AQUATIC RESISTANCE TRAINING REPERCUSSIONS ON THE DYNAMIC STABILITY IN VOLLEYBALL ATHLETES

REPERCUSSÕES DO TREINO DE RESISTÊNCIA AQUÁTICO SOBRE A ESTABILIDADE DINÂMICA DOS ATLETAS DE VÔLEI

REPERCUSIONES DEL ENTRENAMIENTO DE RESISTENCIA ACUÁTICA EN LA ESTABILIDAD DINÁMICA DE LOS ATLETAS DE VOLEIBOL

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ABSTRACT

Introduction: Resistance training is considered a practical pathway for increasing strength and speed. Objective: Explore the aquatic resistance training on the dynamic stability in volleyball athletes. Methods: Using aquatic resistance training reinforcement, 20 first-level national male volleyball athletes were randomly divided into control and experimental groups. The time of the experiment was ten weeks. In the end, lower limb muscle strength, jumping ability, dynamic stability, and muscle pain were compared. Residual effects were also checked six weeks after the end of the experiment. Results: The aquatic resistance training group stopped training for six weeks, peak torque at 60°/s, 180°s of relative knee extension, jump height, full arm swing, and all three phases of the high jump were significantly better than the preliminary test; water entry speed in the vertical direction was also significantly better one week after training. Conclusion: Aquatic resistance training can significantly improve the dynamic stability of the lower limbs, and its effect can be maintained up to 6 weeks after completion. It is recommended to apply resistance enhancement training to maintain fitness, especially for long periods. ***Evidence Level II; Therapeutic Studies - Investigating the result.***

Keywords: Hydrodynamics; Athletes; Resistance Training.

RESUMO

Introdução: O treino de resistência é considerado um meio eficaz para aumento de força e a velocidade. Objetivo: Explorar as repercussões do treino de resistência aquática sobre a estabilidade dinâmica dos atletas de vôlei. Métodos: 20 atletas de primeiro nível nacionais de vôlei masculino, foram divididos aleatoriamente em um grupo de treinamento para controle e outro grupo experimental com reforço utilizando treino de resistência aquático. O tempo do experimento foi de 10 semanas. Ao final, foram comparadas força muscular do membro inferior, capacidade de salto, estabilidade dinâmica, dor muscular. Foram verificados também os efeitos residuais em seis semanas após o término do experimento. Resultados: O grupo de treino de resistência aquática parou de treinar por 6 semanas, com pico de torque a 60°/s, 180°s de extensão relativa do joelho, a altura de salto, o balanço completo dos braços e as três fases do salto em altura foram significativamente melhores do que o teste primário; a velocidade de entrada na água na direção vertical também foi significativamente melhor uma semana após o treinamento. Conclusão: O treino de resistência aquático pode melhorar significativamente a estabilidade dinâmica dos membros inferiores e seu efeito pode ser mantido até 6 semanas após o término. Recomenda-se aplicar o treino de aprimoramento da resistência para manter o condicionamento físico, especialmente por longos períodos. ***Nível de evidência II; Estudos Terapêuticos - Investigação de Resultados.***

Descritores: *Hidrodinâmica; Atletas; Treinamento de Força.*

RESUMEN

Introducción: El entrenamiento de resistencia se considera una forma eficaz de aumentar la fuerza y la velocidad. Objetivo: Explorar las repercusiones del entrenamiento de resistencia acuática en la estabilidad dinámica de los atletas de voleibol. Métodos: 20 atletas masculinos de voleibol de primer nivel nacional, fueron divididos aleatoriamente en un grupo de entrenamiento de control y otro grupo experimental con refuerzo mediante entrenamiento de resistencia acuática. El tiempo del experimento fue de 10 semanas. Al final, se comparó la fuerza muscular de las extremidades inferiores, la capacidad de salto, la estabilidad dinámica y el dolor muscular. También se comprobaron los efectos residuales a las seis semanas de finalizar el experimento. Resultados: El grupo de entrenamiento de resistencia acuática dejó de entrenar durante 6 semanas, el pico máximo de torque a 60°/s, la extensión relativa de la rodilla a 180°s, la altura del salto, el balanceo completo del brazo y las tres fases del salto de altura fueron significativamente mejores que en la prueba primaria; la velocidad de entrada al agua en la dirección vertical también fue significativamente mejor una semana después del entrenamiento. Conclusión: El entrenamiento de resistencia acuática puede mejorar significativamente la estabilidad dinámica de los miembros inferiores y su efecto puede mantenerse hasta 6 semanas después de su realización. Se recomienda aplicar un entrenamiento de mejora de la resistencia para mantener la forma física, especialmente durante largos periodos. ***Nivel de evidencia II; Estudios terapéuticos - Investigación de resultados.***

Descriptores: *Hidrodinámica; Atletas; Entrenamiento de Fuerza.*

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INTRODUCTION

Resistance-enhancing training, also known as rapid expansion and contraction compound training, it is considered an effective way to increase strength and speed. During its movement, presents a lengthening and shortening cycle, which is divided into 2 stages: The first is the violent eccentric contraction of the muscles and the transition phase, this is followed by a rapid centripetal contraction.[1] There are many studies on the review of resistance-enhancing training systems, Mainly focus on jumping performance, sprint running, muscle strength and so on. Vertical jumping is the basic form of exercise for many sports, it is an important indicator to measure the athletic ability of athletes' lower limbs.[2] Therefore, the author often implements enhanced training in training, and college volleyball players who are more likely to have lower limb injuries are the research objects, combined with the holiday training plan, implement 10 weeks of underwater resistance enhancement training content, in order to understand and verify the 10-week underwater resistance enhancement training, on the lower limb muscle strength, jumping ability, dynamic stability, muscle soreness and training, the effect of retention.[3] Underwater resistance enhancement training, the effect on muscle strength of lower limbs and jumping height, the effect is delayed, after 10 weeks of training, the effect is not significant, but after stopping training for 6 weeks, the effects are significantly better than before training.

METHOD

Research object

The author recruited 20 national first-level male volleyball players (average age 20.4±1.8 years old, height 185.2±9.5cm, body weight 81.4±8.9kg), there was no major injury or illness of the lower limbs within six months, and he signed the experimental informed consent form and voluntary participation form.

Research methods

Experimental design

All pre-test items include: Angular velocity 60°/s and 180°/s isokinetic muscle strength, 3-step swing arm vertical jump and dynamic stability, all the tests were completed within 1 week before the execution of the two sets of training. After the pre-test is completed, 18 research subjects, randomly divided into underwater resistance enhancement training group (group A) and control group (group C), 10 people in group A, 10 people in group B, start a 10-week training session. The next morning after training every other week, receive muscle damage (serum creatine kinase, CK) and soreness (visual analog pain perception scale) test.[4] After 10 weeks of training, all groups were given a post-test within 1 week, no longer involved in any enhanced training, only to maintain the original team skills training, after 5 weeks, a second post-test, which is a retention effect test, will be administered, the steps, processes, instruments and test personnel of the two post-tests are the same as those of the pre-test.

ARPT training plan

The author studied the location of ARPT group training, which was conducted in a sports swimming pool of a college, 10 weeks, twice a week, 60min each time, train at 9:00-10:00. The load of the ARPT group is water-blocking equipment, and the training content for 10 weeks is shown in Table 1.

Test items and methods

In order to evaluate the effectiveness of 10-week ARPT training, all research subjects must be 1 week before training (pre-test), and within 1 week (post-test) after training, receive the following physiological assessments:

Table 1. 10-week underwater resistance enhancement training plan.

Training period	Training items	Number of training groups	Training intensity	Project team rest time
1-3	Squat jump	2×6	Low	5min
	Jump and touch high	2×6	Low	5min
	Jump with both feet vertically	2×6	Low	5min
	Double-pedal jump	3×6	middle	5min
4-6	Jump with both feet vertically	2×6	Low	5min
	Bend knees	3×6	middle	5min
	Jump with feet sideways	3×6	middle	5min
	Squat jump	3×8	high	5min
7-10	Vertical on one foot	2×6	Low	5min
	Jump with feet sideways	3×6	middle	5min
	Z-Jump	5×4	high	5min
	Hop	3×8	high	5min

Muscle strength test of lower limbs

To evaluate isokinetic muscle strength, it is tested by the Biodex isokinetic muscle strength test evaluation system. Adjust the seat tilt of the isokinetic muscle system to 85°, the seat direction is 45°, and the power meter direction is 45°(The knee bone attachment has been connected to the power meter during calibration), the research subject adopts a sitting position, and the waist and torso are fixed with a fixing strap, put your arms around your chest, the axis point of the isokinetic muscle strength tester is aligned with the femoral lateral condyle, the bottom edge of the ankle pad is aligned with the 2 inches above the ankle joint, hip and knee joints, fixed at 90°, exercise and test both feet at 60°/s and 180°/s, repeat 3 times each, record the knee extension of one foot, the relative maximum torque peak and the time to reach the peak torque.[5,6]

Experimental process

After the research subjects signed the consent form, they arranged for the pre-test to be carried out one week before the training, after completion, all the research objects, randomly divided into underwater resistance enhancement training group (group A) and control group (group B), start training for 8 weeks, 2 times a week, 60 minutes each time; The post-test was administered 1 week and 4 weeks after the end, the experimental process is shown in Figure 1.

Mathematical Statistics

The experimental measurement data is analyzed with SPSS for Window 22.0 version statistical software. Compare the test before training, 1 week after training and 4 weeks after training in each group, are there a significant difference. Using the independent sample T test, compare the blood CK values of the two groups at the same time point during the training period (2, 4, 6, 8, and 10 weeks), and the difference between the groups in the degree of VAS of the lower limbs, in this study, $\alpha=0.05$ is the significant level.[7]

RESULTS

The influence of different training on muscle strength of lower limbs

Figure 2 shows: The study found that after 10 weeks of training, the ARPT group stopped training for 6 weeks, the relative torque peak of knee extension at 60°/s and 180°/s, all are better than the previous test ($P<0.05$), and the relative peak torque of 180°/s knee extension was significantly better than 1 week after training ($P<0.05$) [8].

The impact of different training on jumping ability

Figure 2 shows: After 10 weeks of training in the ARPT group, the training was stopped for 6 weeks, the TSJ jump height is better than the

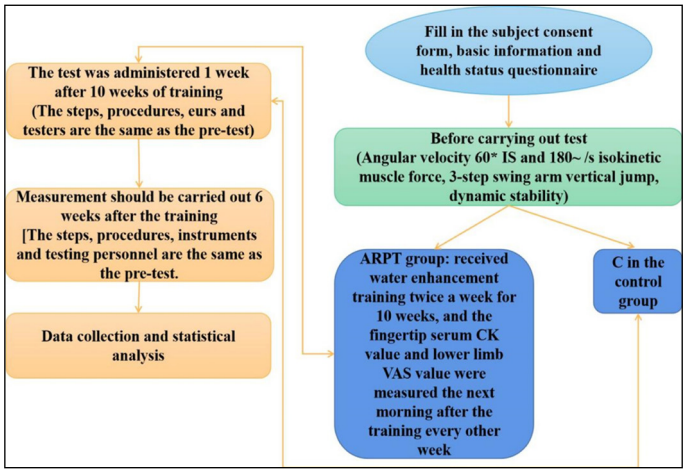

Figure 1. Experimental process.

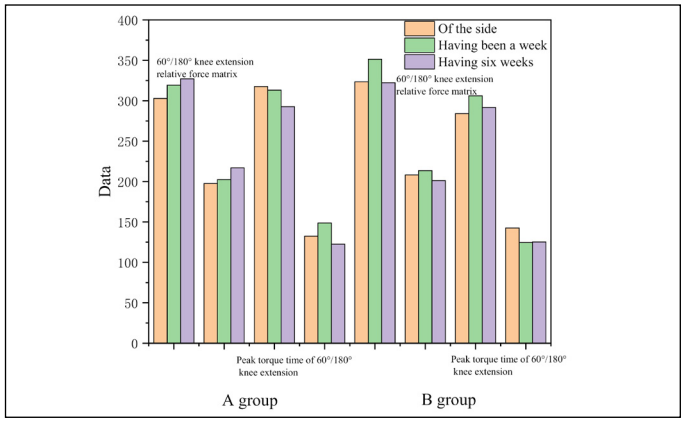

Figure 2. Index parameters of lower limb muscle strength, jumping ability, dynamic stability, muscle damage and pain before and after training.

previous test, and the landing contact time is also significantly better than 1 week after training ($p<0.05$); In the control group without training, after 8 weeks of no training, the TSJ jump height was significantly lower than the previous test ($p<0.05$).[9]

The impact of different training on dynamic stability

Figure 2 shows: One week after the ARPT group entered the 8-week training, the training was stopped for 4 weeks, the SEBT index was significantly better than the previous test ($p<0.05$).

The effect of different training methods on the muscle pain self-conscious scale and serum creatine kinase during training

Table 2. The effect of different training methods on the muscle pain self-conscious scale and serum creatine kinase during training.

	Group	Week 4	Week 6	Week 8	Week 10
CK	Group A	375±124.1	519.4±143.2	471.2±104.5	489.1±162.2
	Group B	314.5±117.3	353.4±84.2	401.2±105.2	512.7±28.9
VAS	Group A	31.2±10.3	41.2±17.8	51.4±11.5	47.8±12.9
	Group B	34.3±21.5	31.2±14.7	21.8±13.5	18.6±13.4

DISCUSSION

CK value of training group and control group, between 350~510IU/L and 300~460IU/L respectively; Pain consciously in the two groups were 35~45mm and 20~35mm respectively. Some research found that, after volleyball players undergo a volleyball simulation test, the CK value will increase to 320~400IU/L. The study found that after underwater enhanced training, the range of CK value is about 200~340IU/L. Because of the above-mentioned research intervention methods, only simulating volleyball matches or carrying, under-weight underwater reinforcement training, enhanced training underwater with additional resistance will result in a higher CK value, training and control group CK value, they are between 410~530IU/L and 350~430IU/L respectively. Therefore, the inference is that in addition to the original team training, the underwater enhancement training with additional resistance is added, there will also be a higher CK value. But according to research, after training, CK is higher than 2000IU/L and above is high-intensity, 500~2000IU/L is medium-intensity, below 500IU/L is a low intensity, and the CK value after training is still in a reasonable range. The VAS value of this study is consistent with other results. However, foreign studies rarely focus on volleyball players, the degree of soreness and self-consciousness of enhanced training, some studies believe that there is no difference between onshore and underwater enhanced VAS. Past studies have found that exercise intensity is directly proportional to the CK value after exercise, 24h after resistance training with 8RM, the CK value is as high as 860IU/L, it is much higher than the 15RM measurement, the 8RM, which shows stronger strength, has a greater impact on skeletal muscles, of course, the greater the impact, the greater the degree of muscle soreness. Some studies have found that after resistance exercise, the CK in the blood is elevated, it is believed that muscle soreness may be related to muscle fiber damage. CK value of underwater resistance enhancement type and control group, there is no significant difference during the training period; In the underwater resistance enhancement group, the VAS in the 6th and 8th weeks were significantly higher than the control group, but the serum creatine kinase reaction triggered, and the degree of soreness consciously, are in a moderate range, indicates that underwater training adds extra resistance, does not cause serious discomfort. Studies have also pointed out that, underwater and control group in the muscle injury part, there is no significant difference, similar to the results of this study.[10]

CONCLUSION

A 10-week resistance-enhancing training program, combined with regular training, it has been demonstrated, for improve the various vertical jumping abilities required by amateur young volleyball players, is useful. After underwater resistance enhancement training, the dynamic stability of the lower limbs can be significantly improved, and its effect can be retained until 6 weeks after stopping training. Underwater resistance enhancement training, the effect on muscle strength of lower limbs and jumping height, the effect is delayed, after 10 weeks of training, the effect is not significant, but after stopping training for 6 weeks, the effects are significantly better than before training.

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

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