

EFFECTS OF ECCENTRIC TRAINING ON BALANCE IN ATHLETES

EFEITOS DO TREINAMENTO EXCÊNTRICO SOBRE O EQUILÍBRIO DOS ATLETAS

EFFECTOS DEL ENTRENAMIENTO EXCÉNTRICO EN EL EQUILIBRIO DE LOS DEPORTISTAS



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ABSTRACT

Introduction: Basketball is a sport of skillful competition. It demands characteristics from its athletes such as agility, balance, and a confrontational spirit. This requires a great improvement in strength, speed, endurance, and physical conditioning. **Objective:** Study the effects of eccentric muscle strength training in the lower limbs on balance ability in basketball players. **Methods:** Current scientific literature was used to design an experimental method with statistical data analysis. The research subjects were divided into 4 groups for a 6-week eccentric training intervention, and the effect of eccentric exercise on flexibility and balance in basketball players was investigated. **Results:** Compared to the pre-test and after the training intervention in the test group, there was a very significant difference ($P < 0.01$); only the intervention group showed a significant difference ($P < 0.05$). **Conclusion:** Eccentric training at the end of basketball training has a positive effect on improving flexibility and balance in basketball players. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

Keywords: Physical Education and Training; Postural Balance; Basketball.

RESUMO

Introdução: O basquetebol é um esporte de competição habilidosa. Exige características dos seus atletas como a agilidade, equilíbrio e espírito de confronto. Para isso, é necessário um grande aperfeiçoamento de força, velocidade, resistência e condicionamento físico. **Objetivo:** Estudar os efeitos do treinamento de força muscular excêntrica nos membros inferiores sobre a capacidade de equilíbrio nos jogadores de basquetebol. **Métodos:** Utilizou-se a literatura científica atual para elaborar um método experimental, com análise estatística de dados. Os sujeitos da pesquisa foram divididos em 4 grupos para intervenção de treinamento excêntrico de 6 semanas, foi investigado o efeito do exercício excêntrico sobre a flexibilidade e equilíbrio nos jogadores de basquete. **Resultados:** Em comparação com o pré-teste e após a intervenção de treinamento no grupo de teste, houve uma diferença muito significativa ($P < 0,01$), somente o grupo de intervenção apresentou uma diferença significativa ($P < 0,05$). **Conclusão:** O treinamento excêntrico ao final do treinamento de basquete tem um efeito positivo na melhoria da flexibilidade e equilíbrio nos jogadores de basquete. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

Descritores: Educação Física e Treinamento; Equilíbrio Postural; Basquetebol.

RESUMEN

Introducción: El baloncesto es un deporte de competición de habilidad. Exige a sus atletas características como la agilidad, el equilibrio y el espíritu de confrontación. Para ello, es necesaria una gran mejora de la fuerza, la velocidad, la resistencia y el acondicionamiento físico. **Objetivo:** Estudiar los efectos del entrenamiento de la fuerza muscular excéntrica en los miembros inferiores sobre la capacidad de equilibrio en jugadores de baloncesto. **Métodos:** Se utilizó la literatura científica actual para diseñar un método experimental, con análisis de datos estadísticos. Los sujetos de la investigación se dividieron en 4 grupos para una intervención de entrenamiento excéntrico de 6 semanas, y se investigó el efecto del ejercicio excéntrico en la flexibilidad y el equilibrio de los jugadores de baloncesto. **Resultados:** En comparación con la pre-prueba y después de la intervención de entrenamiento en el grupo de prueba hubo una diferencia muy significativa ($P < 0,01$), sólo el grupo de intervención mostró una diferencia significativa ($P < 0,05$). **Conclusión:** El entrenamiento excéntrico al final del entrenamiento de baloncesto tiene un efecto positivo en la mejora de la flexibilidad y el equilibrio de los jugadores de baloncesto. **Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.**

Descritores: Educación y Entrenamiento Físico; Equilíbrio Postural; Baloncesto.



INTRODUCTION

Basketball is a skill-led competitive sport, and it is a comprehensive sport that integrates strength, speed, endurance, and skills, it has the characteristics of agility, balance and confrontation.¹ Therefore, good physical fitness is a necessary condition for basketball players to achieve excellent results. Phillip P's research shows that, take balance, control and proprioception as the focus of functional training, and pay more attention to the control, balance and stability of the body core.² Research by Nikiforov A et al. believes that, human balance ability is mainly composed of static balance ability and dynamic balance ability.³ Romahadi D et al believe that, there is a significant correlation between slow muscle strength and fast muscle strength in athletes' knee joints; The larger the peak torque value, the stronger the muscle function, and the stronger the body's ability to maintain balance.⁴ In his research, Koliass P pointed out that balance ability is an important factor for improving sports skills, in his research, he proposed that strengthening core strength training in improving balance ability training is an important means for basketball players to improve their skills.⁵ Koehler also made it clear in the study: Core strength plays a role in controlling body balance and transmitting power during human movement, which is of great significance to the completion of motor skills.⁶ Only by improving muscle strength can basketball players improve the ability to control muscle strength, so as to improve the stability of the athlete's balance ability, thereby improving the performance of the game.

Therefore, the balance ability training can effectively improve the basketball player's own stability control ability, thereby improving the overall technical level. Basketball players are more confrontational during the game, if the body loses its center of gravity, it will affect technical movements, reduce the hit rate of layups or shots, only athletes with strong physical fitness and core ability can adjust their body posture when they are out of balance, only by adapting to the competition environment can you develop your own technical level.⁷ This eccentric strength training intervention was performed at the end of basketball training to explore the effect of hamstring eccentric exercises on hamstring flexibility and balance in basketball players during the end of the training session.

METHOD

Documentation method

Through CNKI, the author reviewed the relevant literature on core strength training, balance ability, muscle strength and special qualities of female basketball players at home and abroad in the past ten years, through the analysis, arrangement and summary of the literature, we can understand and master the research status of the balance ability and muscle strength of outstanding female basketball players at home and abroad.⁸

Experimental method

(1) Research objects

The research object is the basketball players of the sports college team as the research object, and their general physical conditions are shown in Table 1, the research objects are 16 men from the men's basketball team and 16 women's basketball teams. In order to avoid the influence of gender differences on the research results, 32 people were divided into 4 groups by simple random sampling, each group consists of 8 people ($n=8$), with 4 men and 4 women each. Group 1 performed Nordic hamstring exercises and single-leg deadlifts (Nordic hamstring exercise and single-leg deadlift, NHE&SLD), group 2 performed Nordic hamstring exercises (Nordic hamstring exercise, NHE), group 3 performed a single-leg deadlift (SLD), the fourth group was the control group (CG). As shown in Table 1, all subjects in the study have more than 8 years of basketball training experience. Inform the subjects before the intervention experiment, so that the subjects are clear about the content and purpose of the research.

(2) Training intervention plan

The experimental process included 1 pre-test, 6-week eccentric training intervention and 1 post-test. Each group performed intervention

training at the same time at the end of basketball training. The NHE&SLD group performed Nordic hamstring exercises first, followed by single-leg deadlift exercises after a 3-min rest, the NHE group performed Nordic hamstring exercises, the SLD group performed single-leg deadlift exercises, and the CG group performed waist and abdominal muscle strength exercises. The load volume and load intensity of basketball games are both large, and the athletes' body fatigue degree is large after the game, performing strength training at this time may increase the risk of injury to the athlete, so no additional strength training is performed after a basketball game.

Statistical analysis of data

SPSS18.0 statistical software was used to analyze the data, and the test results were expressed as mean±standard deviation ($M\pm SD$). Graphs were made using GraphPad Prism5 software. Paired samples t-test was performed within groups. Due to different test items, single-factor covariance analysis was performed between groups, and the statistical significance level was $P<0.05$, and the very significant level was $P<0.01$.⁹

ETHICAL COMPLIANCE

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

RESULTS

Sitting forward flexion test

The pre-test and post-test data within the group were in line with the normal distribution by K-S test ($P>0.05$), and the paired sample t test could be used. The results show, compared with the pre-experimental test, after the training intervention, the post-test data of the NHE&SLD group and the SLD group were all significantly different ($P<0.01$), there was significant difference in NHE group ($P<0.05$), but no statistical difference in CG group ($P>0.05$). After the training intervention, the NHE&SLD group had the largest increase in the sitting forward flexion test, followed by the SLD and NHE groups, and the CG group had a relatively small increase. (Table 2)

Note: Compared with the pre-experimental test, * means there is a significant difference in the post-experiment test, $P<0.05$, ** means there is a very significant difference in the post-experiment test, $P<0.01$.

Since the subjects' performance in sitting forward flexion before the intervention is not the same, if the performance is better before the intervention, the room for improvement is relatively small. The pre-test scores have an impact on the post-test scores, it is unreasonable to only consider the difference between the post-test and the pre-test without considering the results of the pre-test. Therefore, one-way analysis of covariance was chosen, set the pre-experiment data as covariates, in order to determine the effect of different intervention methods on lower extremity flexibility. Levene's test for homogeneity of variance showed that the residuals of the dependent variable between groups had equal variance ($F=3.14$, $P=0.04$). As shown in Figure 1, there is a linear relationship between the pre-test and post-intervention data in different groups, which meets the requirements of one-way analysis of covariance. After removing the influence of the pre-test data (covariates) on the post-test data, the residual value was generated, and then the residual value was subjected to variance analysis to obtain the results shown in Table 3. Compared with SLD, NHE&SLD had significant difference ($P<0.05$). Compared with NHE and CG, NHE&SLD had a very significant difference ($P<0.01$). Compared with NHE, SLD had a significant difference ($P<0.05$). Compared with CG, the difference in NHE was not significant. NHE&SLD has the most obvious effect on the improvement of hamstring flexibility, the flexibility of SLD group and NHE group is slightly improved, but the effect is not obvious, and there is no statistical difference.

Table 1. Basic information of research objects.

group	n	age	Height/cm	Body mass/kg	sport class
NHE&SLD	8	20.8±1.9	171.8±10.2	63.2±13.7	Level 2 athletes and above
NHE	8	19.6±1.1	171.8±9.0	63.6±12.1	Level 2 athletes and above
SLD	8	20.3±1.9	174.1±6.9	66.0±7.1	Level 2 athletes and above
CG	8	19.5±0.8	171.2±9.9	64.4±11.7	Level 2 athletes and above

Table 2. The results of the sitting body forward flexion test before and after the intervention in different groups.

time	NHE&SLD	NHE	SLD	CG
Pre-test	13.5±7.0	17.6±4.3	15.0±3.2	21.8±7.2
post test	19.1±4.9**	19.1±3.7*	18.7±2.5**	22.2±6.4

Table 3. Unadjusted and covariate-adjusted post-test results of the seated forward flexion test.

group	Unadjusted/cm		After adjustment/cm	
	average value	standard deviation	average value	standard deviation
NHE&SLD	19.1	4.9	21.7**▲▲	0.5
NHE	19.0	3.7	18.6	0.5
OSLD	18.7	2.5	20.1*▲	0.5
CG	22.2	6.4	18.5	0.6

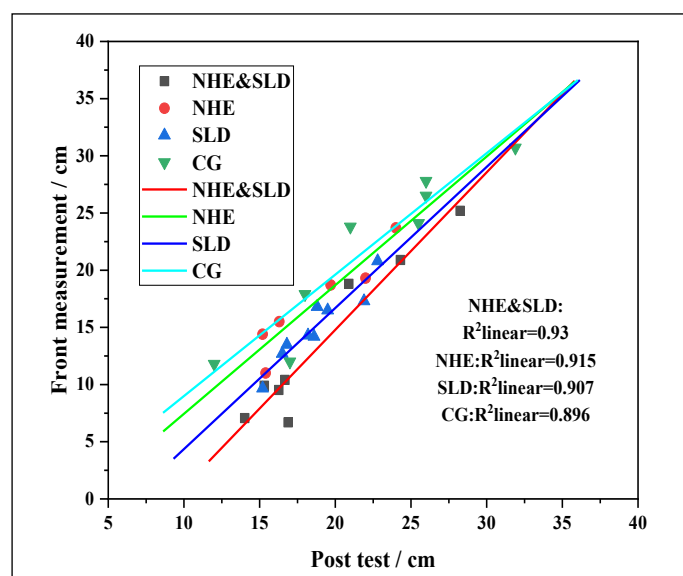


Figure 1. Linear relationship between pre- and post-tests of sitting forward flexion.

DISCUSSION

The effect of eccentric training on the flexibility of hamstrings

Resistance training and functional activities can improve flexibility, and connective tissues such as ligaments, tendons, fascia, muscles, and skin can limit the range of motion in joints, strength training can enhance the elasticity and plasticity of connective tissue and increase the range of motion of the

joints. The maximum force produced by the eccentric contraction of the muscle is compared to the maximum force produced by the concentric contraction, the muscle force produced by eccentric contraction is about 50% greater than that of concentric contraction, and about 25% greater than that of isometric contraction, therefore, eccentric training can significantly improve the flexibility of the hamstrings of basketball players.

The effect of eccentric training on the balance of left and right hamstrings

Muscle balance plays an important role in athletic performance and injury risk in athletes. Muscle balance does not mean that the muscle strength is equal, but that the ratio of the muscle strength of one muscle group to the muscle strength of another muscle group is within a reasonable range, and there is not much difference. Basal strength, explosive power, or muscular endurance of a muscle group is appropriately proportional to that of another muscle or muscle group.¹⁰ During high-intensity exercise, the weaker leg may have some compensation, and the risk of injury is relatively high.

CONCLUSION

Compared with traditional training methods, core strength training can more effectively improve the absolute strength and rapid strength of the lower back and lower limb muscles of basketball players; The good effect on balance ability is closely related to the increase of muscle strength, especially the increase of knee joint muscle strength has a more obvious effect on its balance ability; It is recommended that basketball players strengthen core strength exercises to improve movement balance and stability.

The author declares no potential conflict of interest related to this article.

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