EFFECTS OF PHYSICAL TRAINING ON THE MORPHOLOGY OF THE MAIN MUSCLES IN THE LOWER LIMBS OF SPORTS DANCERS

EFEITOS DO TREINAMENTO FÍSICO SOBRE A MORFOLOGIA DOS PRINCIPAIS MÚSCULOS NOS MEMBROS INFERIORES DE BAILARINOS ESPORTIVOS

EFECTOS DEL ENTRENAMIENTO FÍSICO EN LA MORFOLOGÍA DE LOS PRINCIPALES MÚSCULOS DE LOS MIEMBROS INFERIORES DE BAILARINES DEPORTIVOS

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ABSTRACT

Introduction: The dancers must have the necessary strength qualities to complete the dance movement techniques and coordinate the body movements, besides giving full capacity of execution to the qualities such as muscular strength, explosive power, and control in accelerated movement. Objective: Verify the main muscular morphology of the lower limbs of sports dancers. Methods: 24 undergraduate students were selected from a sports school of a university, specialized in sports dance, and divided into three groups for a physical fitness experiment. Results: Different training pressures responded with different effects on the thickness of major lower limb muscles. Compared to the thickness of the rectus femoris in the resting state before the experiment, muscle thickness immediately after exercise was significantly increased in the 250 and 300 groups ($P<0.05$). Conclusion: Training at a moderate pressure level - pressure value of 200 mmHg to 250 mmHg - can achieve better results. The presented protocol resulted in a functional improvement of the skeletal muscle. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Physical Education and Training; Lower Limbs; Muscles.

RESUMO

Introdução: Os dançarinos devem ter as qualidades de força necessárias para completar as técnicas de movimento de dança, a capacidade de coordenar os movimentos e o corpo, além de conferir total capacidade de execução às qualidades como força muscular, poder explosivo e controle em movimento acelerado. Objetivo: Verificar a principal morfologia muscular dos membros inferiores dos bailarinos esportivos. Métodos: 24 alunos de graduação foram selecionados de uma escola de esportes de uma universidade, especializados em dança esportiva, divididos em três grupos para experimento de aptidão física. Resultados: Diferentes pressões do treinamento responderam com efeitos diferentes sobre a espessura dos principais músculos dos membros inferiores. Em comparação com a espessura do reto femoral no estado de repouso antes da experiência, a espessura muscular imediatamente após o exercício foi significativamente aumentada nos grupos de 250 e 300 ($P<0,05$). Conclusão: O treinamento a um nível de pressão moderado - valor de pressão de 200 mmHg a 250 mmHg - pode alcançar melhores resultados. O protocolo apresentado resultou numa melhora funcional do músculo esquelético. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Educação Física e Treinamento; Membros Inferiores; Músculos.*

RESUMEN

Introducción: Los bailarines deben tener las cualidades necesarias de fuerza para completar las técnicas de movimiento de la danza, la capacidad de coordinar los movimientos y el cuerpo, además de dar total capacidad de ejecución a las cualidades como fuerza muscular, potencia explosiva y control en el movimiento acelerado. Objetivo: Verificar la principal morfología muscular de los miembros inferiores de los bailarines deportivos. Métodos: Se seleccionaron 24 estudiantes de grado de una escuela de deportes de una universidad, especializada en danza deportiva, divididos en tres grupos para el experimento de aptitud física. Resultados: Las diferentes presiones de entrenamiento respondieron con diferentes efectos sobre el grosor de los principales músculos de las extremidades inferiores. En comparación con el grosor del recto femoral en estado de reposo antes del experimento, el grosor del músculo inmediatamente después del ejercicio aumentó significativamente en los grupos 250 y 300 ($P<0,05$). Conclusión: El entrenamiento a un nivel de presión moderado - valor de presión de 200 mmHg a 250 mmHg - puede lograr mejores resultados. El protocolo presentado dio lugar a una mejora funcional del músculo esquelético. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Educación y Entrenamiento Físico; Extremidad Inferior; Músculos.*

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INTRODUCTION

In recent years, with the vigorous development of sports, sports dance has gradually entered the public eye. In sports dance competitions, the physical consumption of athletes is very large, although the time is very short, there are certain requirements for the control of speed and strength, this high-intensity aerobic exercise requires athletes to have good body posture control.[1] Due to the unstable state of the body, sports dancers want to greatly improve the overall beauty and appeal of sports dance movements, it requires sports dancers to maintain good body control at all times, therefore, at present, sports dance researchers are gradually turning their attention to the body posture control ability of sports dancers. However, there is no relevant practical research on the use of EMG and isokinetic muscle strength combined with blood flow restriction training for dance students.[2] Therefore, by using surface electromyography and isokinetic muscle strength professional equipment combined with blood flow restriction training, for analyze the muscle function of the main muscles of the lower limbs of the students specializing in sports dance and dance, and record the changes in the circumference, sebum, resistance muscle strength, root mean square amplitude (RMS value), peak torque, peak power, and maximum work of the main muscles of the lower extremity during weight-bearing and pressure-applied exercise, in order to improve the strength of the main muscle groups of the lower limbs of the students who specialize in dance sports in my country, select scientific and reasonable training methods, conduct scientific and effective special strength training to provide reference data, and make it achieve the proper training effect for exploration and research.[3]

METHOD

Experimental subjects

The author selects 24 students from the sports dance major of a school of physical education of a normal university as the experimental objects, before the start of the experiment, ask and investigate the physical health of all subjects, make sure that subjects are performing experiments on the basis of physical and mental health.[4] Confirmed, the 24 subjects were completely healthy physically and mentally, and their daily rest and fatigue were normal, which provided safety and guarantee for the experimental process. In the experimental study, 24 subjects were divided into non-negative reorganization, negative reorganization, and weight-bearing compression groups, with 8 subjects in each group (N=8), the basic information statistics of age, height and weight of the 24 experimental subjects were performed, as shown in Table 1. Then use SPSS software to test the mean and standard deviation of the statistical data.

Research methods

The indirect test method of repeated testing of 10RM was used to infer the subject's 1RM, and the test results were used to formulate the load intensity of the subject's later exercise program. The experiment is divided into two parts, a one-time experiment and a 2-week exercise intervention experiment.[5] A one-time interval of 48 hours between normal resistance training and KAATSU resistance training. The subjects who participated in the 2-week experiment were trained uniformly at 6:00 a.m. every day, once a day, 4 groups each time, 12 times per group, 6 days a week, resting on Sunday.

Table 1. Basic information of experimental subjects.

group (N=8)	age (y)	height (cm)	weight (kg)
No negative recombination	20.41±0.423	165.38±4.016	53.19±3.261
negative recombination	20.24±0.381	166.35±4.621	51.36±4.952
weight-bearing compression group	20.37±0.349	164.45±6.021	53.11±6.325

Exercise training was performed as follows, and subjects wore compression equipment according to group requirements:[6]

1. Warm up. Do a 5-minute jog to warm up.
2. Dynamic stretching. Do the greatest stretches, sumo squats, lunge twists, glute bridges, and more.
3. Light load squats warm-up exercise. Start with an empty bar and gradually increase the weight, doing 2-4 reps of each weight.
4. Squat training. Use high bar squat, closed grip, stand with feet parallel, stand slightly wider than pelvic distance, place the bar at the bottom of the neck above the rear of the deltoid, keep the chest upright and open. When squatting, keep your back straight, keep your torso at a fixed angle to the ground, slowly bend your hips and knees, keep your heels on the ground, and keep your knees below your toes until your thighs are parallel to the ground. As you go up, keep your back straight, keep your knees slightly bent, heels on the ground, knees directly above your feet, and extend your hips and knees until you return to the starting position. Strength is 30% 1RM.[7]
5. RELAX. Static stretch and foam roll fascia relaxation.

There is no need for a code of ethics for this type of study.

RESULTS

As can be seen from Figure 1, compared with the quiet state, the thickness of the rectus femoris muscle increased after wearing compression devices with different pressures, and there was a significant difference between the 150, 200, 250 and 300 groups (P<0.05).[8]

As can be seen from Figure 2, compared with the resting state, the biceps femoris muscle thickness increased after wearing different

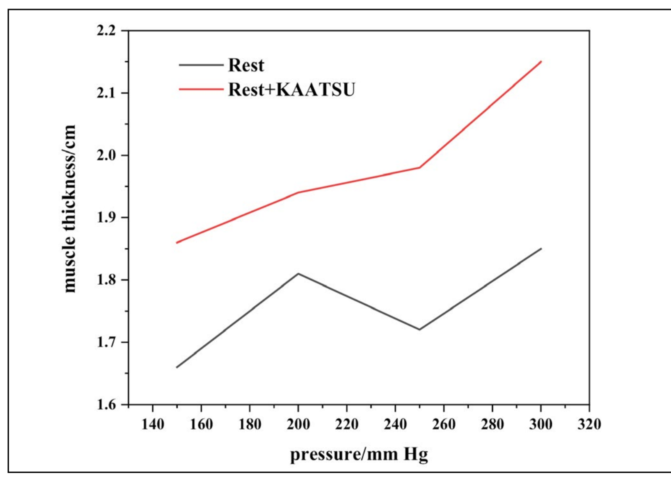

Figure 1. Changes in rectus femoris thickness with and without compression devices at rest.

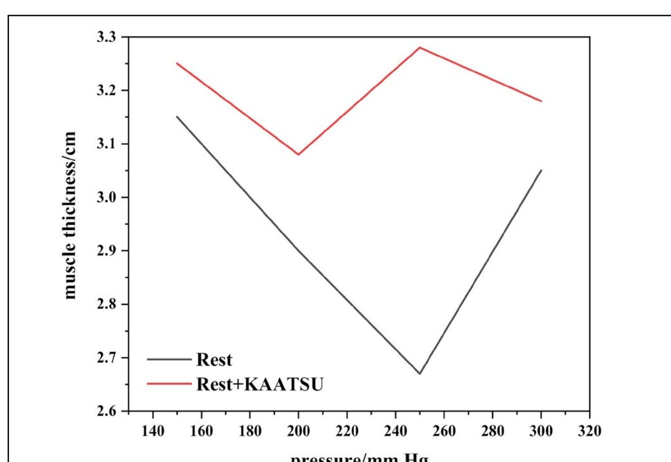

Figure 2. Changes in biceps femoris thickness with and without compression equipment at rest.

pressure compression devices, and there were significant differences among the 150, 200, 250 and 300 groups (P<0.05).

According to Figure 3, it can be seen that wearing pressurized equipment with different pressures, the rectus femoris muscle thickness immediately after exercise was significantly increased compared with the resting state, and there was a significant difference between the 200, 250 and 300 groups (P<0.05).

DISCUSSION

The test results of the lower limb muscle shape before and after the experiment in the static exercise group showed that, the cross-sectional area of the quadriceps and hamstrings increased by 3.5% and 7.7%, with a small increase, the cross-sectional area of gracilis and sartorius increased by 14.4% and 13.3%, and the cross-sectional area of fat decreased by 8.4%, however, there was no significant difference in muscle morphology between the static group before and after the experiment (P>0.05). From the perspective of training, this phenomenon may be related to the joint angle used in training, because static exercises do not maximize the extension and contraction of muscles and joints, the increase in muscle contraction strength is limited to the joint angle used in training, and the effect on improving neuromuscular coordination is not obvious, therefore, the effect on the cross-sectional area of the developing muscle is general.[9] Although the increase was not significant, however, in bodybuilding training, static exercises can improve the nervous system's ability to control muscles and the ability to perform in competitions, at the same time, in the dynamic exercise, the muscles that are not easy to be trained can be specially strengthened to make the muscle lines stand out and cause a strong visual effect. The test results of the lower limb muscle morphology before and after the experiment in the dynamic exercise group showed that, the cross-sectional area of quadriceps femoris and hamstrings increased by 18.5% and 25.2%, and there were significant differences in muscle morphology before and after the experiment (P<0.05), the cross-sectional area of the gracilis and sartorius increased by 80.7% and 64.8%, with a larger increase, there was a significant difference in muscle morphology before and after the experiment (P<0.01). The fat cross-sectional area decreased by 13.7%, and the difference between before and after the experiment was not significant (P>0.05). From the perspective of training, dynamic exercises can well develop neuromuscular coordination, and can maximize the range of motion in each movement of the whole body, it is beneficial to improve the contraction speed of muscles, make more muscle groups exercise, and produce good physiological effects, which can significantly increase the cross-sectional area of muscles.[10] The test results of the morphological changes of the lower limb muscles before and after the experiment in the dynamic group and the static force group showed that, the increase in the cross-sectional area of the gracilis, hamstring, and sartorius muscle in the dynamic group before and after the experiment was greater than that in the static group, and the changes in muscle shape were significantly different (P<0.05), and the cross-sectional area of the quadriceps increased significantly.

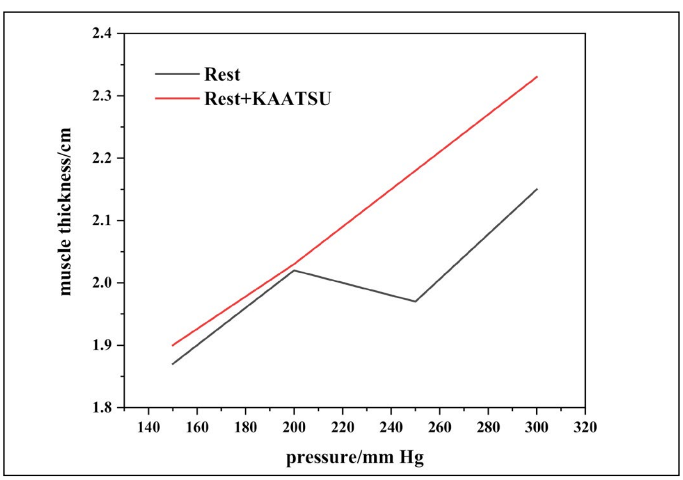

Figure 3. The thickness of the rectus femoris muscle at rest and immediately after exercise after wearing the compression device.

CONCLUSION

Kaatsu training can achieve the effect of ordinary high-intensity resistance training under low-intensity load, under the same load, more motor units are recruited and more muscle fibers are recruited to participate in the movement. After one-time compression resistance training, the muscle fibers contracted more obviously, the muscles of the lower limbs were obviously thickened, and the training effect in the range of 200-250 mm Hg was better. The increased levels of IGF-1, IL-6 and Irisin after one-time KAATSU training may be important factors leading to long-term muscle thickening. VEGF has a certain influence on the improvement of vascular tone and vascular endothelial function, and may alleviate the influence of venous pool effect on vascular function. 2 weeks of KAATSU training increases the thigh circumference, promotes muscle growth, reduces fat content, and improves fat metabolism. Long-term training may achieve the effect of increasing muscle and reducing fat. Through the 12-week experiment, all three groups have improved the circumference of muscle shape, and the weight-bearing compression group has the most significant effect. Using scientifically advanced surface electromyography testing equipment and isokinetic muscle strength testing equipment, through the data obtained after the 12-week experiment, it can be seen that among the 3 groups, the weight-bearing compression group has a significant improvement effect. Experiments can prove that blood flow restriction training combined with low-intensity strength training is scientifically effective, low-intensity compound movements combined with blood flow restriction training at 150mmhg pressure, it can be used as an effective training method for modern dance students to develop and improve muscle strength.

All authors declare no potential conflict of interest related to this article

AUTHORS' CONTRIBUTIONS: Each author made significant individual contributions to this manuscript. Hua Zhang: writing; Ronghui Hu: data analysis and article review.

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