STRENGTH TRAINING IN THE LOWER LIMBS OF SOCCER PLAYERS

TREINAMENTO DE FORÇA NOS MEMBROS INFERIORES DOS JOGADORES DE FUTEBOL

ENTRENAMIENTO DE FUERZA EN LAS EXTREMIDADES INFERIORES DE LOS FUTBOLISTAS

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ABSTRACT

Introduction: The isometric weight training method combines the benefits of physical endurance and hypertrophy. This teaching method performs the isometric exercise with the appropriate body weight. Objective: Study the effects of isometric training with weights on soccer players' explosive strength of the lower limbs. Methods: Twenty soccer players were randomly selected and divided equally into experimental and control groups. The real training situation of the athletes was used. The experimental group adopted the isometrics teaching method with weight, while the control group used conventional muscle strength training. The lower limb strength of the two groups of athletes was compared before and after the experiment. Results: The extensor force growth rate in the experimental groups was significantly increased at medium, high and low speeds, while the peak torque did not show significant changes. The soccer players had their muscle strength improved. There was a significant difference between the two groups (P<0.05). Conclusion: Isometric weight training significantly improves mid and fast-extensor muscle strength in young soccer players. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Resistance Training; Isometric Exercises; Soccer; Athletes.

RESUMO

Introdução: O método de ensino por isometria com peso combina os benefícios de resistência física e hipertrofia. Este método de ensino executa o exercício isométrico com o peso corporal adequado. Objetivo: Estudar os efeitos do treinamento isométrico com pesos sobre a força explosiva dos membros inferiores nos jogadores de futebol. Métodos: Selecionou-se 20 jogadores de futebol por amostragem aleatória, divididos igualmente em grupo experimental e controle. Utilizou-se a situação real de treino dos atletas. O grupo experimental adotou o método de ensino por isometria com peso enquanto o grupo de controle utilizou o treinamento convencional de força muscular. A força dos membros inferiores dos dois grupos de atletas foi comparada antes e após o experimento. Resultado: A taxa de crescimento da força extensora nos grupos experimentais foi significativamente aumentada em velocidades médias, altas e baixas, enquanto o torque de pico não apresentou alterações significativas. Os jogadores de futebol tiveram sua força muscular aprimorada. Houve uma diferença significativa entre os dois grupos (P<0,05). Conclusão: O treinamento isométrico com pesos melhora significativamente a força muscular extensora média e rápida nos jovens jogadores de futebol. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

***Descritores*:** *Treinamento de Força; Exercício Isométrico; Futebol; Atletas.*

RESUMEN

Introducción: El método de enseñanza por isometría con peso combina los beneficios de la resistencia física y la hipertrofia. Este método de enseñanza realiza el ejercicio isométrico con el peso corporal adecuado. Objetivo: Estudiar los efectos del entrenamiento isométrico con pesas sobre la fuerza explosiva de los miembros inferiores en jugadores de fútbol. Métodos: Se seleccionaron 20 jugadores de fútbol por muestreo aleatorio, divididos por igual en grupo experimental y grupo de control. Se utilizó la situación real de entrenamiento de los atletas. El grupo experimental adoptó el método de enseñanza por isometría con peso, mientras que el grupo de control utilizó el entrenamiento de fuerza muscular convencional. Se comparó la fuerza de las extremidades inferiores de los dos grupos de atletas antes y después del experimento. Resultados: La tasa de crecimiento de la fuerza extensora en los grupos experimentales aumentó significativamente a velocidades medias, altas y bajas, mientras que el par máximo no mostró cambios significativos. Los jugadores de fútbol mejoraron su fuerza muscular. Hubo una diferencia significativa entre los dos grupos (P<0,05). Conclusión: El entrenamiento isométrico con pesas mejora significativamente la fuerza de los músculos extensores medios y rápidos en jóvenes futbolistas. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

***Descriptores*:** *Entrenamiento de Fuerza; Ejercicio Isométrico; Fútbol; Atletas.*

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INTRODUCTION

Ultra-isometric training is a training method that stretches the muscles in advance to achieve the contraction of the heart. This form of exercise maximizes the body's elasticity and stimulates the body's tone and response. This enables a combination of exercise intensity and rate to form an instantaneous response. These forms all generate instant responses by stretching the muscle response. The training of knee flexion and extension of football players is critical. In the past, football teams mainly used simple weight-bearing muscle training to train leg muscle strength.[1] Due to the continuous optimization and improvement of various sports methods, the effect of single-weight training also has some drawbacks. Super isometric weight training is a new method developed based on strength training and super isometric training principles. It increases speed and explosiveness by increasing the maximal strength of an athlete's leg muscles. This study examined the effect of this method on lower body strength with a sample of 20 people from a football team.

METHOD

Research objects

The experiment used 20 football players as experimental observation. All contestants are male. In this test, 12 players did not have apparent physical training or injuries. This test can eliminate the interference of factors such as fatigue and injury.[2] There was no significant difference in the primary data between the two groups (P>0.05).

Investigation method

The control group used conventional lower limb muscle strength training. The athlete used high foot lifts and frog leaps. The specific training steps are as follows: (1) At the beginning, the athlete stands on the spot and keeps the body straight. The athlete then runs toward the finish line. When running, take turns raising both feet on the ground and parallel to the floor. (2) The athlete squatted halfway at the beginning. A half squat is with your legs spread out to shoulder width. The athlete's upper body leans forward slightly, then puts his hands behind him. Athletes do the same with both hands on the ground while jumping. Athletes train with a training device and a beat device to record.[3] The athlete's knee is fully extended, and the knee is flexed about 120° to record with a metronome device. Each group was given a super-isometric training session.

The experimental group adopted the method of super isometric weight bearing. The exercise equipment is super isometric. Athletes use this equipment for barbell training. The athlete uses the computer to safely slow down the bar and reduce the impact of the pointer falling.[4] Athletes choose to perform handstands underweight during training. The athlete then places the barbell on the shoulders. The athlete then bends the legs and keeps the knees upright. The speed of the players in this process is breakneck. Movement speed increases as the athlete's leg muscles squeeze toward the center. The maximum load for each training is 30%. In this experiment, two experimental groups were observed for eight weeks. Train three to four times a week. Athletes perform the same amount of training.

Training observations

This test was recorded using multiple hinges and recovery devices from CYBEXNORM in the United States.[5] Tried and tested athletes at 240 degrees per second. Before and after the test, each group performed a squat. In this paper, the relevant results were obtained by measuring the lower limb muscle strength and squatting of the two groups of athletes. These results can be used to determine the effectiveness of training.

The lower limb muscle dynamics of the football team

This paper collects the motion characteristics and sensor data of various parts of a football game. We present a nonlinear dynamic model of a football player.

$$\bar{H} = -\frac{dW}{dS} + g[h\frac{(1-\varepsilon)(1+\varepsilon)}{\varepsilon} - \alpha) \quad (1)$$

In this paper, the mechanical parameters of the hip are obtained by integrating the parameters of the force balance, $i = [\eta, \dot{\eta}, \gamma]^T$. In this paper, the dynamic torque of the leg, $\dot{i} = g(i,u)$, is obtained by analyzing the muscle group movements of football players.[6] When the leg length of a football player is measured, the state value of its stable characteristic functional is $i_0(i_0 = [\eta_0, \dot{\eta}_0, \gamma_0]^T)$. In this paper, the vibration-elastic damping characteristics of football players are studied, and the model's stable model is obtained: f (x0,u0)=0. The dynamic characteristics of the lower limb muscles of a football player are:

$$\begin{aligned} & \Delta\eta \\ i = & [\eta_0 + \Delta\eta] \\ & \gamma_0 + \Delta \\ u = & \Delta u_0 \end{aligned} \quad (2)$$

i, u represents the solution of the muscle force stabilization model in equation (2). This paper derives the kinematic formula for the thigh muscles of a football team:

$$F_{et} = \bar{H} + \frac{\pi(i-u)D^2}{4} \quad (3)$$

In this paper, the 4X4 homogeneous coordinate ${}^{I}T_0(\alpha_0, \beta_0, \gamma_0)$ is used to express the motion inertia number of the football player's leg muscles, ${}^{I}T_0(\gamma_1, \gamma_2, \gamma_3)$. In this paper, $pt = [i_t, y_t, z_t]^T$ is used as the feedback compensation factor for energy error.[7] In this paper, the above methods are used to establish the dynamic model of the leg muscles of football players.

Data Statistics

This paper uses SPSS20.0 to conduct systematic research. Measurement data are expressed as mean ± standard deviation.[8] In this paper, a t-test was used for group comparison. Statistics are expressed as percentages. This paper used the X2 test method to compare the data. P>0.05 means no significant difference. P<0.05 is a significant difference.

Ethical Compliance

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

RESULTS

Analysis of lower limb muscle strength in the two experimental groups before and after the test

Players from both teams were trained and observed for eight weeks. The conclusions indicated a significant change in the calf tendon capacity of the players before and after exercise.[9] The ability of the lower body

muscles in these two groups was significantly improved compared with that before the exercise. The experimental group, on the other hand, showed a considerable increase in lower extremity muscle capacity. The lower limb muscle abilities of the two groups of contestants were significantly compared (P<0.05). (Table 1)

The results of the squat jump test of the two groups of athletes

The maximum burst Pmax is the best reflection of the results of the squat jump test. The value of Pmax indicates the strength of the speed of high and long jumps with the help of gravity. The Pmax values of both groups of athletes were greatly improved.[10] The increase rate of Pmax in the experimental group was also faster than that in the control group, and the comparison between the two was significant (P<0.05). The performance of Pmax in both groups was also significant (P<0.05). The Pmax value of the experimenter was better. (Table 2)

DISCUSSION

Motor units mainly include slow-contraction motor units with slow compression duration, small tension force, and anti-strain solid force. The trot sports unit will take precedence over the slow motion unit in the case of high elastic forces. Slow-twitch motor units that produce low-tense muscle tension over time will be recruited first. Some scholars have studied the effect of different isometric, concentric, and eccentric contraction modes on the recruiting form of motor units. Studies have found that slow motor units are activated in concentric and isometric situations.[11] Fast-moving motion units under moderate, high-speed centrifugation are preferred. Percussive strength training with repetitive stretching and shortening is the preferred fast-twitch motor unit. According to SSC's characteristics, the motor units' recruitment sequence should be consistent with the impact muscle training when super isometric load training is carried out.

Muscle strength-enhancing properties result from evaluating exercise through similar exercise patterns after muscle strength training. Its muscle strength is much higher than other measurements.[12] In eccentric muscle strength training, the eccentric contraction muscle strength is higher than the concentric muscle strength. Some scholars performed 36 eccentric and concentric contractions in 12 weeks. This is to study the different states of the muscle during eccentric and concentric contractions. The conclusion shows that the concentric tightening exercise group increases the proportion of peak ability in the three kinds of tightening states: concentric tightening, eccentric tightening, and isometric tightening are similar. The peak ratio of the increase in distance crunch in the eccentric crunch training group was significantly higher than the isometric and concentric crunch. This experimental study provides further evidence that using eccentric contractions to cultivate body capacity is an effective resistance method. The results under the eccentric mode of muscle strength assessment were significant.

Some scholars have pointed out that the characteristics of muscle strength enhancement can be used to represent the adaptability of nerves. The type of muscle atrophy and how the movements are regulated also vary. Long-term strength training can make neuro muscles more adaptable to this type of contraction. The muscle strength measured under the same contraction method will also significantly improve. The results show that super isometric weight training significantly improves isokinetic muscle strength and early traction. Physical exercise can promote the human central nervous system and body adaptation. Super-length body ability training can significantly improve explosive power. This training style does not consider muscle tissue hypertrophy and muscle fiber changes. Some scholars have studied the effect of hyper isometric weight training on the lower extremity muscles through MRI. The study found that eight weeks of super isometric training did not increase the transverse cross-sectional area of the rectus femoris, biceps femoris, and excretory muscles. This survey showed that hyper-isometric weight training did not cause full-body muscle expansion. The effect of weight training on super isometrics is more significant. The main factor is not the excessive expansion of muscles but the adaptation of nerves and muscles. Pyramid weight training can improve the athlete's strength without causing the athlete to gain weight. Soccer players should use super isometric training.

Table 1. Comparison of peak torque of knee muscles of two groups of athletes before and after the test.

Muscle group	Group	before training	After training	Increase	Increase rate (%)
Flexors	Test Group	108.37±25.92	116.84±26.12	8.47±3.06	8.78
	Control group	106.43±27.14	113.47±23.16	7.04±2.45	5.10
Extensor muscles	Test Group	169.69±33.16	187.35±44.49	15.51±3.88	9.90
	Control group	169.08±33.78	178.27±42.04	10.31±2.96	6.22
P	-	>0.05	<0.05	<0.05	<0.05

Table 2. Comparison of Pmax between two groups of athletes.

Group	Number of cases	Before training	After training	Increase in real
Test Group	10	248.78±43.37	282.45±74.69	39.69±29.69
Control group	10	248.37±43.98	259.49±61.33	16.02±23.67
P	-	>0.05	<0.05	<0.05

CONCLUSION

The athlete has significantly improved the explosive power of the lower body through super isometric weight bearing. In particular, the speed and strength of the knee joint's extension, flexion, and extension were significantly improved. These two metrics can improve an athlete's performance capabilities. This paper argues that coaches can use this technology in the daily training of football players.

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