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Massage Acutely Increased Muscle Strength and Power Force

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ABSTRACT

Abrantes RO, Nunes SF, Monteiro ER, Fiuza A, Cunha JC, Ribeiro M, Martins C, Novaes GS, Serra R, Vianna JM, Novaes JS. Massage Acutely Increased Muscle Strength and Power Force. **JEPonline** 2019;22(7):100-109. The purpose of this study was to verify the acute effect of the massage on power and submaximal muscular strength performance for upper and lower limbs. Thirty-nine physically active men participated in this study. They visited the lab on 7 times. The experimental visits consisted of 10 repetitions maximum (RM) test and retest for bench press (BP) and leg press (LP45) exercises. Then, the subjects performed vertical (VJ), horizontal jump (HJ), and the medicine ball throw (MBT). The remaining visits were used to perform the experimental protocols in randomized order: (a) Massage + 10RM Test; (b) Massage + VJ Test; (c) Massage + MBT Test; and (d) Massage + HJ Test. Significant differences were observed for 10RM BP ($P<0.001$) and LP45 performance ($P<0.001$), VJ ($P<0.001$), HJ ($P<0.001$), and MBT ($P<0.001$). The findings indicate that massage applied before strength and power tests enhanced the 10RM test and muscle power tests performance. Thus, there appears to be a practical use of massage for recreationally trained adults as well as for the athletic population.

Key Words: Athletic Performance, Manual Therapies, Myofascial Release, Resistance Training, Strength Training

INTRODUCTION

Fascia is composed of elastin and collagen (28) that generate and support tension, which may lose the characteristics after strong mechanical stress (4,27). A massage seems to reshape the connective tissue, stimulated by the central nervous system, and adjust the sympathetic system through a shear motion between the skin and the fascia (13,25). Massage increases local temperature and blood supply (16,21,31), and it promotes efficient movements coordinated by a higher viscoelasticity of the tissue (1,16,21,31).

Massage is a manual therapy technique that uses elbows and hands or an accessory (such as a stick, hook, or a spatula) to manipulate the soft tissue of the body (15,23). The subject receives a passive stimulus, which differs from a similar technique called self-massage in which the stimulus is performed actively by the subject. Massage and self-massage are two different techniques used to promote similar tissue modifications. The massage reaches the fascia tissues while the self-massage acts simultaneously on the fascia and muscle, which may not appear to promote shear between the fascia and the muscle to promote release between the tissues (4,7). Both techniques can modify the internal tension produced by the muscular system, which can have a positive influence on the neuromuscular and neuromotor components of a performance (1).

While previous studies have investigated the different effects of self-massage techniques on muscular performance (1,12,18-22), isometric torque (12,18), and maximal voluntary contraction (10), to our understanding this is the first study to evaluate the effects of manual and instrumental massage on strength and muscle power performance. Thus, the purpose of the present study was to verify the acute effect of the massage (manual and instrumental) technique on power and submaximal muscular strength performance of the upper and lower limbs. The hypothesis of this study was that a 1 min low volume massage would improve muscle performance.

METHODS

Subjects

Thirty-nine physically active men (age: 26.0 ± 5.54 yrs; weight: 82.9 ± 8.02 kg; height: 1.79 ± 0.04 m; BMI: 25.97 ± 2.00) with minimum experience of 3 yrs in strength training were recruited for the present study. The sample size was calculated using the G*Power 3.1 software (8). Based on a priori analysis, an n of 30 participants was calculated, after adopting a power of 0.80, $\alpha = 0.05$, correlation coefficient of 0.5, nonsphericity correction of 1 and effect size of 0.35. It was verified that the sample size was sufficient to provide 80% of statistical power. For the calculation of the sample, the procedures suggested by Beck (3) were adopted. Statistical analysis was initially performed in order to reduce the probability of a type II error and to determine the minimum number of participants required for this investigation.

The following exclusion criteria were adopted: (a) functional limitation that would prevent carrying out the tests; (b) medical condition that could influence the test results; (c) use of any type of drugs that could influence the test results; and (d) perform any kind of strenuous physical activity or modify their eating habits throughout the period of the research.

All volunteers answered NO to all PAR-Q questions, read, and signed the consent form which contained all explanations of the test procedures and all data collection. The procedures of the present study were carried out in accordance with Resolution No. 466/12 of the National Health Council. This study was submitted and approved by the Ethics and Research Committee of the University Center of Barra Mansa- RJ under the number 69624317.7. 0000.5236.

Procedures

A randomized (random entry in Latin square format) within-subject design was used for protocols. The subjects visited the laboratory on 7 occasions during a 19-day period with at least 48 hrs between each visit. All tests were performed at the same time of day for both experimental conditions and familiarization to reduce the circadian effects. The experimental visit consisted of the 10 repetitions maximum (RM) test and retest procedure of bench press (BP) and leg press 45º (LP45) exercise. Following 10RM, the subjects performed the Vertical Jump (VJ), Medicine Ball Throw (MBT), and Horizontal Jump (HJ). From the 4th to the 7th visit, the subjects performed 4 experimental protocols with counterbalanced and alternating inputs: (a) the Massage + 10RM Test; (b) the Massage + VJ Test; (c) the Massage + MBT Test; and (d) the Massage + HJ Test.

Ten Repetition Maximum Test

The 10RM Test was determined for each subject in accordance with the American College of Sports Medicine (2) and preformed for BP and LP45. The subjects initially performed a standardized warm-up that consisted of a single set of 15 repetitions at a self-determined load, which was ~20% of their normal training load. After a resting time of 1 min, the 2nd set was performed between 8 and 12 repetitions at 40% to 60% of their normal training load. After the additional weights were previously measured on a precision scale, the tests were started, in which to 3 attempts could be made, and the weight was always adjusted before a new attempt in order to mobilize the highest load as possible in 10 uninterrupted times. The recovery time between attempts was standardized at 5 min. When the subject could no longer perform the movement correctly or needed external support, the test was interrupted and registered as the maximum load for the 10RM. If the load for 10RM could not be found in 3 attempts, the protocol was repeated after 48 hrs. Some strategies were adopted in order to reduce the margin of error of the collection, they were: (a) standardized instructions were offered before the tests so that the subjects were aware of every routine that involved data collection; (b) The subjects were given instructions regarding the correct technique to perform the exercise; (c) The evaluator was aware of the position adopted by the subject at the time of the execution; (d) All subjects received verbal encouragement during the tests; and (e) the tests were performed at the same time of day in all sessions.

Muscle Power Assessment

The subjects' muscular power was evaluated by the following 3 tests: (a) the Horizontal Jump Test; (b) the Vertical Jump Test; and (c) the Medicine Ball Throw Test. The Horizontal Jump Test was standardized as proposed by Cochrane and Booker (5). The test was performed with a standard jump with a countermovement. The subjects started the test with both feet parallel and on a marked starting line. With the assistance of their arms, the subjects were instructed to take a maximum jump using the lower extremity muscles coupled with a strong arm swing forward to jump the longest possible horizontal distance. Three attempts were allowed for each subject. A measuring tape was used on the floor to measure the distance of the jump, which was determined from the starting line to the heel contact in the soil after the jump.

The Vertical Jump Test was performed according to the standardization procedures suggested by Stockbrugger and Haennel (30). To perform the jump, the subjects began with the feet apart at the width of their shoulders, close to the wall, with the arms abducted laterally at the shoulder height. The countermovement consisted of the subjects flexing the hips and knees while they also flexed the trunk forward, lowering the arms to the height between the waist and the hip. After the countermovement, the subjects extended their hips, knees, and trunk. They flexed their shoulders, raising them back by the shoulder height while projecting to touch the wall with the closest hand to the wall as high as possible.

The Medicine Ball Throw Test was adapted according to the standardization suggested by Vossen et al. (33). The test was performed with a medicine ball (MB) using a gesture similar to the basketball pitch. The subjects began by sitting on a bench with approximately a 90° backrest with the back fully supported. The legs were joined and flexed. The subjects were instructed to hold the MB of 3 kg (51 cm in diameter) with both hands, starting from the isometric position for ~3 sec. With the ball resting on the subjects' thorax at the nipple level, they explosively performed a basketball chest pass, pushing the ball forward and upward at an angle of ~30° above the horizontal. The same instructions and demonstrations were given to each subject before each test. In order to facilitate the distance measurement, the surface of the MB was lightly moistened to leave a mark on the ground where the first contact was made. The distance was measured from the base of the wall to the closest edge from the mark left by the MB on the floor.

The subjects performed 3 attempts in each test. The highest measure achieved was adopted. A 5-min passive rest interval was respected between the attempts of each test.

Massage Protocol

For the massage protocol, two different techniques were adopted: (a) the manual massage; and (b) the instrumental massage using a stick in the upper and lower limbs, respectively. The manual massage used a protocol for the upper limbs followed that was consistent with the guidelines and adaptations suggested by Stecco (27). The instrumental massage used a protocol for the lower limbs (with a stick) in accordance with the orientations and adaptations suggested by Halperin et al. (11). For upper limbs, the massage technique was applied to the chest muscle while in the supine position. The therapist performed constant pressure using the fingers and the thenar and hypothenar regions of the hand and the elbows by sliding them in a deep way in the middle-lateral and cephalic-caudal direction of the chest in both directions. The instrumental massage with the stick was not used in the upper limbs due to anatomical impossibilities. The duration of the protocol was 1 min on each side. For the lower limbs, due to the size of the region covered in relation to the time adopted, the technique was applied using the stick to increase the contact area. The quadriceps, hamstring, and triceps sural muscles (i.e., the gastrocnemius and the soleus) received instrumental massage with the stick. The same therapist performed the massage intervention on all of the subjects, applying constant pressure, using the stick and sliding it along the muscles towards the muscle fibers in both directions. The application time of the massage in each muscle was 1 min. Levels 7 and 8 of the Visual Analogue Scale (VAS) of affective sensorial intensity (24) were used to equalize the pressure applied in all techniques.

Statistical Analyses

Normality and sphericity were confirmed by the Shapiro-Wilks test, as well as the homoscedasticity by the Levene test. The intraclass correlation coefficient (ICC) was calculated to test the reproducibility (r^2) between the maximum loads for 10RM from the test-retest data (ICC: BP = 0.995; LP = 0.991), suggesting a very strong correlation between measurements. Paired *t*-test was used to determine the difference between the Control Sessions (i.e., Without the Massage) and the Experimental Sessions (Massage + Tests). Additionally, Cohen d was used to identify the effect size (ES). Cohen's d (6) was defined as small (0.2 - 0.3), medium (0.4 - 0.7) and large (≥0.8). Statistical analyses were performed using the Graph Pad Prism software package 6.01 (Graph Pad Software Inc.), adopting a critical significance level of 95% (P<0.05).

RESULTS

Significant differences were found between the Control situation that performed the tests without the massage and the Experimental protocol that performed the tests after the massage for 10RM test in LP45I (220.42 ± 62.40 kg vs. 207.84 ± 58.60 kg; Δ% = 5.8%; P<0.001) and BP (76.63 ± 14.25 kg vs. 71.53 ± 14.54 kg; Δ% 7.1%; P<0.001), respectively (Table 1).

Significant differences were found between the Control situation that performed the tests without the massage and the Experimental situation that performed the tests after massage for muscular power tests of HJ (1.85 ± 0.14 kg vs. 1.93 ± 0.15 kg; Δ% 4.3%; P<0.001); MBT (4.85 ± 0.45 kg vs. 4.99 ± 0.41 kg; Δ% 2.8%; P<0.001), and VJ (2.68 ± 0.07 kg vs. 2.75 ± 0.07; Δ% = 2.6%; P<0.001) (Table 1).

Table 1. Mean ± Standard Deviation for Each Condition.

Conditions	Tests	Massage + Tests	P	d	
10RM BP (kg)	71.53 ± 14.54	76.63 ± 14.2*	<0.001*	0.54	Medium
10RM (kg)	207.84 ± 58.6	220.42 ± 62.4*	<0.001*	0.52	Medium
HJ (m)	1.85 ± 0.14	1.93 ± 0.15*	<0.001*	0.89	Large
VJ (m)	2.68 ± 0.07	2.75 ± 0.07*	<0.001*	0.44	Medium
MBT (m)	4.85 ± 0.44	4.99 ± 0.41*	<0.001*	0.44	Medium

*Statistical difference between post and baseline. **d** = Cohen's Effect Size; **RM** = Repetitions Maximum; **HJ** = Height Jump Test; **VJ** = Vertical Jump Test; **MBT** = Medicine Ball Throw Test

DISCUSSION

The purpose of the present study was to verify the acute effect of the massage (manual and instrumental) technique on the performance of power and the submaximal muscular strength in upper and lower limbs. The findings indicate that massage significantly increased the subjects' strength performance in 10RM test for BP (7.1%) and LP45 (5.8%) and muscle power in HJ (4.3%), VJ (2.6%), and MBT test (2.8%). The results confirmed our initial hypothesis that a low volume (i.e., 1 min) of massage improves muscle performance.

Although the findings reported by Kivlan et al. (15) are in agreement with the results of the present study, they used different volumes for 6 muscles in one limb, which means 2 min of stimulus for each muscle (for a total of 12 min). On the other hand, in our study it took only 6 min to apply the massage for 3 muscles of both limbs, which corresponds to a 1-min stimulus for each muscle. Although the intervention time was different in the studies, both types of massage improved strength of the lower limb muscles. Also, they used Astym® therapy, which is a passive technique that is partially similar to manual massage. They also used a rigid spatula to rub the skin on the target tissue. It is believed that the use of a spatula with a small contact area provides sufficient pressure in the target tissues; whereas, the use of the instrumental massage with the stick covers a large area in a shorter time due to its larger dimensions. In addition, the intensity control of the applied pressure was not performed using Astym® therapy. In our study, the intensity control of the massage was performed using the EVA scale. Yet, despite the different time volumes, massage techniques, and intensity of both studies, it seems that the applied pressure was satisfactory to improve muscle strength. However, it is worth emphasizing that the applied pressure has greater importance in order to achieve the necessary effects in the soft tissues, since with little intensity it does not generate local heating and vasodilation (16,17,31). Therefore, it seems that the application of massage in less time, controlled by the sensorial intensity scale, has produced the same effective results of the technique tested by Kivlan et al. (15) It is known that an excessive intensity generates too much discomfort and unnecessary pain during the application, aside from disrupting the relaxation necessary to achieve the desired effect when modifying muscle tone (13).

In contrast to the findings of the present study, Kargarfard et al. (14) reported that they did not find significant differences in the isometric strength evaluation of the lower limbs after applying a light manual massage session. A possible reason for the difference in results may be related to the types of massages performed. Kargarfard et al. (14) applied three types of manual massages (effleurage, petrissage, and vibration) with little pressure in the tissue and with 5 min of duration for each type of massage, unlike our study, in which MFR was applied with moderate pressure to high in just 1 min. It seems that the three types of light massage did not have the capacity to promote sufficient structural and physiological changes to improve performance, even using a much longer time for massage application. The approach performed by Kargarfard et al. (14) was not efficient to promote the necessary stimulus for the change in viscoelasticity (e.g., hyaluronic acid) that promotes a greater slip between muscle and fascial tissue, which would allow for decreasing the friction between the tissues (14). Had that happened, there would be an increase in the efficiency of the movement and, consequently, the neuromuscular performance (1,16,31).

For further explanation, the present study was the first to approach passive massage in muscle power effects of upper limbs and horizontal jump. Significant improvements were found in the m Experimental Group with massage and the muscular power tests of HJ, MBT, and VJ. Partially corroborating our results of lower limbs, Filippi et al. (9) submitted 60 elderly women to 3 passive interventions with a particular mechanical vibration device to verify the effect on the power of lower limbs. In their study, 3 sections of tendon vibration were performed on the insertion of the vastus medialis muscle for 30 min on 3 consecutive days. The authors compare the application effects of the contracted muscle protocol with the application of the relaxed muscle protocol, and the application of a placebo protocol, in which the application was performed with the device turned off. The authors did not find immediate improvements after the application of the mechanical vibration device. However, they found a significant improvement of 55% in VT power only 24 hrs after the end of the last session. Even though different passive techniques have also been applied, both studies differ in the application of the protocol, duration of the intervention, and number of sessions.

The massage performed in the present study had as its main characteristic the shearing of a great part of the structure of the target muscles; whereas, in the study by Filippi et al. (9) it had as a main characteristic the vibration at a specific point that promoted modification in the neural tonus and the response of the central nervous system. The authors argue that the vibrations caused by the device partially affected some receptors by the tonic vibration (afferent spindles, Golgi tendon organ, skin receptors, and joint mechanoreceptors) acting on the modulation of the synapses through plastic changes in the primary motor cortex due to the increase of the standard rate of neural firing (17). A similar situation occurs with the effects of massage, promoting proprioceptive improvement in the feedback of movement control, generated by pressure changes in the Pacini corpuscle (25), and improving muscle tone through a reflex mechanism in the stimulation of the sympathetic and parasympathetic nervous system (13,25). These changes also generate a decrease in pain perception, which allows for greater performance. (32).

On the other hand, the findings of Kargarfard et al. (14) disagree with the present study with respect to the effect on muscle power in the lower limbs. In their study, a light massage session (effleurage, petrissage, and vibration) was used in the muscles of the anterior and medial regions of the thigh for 30 min. The authors found a significant decrease in VT performance (-3.7%) in the results of the tests applied immediately after the massage, unlike our study, which found significant improvements in the muscular power (2.6%) of the VJ. This may have occurred because the mild massages were not able to reshape, normalize and hydrate the tissue, which usually occurs after the massage application (26). This may have been a determining factor for the divergence of the results.

Limitations in this Study

All tests used in the present study were chosen intentionally to approximate the practical applicability of the training centers and the academy, thus increasing the ecological validity of the results found. This could be a concern in the analysis of the data. Second, the movement cadence was not control by a metronome throughout the 10RM test. This may be considered as both a limitation and a positive aspect of the study, since it maintains the characteristic of the test and approaches the practical scenario of resistance training.

CONCLUSIONS

The results of this study suggest that massage applied before strength and power tests can improve the performance of 10RM and muscle power tests. The findings have practical applications for recreationally trained adults as well as for the athletic population. Future studies are recommended to clarify the physiological and neurophysiological mechanisms, mainly with regards to massage volume and the time course effects post-intervention in different samples of subjects.

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