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The Effect of Foam Roller Exercises on FMS Scores Applied to Youth Volleyball Players

Şebnem ŞARVAN CENGİZ[1], Buse DELEN[2], Hayal ÖRCÜTAŞ[2]

[1]Manisa Celal Bayar University, Faculty of Sport Sciences, https://orcid.org/0000-0002-2916-4784
[2]Manisa Celal Bayar University, Graduate School of Health, https://orcid.org/0000-0002-8045-3143
[2]Manisa Celal Bayar University, Graduate School of Health, https://orcid.org/0000-0002-4665-9623

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Abstract
This study aims to examine the effect of FR exercises applied to youth female volleyball players on their FMS test scores. 30 volunteer female volleyball players (Avg_{age}=12.38±1.22) participated in the study. In addition to volleyball training 3/week, 20 mins of FR exercises were applied during the warm-up phase. To see the difference, the FMS test was applied twice, as a pre-test and post-test. Descriptive statistics and paired t-tests were used in the analysis of the data. After the applied exercises, an increase was observed in the deep squat, hurdle step, and in-line lunge patterns of the FMS, while a decrease was observed in the active straight-leg raise movement in the athletes whose training age was four years and under. These changes were not found to be statistically significant. A positive significance was found between the pre-post tests of the trunk stability push-up pattern of the athletes whose training age is four years and under. In both groups, a positive significance was determined between the pre-post test scores of lower extremity patterns and the training age in FMS total scores. It has been determined that the application of FR exercises applied to youth female volleyball players during the competition season has an effect on the FMS patterns, but there is no significant difference. It can be thought that the FR application does not provide sufficient efficiency for the performance of the youth female volleyball players during the competition period.

Keywords: FMS, Volleyball, Foam roller, Myofascial release

Altyapı Voleybolcularına Uygulanan Foam Roller Egzersizlerinin FMS Skorları Üzerine Etkisi

Özet
Sporda performans arttırmaya yönelik yöntemlerden birisi foam roller (FR) ile gerçekleştirilen kas dokusu üzerine baskı ile uygulanan myofasyal gevşetme hareketleridir. Fonksiyonel hareket taraması (FMS) ile yapılan taramalarda, fonksiyonel hareketlerdeki kısıtlılık, asimetri ve işlevsizlikler belirlenir. Bu çalışmanın amacı, altyapı kadın voleybolcularda uygulanan FR egzersizlerinin FMS test skorları üzerine etkisinin incelenmesidir. Çalışmaya 30 gönüllü kadın voleybolcu ($Ort_{yaş}$=12,38±1,223) katılmıştır. Katılımcılara haftada üç gün voleybol antrenmanlarına ek olarak ısınma evresinde 20 dakikalık FR egzersizleri uygulanmıştır. Katılımcılara uygulanan egzersizlerin farkını görmek amacıyla ön-test ve son-test olmak üzere iki kez FMS testi uygulanmıştır. Verilerin analizinde tanımlayıcı istatistikler ve eşleştirilmiş t-testleri uygulanmıştır. Uygulanan egzersizlerden sonra antrenman yaşı dört yıl ve altı olan sporcularda FMS'nin derin çökme, engel adım ve ileri düz çökme parametrelerinde bir artış gözlemlenirken, aktif bacak düz kaldırma hareketinde bir düşüş gözlemlenmiştir. Bu değişimler istatistiksel olarak anlamlı bulunmamıştır. Antrenman yaşı dört yıl ve altı olan sporcuların gövde rotasyon dengesi parametresi ön-son testi arasında pozitif yönde bir anlamlılık tespit edilmiştir. Her iki grupta da FMS toplam skorlarında alt ekstremite parametrelerinin ön-son test puanları ile antrenman yaşı arasında pozitif

yönde bir anlamlılık tespit edilmiştir. Altyapı kadın voleybolcularına uygulanan FR egzersizlerinin müsabaka sezonunda uygulanmasının FMS parametreleri üzerinde etkili olduğu, fakat anlamlı bir farklılık olmadığı tespit edilmiştir. FR uygulamasının altyapı kadın voleybolcularda müsabaka döneminde performansa yönelik yeterli verimliliği sağlayamadığı düşünülebilir.

Anahtar Kelimeler: FMS, Voleybol, Foam roller, Myofasyal gevşetme

INTRODUCTION

The development of technology and the diversity of training methods and training equipment play an active role in planning the training of athletes and increasing their sportive performance (Barak et al., 2016). Power is a key determinant of many athletic performances, and optimization of power during training and competition can be increased by an appropriate active warm-up. It is believed that the use of stretching exercises as a part of the warm-up routine can improve performance (Carvalho, 2012).

Athletes and trainers of many sports branches resort to various methods to improve flexibility, strength, and balance. One of the methods is myofascial release (MFR) movements applied with pressure on the muscle tissue performed with foam roller (FR) equipment (Ertunç, 2022). MFR, which is a technique used in manual therapy, is used as an effective application in low loading, long stretching in the myofascial complex, and in restoring optimal length, reducing pain, and increasing function (Ajimsha et al., 2015). MFR techniques provide soft tissue formation by relaxing tense connective tissues (Prentice, 2003). This technique usually uses a roller in which a person places their body on an FR and moves it back and forth to apply pressure to the fascia that surrounds the muscles. In this way, the fascia relaxes (Curran et al., 2008; Healey et al., 2014; Renan-Ordine et al., 2011). In recent years, the self-myofascial release has become a popular technique in gyms to supplement traditional methods for performance and conditioning improvement. This current technique is applied with an FR device. FR is widely used before and after exercise (Yıldız et al., 2018). Many factors affect goal achievement in sports. The most important of these is the physical and physiological fitness of the athlete. The more the individual's fitness level is improved according to the characteristics of the sports branch, the more its reflection on performance increases (Er, 2019). Sport-specific performance tests are performed to determine performance in sports and to detect possible injuries. In addition to these performance tests, there are also sportive tests that are used to detect injuries in athletes and to take precautions for this. Motion analysis systems are one of these assessments. These systems are used as a guiding tool to predict injuries and take precautions against possible injury (Chimera and Warren, 2016).

It is common in many sports to use and evaluate field tests to measure athletic performance. These tests are recorded from the beginning of the season and followed up by repeating them regularly. In addition, athletic performance tests and functional movement forms are evaluated to analyze the detailed performance values of athletes (Altundağ et al., 2019). Recently, there has been increased interest in scans that demonstrate neuromuscular control during basic motor movements. Functional Movement Screening (FMS) is an assessment system that observes the basic movements of the individual, developed by Gray Cook and Lee Burton in 1997. This analysis system, which is generally evaluated on athletes, consists of seven basic movement patterns that require mobility, stability, and balance (deep squat, hurdle

step, in-line lunge, shoulder mobility, active straight-leg raise, trunk stability push-up, and rotation stability). These movement patterns allow observing the performance of basic locomotor, manipulative and stabilizing movements. These movements not only include the holistic movement of the body but also evaluate all extremities separately. As a result of the evaluation, the mobility of the athletes and, if any, the weaknesses of the movement and existing muscle strength imbalances are determined. Although the performance level is high in studies in this field, it has been reported that many athletes cannot perform these simple movements (Birben, 2017).

This study aims to examine the effects of FR exercises applied to female volleyball players on their FMS scores.

METHOD

30 volunteer female volleyball players with a mean age of 12.38±1.223 participated in the study. In addition to volleyball training three days a week, 20 minutes of FR exercises were applied to the participants during the warm-up phase. To see the effect of the exercises applied to the participants, the FMS test was applied twice as a pre-test and a post-test. The tests were applied during the competition period when the volleyball players did not participate in the sportive activity in the last 24 hours.

FMS (Functional Movement Screen)

FMS is a test for asymmetry and weak connections found in functional movement patterns. This test consists of seven different movements. These consist of deep squat, hurdle step, in-line lunge, active straight leg raise, shoulder mobility, trunk stability push-up, and rotary stability. FMS is also performed to determine the functional range of motion and the limitations of the athletes, to determine the injury risks, and to eliminate the injury risk factors by applying for corrective exercise programs. The total score obtained from the seven movements measures the functional movement capacity of the person (Cook et al., 2006a; Cook et al., 2006b; Cook et al., 2010).

Before starting the FMS test, the participants were informed by the expert who applied the test, and the movements including the FMS patterns were shown in practice. After the practical and theoretical briefing about the test, the test was started on the participants. The participants were included in the test, taking into account the basal conditions of their bodies, without any warm-up period before the test. During the test, each participant was tested separately, and they were asked to repeat each movement three times. The athletes included in the study were asked to notify us if they felt any pain or limitation while performing the patterns. First of all, patterns that were evaluated unilaterally (trunk stability push-up, deep squat) were measured. The patterns that were evaluated bilaterally (single-line lunge, shoulder mobility, active leg straight raise, hurdle step, and rotatory stability) were scored separately as right and left. During the scoring, the scores of the participants in both body aspects were recorded. As a result of the tests, the lowest score obtained from the movement was accepted as the result of the test. In the FMS test, each pattern is scored between 0 and 3 points, so the individuals participating in the evaluation can get a score between 0 and 21 in total. The total FMS score of the participant is calculated by calculating the scores obtained from each

movement. As a result of the calculation, 14 points and below indicate that the FMS capacity of the participants is low and the risk of injury is high, and 14 points and above indicate that the FMS capacity is high.

Foam Rolling

FR exercises were applied to the participants during the warm-up phase of their volleyball training 3 days a week for 12 weeks. In our research, an FR exercise program consisting of a total of 12 movements, which is thought to improve FMS scores, was applied to the participants. The training program includes lateral quad massage, adductor massage, hamstring roll out, lat smash/oblique massage, triceps massage, rhomboid massage and chest opener, upper back extension massage, regular calf rollout, kneeling calf massage, lateral shin mobilization, and foot roll exercises. The movements were applied in the form of 20 s x 1.

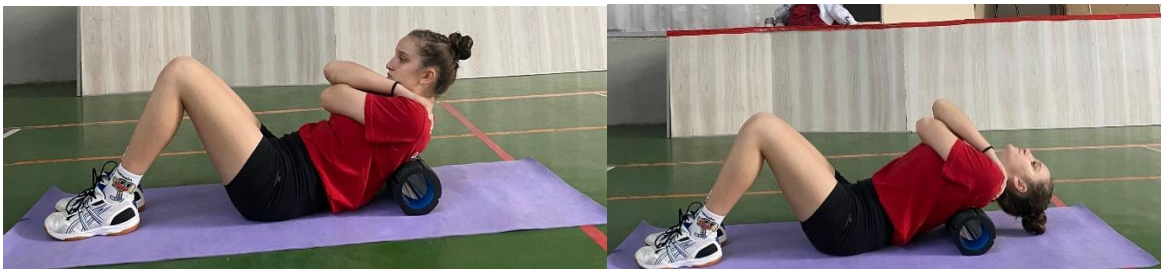

Figure 1. Upper Back Extension Massage

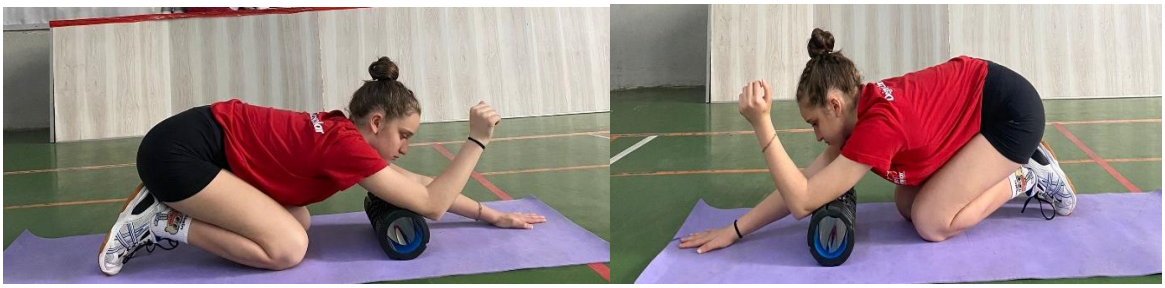

Figure 2. Triceps Smash

Figure 3. Rhomboid Massage and Chest Opener

Figure 4. Regular Calf Roll Out

Figure 5. Lat Smash and Oblique Massage

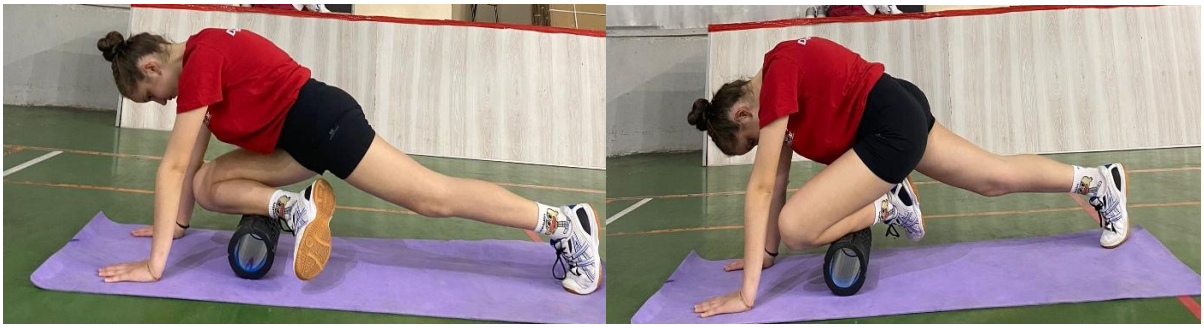

Figure 6. Lateral Shin Mobilization

Figure 7. Kneeling Calf Massage

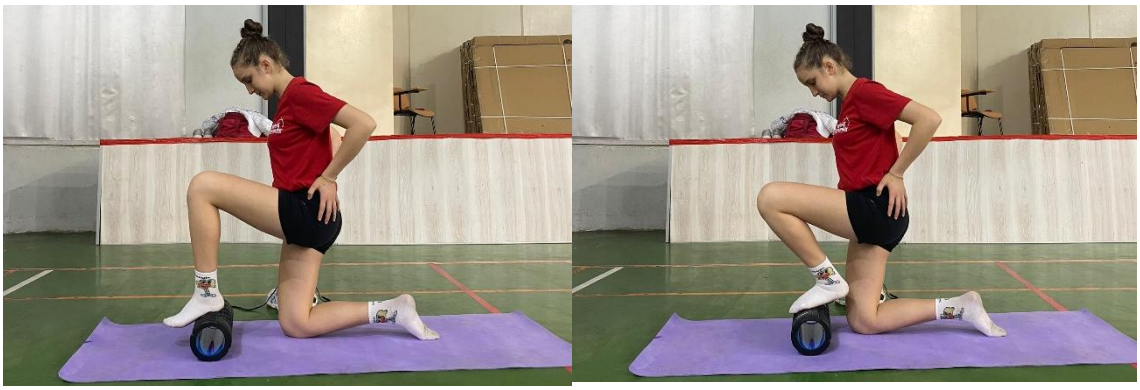

Figure 8. Foot Roll

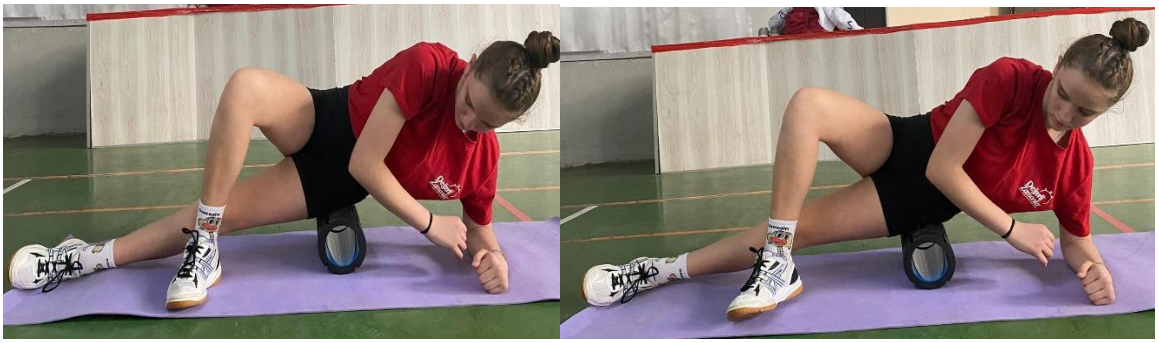

Figure 9. Lateral Quad Massage

Figure 11. Hamstring Roll Out

Figure 12. Adductor Massage

Analysis of Data

The analysis of the obtained data was done by using SPSS 22.0 package program. Descriptive statistics were used to analyze the demographic data of the participants. Paired T-Test was used to determine the relationships between the pretest and post-test values of the mean scores of the FMS scores.

RESULTS

Table 1. Demographic data of participants

Training Age	Variables	N	$\overline{X}$	Sd
≤4 Years	**Age**	16	12,4	0,89
	Training Age	16	2,88	1,09
	Height	16	167	6
	Weight	16	53,9	7,4
	BMI	16	19,2	2,01
>4 Years	**Age**	14	13,2	1,42
	Training Age	14	6,5	1,23
	Height	14	165	5,68
	Weight	14	53,2	7,6
	BMI	14	19,6	2,73

According to the demographic data of the participants given in Table 1, a total of 30 female volleyball players residing in Manisa between the ages of 11-15 and playing in the youth team voluntarily participated in our research. The mean age of the individuals in the research group was 12.38±1,223 and the mean BMI was determined as 19.5796±2.33609. The athletes participating in the study were divided into two groups as four years and six and over four years based on the training age.

Table 2 T-test results of pre-test and post-test mean scores of FMS lower extremity patterns

Training Age		Deep Squat				Hurdle Step				In-Line Lunge				Active Straight Leg Raise			
		$\overline{X}$	Sd	t	p	$\overline{X}$	Sd	t	p	$\overline{X}$	Sd	t	p	$\overline{X}$	Sd	t	p
≤4 Years	Pre	1,31	,873	-0,808	,432	1,50	,632	-1,861	0,83	1,69	,602	-0,565	0,58	1,69	,704	1,861	0,083
	Post	1,44	,814			1,69	,793			1,75	,683			1,50	,816		
>4 Years	Pre	1,71	,914	1	,336	1,93	,917	0,00	1	1,93	,917	0,434	0,671	1,93	,829	0,00	1
	Post	1,64	,842			1,93	,829			1,86	,770			1,93	,730		

According to the t-test results of the pretest and posttest mean scores of the lower extremity patterns given in Table 2, no significant difference was found between the patterns and the training age variable (p>0,05). While an increase was observed between the pretest and posttests in the lower extremity patterns of FMS (deep squat, hurdle step, and in-line lunge) in the athletes whose training age is four years and below, a decrease was observed between the

pretest and posttest of the active straight leg raise pattern. However, these changes were not statistically significant.

Table 3. T-test results of pre-test and post-test mean scores of FMS upper extremity patterns

Training Age		Trunk Stability Push-Up				Shoulder Mobility				Rotatory Stability			
		$\overline{X}$	Sd	t	p	$\overline{X}$	Sd	t	p	$\overline{X}$	Sd	t	p
≤4 Years	Pre	1,50	,966	1,291	0,216	1,75	,856	1,00	0,333	1,25	,577	-2,611	0,20
	Post	1,75	,931			1,63	,806			1,56	,727		
>4 Years	Pre	2,14	,663	0,806	0,435	1,93	1,072	0,694	0,5	1,21	,802	0,563	0,583
	Post	2,00	,392			1,79	,802			1,14	,663		

According to the t-test results of the pretest and posttest mean scores of the FMS upper extremity patterns given in Table 3, no significant difference was found between the rotatory stability pattern pretest and posttest of the athletes in both groups of training age (p>0,05).

Table 4. T-test results of FMS pre-test and post-test mean scores

Training Age	Total FMS Scores					
	N		$\overline{X}$	Sd	t	p
≤4 Years	16	Pre	10,7	3,77	3	**0,009***
		Post	9,56	3,44		
>4 Years	14	Pre	12,8	3,91	4,3	**0,001***
		Post	10,3	2,7		

According to the t-test results of the FMS total score pre-test and post-test mean scores given in Table 4, a positive significance was determined between the training age variable (p<0.05). When the findings of the study were examined, it was determined that the FR exercises applied to the youth female volleyball players during the competition season were effective on the FMS patterns, but no significant difference was revealed (p>0.05). Accordingly, it can be considered that the application of the FR exercises in the youth female volleyball players during the competition period does not provide enough contribution.

DISCUSSION AND CONCLUSION

This research was conducted to examine the effect of FM exercises applied to female volleyball players on their FMS scores. According to the findings obtained as a result of the research, a positive significance was determined between the training age variable and FMS total scores (p<0.05). According to the t-test results of the pretest and posttest mean scores of the FMS lower extremity patterns, an increase was observed between the pretest and posttest of the trunk stability push-up pattern of the athletes whose training age was four years and below, but it was not found significant. When the literature is examined, Alim (2021)

determined in his master's thesis that FR equipment increases the flexibility of the latissimus dorsi muscle and the range of motion of the shoulder joint for football players and volleyball players in their applications for use in training or competitions. In addition, an increase in upper extremity strength was observed after FR exercises performed in volleyball players, and it was determined that it contributed positively to these characteristics. The result we found is similar to other studies in the literature (Table 3).

In the findings of our study, an increase was observed in the lower extremity patterns of FMS between the pretest and posttests in athletes whose training age is four years and below, while a decrease was observed between the pretest and posttest of the active leg straight lifting movement. However, these changes were not statistically significant (Table 2).

Sports injuries are a common problem in volleyball athletes as well as in many sports branches. However, when compared to other sports branches, the risk of injury in volleyball players is less due to the fact that there is less one-on-one contact with the player on the opposite side. The occurrence of fatigue as a result of intense training programs in volleyball athletes is also among the causes of disability, and this reveals the importance of muscle strength and muscle strength balance, which are the main factors underlying injuries and are affected by fatigue (Ciesla et al., 2015).

In a study conducted by Marwan et al. (2012), it was determined that athletes in volleyball experienced especially lower extremity injuries. In a study by Altundağ and Uçan (2019), it was determined that such problems are frequently seen especially in young athletes and unilateral loads and uniaxial exercises, muscular imbalances in the bodies of athletes due to the fact that only some parts of the body are exercised negatively affect the daily quality of life and sportive performance of the athletes. Understanding and revealing the mechanisms of injury in sports is very important to place a preventive approach (Bahr and Krosshaug, 2005).

When the studies in the literature in which FMS was used to predict injuries were examined, it was seen that FMS was successful in estimating the risk of injury (Alkhathami et al., 2021).

FMS plays an important role in determining the adequacy of asymmetries and basic movements (Bilge and Yıldırım Köse, 2020). When the studies with similar research designs in the literature were examined, it was seen that the training interventions had positive effects on different variables of FMS. The main difference here is that the applied training protocols are different from each other (Fakazlı, 2018). In a study conducted by Aktuğ et al. (2019), it was stated that stabilization and corrective exercises applied to volleyball players provided improvements in FMS (total scores) and functional competence. In our study, it was determined that FR applications had a positive effect on the total scores of FMS patterns (Table 4). The results that we found are similar to the literature studies.

In a study conducted by Altundağ et al. (2019), it was determined that there was no statistically significant relationship between FMS total score and athletic performance ($p>0.05$). It has been determined that there is a positive relationship between the patterns that make up the FMS test and the conditional features.

FR studies have multiple acute and chronic effects. The best-known ones are acute and chronic increases in flexibility, decrease in muscle pain, modulation of autonomic nervous

system activity, and arterial and vascular endothelial function effects (Sağıroğlu, 2020). In the master's thesis of Ali (2019), it was determined that FR exercises of both 30 and 60 seconds duration did not have a negative effect on flexibility and vertical jump performance. He stated that FR exercises can be used by athletes as an alternative warming tool before training or competitions. In a study conducted by Yıldız et al. (2018), it was found that a vibrating FR applied before exercise acutely increased flexibility without any decrease in speed, agility, and vertical jump performance. In their study, Beyleroğlu et al. (2021) found that FR exercises applied in addition to dynamic stretching exercises showed more positive results in squat jump and vertical jump values compared to dynamic stretching exercises performed alone. In Ertunç's (2022) master's thesis, it was determined that static stretching exercises performed on the quadriceps muscle group for 3 sets of 30 seconds adversely affected the quadriceps muscular endurance performance, but FR exercises positively affected the muscular endurance performance. As a result of the research, FR exercises are recommended to be performed before muscular endurance performance. Barnes et al. (1997) stated in a study that FR applications have many positive aspects and FR application increases coordination by reducing the friction feature of the muscles of the athletes and positively affects the joint range of motion, appropriate muscle length, and strength and power production of the muscles. In other studies, in the literature, it has been stated that the applied myofascial release techniques not only provide flexibility and increase the joint range of motion but also negatively affect the maximal isometric strength that continues after the application of the myofascial release technique. In the master's thesis of Karabağ (2022), it was suggested that FR application is effective in improving flexibility, agility, and fatigue parameters, and athletic trainers and coaches should prefer FR application in addition to dynamic warm-up in order to prevent time loss in training and to get more efficiency from training.

As a result, it was determined that the application of FR exercises applied to the youth female volleyball players during the competition season was effective on the FMS patterns, but no significant difference was revealed.

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