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Effects of Foam Roller Application on Flexibility and Performance in Young Swimmers

Efectos de la aplicación del rodillo de espuma en la flexibilidad y el rendimiento en nadadores jóvenes

Efeitos da aplicação do rolo de espuma na flexibilidade e no desempenho do jovens andadores

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ABSTRACT

This study aimed at investigating the effects of foam roller applications on joint mobility and performance in young swimmers. Thirty swimmers participated in the study. 17 males and 13 females. While the control group continued with the regular swimming training and dynamic warm-up exercises, the experimental group incorporated myofascial release techniques into their routine. The eight-week study was conducted for four days a week for two hours each day. The study used pre- and post-test measurement methods. The SPSS package program was used to analyze the obtained data. The results showed that the swimming athletes who used the myofascial release technique with a dynamic warm-up significantly improved their maximal performance levels and flexibility values in all four styles compared to the group that only used the traditional dynamic warm-ups.

KEYWORDS: dynamic warm-up, flexibility, foam roller, joint mobility, myofascial release, swimming performance.

RESUMEN

El objetivo de este estudio fue investigar los efectos de las aplicaciones del rodillo de espuma en la movilidad articular y el rendimiento en jóvenes nadadores. En el estudio participaron treinta nadadores: diecisiete hombres y trece mujeres. El grupo de control continuó con su entrenamiento habitual de natación y ejercicios de calentamiento dinámico, mientras que el grupo experimental incluyó técnicas de liberación miofascial en su rutina. El estudio, que duró ocho semanas, se llevó a cabo cuatro días a la semana durante dos horas cada día. Se utilizó un método de medición antes y después de la prueba. Los datos obtenidos se analizaron con el programa SPSS. Los resultados mostraron que los nadadores que utilizaron técnicas de liberación miofascial junto

con calentamientos dinámicos mejoraron significativamente sus niveles máximos de rendimiento y sus puntuaciones de flexibilidad en los cuatro estilos, en comparación con el grupo que solo realizó calentamientos dinámicos tradicionales.

PALABRAS CLAVE: calentamiento dinámico, flexibilidad, rodillo de espuma, movilidad articular, liberación miofascial, rendimiento en natación.

RESUMO

O presente estudo teve como objetivo investigar os efeitos da aplicação do rolo de espuma na mobilidade articular e no desempenho de jovens nadadores. Trinta nadadores participaram no estudo, dos quais 17 eram homens e 13 mulheres. Enquanto o grupo de controlo manteve o seu treino regular de natação e os respetivos exercícios de aquecimento dinâmico, o grupo experimental incorporou técnicas de libertação miofascial na sua rotina. O estudo, com a duração de oito semanas, decorreu quatro dias por semana, durante duas horas por dia. Foi utilizado o método de medição pré e pós-teste. Os dados obtidos foram analisados com recurso ao programa informático SPSS. Os resultados mostraram que os nadadores que utilizaram técnicas de libertação miofascial juntamente com aquecimentos dinâmicos melhoraram significativamente os seus níveis máximos de desempenho e a pontuação de flexibilidade nas quatro modalidades em comparação com o grupo que apenas realizou aquecimentos dinâmicos tradicionais.

PALAVRAS-CHAVE: aquecimento dinâmico, flexibilidade, rolo de espuma, mobilidade articular, liberação miofascial, desempenho na natação.

INTRODUCTION

Doday, the idea of improving athletic performance solely by increasing athletes' physical capacity is no longer accepted because sports technology, biomechanical studies, and ergogenic aids have increased performance to unprecedented levels, setting new records. These developments continue in the form of designing new sports equipment, producing personalized equipment, and applying sports science more broadly (Atasoy & Kuter, 2005).

In this context, flexibility training is widely used today to improve and maintain physical fitness and health. It is also an important factor in performance sports. Appropriate flexibility enables muscle tissue to adapt more easily to stress and perform more efficiently. It can help prevent or minimize injuries and improve performance (Lardner, 2001).

Taylor et al. (1990) stated that muscle-tendon structures exhibit a viscoelastic response to tensile loads. Regular static stretching programs have been shown to increase muscle performance and lead to significant improvements in hamstring flexibility values associated with this increase. (Chan et al., 2002; Hartig et al., 1999).

According to Taylor et al. (1990) and Gajdosik (2001), gains in flexibility are related to the viscoelastic properties of the muscle-tendon unit. However, these researchers have also stated that regularly applied stress forces enable tissues to adapt positively (Caiozzo et al., 2002; Goldspink et al., 2002; Friden et al., 2000) and that different types of loading can improve athletic performance (Ocak & Yildiz 2024).

The myofascial release technique (MRT), for example, has recently become widely used among sports scientists and coaches. The MRT technique involves creating long stretches in the myofascial complex with low loads. It is an effective method

for restoring optimal muscle length, reducing pain, and improving muscule function (Ajimsha et al., 2015; Yildiz et al., 2018).

This technique typically involves using a foam roller (FR), on which a person places their body and moves back and forth to apply pressure to the fascia surrounding the muscles (Healey et al., 2014). This relaxes the fascia (Curran et al., 2008; Renan-Ordine et al., 2011). The most important feature of MRT is that it increases flexibility without decreasing anaerobic power performance (Renan-Ordine et al., 2011), which is why it is widely used among athlets before exercise.

Conversely, numerous studies have concluded that flexibility is a critical factor in swimming performance (Shrier, 2004; Zakas et al., 2003). During adolescence, muscle coordination can deteriorate, and joint mobility may decrease due to rapid growth. Swimming exercises promote the balanced development of muscles throughout the body. Keeping this in mind, many parents encourge their children to swim to promote their physical development.

This study aimed to determine the effects of the myofascial release method used as a warm-up technique on flexibility and performance in young swimmers. The study was based on the scientific data mentioned above.

METHODOLOGY

Research Model

This study investigated the effect of foam roller application on swimming performance in swimmers using an experimental model from quantitative research methods.

Participants

The study included swimmers between the ages of 9 and 14 with at least four years of swimming experience in Afyonkarahisar Province and who did not have any health problems. There were 30 participants in total: 15 in the experimental group (nine girls, six boys) and 15 in the control group (seven girls, eight boys). The participants were selected using th non-probability sampling technique of convinient sampling.

Ethics Committee Approval

Permission for this study was obtained from the Afyon Kocatepe University Health Sciences Scientific Research and Publication Ethics Committee on September 26, 2019, with approval number 09.

Procedure

Anthropometric measurements (height and body weight) and flexibility of the hip and hind leg muscles were assessed using the sit-and-reach test. Before the study began, 50-meters time trials were conducted in freestyle, backstroke, breaststroke, and butterfly styles.

The control group athletes were given a 30-minute dynamic warm-up before training and then a 15-minute warm-up in the water. They then performed 1 hour of main training and a 15-minute cool-down in the water. The total training time was 1.5 hours. The athletes in the experimental group performed 15 minutes of foam roller applications in addition to the 15-minute dynamic warm-up exercises. Then they completed 15 minutes of warm-up exercoses in the water, 1 hour of main training, and 15 minutes of cool-down exercises in the water, for a total of 1.5 hours.

After the study, both groups performed standard cooling exercises. Eight weeks later, one day after the final training session, the same measurements were repeated as a post-test. The flexibility of the candidates' hind leg and hip muscles was measured using a sit-and-reach test.

Warming Protocols

Dynamic Warm-Up Exercises
Athletes performed the following dynamic warm-up exercises: forward run, backward run, toe walking, heel walking, walking calf stretch, big bear walk, forward leg swing, walking hamstring stretch, knee pull-up, carioca with high knee drive, walking lunge with transverse reach, balanced gluteal stretch, dynamic skip, high skip, rear leg swing, backward run, shuffle, run with 360° turn, run with opposite 360° turn, and acceleration (Aguılar et al., 2012).

50-Meter Swimming Test
Participants performed the 50-meter swimming test in the Afyon Kocatepe University semi-Olympic swimming pool. They were asked to swim the 50-meter distance as quickly as possible after the exit command, using freestyle, backstroke, Breaststrok style, or butterfly.

Foam Roller Applications
The foam roller exercises used in this study were performed by the participants on five different parts of the body: the erector spinae, iliotibial band, hamstrings, quadriceps femoris, and calves. These exercises targeted anterior and posterior muscle groups in the lower and upper extremities.

For each muscle group, participants rolled the segmented foam roller from the begining to the end of the muscle region, then returned to the starting position. This action was repeated for 30 seconds for each muscle group. This was done once

for each region. There was a 20-second transition between applications of the two exercises (Healey et al., 2014).

Sit and Reach Test

Participants sat on a flat hard floor. The sit-and-reach table was fixed to the floor. Participants placed the soles of their bare feet flat on the table and reached forward with their arms and fingers stretched out. They were then asked to hold the last point with both hands for one or two seconds. After two attempts for each candidate, the best score was recorded.

Data Analysis

In this study, pre-test and post-test data were recorded on a computer. The measurement results were analyzed using the SPSS program. First, a normality test was performed on the obtained data. A t-test was used to compare normally distributed data in two groups, and a paired t-test was used for intra-group comparisons. An intraclass correlation coefficient test with a 95 % confidence interval was applied to determine the relationship between the pre-test and post-test values of the intragroup data. A significance level of $p < 0.05$ was accepted.

RESULTS

Table 1 shows statistical analyses of the demographic characteristics of the male and female swimmers who participated in the study. The study included 30 athletes: 17 boys and 13 girls. There was no difference in height or body weight between the athletes. These results indicate that experimental and control groups are similar.

Table 1. *Demographic characteristics*

Parameter		Age	Height	Weigt
Male	$\bar{x}$	11.71	152.47	44.910
	N	17	17	17
	Standard Deviation	1.649	12.630	11.972
Female	$\bar{x}$	10.77	145.23	42.187
	N	13	13	13
	Standard Deviation	1.301	9.842	11.443
Experiment	$\bar{x}$	11.47	151.87	45.824
	N	15	15	15
	Standard Deviation	1.457	9.117	8.092
Control	$\bar{x}$	11.13	146.80	41.636
	N	15	15	15
	Standard Deviation	1.685	14.001	14.320

Note. Own ellaboration.

Table 2 shows that there was no statistically significant difference ($p > 0.05$) between the 50-meter freestyle pre-test and post-test results of the control group. However, statistically significant differences were observed in the 50-meter backstroke, 50-meter Breaststrok, 50-meter butterfly and sit-and-lie tests ($p < 0.05$).

Table 2. *Statistical analysis of pre-test and post-test results of the control group*

Parameters		N	$\bar{x}$	Standard Deviation	%	t	P
50 Meter Freestyle	Pre-test	15	48.304	7.918	0.77	1.266	.226
	Post-test	15	47.930	8.226			
50 Meter Backstroke	Pre-test	15	60.283	13.519	1.79	3.835	.002**
	Post-test	15	59.204	13.355			
50 Meter-Breaststrok	Pre-test	15	62.728	12.259	2.85	6.755	.000**
	Post-test	15	60.940	12.140			
50 Meter Butterfly	Pre-test	15	60.624	11.375	1.50	3.414	.004**
	Post-test	15	59.716	10.837			
Sit and Reach	Pre-test	15	26.53	3.962	7.31	-6.052	.000**
	Post-test	15	28.47	3.894			

Note. Own ellaboration.

Statistically significant differences emerged between the pre-test and post-test values of all styles of the experimental group from myofascial release techniques and dynamic warm-up exercises during the eight-week study period ($p < 0.01$) as seen in table 3.

Table 3. *Statistical analysis of pre-test and post-test results of experimental groups*

Parameters		N	$\bar{x}$	Standard Deviation	%	t	P
50 Meter-Freestyle	Pre-test	15	42.920	6.904	3.88	4.771	.000**
	Post-test		41.256	6.435			
50 Meter Backstroke	Pre-test	15	53.779	15.299	7.03	5.835	.000**
	Post-test		50.001	13.890			
50 Meter-Breaststrok	Pre-test	15	64.617	16.464	14.81	5.214	.000**
	Post-test		55.047	10.622			
50 Meter Butterfly	Pre-test	15	58.053	14.821	8.90	4.373	.001**
	Post-test		52.884	12.211			
Sit and Reach	Pre-test	15	27.07	6.216	17.36	-17.082	.000**
	Post-test		31.77	6.582			

Note. Own ellaboration.

As shown in Table 4, when the post-test performance measurements of the group that warmed up with the myofascial relaxation technique in addition to the dynamic warm-up and the group that only performed the dynamic warm-up were analyzed, it was concluded that the differences in the 50-meter freestyle pre-test and post-test results were statistically significant, while the differences in the other parameters were not ($p > 0.05$).

The average grade of the experimental group in the 50-meter freestyle was 41.25 seconds, while the average grade of the control group was 47.93 seconds. The average grade of the experimental group in the 50-meter backstroke was 50.00 seconds, while the average grade of the control group was 59.20 seconds. The average grade of the experimental group in the 50-meter Breaststrok was 55.04 seconds, while the control

group's average was 60.94 seconds; the average for the 50-meter butterfly style was 52.88 seconds, while the control group's average was 59.71 seconds; and the average for the sit-lie test was 31.77 cm for the experimental group and 28.47 cm for the control group.

Table 4. *Statistical analysis of post-test results of experimental and control groups*

Parameters	Group	N	x̄	Standard Deviation	t	P
50 Meter-Freestyle	Experiment	15	41.256	6.435	-2.475	.020*
	Control	15	47.930	8.226		
50 Meter Backstroke	Experiment	15	50.001	13.890	-1.850	.075
	Control	15	59.204	13.355		
50 Meter-Breaststrok	Experiment	15	55.047	10.622	-1.415	.168
	Control	15	60.940	12.140		
50 Meter Butterfly	Experiment	15	52.884	12.211	-1.621	.116
	Control	15	59.716	10.837		
Sit and Reach	Experiment	15	31.77	6.582	1.671	.106
	Control	15	28.47	3.894		

Note. Own ellaboration.

Table 5 shows that the breaststroke and the sit-and-reach test have the largest percentage difference in favor of the experimental group between the values of the experimental and control groups. The control group showed positive improvements in the following areas: 1.79% in the 50 meters backstroke, 2.85% in the 50 meters breaststroke, 1.50% in the 50 meters butterfly, and 7.31% in the sit-and-reach flexibility test.

Table 5. *Percentage of pre-test and post-test data of experimental and control*

Parameters	Experiment Group Pre and Post Test % Difference	Control Group Pre and Post Test % Difference
50 Meter Freestyle	3.88	0.77
50 Meter Backstroke	7.03	1.79
50 Meter Breaststrok	14.81	2.85
50 Meter Butterfly	8.90	1.50
Sit and Reach	17.36	7.31

Note. Own ellaboration.

As shown in Table 6, the experimental and control groups demonstrated high reliability (0.90-0.99) in their pre- and post-test results ($p < 0.05$).

Table 6. *Reliability of pre-test and post-test data of experimental and control groups*

Parameters	Experiment %95 Confidence İnterval	Control %95 Confidence İnterval
50 Meter Freestyle	0.99 (0.96-0.99)	0.99 (0.98-0.99)
50 Meter Backstroke	0.99 (0.97-0.99)	0.99 (0.99-0.99)
50 Meter Breaststrok	0.90 (0.71-0.96)	0.99 (0.99-0.99)
50 Meter Butterfly	0.97 (0.91-0.99)	0.99(0.99-0.99)
Sit and Reach	0.99 (0.97-0.99)	0.97 (0.92-0.99)

Note. Own ellaboration.

DISCUSSION

A total of 30 swimmers participatede in the study: 17 boys and 13 girls. The athletes participated in the study as either the control or experimental group. There were no differences between height or body weight between the participants. These results indicate that experimental and control groups are similar.

The study showed that in the pre-test and post-test results of the control group, there were no statistically significant differences in the results of the 50-meter freestyle. In contrast, statistically significant differences were observed in the 50-meter backstroke, 50-meter breaststroke, 50-meter butterfly, and the seated reach test. This is because freestyle is a technique that anyone who enters the water tries to perform. People adapt to this technique. Most individuals repeat the freestyle and have a skill related to this style. Other styles often include techniques that are unknown to people, which they do not generally use and require technical preparation. Therefore, it is thought that there are differences in the skills of these styles that people learned during the eight-week period between the pre-test and the post-test.

As shown in the results, there were differences in the pre and post-test values for all styles in the experimental group that were statistically significant ($p < 0.05$). The results of the post-test for the group that performed myofascial release techniques in addition to dynamic warm-up exercises during the eight-week study period were better than the pre-test results. According to the results, the group that warmed up with the myofascial release technique performed better. In addition to classical and standard warm-up methods, myofascial release method, which is a different method, a technique that attracts the attention of athletes and can always be applied individually, increased the performance in the experimental group.

According to what was indicatedin the literature, the most important feature of the myofascial release technique is that it increases flexibility without decreasing anaerobic power performance (Renan-Ordine et al., 2011). This technique is widely used among athletes before exercising.n this context, the flexibility values of the experimental group improved more than those of the control group. This positive increase in flexibility values can be attributed to the fact that swimming exercises performed for eight weeks, four days a week, and two hours a day improved range of motion positively.

Regarding the post-test performance of the two groups: one that warmed up using myofascial release technique in addition to dynamic warm-up, and one that only performed a dynamic warm-up, it is evident that the results of the pre-test and post-test of 50 meters freestyle for the group that performed MRT showed a statistically significant difference, while the differences in other parameters were not statistically significant ($p > 0.05$). In fact, the group that used MRT scored lower than the control group in terms of duration in all strokes. In other words, MRT positively increased the swimmers' performance. However, these differences were not statistically significant.

Another aspect to highlight is that the control group showed positive improvements in terms of percentage difference in the following areas: 1.79% in the 50 meters backstroke, 2.85% in the 50 meters breaststroke, 1.50% in the 50 meters butterfly, and 7.31% in the seated and reach flexibility test. The pre and post test values for the experimental group increased by 3.88% in the 50 meters freestyle, 7.3% in the 50 meters backstroke, 14.81% in the 50 meters breaststroke, 8.90% in the 50 meters butterfly, and 17.36% in the seated and reach flexibility test. This shows that the breaststroke and the seated and reach test have the highest percentage difference in favor of the experimental group between the values of the experimental and control groups. These results demonstrate that myofascial

release method significantly improves swimmers' performance compared to dynamic warm-up method.

As stated in the literature, the most important feature of the MRT is that it increases flexibility without decreasing anaerobic power performance (Renan-Ordine et al., 2011). This technique is widely used among athletes before exercise. In this study, the flexibility values of the experimental group improved more than those of the control group. This positive increase in flexibility improved the range of motion of the joints. This allowed the swimmers to reach farther and apply branch-specific techniques more effectively. The difference arising from the myofascial release technique resulted in the experimental group receiving better grades in all styles compared to the control group. Therefore, it can be concluded that the myofascial release method improved the swimmers' performance.

Studies have shown that myofascial release technique positively contribute to athletic performance (Halperin et al., 2014; MacDonald et al., 2013; Miller & Rockey, 2006; Peacock et al., 2014; Yıldız et al., 2018). Strength development training techniques are important for achieving a high level of motor performance. The strength training and exercises we perform during sports engage our joints and muscles.

One of the most important factors for success in sports is strength, which can be developed through training to achieve superior motor performance. This type of training includes joints as well as muscles (Akkoyunlu et al., 2006). Concurrently, studies examining the MRT have shown positive effects on joint range of motion, the vascular system, and the central nervous system (Hall et al., 2011; Okamoto et al., 2014). Sullivan et al. (2013) had 17 university students apply constant pressure with foam rollers to their hamstring muscles. Afterwards, they reported that foam roller application increased joint motion angles in the hamstring muscle group by more than 4 %.

The Breaststrok style requires heel flexibility in the opposite direction. This flexibility is necessary for Breaststrok-style swimmers and enables the feet to propel themselves through the water from a farther back position (Alpar, 1988). Supporting our findings, Kippenhan (2002) reported a high correlation between ankle internal rotation range of motion and maximal performance in the Breaststrok style. Additionally, Jagomägi & Jürimäe (2005) found that 100-meter breaststroke exercises improved knee external rotation and ankle supination flexibility by 24.4 %.

Sports injuries exhibit branch-specific distributions (Ocak et al., 2019). Once success is achieved, the MRT can be considered an effective exercise method for protecting athletes from injury by increasing joint mobility prior to training. Significant differences were observed between the pre-test and post-test results of both groups that applied the dynamic warm-up and myofascial release methods.

The improvements in the group that applied the myofascial relaxation method were higher than those in the group that applied the dynamic warm-up method. The experimental group improved in four styles more than twice as much as the control group. Additionally, it was observed that the flexibility values of the group that practiced foam rolling with a dynamic warm-up improved significantly more than those of the control group.

These results indicate the positive effects of foam roller applications on the fascia. In this context, it´s recommend that coaches, athletes, and sports scientists use myofascial release technique in addition to a dynamic warm-up to increase flexibility, improve performance, enhance efficiency, and prevent injuries.

Data Availability Statement

The datasets generated and analyzed during this study are available from the corresponding author upon reasonable request.

Explanatory Statement

This article is derived from the master's thesis entitled "The Effect of Foam Roller Application on Flexibility and Swimming Performance Values in Swimming".
The authors reported no potential conflicts of interest.

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