Acute Effect of Myofascial Release Technique on Upper Extremity Muscle Strength and Performance in Volleyball Players

Voleybolcularda Miyofasyal Gevşeme Tekniğinin Üst Ekstremite Kas Gücü ve Performans Üzerindeki Akut Etkisi

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ABSTRACT

Our aim in this study is to investigate the acute effect of manual myofascial release applied in warm-up period by a physiotherapist on upper extremity muscle strength and sportive performance in volleyball players. This prospective, single-center longitudinal study included 20 female amateur players, between ages of 18-27 in the college women's volleyball team. Upper extremity muscle strength and athletic performance of players were evaluated before (pre-application) and 30 minutes after (post-application) applying a single myofascial release session. Hand dynamometer (Jamar, JLW Instruments, Chicago, IL 60607) was used to evaluate upper extremity muscle strength and seated medicine ball throw test was used to evaluate athletic performance. Myofascial release therapy was manually applied to each participant by a physiotherapist for a total of 20 minutes for both upper extremities. Post-application values for upper extremity muscle strength and sportive performance were higher than pre-application values. Muscle strength was significantly improved (23.71±4.36; 25.35±5.41, p=0.014), while no improvement observed in sportive performance (261.08±86.05; 657.25 ± 1723.68, p=0.321). Applying a single session of myofascial release technique manually on upper extremities in warm-up period will be helpful to improve muscle strength as an acute effect.

Keywords: Myofascial release, Performance, Strength, Volleyball, Upper extremity.

ÖZ

Bu çalışmadaki amacımız voleybolcularda ısınma döneminde fizyoterapist tarafından uygulanan manuel miyofasiyal gevşetmenin üst ekstremite kas kuvveti ve sportif performans üzerine akut etkisini araştırmaktır. Bu prospektif, tek merkezli uzunlamasına çalışmaya üniversite kadın voleybol takımında yer alan, yaşları 18-27 arasında olan 20 amatör kadın oyuncu dahil edildi. Oyuncuların üst ekstremite kas kuvveti ve atletik performansları, tek miyofasyal gevşetme seansı uygulandıktan önce (uygulama öncesi) ve uygulamadan 30 dakika sonra (uygulama sonrası) değerlendirildi. Üst ekstremite kas kuvvetini değerlendirmek için el dinamometresi (Jamar, JLW Instruments, Chicago, IL 60607), atletik performansı değerlendirmek için oturarak sağlık topu fırlatma testi kullanıldı. Her katılımcıya her iki üst ekstremite için toplam 20 dakika miyofasyal gevşetme terapisi fizyoterapist tarafından manuel olarak uygulandı. Üst ekstremite kas kuvveti ve sportif performans açısından uygulama sonrası değerlerin uygulama öncesine göre daha yüksek olduğu belirlendi. Kas gücünde anlamlı artış görülürken (23,71±4,36; 25,35±5,41, p=0,014), sportif performansta herhangi bir iyileşme gözlenmedi (261,08±86,05;657,25±1723,68, p=0,321). Miyofasyal gevşetme tekniğinin ısınma döneminde üst ekstremitelere manuel olarak tek seans uygulanması, akut etki olarak kas kuvvetinin artırılmasına yardımcı olacaktır.

Anahtar Kelimeler: Kuvvet, Miyofasyal gevşetme, Performans, Voleybol, Üst ekstremite.

Önemli Noktalar

*Miyofasyal gevşetme, üst ekstremite kas kuvvetini anlık olarak artırabilir.
*Tek seans miyofasyal gevşetme, sportif performans artırmada etkili değildir.
*Miyofasyal gevşetme voleybolculara ısınma fazında uygulanabilir.

Approval for the study was granted by the Non-Interventional Clinical Research Ethics Committee of Istanbul Medipol University on 26 May 2022 (Decision No: E-10840098-772.02-3064). The summary of this study was presented as an oral presentation at the 18th Traditional Developments in Physiotherapy Congress on 08-11 September 2022.

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INTRODUCTION

The myofascial complex includes muscles and associated fascia. Fascia is a type of connective tissue that surrounds and separates muscles, bones, and nerve fibers.[1] This tissue is located between the skin and the underlying muscle or bone structure and represents the main element in the functioning of the musculoskeletal system by connecting the body from head to toe.[2, 3] This continuity is from top to bottom, from superficial layers to deep layers, from microscopic level to macroscopic level. Therefore, fascia does not have sections or divisions belonging to structures.[2] The myofascial complex works to transmit muscle strength and fibroelastic activity throughout the muscle. Additionally, regional friction is reduced by sliding the fascial layers over each other during movement.[4] Microtrauma or acute injuries lead to general dysfunction such as decreased fascial mobility, tissue adhesion, tenderness and associated pain, weakness in muscle strength, muscle imbalance, and problems in muscle length or coordination.[3,4] Since muscle strength is related to sport-specific performance, myofascial disorders may also indirectly cause a decrease in athletic performance.[5,6]

Myofascial release (MFR) applications, which is a manual therapy method, can treat disorders in myofascial tissues.[7] Widely practiced around the world, this method involves the direct or indirect application of manual traction and low-loaded, long-term mechanical forces to the myofascial complex to alleviate abnormal tension. The therapy involves applying gentle, sustained pressure to specific areas to relieve restrictions, improve functionality, and provide pain control.[7,8] The process typically involves assessing the fascial condition of the individual receiving the treatment and then applying pressure to the appropriate areas.[9] This technique reduces fascial adhesions, muscle tension and pain levels, increasing circulation and functionality.[7,8] With MFR therapy force is applied to fascial fibroblasts while strains are indirectly applied to nerves, blood vessels, the lymphatic system, and muscles.[8] Although the effect of self-myofascial release (SMFR) on the lower extremity has been investigated, studies on the acute effect of manual myofascial release (MMFR) applications on the upper extremity on muscle strength and performance are limited.[5, 10-13] Therefore, we believe that our study can make a significant contribution to physiotherapists who may consider working in this field and work in the field of sports. Since MFR treatment is effective in relieving tension, adhesion and restriction in tissues, as mentioned above, this study aims to investigate the acute effect of MMFR on upper extremity muscle strength and sports performance in volleyball players before training. We hypothesize that the MMFR technique applied to players by physiotherapists will increase the athletes' sports performance and upper extremity muscle strength.

MATERIAL AND METHODS

Research Design

This study was designed as a prospective, single-center longitudinal study that was conducted at the Divisions of Physiotherapy and Rehabilitation Department in Istanbul Medipol University. Initial recruitment for our study started in October 2022 in Istanbul, and data collection lasted 3 months.

Ethical Aspect of Research

All procedures were followed in accordance with the ethical standards of the responsible committee on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. Approval for the study was granted by the Non-Interventional Clinical Research Ethics Committee of Istanbul Medipol University University on 26 May 2022 (Decision No: E-

10840098-772.02-3064). Written, informed consent was obtained from all participants.

A total of twenty female amateur players, who are members of the university volleyball team, aged between 18-27 participated in this study. Being actively playing in the team for at least a session, participating in training regularly and volunteering to study were among the inclusion criteria. Exclusion criteria for this study were acute/subacute pain/injury, history of upper extremity surgery in the last 1 year, fracture healing in the upper extremity or injury to disrupt the fascial structure, and any inflammatory condition.

Demographic variables were documented prior to assessment. Muscle strength and athletic performance data were collected at baseline and 30 mins after the MFR intervention. Upper extremity muscle strength was evaluated with the Hand Dynamometer (Jamar Handheld Dynamometer, JLW Instruments, Chicago, IL 60607), and the sportive performance of the athletes was evaluated on the seated medicine ball throwing test. The hand dynamometer has both intra- and inter-rater reliability for evaluating upper extremity muscle strength.[14] This device measures force in kilograms (kg) and has an accuracy of 0.1 kg.[15] In order to evaluate the muscle strength, the participants were asked to sit in a chair with back support with their feet flat on the floor. The shoulder was in the neutral position, the elbow was in 90 degrees flexion, and the forearm and wrist were in the neutral position. The participant was asked to squeeze the dynamometer in the dominant hand for 3 seconds with the maximum force that could be reached. In order for the test to provide more accurate results, each participant was measured 3 times, with 15-second rest periods between trials. Then the average of the 3 tests was calculated and recorded.

The sitting medicine ball shot test is valid and safe in the performance measurements of volleyball players.[16] This test was carried out with a chair, the participant sitting in a position with his back to the chair for support and stabilization, with feet flat on the floor. A medicine ball weighing 3 kilograms is used to perform the test. The participant, holding the ball with both hands at chest level with the arms extended, throws it forward as hard as possible. The angle of throw of the ball should be 40-45 degrees. The point of the first contact of the ball's front end with the ground was measured with a tape measure and saved in meters. This test was repeated 3 times with 2 minutes rest between each trial and the mean score was recorded.[17,18]

After the initial evaluation, MMFR was applied to both the right and left sides for 20 minutes, covering both the scapula and the entire distal upper extremity regions. In this technique, the physiotherapist palpated the restricted fascia using fingers, elbows and fists, and began the technique by applying light pressure to narrow the tissue by following the anatomical direction and continued by applying manual traction to the superficial tissues. No oil or lotion was used during the application. The skin was requested to be pale by observation. Because the tissue begins to soften with the applied traction and the adhesions are activated, changing the fascia structure and the tissue becomes pale by loosening.[2] The evaluation and application process lasted approximately one hour for each participant.

Statistical Analysis

Data obtained in the study were analyzed by IBM® SPSS© 22.0 software (SPSS Inc., Chicago, IL, USA). Descriptive statistical methods were used, and results were stated as mean ± standard deviation values, number (n), and percentage (%). One-sample Kolmogorov test was performed for normality. The conformity of the variables for normality was examined with the Kolmogorov-Smirnov test and histogram plots. Since the upper extremity strength data showed normal distribution, the student's t-paired test and for non-parametric performance data analysis, the Wilcoxon test was used to determine the difference between pre- and post-treatment evaluations in the same group. The statistical significance limit was determined as 5% ($p < 0.05$).

The power of our study, which aims to increase strength in a single session of MFR, reached 90% with 20 participants (effect size = 0.30, α = 0.05, t = 1.66).[19,20]

RESULTS AND DISCUSSION

Twenty females aged between 18-27 years old applied upper extremity MFR in this study. According to demographic and clinical presentations of participants, none of them were excluded from the study. The participants had a mean age of 20.65±2.27 years, height of 165.4±5.42 cm, weight of 64±11.63 kg, and BMI of 23.29±3.36 kg/cm^2. Demographic characteristics of individuals are shown in the table (Table 1).

Table 1. Demographic Characteristics of Participants.

Parameters	N	Mean	Standard Deviation	95% CI (Lower-Upper Bound)
Age (years)	20	20.65	2.27	19.58-21.72
Height (cm)	20	165.40	5.42	162.86-167.94
Weight (kg)	20	64.00	11.63	58.56-69.44
BMI (kg/cm^2)	20	23.29	3.36	21.72-24.86

CI: Confidence Interval, BMI: Body Mass Index

The mean, and standard deviation of pre/post-MMFR, 95% confidence interval, t-value, and p-value were obtained for upper extremities muscle strength and athletic performance (Table 2). The post-MFR application values for upper extremity muscle strength, and sportive performance were higher than pre- MFR application values. The differences were significant for muscle strength (25.35±5.41 vs. 23.71±4.36, p = 0.014). However, a difference was not found between post and pre-MMFR application values for athletic performance (261.08 ± 19.24 vs. 261.08±86.05, p = 0.321).

Table 2. Upper Extremity Strength and Sportive Performance Assessment Results and Differences Pre/Post MMFR.

	Pre-MMFR M±SD	Post-MMFR M±SD	95% CI (Lower-Upper Bound)	Statistics Coefficient	p
Strength (kg)	23.71±4.36	25.35±5.41	-2.90-(-0.36)	-2.691^t	0.014*
Performance (m)	2.61±0.19	6.57±3.85	-12.09-4.16	-2.657^z	0.061

**p<0.05, CI: Confidence Interval, M: Mean, MMFR: Manual Myofascial Release, SD: Standard Deviation, t: student's t-paired test, z: Wilcoxon test*

In this study we examined if MMFR will acutely be effective for improvement of muscle strength and performance of upper extremities in volleyball players. The results of this study showed a significant increase and improvement in muscle strength while the increase of the sportive performance in upper extremities was relevant but not significant. Although MMFR increases both muscle strength and performance, it only has a significant effect on increasing muscle strength.

Majority of research that was carried out on myofascial release effect on muscle strength or performance with foam rollers.[21-23] Narrative review focused on the effect of SMFR on range of motion, flexibility, and pain rather than muscle strength, and has been shown to be effective in increasing joint range of motion and flexibility. However, stated that

high-quality studies are needed to ensure its effectiveness on pain and muscle strength.[21] In this study, it was found that manual MFR application increases muscle strength. It is thought that there may be differences in effect between application of SMFR and MMFR. In our study, contrary to the literature, we preferred to use the manual myofascial release technique applied by the physiotherapist rather than self-applications and acute effects. We can interpret that MMFR performed by a physiotherapist can be more conscious and comprehensive, and adhesions and painful points can be found and treated more easily by the healthcare professional.

Most research has been conducted on the myofascial release effect of foam rollers on muscle strength or performance.[21-23] The narrative review focused on the effect of SMFR on range of motion, flexibility, and pain rather than muscle strength, and has been shown to be effective in increasing joint range of motion and flexibility. However, it has been stated that high quality studies are needed to ensure its effectiveness on pain and muscle strength.[21] In our study, contrary to the literature, we preferred to use the manual myofascial release technique applied by a physiotherapist instead of self-application and acute effects. In this study, it was determined that manual MFR application increased muscle strength. It is thought that there may be differences in effects between SMFR and MMFR applications. We can speculate that MMFR performed by a physiotherapist may be more conscious and comprehensive, adhesions and painful points can be more easily found and treated by the healthcare professional, and this may be superior to SMFR in leading to strength gains.

There are studies focusing on the acute effects of SMFR applied to the lower extremity during the warm-up period in young adults.[23,24] A study comparing the acute effect of foam rolling, static stretching, and dynamic stretching on flexibility and muscle strength during the warm-up in college students concluded that foam rolling was more effective than the other two techniques and can be recommended as part of the warm-up period in healthy young adults. Foam rolling does not reduce strength while significantly increasing the flexibility of the quadriceps and hamstrings without impeding muscle strength. However, no increase in muscle strength and performance was achieved.[23] In addition, in the study investigating the instantaneous effects of vibration rolling, a SMR tool, on muscle strength during warm-up, it was found that muscle strength and agility increased. It has been suggested that the findings may have implications for warm-up prescription and practice in both rehabilitation and athletic practice settings.[24] Another study investigating the effects of self-myofascial release (SMFR) on performance and strength, as opposed to traditional static and dynamic stretching used in warm-ups, found that SMFR was effective in increasing the isokinetic strength of both the knee extensor and flexor muscles.[25] In our study, it was shown that MMFR used during the warm-up period of the upper extremity in collegiate volleyball team players caused acute improvement in muscle strength. In another study, the results showed that SMFR could improve the results in strength performance tests, muscle strength, speed and agility tests. However, no explanation was given as to why muscle strength improved.[24] Single application of SMFR techniques with foam rollers has been reported to increase muscle flexibility in long-distance runners. The increase in flexibility in distance runners after a single application may be parallel to the increase in strength after a single session application in our study. In the literature, this relationship has been described as: having muscles with a greater flexibility index, allows for a greater amount of elastic energy.[15]

In a study by Raphael Ferreira de Oliveira et al. focused on the effects of single and multiple sessions of applying SMFR. They demonstrate that single and multiple sessions of applying SMFR despite their similar effects on recovery of agility, the reduction in late-onset muscle pain, lactate removal, increased flexibility, and perceived recovery, have different effects on recovery of lower limb power, speed, and strength. Single session of

MFR is more effective for recovering the strength performance, whereas multiple sessions of SMFR application seem to be more efficient for restoring the power of the lower limbs and speed.[25] Parallel to the literature, we investigated the acute effects of MFR after a single session application and concluded that it increases the strength of the upper extremity in female volleyball players. In our study, no improvement in performance was achieved in a single session, consistent with the results of this study. In the future, long-term studies that collect the results of single and multiple sessions of MMFR application should be designed to investigate the effects on performance and strength.

Limitation

There were some limitations to this study, only a single session of MMFR efficacy was examined, there were no long-term comparisons. There is a need for further larger and longer-term studies to confirm these results. This study investigated the effect of manual MFR on the upper extremity, unlike many other studies for which there are limited studies in the literature. To date, to our knowledge no study that we can discuss shows the effect of MMFR on upper extremity muscle strength and sports performance in athletes.

CONCLUSION AND RECOMMENDATIONS

According to the results of this study, it is concluded that applying a single session of myofascial release technique manually on upper extremities in warm-up period will be helpful to improve muscle strength as an acute effect. However, in further studies it should be investigated whether manually applied myofascial release is more effective than SMFR with control group comparison.

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