IMPACT OF MUSCLE STRENGTHENING ON JOINT STRENGTH IN TAE KWON DO ATHLETES

IMPACTOS DO FORTALECIMENTO MUSCULAR SOBRE A FORÇA ARTICULAR NOS ATLETAS DE TAE KWON DO

IMPACTO DEL FORTALECIMIENTO MUSCULAR EN LA FUERZA DE LAS ARTICULACIONES EN ATLETAS DE TAE KWON DO

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ABSTRACT

Introduction: Taekwondo athletes' knee flexor and extensor muscle groups reveal the joint's biomechanical characteristics when tested and may suggest a direction for individual strength training in Tae Kwon Do athletes. Objective: Evaluate the impact of muscle strengthening on joint strength in Tae Kwon Do athletes. Methods: The study was conducted through a literature review, experimental test, and logical analysis. Results: The strength of the flexion muscle group in Taekwondo athletes was significantly higher than that of extension. The flexion-extension ratio is high. This characteristic may be related to the athletes' habit of supporting body weight with the left leg and attacking with the right leg. Conclusion: Strength training of the knee flexors is indicated for Tae Kwon Do athletes, balancing the muscular balance by raising the flexor fatigue index close to that of the extensors, improving the strength and endurance of the knee flexor muscles. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: *Physical Education and Training; Athletes; Muscle Strength.*

RESUMO

Introdução: Os grupos musculares flexores e extensores do joelho dos atletas de taekwondo revelam as características biomecânicas da articulação ao serem testados, podendo sugerir um direcionamento para o treinamento de força individual nos atletas de Tae Kwon Do. Objetivo: Avaliar os impactos do fortalecimento muscular sobre a força articular nos atletas de Tae Kwon Do. Métodos: O estudo foi conduzido pelos métodos de análise literária, teste experimental e análise lógica. Resultados: A força do grupo muscular da flexão em atletas de Taekwondo foi significativamente maior do que a da extensão, a relação flexão-extensão é elevada. Esta característica pode estar relacionada ao hábito dos atletas suportarem o peso corporal com a perna esquerda e atacar com a perna direita. Conclusão: O reforço com o treinamento de força nos flexores do joelho é indicado aos atletas de Tae Kwon Do, equilibrando o balanço muscular ao elevar o índice de fadiga dos flexores próximo ao dos extensores, aprimorando a força e a resistência dos músculos flexores do joelho. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Educação Física e Treinamento; Atletas; Força Muscular.*

RESUMEN

Introducción: Los grupos musculares flexores y extensores de la rodilla de los atletas de Taekwondo revelan las características biomecánicas de la articulación cuando se someten a prueba, y pueden sugerir una dirección para el entrenamiento de fuerza individual en los atletas de Tae Kwon Do. Objetivo: Evaluar el impacto del fortalecimiento muscular sobre la fuerza articular en atletas de Tae Kwon Do. Métodos: El estudio se llevó a cabo mediante los métodos de análisis bibliográfico, prueba experimental y análisis lógico. Resultados: La fuerza del grupo muscular de la flexión en los atletas de taekwondo fue significativamente mayor que la de la extensión, la relación flexión-extensión es alta. Esta característica puede estar relacionada con el hábito de los atletas de apoyar el peso del cuerpo con la pierna izquierda y atacar con la pierna derecha. Conclusión: El entrenamiento de fuerza de los flexores de la rodilla está indicado para los atletas de Tae Kwon Do, equilibrando el balance muscular al elevar el índice de fatiga de los flexores cerca del de los extensores, mejorando la fuerza y la resistencia de los músculos flexores de la rodilla. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Educación y Entrenamiento Físico; Atletas; Fuerza Muscular*

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INTRODUCTION

Strength is the basis for all sports activities performed by taekwondo athletes, an excellent sport can only have an advantage in a high-intensity competition if it has sufficient physical reserves.[1] Strength quality is the core of physical training, the size of muscle strength not only plays an important leading role in sports performance, but also directly affects the development and improvement of other sports qualities. However, when the technical and tactical levels of the athletes on both sides are similar, the competition of the joints and muscles between the athletes has been transformed into a confrontation of strength and quality, in the fierce taekwondo competition, the strong athlete can finally gain the upper hand in the competition and gain a competitive advantage. The ankle joint is one of the main joints of the human body, and it is a joint with a complex structure of the human body, most sports require the direct or indirect participation of their muscle groups to complete.[2] Strength is the basis of taekwondo, and the improvement of strength can effectively promote the development of other physical qualities. Strength quality refers to the ability of muscles to overcome internal and external resistance during work. It is a very important factor in the competition of Taekwondo athletes, including general strength and special strength. Special strength refers to the strength required by athletes to complete technical movements in special sports and improve their performance in special sports, it is closely related to the development of special techniques in the actual combat of taekwondo athletes, and is an important key to whether taekwondo athletes can continue to demonstrate high-level and stable techniques.[3]

METHOD

Documentation method

The test adopts the Isomed2000 ankle joint test program, and the immobilization and testing are carried out in strict accordance with the methods specified in the experimental manual. The subjects were asked to do sufficient preparatory activities to ensure accurate test data and avoid muscle strain. Athletes were required to perform 30 minutes of preparatory activities before the test, including bilateral ankle flexion and extension activities and stretching exercises.[4] During the test, the subject takes the supine position, naturally holds the handles on both sides with both hands, and the rotation axis of the power head is aligned with the test site, so that the axis of joint movement is consistent with the axis of rotation of the power arm of the instrument, and gravity is carried out before the test. Compensation, before the formal test, under the test angular velocity, exercise 3 times with low intensity, so as to be familiar with the whole test process.[5] Concentric contraction of joint isokinetic test, the joint angular velocity is 60°/s, 120°/s, 180°/s, 240°/s, 300°/s, each speed is repeated 1 group, each group is 5 times, group interval of 30 seconds. In selecting the test angular velocity value, the author refers to the previous research literature, and this study believes that the muscle strength tested when the angular velocity is 60°/s represents the basic knee strength, 180°/s represents medium and fast strength, and 300°/s represents fast strength, in order to obtain the variation law of the athlete's isokinetic concentric contraction force with angular velocity more completely, a test of 120°/s between the basic strength test and the medium and fast strength test was added, there is also a 240°/s force test between medium and fast force and fast force.[6] As shown in Table 1, the relative peak torque of the isokinetic concentric contraction of the joint flexor and extensor group, and the peak torque flexion-extension ratio.

Experimental test method

Through the experimental study, it was found that the concentric contraction of the flexor and extensor muscle groups in the ankle joint isokinetic test, the joint angular velocities were 60°/s, 120°/s, 240°/s, each speed was repeated 1 group, each group 5 times, the components interval of 30 seconds. The relative peak torque of the isokinetic concentric contraction of the right ankle flexor and extensor group, and the peak torque flexion-extension ratio display, the peak muscle moment of isokinetic concentric contraction of the right ankle plantar flexor group decreases with the increase of a given movement speed (60°/s-240°/s), the relative peak muscle torque of the right ankle plantar flexors decreased from 1.70N m/kg to 1.41N m/kg, and the peak muscle torque of the dorsiflexors decreased from 1.13 to 0.17N m/kg.[7,8] As shown in Table 2, the percentage decrease in the peak torque of isokinetic concentric contraction of the left and right knee flexor and extensor groups.[9] Figures 1 and 2 show the change curves of the average power and torque of the joint muscle group with the angular velocity.

Logic Analysis

Core strength stability plays an important role in supporting athletes' use of combo legs. Athletes with strong core strength can quickly adjust the body's center of gravity to perform a second strike after an effective strike, and ensure smooth movement changes and connections when changing body posture, improving the coherence of the combined leg technique.[10]

Table 1. Relative peak torque of isokinetic concentric contraction of joint flexor and extensor group, and peak torque flexion-extension ratio.

Angular velocity (%)	60	120	240
Joint relative peak torque (N.m/kg)	1.70±0.48	1.62±0.41	1.41±0.53
Dorsiflexion relative peak moment (N.m/kg)	1.13±0.96	1.21±0.06	0.17±0.06

Table 2. The percentage decrease of the peak torque of isokinetic concentric contraction of left and right knee flexor and extensor groups.

Percent decrease in peak relative flexor torque of the left knee	Right knee relative flexor peak torque reduction percentage	Left knee extension relative peak torque reduction percentage	Right Knee Extension Relative Peak Moment Reduction Percentage
13.83	10.16	6.23	7.23
7.78	8.01	18.93	17.75
3.37	5.91	4.91	4.54
5.26	2.64	6.46	6.74

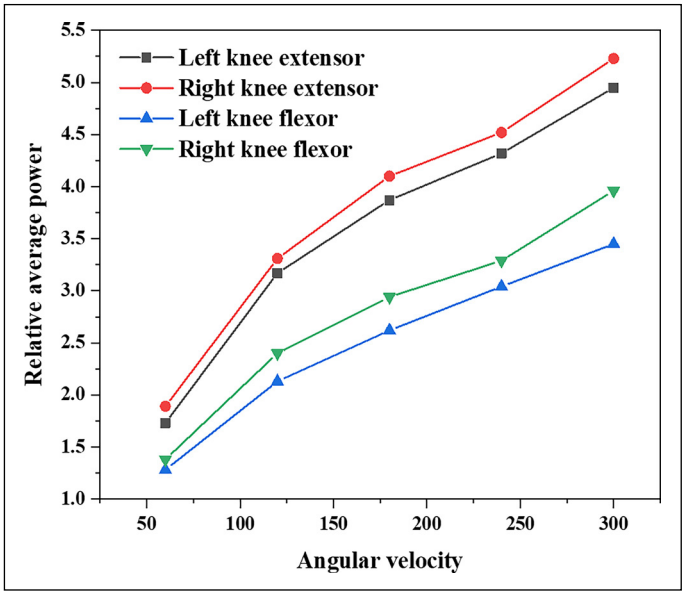

Figure 1. The curve of the average power of the joint muscle group as a function of the angular velocity.

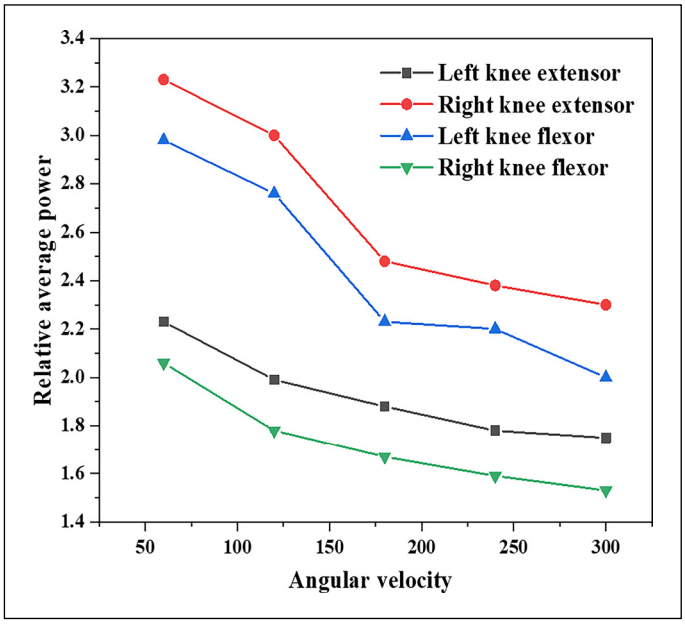

Figure 2. Variation curve of joint muscle group torque with angular velocity.

The strength of the muscle group in the core area directly affects the transmission of the muscle strength of the upper and lower limbs of the human body, and plays a pivotal role in the coordinated work of the upper and lower limbs, the core strength is the basic strength generated by the deep and superficial muscle groups attached to the core area, strength training refers to strength training that strengthens the deep and superficial muscles of the human core area.

ETHICAL COMPLIANCE

Research experiments conducted in this article with animals or humans were approved by the Ethical Committee and responsible authorities of Henan University of Urban Construction following all guidelines, regulations, legal, and ethical standards as required for humans or animals.

RESULTS AND ANALYSIS

Taekwondo emphasizes the rapid attack of the lower limbs while emphasizing the rapid return of the lower limbs, rapid return to defense requires strong strength of the knee flexors, this action is guaranteed to be completed. It can be seen that the peak muscle torque flexion-extension ratio of the right knee increases from 0.64 at 60°/s to 0.78 at 300°/s, and the peak muscle torque flexion-extension ratio of the left knee increases from 0.64 at 60°/s. 66 increased to 0.75 at 300°/s, it can be seen that the flexor strength is smaller than the muscle group strength at all angular velocities. The flexion-extension ratio of the knee joint in the slow isokinetic test (60°/s) is about 67%, while the mid-speed test (180°/s) is about 76%, and the fast test (240°/s) is about 83% . Compared with the reference value, the results of this study show that the flexion-extension ratio is lower at medium and high speed, and the gap is larger at high speed, and the flexion-extension ratio is relatively unreasonable. The relatively small flexor strength has a certain impact on the athlete's rapid recovery of the calf to return to the stance, and is not conducive to defensive counterattacks. Strengthen the strength and endurance training of knee flexors, only in this way can the fatigue index of the knee flexors be close to that of the extensors, and the strength and endurance of the flexors can be improved.

DISCUSSION

When the average power of isokinetic concentric contraction of the left and right knee flexors is at 300°/s, the maximum value is reached, the athlete flexes the calf at this speed, which can quickly and effectively return to defense and prepare for the next attack. When the average power of the left and right knee extensor group isokinetic concentric contraction extensor group reaches the maximum value at 300°/s, the athlete stretches the calf at this speed, which can exert the explosive ability of the calf extensor group and provide a favorable attack effect. A small relative plantar flexion/dorsiflexion ratio indicates that the strength of the ankle joint dorsiflexors is relatively small, which is related to the main movement characteristics of the ankle joint, most sports and strength training focus on the moment flexion of the ankle joint, followed by the heel joint, there is a certain relationship with the anatomical structure of the ankle joint, the range of dorsiflexion of the ankle joint is smaller than that of plantar flexion, resulting in short contraction time and short muscle working time, the nerve may only activate the fast twitch fibers in the muscle, the muscles involved in the active muscle group may not be fully activated, thus producing less muscle force and decreasing peak muscle torque. By comparing the relative peak moment plantar flexion/dorsi-extension ratio at 240°/s, it was found that the ratio became larger, which fully indicated that the joint strength was weaker under high angular velocity movement.

CONCLUSION

The results of this study show that, in strength training, further refinement of core strength training is the method and basic principle that taekwondo athletes should follow. The strength training of joint muscle groups can be divided into static, dynamic exercises in a stable state and static, dynamic and resistance exercises in an unstable state, and use staged training strategies to strengthen the core muscles of athletes the power of the crowd, it can ensure that the strength of these muscle

groups can fully act on the use of difficult techniques, thereby improving the competitive level of athletes in actual combat. Therefore, the strength training method can enable athletes to fully appreciate the strength of the abdominal and leg muscles, and improve the ability of athletes to control the center of gravity when using the high technical leg method.

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