacromolecules**, v. 9, n. 6, p. 1535-1540, 2008. https://doi.org/10.1021/bm701341y

URSI, E.S.; GAVÃO, C.M. Prevenção de lesões de pele no perioperatório: revisão integrativa da literatura. **Revista Latino-Americana de Enfermagem**, v. 14, p. 124-131, 2006. https://doi.org/10.1590/S0104-11692006000100017.

Vigotsky, A; BRUHNS, R. The role of descending modulation in manual therapy and its analgesic implications: a narrative review. **Pain Res Treat**,v. 9,p. 292805, 2015. doi: http://dx.doi. org/10.1155/2015/292805.

WHITTEMORE, R; KNAFL, K. The integrative review: updated methodology. **Journal of advanced nursing**, v. 52, n. 5, p. 546-553, 2005. https://doi.org/10.1111/j.1365-2648.2005.03621.x.

WILKE, J, et al. Influence of Foam Rolling Velocity on Knee Range of Motion and Tissue Stiffness: A Randomized, Controlled Crossover Trial. **J Sport Rehabil.** v.28, n.7, p. 711-715, 2018. https://doi.org/10.1123/jsr.2018-0041.

YUCESOY, CA; BAAN, G; HUIJING, PA. Substantial inter-antagonistic epimuscular myofascial force transmission occurs within the entire lower leg of the rat between the deep flexor muscles and the muscles of the anterior crural and peroneal compartments. **J. Electromyogr. Kinesiol, v.** 20, p.118–126, 2010. https://www.academia.edu/25734848/Substantial_Inter_Antagonistic_Epimuscular_Myofascial_Force_Transmission_Occurs_Within_the_Entire_Lower_Leg_of_the_Rat

ZANDONAI, AP et al. Qualidade de vida nos pacientes oncológicos: revisão integrativa da literatura latino-americana. **Revista eletrônica de enfermagem**, v. 12, n. 3, p.554-561, 2010. https://doi.org/10.5216/ree.v12i3.6957

ZÜGEL, M. et al. Fascial tissue research in sports medicine: from molecules to tissue adaptation, injury and diagnostics. **British Journal Of Sports Medicine**, v. 52, n. 23, p. 1497-1497, 2018. https://doi.org/10.1136/bjsports-2018-099308