EFFECTS OF DEEP JUMPING ON EXPLOSIVE STRENGTH IN THE LOWER LIMBS OF ATHLETES

EFEITOS DO SALTO PROFUNDO SOBRE A FORÇA EXPLOSIVA NOS MEMBROS INFERIORES DE ATLETAS

EFECTOS DEL SALTO PROFUNDO EN LA FUERZA EXPLOSIVA DE LOS MIEMBROS INFERIORES DE LOS ATLETAS

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ABSTRACT

Introduction: Volleyball has become popular worldwide, and its athletic standard has risen. The skills of jumping into a net test athletes' lower limb strength and speed. Objective: Study the effects of deep jumping exercises on the explosive strength in the lower limbs of volleyball athletes. Methods: Through the experimental method, logical analysis method, and mathematical statistics method, the kinematics and the results of the practical tests on the 8 muscles of the athletes' lower limbs were studied. The training took place for 8 weeks of training intervention, and the characteristic biomechanical structure of the athletes' lower limb muscles during the deep jump was established. Results: The landing time of the athletes in the deep jump group was improved, with a change of 0.03s. The deep jump group increased in time by 0.02s, indicating that the jumping ability was significantly improved. Conclusion: The deep jump training method reduces the time spent landing, with a strong level of evidence. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Exercise; Volleyball; Athletes.

RESUMO

Introdução: O voleibol tornou-se popular em todo o mundo, e seu padrão atlético elevou-se. As habilidades de salto em rede, testam a força dos membros inferiores e a velocidade dos atletas. Objetivo: Estudar os efeitos dos exercícios de salto profundo sobre a força explosiva nos membros inferiores dos atletas de voleibol. Métodos: Através do método experimental, método de análise lógica e método de estatística matemática, foram estudas a cinemática e os resultados dos testes práticos nos 8 músculos dos membros inferiores dos atletas. O treinamento deu-se por 8 semanas de intervenção de treinamento, e a estrutura característica biomecânica dos músculos dos membros inferiores dos atletas durante o salto profundo foi estabelecida. Resultados: O tempo de pouso dos atletas no grupo de salto profundo foi aprimorado, com uma mudança de 0,03s, o grupo de salto em profundidade teve um aumento de tempo em 0,02s, indicando que a capacidade de salto foi significativamente aprimorada. Conclusão: O método de treinamento de salto profundo reduz o tempo gasto no pouso, com forte nível de evidência. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Exercício Físico; Voleibol; Atletas.*

RESUMEN

Introducción: El voleibol se ha hecho popular en todo el mundo y su nivel deportivo ha aumentado. Las habilidades de salto en red, ponen a prueba la fuerza de los miembros inferiores y la velocidad de los atletas. Objetivo: Estudiar los efectos de los ejercicios de salto profundo sobre la fuerza explosiva en los miembros inferiores de los deportistas de voleibol. Métodos: Mediante el método experimental, el método de análisis lógico y el método de estadística matemática, se estudiaron la cinemática y los resultados de las pruebas prácticas de los 8 músculos de los miembros inferiores de los atletas. El entrenamiento se llevó a cabo durante 8 semanas de intervención, y se estableció la estructura biomecánica característica de los músculos de las extremidades inferiores de los atletas durante el salto en profundidad. Resultados: El tiempo de aterrizaje de los atletas del grupo de salto profundo mejoró, con un cambio de 0,03s, el grupo de salto en profundidad tuvo un aumento de tiempo de 0,02s, lo que indica que la capacidad de salto mejoró significativamente. Conclusión: El método de entrenamiento de salto profundo reduce el tiempo empleado en el aterrizaje, con un fuerte nivel de evidencia. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Ejercicio Físico; Voleibol; Atletas.*

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INTRODUCTION

Since the 21st century, volleyball has become popular all over the world, and the standard of volleyball has become higher and higher in the world, as a net jumping project, it tests the lower body strength and speed of athletes. Especially in the explosive power of lower extremities, relevant experts at home and abroad have found through experiments and scientific research: The analysis of the motion characteristics of the lower limb muscles is of great significance to the volleyball training effect and competition performance.[1]

Ma H believes that the strength of the legs of football players has an important effect on the speed of the shot, using the experimental method, the three-dimensional high-speed video equipment was used to train the athletes, the training time was 3 weeks, by comparing and analyzing the obtained data, it was found that the athletes had obvious changes in the quadriceps femoris and biceps femoris of the lower limbs after the frog leap training, the explosive power of the legs has been significantly improved.[2] Martins T performed functional screening of experimental subjects, and tested squat jumps and squat jumps using the Bosco squat jump protocol.[3] Zhang S pointed out that deep jump training is a special training method for the development of lower limb muscle strength, and it has very ideal training results for the physical fitness of athletes with higher sports levels.[4]

METHOD

Research object

Taking 12 volleyball players as the experimental subjects, through the investigation of the players' natural information. All athletes have filled out the experimental informed consent form, and all experimental subjects are willing to participate in this experiment. Before the start of the experiment, they were divided into groups, namely leapfrog group, squat jump group and deep jump group, as shown in Table 1.

Research methods

1. Documentation method

By consulting China Academic Journal Network, China Excellent Master's Dissertation Database, China Excellent Doctoral Dissertation Database and university library resources, consult a large number of relevant materials to understand the existing research results and background knowledge, and provide a theoretical basis for this research.[5]

2. Mathematical Statistics

SPSS 20.0 software was used for statistical processing, and all values were expressed as mean ± standard deviation, statistical software included paired T-test (two-sided) (PairedSamplesT-Test) significance level p=0.05 for relevant kinematic, kinetic and EMG variables parameters. Use Office2016, Microsoft Excel spreadsheet to draw related data tables and curves, and the curve data are the average values of the samples.[6]

Ethical Compliance

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

Table 1. Natural information of experimental subjects (n=12).

Serial number	Weight (kg)	Height (cm)	Age	Sport class
1	66.5	1.79	22	Level 1
2	72.8	1.84	22	Level 1
3	80.1	1.86	24	Level 1
4	82.6	1.81	25	Level 1
5	80.7	1.86	24	Level 1
6	86.3	1.97	23	Level 1
7	67.1	1.76	23	Level 1
8	82.4	1.85	24	Level 1
9	81.9	1.90	21	Level 1
10	80.2	1.87	23	Level 1
11	85.5	1.88	21	Level 1
12	79.3	1.83	21	Level 1

RESULTS

Analysis of the test landing time before and after training

The three groups of athletes were tested respectively, and the time of each athlete's landing stage was calculated, and the average value was obtained, and once before and after training, the changes between the landings of each group were found, and the relationship between the changes was analyzed. It can be seen from the test results in Table 2 that: When the leapfrog group, squat jump group and deep jump group have the same amount of exercise in 8 weeks, after training, the time of landing stage will change, and the time of the buffer period and the extension period of the muscle group in the landing stage varies, and in the whole process, the amplitude of each group change is different.[7]

See Table 2, according to the experimental results, it can be seen that, the experimental subjects were divided into frog leaping group, squat jumping group and deep jumping group, in the three groups of experiments, the mean ± variance was used respectively. There were differences in the time of vertical jump landing in the frog leaping group, the squatting jumping group and the deep jumping group. In the leapfrog group, the landing time before training was 0.26±0.005s, and the change after training was 0.01s. The time spent in the landing stage of the squat jump group was 0.28±0.012s, and the time spent in the landing stage after training was 0.26±0.046, with a change of 0.02s. Athletes in the deep jump group had the most improvement in landing time, 0.26±0.031s before training and 0.23±0.014s after training, with a change of 0.03s. The greater the amount of change before and after training, the three training methods are effective, effectively shortening the vertical jump time.[8] Then it is obvious that the three groups of changes before and after training are sorted: Deep jump group > leapfrog group > squat jump group. In volleyball competitions and training, the shortening of the time used for vertical jumps has a great impact on the game, a quick take-off can occupy the corresponding position in time and be fully prepared for the next step of defense and offense. Among them, the athletes in the deep jump group have the best continuous jumping ability, the deep jump training method can effectively shorten the jumping time, thereby effectively providing sports performance.

Analysis of the test muscle buffer period and stretch period before and after training

The shorter the time, the higher the energy conversion rate of the muscle from the buffering process to the kicking and stretching process, and it has a greater advantage in the volleyball offensive and defensive stages. The buffering phase is from the moment the foot touches the ground to the moment before the start of the kick, and the buffering time of the muscles is carried out during this period. According to the results of buffering time before and after training, see Table 3, the buffering time of leapfrog group before training is 0.12±0.003s, the buffering time

Table 2. Vertical jump time before and after training (s).

Training method	Leapfrog group	Squat jump group	Deep jump group
before training	0.26±0.005	0.28±0.012	0.26±0.031
after training	0.25±0.026	0.26±0.046	0.23±0.014
shortening	0.01	0.02	0.03
P value	0.009	0.008	0.003

Table 3. Buffer period time before and after training (s).

Training method	Leapfrog group	Squat jump group	Deep jump group
before training	0.12±0.003	0.13±0.014	0.13±0.009
after training	0.11±0.026	0.12±0.023	0.11±0.046
shortening	0.01	0.01	0.02
P value	0.02	0.01	0.009

after training is 0.11±0.026s, and the buffering time is increased by 0.01s; The buffer time required for the squat jump group before training was 0.13±0.014s, and the time required after buffering was 0.12±0.023s, and the muscle buffering time increased by 0.01s before and after training; In the deep jump group, the time required before and after training was 0.13±0.009s, and the time required after training was 0.11±0.0046s, and the change before and after training increased by 0.02s. The changes in muscle time before and after training for the three groups of athletes were: Deep jump group > squat jump group > frog leap group. It can be clearly seen that after 8 weeks of deep jump training, volleyball players have the most improvement in muscle buffering time, indicating that deep jump training has significantly improved the buffering action of athletes' muscles.[9,10]

According to Table 4, it can be seen that the kicking and extension time of the athletes in the leapfrog group before training is 0.14±0.005s, and after the leapfrog training, the required time is 0.14±0.014s, the amount of time change required in the extension phase was 0, while the time required for the squat jump group before training was 0.14±0.012s, and the time required after training was 0.15±0.021s, and the time required for the extension phase increased by 0.01s ; In the deep jump group, the time required for the stretch period before training was 0.13±0.031s, and the time required after 8 weeks of training was 0.15±0.024s, and the time required for the stretch period before and after training increased by 0.02s, after the intervention of the training method, athletes in the deep jump group increased the most time in the extension phase after landing. Then the lift during the kick-and-extension period is the largest, indicating that the jumping ability has been significantly improved.

DISCUSSION

The ratio of the extension period to the buffer period is an effective indicator to reflect the bouncing ability of the lower limbs, the larger the ratio, the higher the conversion rate of the energy stored in the athlete's muscles during the buffering stage into the mechanical energy during the kicking and extension stage, therefore, it can effectively improve the bouncing ability of the lower limbs of volleyball players. Comparing the three groups before and after training, in the muscle buffering period, the athletes in the deep jump group shortened the most time, and in the muscle buffering period, athletes in the deep jump group had the greatest increase in the time required for the extension period, then, among the leapfrog group, the squat jump group and the deep jump group, the deep jump group had the largest increase in the ratio of the extension period to the buffer period. To sum up, deep jump training can improve the lower limb's bouncing ability better than frog leap and squat jump.

Table 4. Duration of stretch period before and after training (s).

Training method	Leapfrog group	Squat jump group	Deep jump group
before training	0.14±0.005	0.14±0.012	0.13±0.031
after training	0.14±0.014	0.15±0.021	0.15±0.024
increase amount	0	0.01	0.02
P value	0.008	0.009	0.012

CONCLUSION

In volleyball training and competition, the quality of lower body bounce is a very important technical action, the buffer period and stretch period of muscles are reduced, which can effectively improve the speed of bounce. The training method of deep jump is adopted to reduce the time spent on landing, and the amount of change is the most significant. Compared with frog jumping and squat jumping training, deep jump training has the most obvious stimulation to the muscles of the lower limbs, the training effect is the best in terms of take-off speed, air time, and the force on the ground during the landing stage. Therefore, when training the lower limbs' bouncing ability, the best way to train deep jumps.

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

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