

INFLUENCES OF ECCENTRIC CONTRACTION TRAINING ON SOCCER PLAYER'S SPEED

INFLUÊNCIAS DO TREINAMENTO DE CONTRAÇÃO EXCÊNTRICA SOBRE A VELOCIDADE DE FUTEBOLISTAS

INFLUENCIAS DEL ENTRENAMIENTO DE CONTRACCIÓN EXCÉNTRICA EN LA VELOCIDAD DE FUTBOLISTAS



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ABSTRACT

Introduction: Strength quality can be divided into maximum strength, rapid strength, endurance, and reaction strength. Rapid strength has been a hot topic of discussion in contemporary sports industry research. **Objective:** Study the influences of eccentric contraction training of the lower limbs in soccer players and its repercussions on the athletes' speed. **Methods:** A multifunctional centrifugal training instrument was used as a training tool through the experimental method to analyze the effect of eccentric contraction training on the rapid strength of soccer players. The athletes were divided into experimental and control groups for training. Explosive power, speed sensitivity, and dynamic index of special rapid power were tested before and after training. **Results:** Compared to the control group, the explosive power index, the sensitivity index, and the kinetic index showed better expressivities in the experimental group; the four jumping ability indexes, the three sensitivity indexes - except the 15s step frequency - and the eccentric training in the experimental group showed a very significant improvement ($P < 0.01$). **Conclusion:** Eccentric contraction training can effectively improve muscle strength; its training effect is better than that of concentric training, especially eccentric contraction training on the lower limbs, which has an important impact on the rapid strength of soccer players. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

Keywords: Limbs, Lower; Training, Strength; Soccer.

RESUMO

Introdução: A qualidade da força pode ser dividida em força máxima, força rápida, resistência e força de reação. Entre elas, a força rápida tem sido um tema de discussão acirrado nas pesquisas da indústria esportiva contemporânea. **Objetivo:** Estudar as influências do treinamento de contração excêntrica dos membros inferiores em jogadores de futebol e suas repercussões sobre a velocidade dos atletas. **Métodos:** Utilizou-se um instrumento de treinamento centrífugo multifuncional como ferramenta de treinamento através do método experimental para analisar o efeito do treinamento de contração excêntrica sobre a força rápida dos jogadores de futebol. Os atletas foram divididos no grupo experimental e no grupo de controle para o treinamento. Foram testados a potência explosiva, a sensibilidade à velocidade e o índice dinâmico de potência rápida especial antes e após o treinamento. **Resultados:** Em comparação com o grupo de controle, o índice de potência explosiva, o índice de sensibilidade e o índice cinético demonstraram melhores expressividades no grupo experimental; os quatro índices de capacidade de salto, os três índices de sensibilidade - exceto a frequência de passos de 15s - e o treinamento excêntrico no grupo experimental mostraram uma melhora significativa ($P < 0,01$). **Conclusão:** O treinamento de contração excêntrica pode efetivamente melhorar a força muscular, seu efeito de treinamento é melhor do que o do treinamento concêntrico, especialmente o treinamento de contração excêntrica sobre os membros inferiores, que tem um impacto importante sobre a força rápida dos jogadores de futebol. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

Descritores: Membros Inferiores; Treinamento de Força; Futebol.

RESUMEN

Introducción: La calidad de la fuerza puede dividirse en fuerza máxima, fuerza rápida, resistencia y fuerza de reacción. Entre ellos, la fuerza rápida ha sido un tema candente de discusión en las investigaciones de la industria deportiva contemporánea. **Objetivo:** Estudiar las influencias del entrenamiento de la contracción excéntrica de los miembros inferiores en jugadores de fútbol y sus repercusiones en la velocidad de los atletas. **Métodos:** Se utilizó un instrumento de entrenamiento centrífugo multifuncional como herramienta de entrenamiento a través del método experimental para analizar el efecto del entrenamiento de la contracción excéntrica en la fuerza rápida de los jugadores de fútbol. Los atletas se dividieron en el grupo experimental y el grupo de control para el entrenamiento. La potencia explosiva, la sensibilidad a la velocidad y el índice dinámico de potencia rápida especial se probaron antes y después del entrenamiento. **Resultados:** En comparación con el grupo de control, el índice de potencia explosiva, el índice de sensibilidad y el índice cinético mostraron mejores expresividades en el grupo experimental; los cuatro índices de capacidad de salto, los tres índices de sensibilidad -excepto la frecuencia de paso de 15s- y el entrenamiento excéntrico en el grupo experimental mostraron una mejora significativa ($P < 0,01$). **Conclusión:** El entrenamiento de la



contracción excéntrica puede mejorar eficazmente la fuerza muscular, su efecto de entrenamiento es mejor que el del entrenamiento concéntrico, especialmente el entrenamiento de la contracción excéntrica en los miembros inferiores, que tiene un impacto importante en la fuerza rápida de los jugadores de fútbol. **Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.**

Descriptores: Miembros Inferiores; Entrenamiento de Fuerza; Fútbol.

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INTRODUCTION

Strength quality can be divided into maximum strength, rapid strength, strength endurance, reaction strength, among them, fast power is a hot topic in sports industry research in recent years. Eccentric training through the multi-functional eccentric training instrument can effectively avoid the shortcomings of the above training methods, and has the advantages of high-intensity stimulation and low-fatigue electrical stimulation training.¹ This method has the advantages of eccentric contraction and low fatigue, strengthens muscle elastic tissue and stretch firing, and promotes the periodic transformation of muscle "shortening-lengthening", thereby improving the rapid training of the body. Eccentric strength training is one of the important training methods to improve muscle strength.²

Kubota S believes that fast force is the energy generated by the neuromuscular system at high speed, and its magnitude depends on the mobilization and activation rate of motor units and the contraction characteristics of muscle fibers.³ BrarKhushpal defines fast strength from the perspective of sports training as: The ability of the neuromuscular system to exhibit maximal muscle strength during transient or high-velocity contractions.⁴ Qin N used the miha strength trainer made in Germany to perform concentric fast and slow eccentric training of the joint muscles of the lower limbs for different subjects for 6 weeks.⁵ The results show, both fast and slow eccentric strength training can increase maximal concentric and eccentric strength, no significant difference. S Grosprêtre compared the national women's football team's defender and avant-garde athletic ability by testing four physical fitness indicators: 30m run, one-step approach kick, vertical jump in place, and YO-YO run level test.⁶ Syler M According to the research physical fitness test indicators, they are the vertical jump test in situ that reflects the athlete's explosive power, the 30m fast run that reflects the athlete's speed and power, the 12-min run that reflects the athlete's aerobic endurance, and the athlete's sensitivity test.⁷

Eccentric training is currently relatively understudied and has not made relatively large breakthroughs, and there is little data on eccentric training improving rapid strength in athletes. Based on the above analysis, this study uses the lower limb eccentric training machine for athletes' training, and analyzes the effect of eccentric training on rapid strength.

METHOD

Group training of football players

The subjects of the study were 24 male football players of a football team, who were randomly divided into the experimental group and the control group with 12 players in each group, the experimental group performed eccentric training, while the control group only performed daily training. The training period is 8 weeks, except that the training cannot be carried out normally due to the weather, the rest of the training is carried out according to the plan. The weekly training routine of football players is shown below. The experimental group additionally performed lower body eccentric training twice a week. Combining the training data of women's volleyball players and referring to the training program provided by BTE, there are 16 times in total.

The training load is gradually increased under the condition of the first eating training, when the number of training reaches the fifth time, the test load used is 1.3 times of its own body weight, after that,

the training load can be increased or maintained according to the athlete's own conditions.⁸ For the training speed, gradually increase the speed according to the athlete's condition, and the speed range is 23 steps/min to 35 steps/min. The athlete's target strength range is eventually reduced to 0.9 to 1.1 times body weight.

Sports measurement of football players

Three categories of 10 indicators are determined according to different test conditions and conducted in indoor and outdoor environments, indoor test items include standing long jump, triangle running, Illinios running, and 30s running. Before the test, about 15 minutes of warm-up activities are required, including various forms of running sports such as variable-speed running, accelerated running, and changing-direction running, and muscle stretching of various parts of the body. The test sequence is 30-meter run, triangle run, Illinios run, standing long jump. The indoor test items are 15s continuous vertical jump, 15s fast cadence, right foot vertical jump, left foot vertical jump, and vertical jump in situ, the test instrument is the infrared sensing device OptoGait tester.⁹

The comprehensive training load is realized by the length of training time, the speed of the pedal, and the size of the resistance, the accuracy of the training strength is determined by the target strength range, foot stride and seat can also be adjusted to suit different athletes' physical conditions.¹⁰

Ethical Compliance

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

RESULTS

Results of eccentric training and explosiveness test results of football players

The experiment first performs K-S test on a single sample, after confirming that the data conform to the law of normal distribution ($P>0.05$), then carry out T-test on independent samples of different groups, and it is necessary to satisfy that there is no significant difference between the two groups of data ($P>0.05$), finally, a paired sample T test was performed on the test data of different groups before and after training. The basic information of the experimental group and the control group is shown in Table 1, there is no significant difference in age, height, weight, and training years between the experimental group and the control group ($P>0.05$), so the data of the two groups are comparable.

Table 1. Comparison of basic information between the experimental group and the control group (n=24).

Project	Test group (n=12)	Control group (n=12)	T value	P value
Age	14.9±0.3	14.8±0.3	0	1.00>0.05
Height (cm)	167.8±8.7	167.1±8.3	0.2	0.84>0.05
Weight (kg)	57.3±8.2	56.9±6.6	0.3	0.19>0.05
Years of training (years)	4.2±1.4	3.5±1.4	1.1	0.30>0.05

Sensitivity and kinetic test results of football players

The sensitivity test results of the experimental group and the control group before and after training are shown in Figure 1 and Figure 2, respectively, and the single data tested all passed the K-S test. In the experimental group, the 30-meter running, triangle running, and Illinois running before and after training decreased by 0.27s, 0.4s, and 0.27s, respectively, and the 15s stride frequency increased by 2.36 times, in the control group, the 30-meter run, triangle run, and Illinois run decreased by 0.16s, 0.08s, and 0.2s, respectively, and the 15s stride frequency increased by 1.75 times. The paired sample T test showed that the sensitivity of 30-meter running, triangle running and Illinois running in the experimental group were significantly improved ($P < 0.01$), but there was no significant improvement after 15s cadence training ($P > 0.05$). The 15s stride frequency in the control group was significantly increased ($P < 0.05$), and the 30-meter running and triangle running were significantly decreased after daily training ($P < 0.01$). After training, the experimental group compared with the pair after training, the 30-meter running, triangle running, and Illinois running time decreased by 0.11s, 0.32s, and 0.07s, respectively, and the 15s stride frequency increased by 0.61 times. Therefore, both the experimental group and the control group improved sensitivity scores, but the experimental group improved faster.

The kinetic test results of the experimental group and the control group before and after training are shown in Table 2, and the single data tested all passed the K-S test. The maximum eccentric strength of the experimental group increased by 398.09N before and after training, and the 15s vertical jump power increased by 1.46W. In the control group, the maximum eccentric strength increased by 154.66N before and after training, and the 15s vertical jump power increased by 0.51W. The paired sample T test showed that the experimental group and the control group showed a very significant increase before and after the maximum eccentric strength training ($P < 0.01$), and the 15s vertical jump power was not significant ($P > 0.05$). Compared with the control group after training, the maximum eccentric strength increased by 243.3N, and the 15s vertical jump power increased by 0.95W. Therefore, both the experimental group and the control group improved kinetic performance, but the experimental group improved faster.

DISCUSSION

The effect of eccentric training on the rapid strength of football players is a hot topic that sports experts and scholars have paid close attention to in recent years. Aiming at the current situation of rapid strength training, this study uses a multifunctional eccentric training instrument to explore the effect of eccentric training of increasing load and speed on the rapid strength of football players. The sensitivity of 30-meter running, triangle running and Illinois running in the experimental group were significantly improved, after 15s cadence training, there was no significant increase, while the control group showed a significant increase after 15s cadence training, and a very significant decrease after daily training in 30-meter running and triangle running. Compared with the control group after training, the maximum eccentric strength increased by 243.3N, and the 15s vertical jump power increased by 0.95W. The experimental group and

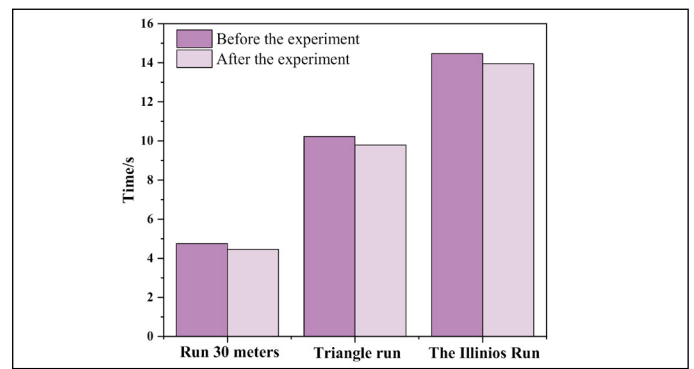


Figure 1. Sensitivity test results before training in the experimental group and the control group.

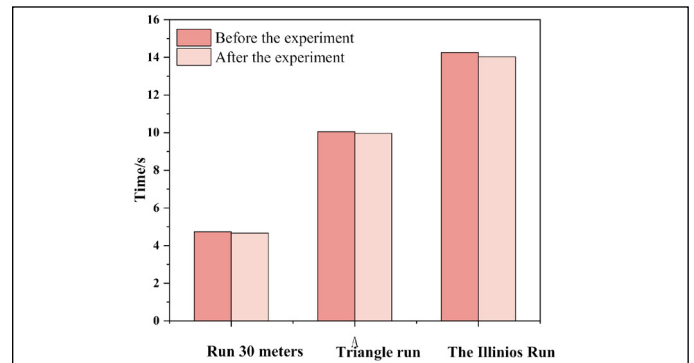


Figure 2. Sensitivity test results after training in the experimental group and the control group.

Table 2. Dynamic test results before and after training in the experimental group and the control group.

Project	Test group		Control group	
	Before training	After training	Before training	After training
Maximum centrifugal force (N)	611.7±159.0	1009.8±172.0	477.2±191.3	631.8±167.2
15s vertical jump power (w)	39.2±4.7	40.6±5.7	38.1±5.3	38.7±5.9

the control group showed a very obvious improvement before and after the maximum eccentric strength training, and the 15s vertical jump power was not significant.

CONCLUSION

All in all, the rapid strength of football players is related to their game performance and is a core content in strength training, the impact of lower body eccentric strength training on football players' fast power owners cannot be ignored, from the perspective of coaches, lower body eccentric strength training should be highly valued, it is reasonably applied to the rapid strength training of football players, and a good training effect is guaranteed through the mutual cooperation with the traditional training methods.

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

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