

Comparison of University Students' Flexibility Before and After Myofascial Release Applied to the Non-Dominant Foot

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Abstract

Background: Myofascial release applied directly at the site of tension may produce an acute improvement in flexibility. However, can myofascial release applied to the distal portion of the functional line also lead to a significant increase in range of motion throughout the entire functional chain? **Objective:** Therefore, the aim of the present study was to compare lower-limb flexibility before and after the application of a myofascial release technique performed exclusively on the non-dominant foot of young adults. **Methods:** Physical Education undergraduate students of both sexes were evaluated in a convenience sample of 29 individuals. The Wells and Dillon sit-and-reach test was used to assess posterior chain reach, lateral line reach, and spiral line reach, all measured unilaterally. **Results:** When comparing lower-limb flexibility before and after the application of the myofascial release technique exclusively to the non-dominant foot, it was possible to identify that the procedure, characterized predominantly by transverse movements, resulted in a significant improvement in flexibility of the spiral line and also led to a significant bilateral improvement in the posterior functional line. **Conclusion:** a

Keywords: Flexibility; Functional lines; Myofascial release.

1. Introduction

Flexibility is a motor capacity related to the angular range of motion of each joint, and the term is also used to describe the physical condition resulting from the combined movements of multiple joints in one or more planes of motion simultaneously. In this regard, flexibility may be limited in certain joints due to changes in bone structure, as in the progression of osteoarthritis, due to reduced muscular elasticity, as occurs with the natural decline in the stretching capacity of muscle fibers, or by both factors [1]. However, for most joints, limitations in range of motion are imposed by soft tissues, including the musculature and its surrounding structures, connective tissue (muscle fascia), and the skin. For this reason, flexibility should never be assessed in a single muscle, but always as part of a functional chain. Every muscle in the body is surrounded by a connective tissue known as fascia, which also envelops the viscera, arteries, and veins, forming a connected network from the skull to the soles of the feet [1, 2].

It is known that functional lines are activated for contraction or stimulated for stretching through the muscle fascia. Fascia is understood as a tensional network of connective tissue that envelops all structures of the human body, including muscles, viscera, and endothelium. Like other soft joint components, fascia tends to accumulate tension caused by internal and external factors, gradually leading to a loss of functionality [3, 4].

Muscle fascia exerts a significant influence on the expression of flexibility, and in-depth knowledge of this tissue is widely applied in various techniques, such as myofascial release (MFR). This technique is similar to other manual therapy approaches and has a passive characteristic, performed by healthcare professionals using the hands, elbows, fingers, or specific tools such as sticks and foam rollers. It can also be applied actively, with direct pressure exerted by the individual requiring treatment. The recommendation is that this technique be performed using shearing movements between the skin and the fascia [5, 6].

Thus, the primary purpose of the MFR technique is to reduce fibrous adhesions within the fascial networks and, consequently, restore the tissue's capacity for tension dissipation following intense mechanical stress (hysteresis), allowing the recovery of fascial network functionality [3, 4]. But can flexibility be significantly improved by performing

myofascial release only at the distal portion of the functional line? Therefore, the objective of the present study was to compare lower-limb flexibility before and after the application of a myofascial release technique performed exclusively on the non-dominant foot of young adults.

2. Methods

2.1 Experimental Approach

The present study is a cross-sectional field investigation with a quantitative approach, based on data obtained from a linear assessment of flexibility.

2.2 Sample

Undergraduate students from the Physical Education program were recruited and invited to participate. A convenience sample of 29 individuals (16 men and 13 women) was formed. Participants were assessed for flexibility after completing an anamnesis. The next step involved anthropometric measurements, including height, body mass, abdominal circumference, sitting height, upper-limb length, and lower-limb length.

2.3 Design of Study and Procedures

The following tests were applied as described by Kaminsky and Bonzheim [7]:

- a) Bilateral sit-and-reach – The participant was positioned on the box with the feet placed on the indicated support and the knees fully extended. The evaluator placed their hands over the participant's knees to prevent flexion and instructed the participant to reach as far as possible across the top platform of the box.
- b) Unilateral sit-and-reach – This test followed the same evaluator procedures as the previous one. However, the participant maintained one knee flexed, with the medial malleolus of the flexed limb positioned at the height of the extended knee, and the hip joint in a non-forced abduction.
- c) Third test – Each participant sat on the floor and performed external rotation of the hip of the front limb, with the knee flexed to approximately 90°, the foot in dorsiflexion, and the heel directed toward the pubis. Meanwhile, the opposite limb remained in hip extension with the knee flexed, but with the hip in internal rotation and the heel of the rear leg aligned with the coccyx. The participant was then instructed to lean forward and attempt to reach the front leg as far as possible using the contralateral hand. For this measurement, a measuring tape was fixed to the floor starting from the tip of the front foot.

Each test was performed in three pre-intervention and three post-intervention attempts following the application of the myofascial release technique. This technique was performed using a squash ball, and participants were instructed to carry out self-myofascial release. The protocol consisted of 50 longitudinal movements along the plantar surface of the non-dominant foot, followed by 30 transverse movements on the forefoot and 30 transverse movements on the midfoot. Finally, 30 circular movements to the right and 30 to the left were performed, also on the midfoot. The total duration of the self-myofascial release procedure was approximately two and a half minutes. Immediately afterward, the four flexibility tests were repeated and recorded.

It is important to emphasize that the dominant foot, which did not receive the self-myofascial release intervention, served as the control.

The sample was also divided into “more flexible” and “less flexible” groups based on the Canadian Standardized Test of Fitness table [8] for the bilateral sit-and-reach test using the Wells and Dillon box. In this classification, individuals are categorized according to performance while considering sex and age group. Those classified as “average” or “below average” composed the “less flexible” group, whereas those classified as “above average” or “excellent” composed the “more flexible” group.

2.4 Statistical analysis

To achieve the study objective, descriptive statistics were conducted using mean, standard deviation, and percentage frequency. The Shapiro–Wilk normality test was applied and demonstrated normal distribution of the data, both when analyzed as a whole and when separated into the two flexibility groups. Subsequently, inferential statistics were performed using the paired t-test, comparing the dominant and non-dominant sides before and after the myofascial release intervention.

A significance level corresponding to two standard deviations ($p < 0.05$) was adopted. Statistical analyses were conducted using the Statistical Package for the Social Sciences (SPSS) for Windows, version 21.0.

3. Results

Tables 1, 2, and 3 present the results that address the study objectives. Table 1 displays the sample characteristics, and it can be observed that age ranged from 19 to 33 years, indicating that the sample consisted exclusively of young adults. The standard deviation for body mass was 12.5 kg, while for height it was 10 cm, reflecting the morphological heterogeneity of the sample, which is typical of a university population. In contrast, foot length, measured in centimeters, showed a much less pronounced standard deviation.

Table 1. Descriptive Characteristics of the Sample

Variables	n	Minimum	Maximum	Mean	SD
Age (years)	29	19	33	25.21	3.74
Body mass (kg)	29	52	91	71.97	12.55
Height (m)	29	1.55	1.91	1.72	0.10
Foot length (cm)	29	24	30	27.29	1.27

Source: Research data. Where: n = sample size; SD = standard deviation.

Table 2 presents the comparisons of the tests performed before and after the intervention, consisting of myofascial release applied to the plantar surface of the non-dominant foot. Under these conditions, it was observed that in the bilateral sit-and-reach test there was a significant difference, with a bilateral gain in flexibility, even though the intervention was performed on only one foot. There was an average increase of 1.5 cm in range of motion for the posterior chain measured bilaterally.

In the unilateral sit-and-reach test, no significant difference was observed, either when comparing the dominant side before and after the intervention or the non-dominant side. Likewise, no significant difference was identified for the flexibility of the lateral line for either the dominant or non-dominant lower limb.

Regarding the assessment of the spiral line, for the dominant limb—which did not undergo myofascial release on the plantar surface—a significant reduction in flexibility was identified in the second assessment. There was an average reduction of 1.2 cm in range of motion on the dominant side. In contrast, when comparing the non-dominant side before and after the intervention, a significant difference was found, with an average increase of 1 cm in range of motion for this functional line.

Another noteworthy point is that when analyzing the post-intervention measurements, the mean difference between the dominant and non-dominant sides was 2.8 cm. This highlights how expressive the procedure was for the spiral functional line compared to the other functional lines and underscores how the technique used for its execution may influence each functional line differently. This finding leads to important considerations regarding the composition of each functional line and how the applied procedure may interfere with them. It is also worth noting that the standard deviation remained stable despite the variations observed in the means.

Table 2. Comparison of flexibility before and after the intervention with myofascial release on the plantar surface of the non-dominant foot.

Flexibility tests (all measures in cm)	Mean	SD	p
Bilateral sit-and-reach – pre-intervention	33.74	3.51	0.01
Bilateral sit-and-reach – post-intervention	35.28	3.71	
Sit-and-reach dominant limb – pre-intervention	33.84	3.63	0.07
Sit-and-reach dominant limb – post-intervention	33.14	3.26	
Sit-and-reach non-dominant limb – pre-intervention	33.78	3.55	0.09
Sit-and-reach non-dominant limb – post-intervention	33.50	3.53	
Spiral line dominant limb – pre-intervention	86.38	5.23	0.03
Spiral line dominant limb – post-intervention	85.10	5.45	
Spiral line non-dominant limb – pre-intervention	86.97	5.47	0.01
Spiral line non-dominant limb – post-intervention	87.91	5.23	

In Table 3, it is possible to observe the comparison only among the variables that showed a significant difference following the acute intervention using self-myofascial release on the plantar surface of the foot with a squash ball. For this purpose, the sample was divided into “more flexible” and “less flexible” groups, as described in the methodology.

Table 3. Comparison of intervention outcomes after dividing the group into less flexible and more flexible individuals based on the results of the sit-and-reach test.

Group	Flexibility tests (all measures in cm)	Mean	SD	p
Less flexible	Bilateral sit-and-reach – pre-intervention	32.42	3.01	0.62
	Bilateral sit-and-reach – post-intervention	32.11	3.06	
More flexible	Bilateral sit-and-reach – pre-intervention	37.10	1.24	0.02
	Bilateral sit-and-reach – post-intervention	38.10	1.57	
Less flexible	Spiral line non-dominant limb – pre-intervention	82.61	4.61	0.26
	Spiral line non-dominant limb – post-intervention	82.21	4.68	
More flexible	Spiral line non-dominant limb – pre-intervention	88.60	3.17	0.03
	Spiral line non-dominant limb – post-intervention	90.06	3.13	

Source: Research data. Where: SD = standard deviation; p = probability of accepting the null hypothesis (significance).

Based on these data, it was possible to identify that the “less flexible” individuals did not show a significant difference following the myofascial release. The participants who actually demonstrated improved performance were those classified as “more flexible,” both in the bilateral sit-and-reach test and in the spiral line assessment. In addition to not showing positive changes in flexibility, the less flexible individuals also exhibited the largest standard deviations, indicating greater heterogeneity in this group compared to the “more flexible” group.

4. Discussion

DO et al. [9] conducted a study in which they applied myofascial release to the plantar fascia using a foam roller in healthy adults and reported that individuals who underwent the myofascial release process demonstrated improvements in posterior chain flexibility, hamstring muscles, and the lumbar spine. The assessment was performed using two tests: the toe-touch test and the passive straight leg raise test in the supine position. In the present study, myofascial release applied to the plantar fascia also produced significant improvements; however, these were observed only in the spiral functional line, whereas in the cited study the effect was found in the posterior functional line.

In the present study, the myofascial release technique was performed using a squash ball rather than a foam roller, and the self-release procedure lasted, on average, two and a half minutes. In contrast, in the cited study, the procedure required a total application time of five minutes. Another important difference is that, after the MFR procedure in the cited study, the group received passive stretching, whereas in the present study, participants were reassessed immediately after MFR. This was done because the objective was to identify how much myofascial release alone could produce results, without the assistance of passive or active stretching procedures.

Additionally, in the referenced study, the movements performed during the MFR procedure with the foam roller were exclusively longitudinal, which produced a direct effect on the posterior chain. In contrast, in the present study, the emphasis of movement was primarily transverse, consequently promoting greater effects on the spiral line. Therefore, it is extremely important that future studies compare transverse and longitudinal MFR movements to better understand their different influences on functional lines.

The study by Grieve et al. [10] also evaluated the effect of myofascial release applied to the plantar fascia in order to improve bilateral flexibility throughout the posterior chain, assessed using the sit-and-reach test. Their study was conducted with 24 healthy individuals with a mean age of 28 years (8 men and 16 women) and demonstrated significant improvements in performance solely with the application of this technique, which is consistent with the findings of the present study. It is worth noting that in the present study, the release was performed only on the non-dominant foot, yet significant bilateral improvements in flexibility were still observed, emphasizing the importance of this technique in the daily routine of healthy individuals.

Russo et al. [11] further demonstrated that self-myofascial release using a rigid ball not only improves hamstring flexibility but also that this improvement is maintained for approximately 60 minutes, which corresponds to the average duration of a typical training session in fitness centers. This highlights not only the importance of the technique but also the relevance of applying self-myofascial release in individuals with flexibility deficits or those preparing to perform movements requiring greater joint mobility or muscle extensibility.

For more than a decade, several studies have demonstrated that mechanical stimuli are transmitted through the muscle fascia, whether these stimuli involve stretching or contraction [12, 13, 14]. These authors also indicate that

accumulated tension in the muscle fascia can impair the dissipation of tension, which is often reflected in limitations in flexibility, especially in the posterior chain. 172
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Wilke et al. [15] further report that myofascial release at the point of tension produces effects throughout the entire functional line, regardless of the age of the individual performing the self-myofascial release. However, a new piece of evidence brought to light by the present study, which deserves further investigation, concerns the direction of movement in which myofascial release is performed, as this may produce effects on different functional lines. 174
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5. Conclusions 178

When comparing lower-limb flexibility before and after the application of myofascial release exclusively to the non-dominant foot of young adults, it was possible to identify that, with the procedure performed primarily using transverse movements, there was a significant improvement in the flexibility of the spiral line and also a significant improvement in the posterior chain when measured bilaterally. 179
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Further studies are recommended to compare myofascial release movements performed in different directions and applied to different body regions, especially considering the tension dissipation pathway of the specific functional line being investigated. 183
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Supplementary Materials: Not applicable 186

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