LOWER LIMB STRENGTH TRAINING FOR BASKETBALL PLAYERS

TREINAMENTO DE FORÇA EM MEMBROS INFERIORES PARA JOGADORES DE BASQUETEBOL

ENTRENAMIENTO DE FUERZA DE LOS MIEMBROS INFERIORES PARA JUGADORES DE BALONCESTO

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ABSTRACT

Introduction: Lower limb strength training can improve body balance and impact the professional level of athletes. According to recent research, the strength training design has been gaining emphasis in supplementing the training of Chinese basketball professionals, although it still lacks evidence about its real optimization effect. Objective: Study the lower limb explosive strength training method in basketball players by exploring its optimization effects. Methods: The randomized controlled experiment on 30 students randomly divided into control and experimental groups lasted 12 weeks, with three weekly training sessions, each lasting 80 minutes. The control group underwent the traditional mode of lower limb strength training. In contrast, the experimental group performed a functional training protocol consisting of the single-foot jump, spring exercise, push-pull exercise, and pedaling, among other movements, according to the students' sports conditions and needs. Results: Statistically, the results of the functional evaluative tests showed an improvement of the test group's approach to single foot takeoff touch to (3.389 ± 0.042) m, the optimization rate was 2.5078%, the double foot takeoff touch height was improved to (3, 016 ± 0.299) m, the optimization rate was 0.7950%, the whole fast dribbling range was reduced to (20.176 ± 0.374) s, the optimization rate was 6.0401%, and benefit spectrum was significantly higher than that of the control group. Conclusion: Functional strength training can significantly increase the explosive power of the lower limbs of basketball athletes. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Strength Training; Lower Extremity; Basketball.

RESUMO

Introdução: O treinamento da força dos membros inferiores pode melhorar o equilíbrio corporal e impactar no nível profissional dos atletas. Devido às pesquisas recentes, o projeto de treinamento de força vem ganhando ênfase ao complementar o treino de profissionais do basquetebol chinês, embora ainda careça de evidências sobre o seu real efeito de otimização. Objetivo: Estudar o método de treinamento de força explosiva dos membros inferiores nos jogadores de basquetebol explorando seus efeitos de otimização. Métodos: O experimento randomizado controlado sobre 30 estudantes divididos aleatoriamente em grupos controle e experimental durou 12 semanas, com três sessões de treinamento por semana, cada sessão com duração de 80 minutos. O grupo de controle foi submetido ao modo tradicional de treinamento da força dos membros inferiores, enquanto o grupo experimental executou um protocolo de treinamento funcional consistindo em salto com um único pé, exercício de mola, exercício de empurrar e pedalar, entre outros movimentos de acordo com as condições e necessidades esportivas dos estudantes. Resultados: Estatisticamente, os resultados pelos testes avaliativos funcionais demonstraram uma melhora da aproximação do grupo de teste ao toque de decolagem com pé simples para (3,389 ± 0,042) m, a taxa de otimização foi de 2,5078%, a altura de toque de decolagem com pé duplo foi melhorada para (3,016 ± 0,299) m, a taxa de otimização foi de 0,7950%, toda a faixa de drible rápido foi reduzida para (20,176 ± 0,374) s, a taxa de otimização foi de 6,0401%, e espectro de benefícios foi significativamente maior do que a do grupo de controle. Conclusão: O treinamento de força funcional pode aumentar significativamente o poder explosivo dos membros inferiores dos atletas de basquetebol. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

Descritores: *Treinamento de Força; Extremidade Inferior; Basquetebol.*

RESUMEN

Introducción: El entrenamiento de la fuerza de las extremidades inferiores puede mejorar el equilibrio corporal y repercutir en el nivel profesional de los deportistas. Gracias a recientes investigaciones, el proyecto de entrenamiento de fuerza ha ido ganando importancia como complemento del entrenamiento de los profesionales chinos del baloncesto, aunque todavía carece de pruebas sobre su efecto real de optimización. Objetivo: Estudiar el método de entrenamiento de la fuerza explosiva de las extremidades inferiores en jugadores de baloncesto explorando sus efectos de optimización. Métodos: El experimento controlado aleatorizado con 30 estudiantes divididos al azar en grupos de control y experimental duró 12 semanas, con tres sesiones de entrenamiento por semana, cada una de 80 minutos. El grupo de control se sometió a la modalidad tradicional de entrenamiento de fuerza de las extremidades inferiores, mientras que el grupo experimental realizó un protocolo de entrenamiento funcional consistente en saltos con un solo pie, ejercicios de resorte, ejercicios de empuje y tracción y pedaleo, entre otros movimientos acordes con *las condiciones y necesidades deportivas de los alumnos. Resultados: Estadísticamente, los resultados de las pruebas evaluativas funcionales mostraron una mejora de la aproximación del grupo de prueba al toque de despegue con un solo pie hasta (3,389 ± 0,042) m, el índice de optimización fue del 2,5078%, la altura del toque de despegue con dos pies mejoró hasta (3,016 ± 0,299) m, la tasa de optimización fue del 0,7950%, todo el rango de regate rápido se redujo a (20,176 ± 0,374) s, la tasa de optimización fue del 6,0401%, y el espectro de beneficios fue significativamente mayor que el del grupo de control. Conclusión: El entrenamiento de fuerza funcional puede aumentar significativamente la potencia explosiva de las extremidades inferiores de los atletas de baloncesto.* ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Entrenamiento de Fuerza; Extremidad Inferior; Baloncesto.*

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INTRODUCTION

Since the development of basketball, relevant research has been conducted on a certain scale. There is a strong antagonism in the actual combat link of basketball.[1] Moreover, every technical movement of basketball requires strong muscle strength to control the body. In particular, some movements combined with jumping, such as offensive shooting, blocking, rebounding, etc. Through the study of the essence of basketball, players with excellent explosive power of lower limbs tend to jump faster, jump higher, and stay in the air for a long time.[2] With these sports abilities, athletes can often be supported to use more advanced technical movements. It is easier to get match scores. Basketball often has some fast break links. The fast break link also requires excellent lower limb explosive force.[3] In the process of fast break, both the offensive side and the defensive side fight against the clock. Excellent basketball players rely on their own excellent lower limb explosive force. You can get more chances to get scores easily by starting faster. Therefore, in the daily training of basketball players, we should pay attention to the relevant training of lower limb explosive force.[4] Long term explosive training of lower limbs can significantly improve the physical quality and technical level of athletes.[5] Moreover, long training can help athletes maintain a longer peak age. The training of lower limb strength can improve the core strength of the body and has a qualitative impact on the professional level of athletes.[6] Because of the relevant theoretical research, training intensity design and talent training system of China's basketball, there is still a certain gap compared with the current world basketball powers. Therefore, at this stage, it is necessary to introduce an advanced training system as a reference for the development of training links suitable for Chinese basketball players. Moreover, we need to further study how to improve basketball related skills through training, and different training methods will bring specific effects to athletes. Basketball practice is a medium to show the training effect.[7] Therefore, strengthening the training links and improving the comprehensive physical quality of basketball players can effectively improve the performance of athletes.

METHOD

Research objects

First of all, 30 students from basketball majors in a college of physical education were selected as research objects. The study and all the participants were reviewed and approved by Ethics Committee of Chongqing Creation Vocational College (NO.2019CQVC075Z). The 30 selected subjects were divided into experimental group and control group according to the form of random sampling, with 15 student athletes in each group. The basic information of the two groups of subjects is shown in Table 1, P>0.05, indicating that there is no significant difference.

Research methods

This experiment is a controlled experiment. The experiment lasts for 12 weeks, three times a week, and each training time is 80 minutes.

Table 1. Basic information of two groups of subjects.

Group	Control group	Experimental group
Age (years)	19.968±0.843	19.968±0.872
Height (cm)	176.471±0.629	181.032±0.497
Weight (kg)	74.500±7.759	73.357±9.795
BMI (kg/m^2)	22.412±1.884	22.858±2.241
Training years (years)	8.179±0.417	8.179±0.417

First of all, 10 minutes of warm-up preparation should be carried out to reduce the degree of muscle viscosity and prevent sports injuries during the exercise. Then 60 minutes of exercise training will be carried out. After the exercise, 10 minutes of relaxation training will be carried out to relax the body and prevent muscle damage. In the 60 minutes training process, the control group chose traditional lower limb strength training methods, including 45 ° back extension, barbell squat, barbell hard pull, etc. According to the students' own conditions and sports needs, the experimental group chose functional compound training consisting of single foot hurdle jumping plus bouncing, leg pushing and pedaling machine, Cook style hip lifting, single leg straight leg hard pulling and other movements. During the whole 12 week experiment, the experimental group and the control group basically kept the same physical training, work and rest time, except for the 60 minute sports training content, so as to minimize the interference of irrelevant changes to this experiment. Before and after the experiment, the relevant data were measured and compared.

Data processing

The measurement of the value includes two aspects. From a micro perspective, the isokinetic muscle force testing system is used to measure the peak power and maximum peak torque of the lower limb muscles of athletes, so as to analyze the impact of lower limb explosive force training on the lower limb muscle data of basketball players from a micro perspective. The data results can more directly compare the experimental results.

From a macro perspective, the indicators such as the run-up with one foot taking off and touching the height, the standing with two feet taking off and touching the height, the whole court fast dribble layup, the standing long jump, the "T" turn back run and so on are selected as the test contents, which can be directly displayed in the sports arena and will provide some help for the improvement of the basketball competitive level of the athletes.

After obtaining the relevant data, SPSS and Excel software were used for statistics and analysis of the data. The independent sample T test was used for calculation. When $P > 0.05$, there was no significant difference. When $P < 0.05$, there was a significant difference. When $P < 0.01$, there was a very significant difference.

RESULTS

Influence of lower limb explosive force training on lower limb muscle data of basketball players

As shown in Table 2 and Table 3, it is the analysis of changes in leg muscle data of athletes in the control group and experimental group before and after training. The maximum peak torque and peak power when the left and right knees extend 60 ° and 180 ° are selected as the observation objects of the experiment.

Table 2 shows the changes of muscle data in the control group. It can be seen from the table that after the experiment, the control group athletes' left knee extension 60 ° peak torque increased by 3.1759%, the left knee extension 60 ° peak power increased by 9.5277%, the right knee extension 60 ° peak torque increased by 2.4812%, the right knee extension 60 ° peak power increased by 18.9893%, the left knee extension 180 ° peak torque increased by 14.1746%, and the left knee extension 180 ° peak power increased by 16.1778%, The peak torque of 180 ° extension of the right knee is increased by 17.7707%, and the peak power of 180 ° extension of the right knee is increased by 19.2511%. It shows that ordinary training can optimize the leg muscle data of the control group, but some data are not ideal.

Table 3 shows the changes of muscle data in the experimental group. It can be seen from the table that after the experiment, the peak torque of 60 ° extension of left knee of the athletes in the experimental group decreased by 2.5804%, the peak power of 60 ° extension of left knee increased by 10.2224%, the peak torque of 60 ° extension of right knee decreased by 6.1533%, the peak power of 60 ° extension of right knee increased by 7.6160%, the peak torque of 180 ° extension of left knee increased by 41.5112%, and the peak power of 180 ° extension of left knee increased by 21.2651%, The peak torque of 180 ° extension of the right knee is increased by 42.1419%, and the peak power of 180 ° extension of the right knee is increased by 21.1463%. It shows that functional compound training can optimize the leg muscle data of experimental group athletes, and the effect is significant.

Optimization effect of lower limb explosive force training on lower limb explosive force of basketball players

As shown in Table 4 and Table 5, the optimization effect of lower limb explosive force related indicators of athletes in the control group and experimental group before and after training. The research selected the indexes of approach single leg takeoff, standing double feet takeoff, whole court fast dribble layup, standing long jump, "T" turn back run and so on as the judgment criteria of the experiment.

As shown in Table 4, the change of the explosive force of the lower limbs in the control group can be seen from the table that the height of the athletes in the control group before the run-up single leg take-off touch height experiment was (3.248 ± 0.065) m, and after the experiment it was increased to (3.312 ± 0.051) m, the optimization ratio was 0.4679%, P=0.0588>0.05, indicating that there was no significant difference. Before the experiment, the touch height of two feet on the spot was (2.932 ± 0.321) m, and after the experiment, it was improved to (2.999 ± 0.440) m, with an optimized ratio of 0.4611%, P=0.0757>0.05, indicating that there was no significant difference. The whole court fast dribble layup time before the experiment was (21.928 ± 0.431) s, and after the experiment was shortened to (21.319 ± 0.403) s, the optimization ratio was 0.7142%, P=0.0546>0.05, indicating that there was no significant difference. The distance of standing long jump before the experiment was (2.746 ± 0.061) m, and after the experiment it was improved to (2.838 ± 0.895) m, with an optimized ratio of 0.8910%, P=0.0343 < 0.05, indicating that there was a significant difference. The time of "T" turn back running was

Table 2. Analysis on the changes of leg muscle data of athletes in the control group before and after training.

Test indicator	Before experiment	After experiment	Improvement rate	P value
Left knee extension 60° peak torque (N/m)	199.494±52.990	209.024±42.142	3.1759%	0.4589
Left knee extension 60° peak power (W)	119.427±28.642	133.209±32.384	9.5277%	0.2459
Right knee extension 60° peak torque (N/m)	215.008±74.172	225.970±60.763	2.4812%	0.6075
Right knee extension 60° peak power (W)	123.299±40.651	149.481±50.320	18.9893%	0.1417
Peak moment of 180° extension of left knee (N/m)	145.746±43.141	170.142±35.839	14.1746%	0.0020
Left knee extension 180° peak power (W)	204.064±60.566	242.615±60.490	16.1778%	0.0020
Right knee extension 180° peak torque (N/m)	143.317±47.420	172.787±42.291	17.7707%	0.0132
Right knee extension 180° peak power (W)	211.284±71.031	255.790±76.473	19.2511%	0.0051

Table 3. Analysis of leg muscle data changes of experimental group athletes before and after training.

Test indicator	Before experiment	After experiment	Improvement rate	P value
Left knee extension 60° peak torque (N/m)	199.204±29.608	196.854±18.390	-2.5804%	0.4345
Left knee extension 60° peak power (W)	115.706±21.153	129.980±17.587	10.2224%	0.0506
Right knee extension 60° peak torque (N/m)	215.118±37.388	206.801±25.264	-6.1533%	0.0987
Right knee extension 60° peak power (W)	128.643±34.313	141.239±23.013	7.6160%	0.2329
Peak moment of 180° extension of left knee (N/m)	144.635±28.541	208.933±42.682	41.5112%	0.0000
Left knee extension 180° peak power (W)	203.995±42.682	253.095±47.610	21.2651%	0.0000
Right knee extension 180° peak torque (N/m)	145.002±29.784	210.616±46.351	42.1419%	0.0000
Right knee extension 180° peak power (W)	206.476±45.435	254.008±52.888	21.1463%	0.0061

Table 4. Optimization effect of lower limb explosive force of control group athletes before and after training.

Control group	Before experiment	After experiment	Improvement rate %	P value
Run up single leg take-off touch height (m)	3.248±0.065	3.312±0.051	0.4679%	0.0588
Take off and touch height with two feet in situ (m)	2.932±0.321	2.999±0.440	0.4611%	0.0757
Full court fast dribble layup (s)	21.928±0.431	21.319±0.403	0.7142%	0.0546
Standing long jump (m)	2.746±0.061	2.838±0.895	0.8910%	0.0343
"T" turn back run (s)	9.858±0.216	9.055±0.534	0.6169%	0.0552

Table 5. Optimization effect of lower limb explosive force of experimental group athletes before and after training.

Control group	Before experiment	After experiment	Improvement rate %	P value
Run up single leg take-off touch height (m)	3.257±0.045	3.389±0.042	2.5078%	0.0056
Take off and touch height with two feet in situ (m)	2.939±0.244	3.016±0.299	0.7950%	0.0524
Full court fast dribble layup (s)	21.994±0.322	20.176±0.374	6.0401%	0.0079
Standing long jump (m)	2.764±0.048	2.861±0.356	1.0751%	0.0355
"T" turn back run (s)	9.982±0.454	9.116±0.399	1.2608%	0.0043

(9.858 ± 0.216) s before the experiment, and shortened to (9.055 ± 0.534) s after the experiment. The optimized ratio was 0.6169%, P=0.0552>0.05, indicating that there was no significant difference.

As shown in Table 5, the changes of lower limb explosive force in the experimental group can be seen from the table that the run-up single leg take-off touch height before the experiment was (3.257 ± 0.045) m, and after the experiment was increased to (3.389 ± 0.042) m, the optimization ratio was 2.5078%, P=0.0056 < 0.01, indicating that there was a significant difference. Before the experiment, the touch height of two feet on the spot was (2.939 ± 0.244) m, and after the experiment, it was improved to (3.016 ± 0.299) m, with the optimized proportion of 0.7950%, P=0.0524>0.05, indicating that there was no significant difference. The whole court fast dribble layup time was (21.994 ± 0.3221) s before the experiment, and shortened to (20.176 ± 0.374) s after the experiment. The optimization ratio was 6.0401%, P=0.0079 < 0.01, indicating that there was a very significant difference. The distance of standing long jump before the experiment was (2.764 ± 0.048) m, and after the experiment it was improved to (2.861 ± 0.356) m, with the optimization ratio of 1.0751%, P=0.0355 < 0.05, indicating that there was a significant difference. The time of "T" turn back running was (9.982 ± 0.4541) s before the experiment, and shortened to (9.116 ± 0.399) s after the experiment. The optimization ratio was 1.2608%, P=0.0043 < 0.01, indicating that there was a very significant difference.

DISCUSSION

The optimized lower limb explosive force training method can improve the athletes' core strength, jumping ability, physical fitness, body control and other sports attributes. Moreover, the excellent explosive force of lower limbs provides a basis for athletes to use technical movements. Athletes have the ability to use more advanced techniques. It effectively enriches the attacking means of athletes, and can promote the scoring ability of athletes to a higher level. And when defending, it can give the other side a strong confrontation, and the defensive ability is also strengthened, which makes it difficult for the other side to score easily in actual combat. After a long period of explosive training of lower limbs, the athletes' overall project level can be improved significantly in sports performance. Athletes with strong explosive lower limbs tend to maintain their peak sports age longer. Therefore, long-term explosive training of lower limbs can effectively prolong the athletes' sports career.

CONCLUSION

In the basketball game, athletes can complete the rapid movement of lower limbs in a short time, which means they can get more opportunities. Optimizing the explosive power of athletes' lower limbs, whether it is the change of microscopic muscle data or the improvement of intuitive sports level, means the improvement of competitive level. Therefore, training the explosive power of athletes' lower limbs can make athletes master more initiative in the field, which is also the focus of current coaches' research. The results of this study show that functional compound training can better improve the explosive power of athletes' lower limbs, and it is worth promoting in the daily training of basketball players.

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