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Influences of Core-strength Training on the Balanced Capacity and Partial Blood Biochemical Indexes of University Basketball Players

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Abstract: Purpose*: The aim of this study was to objective the effect of balance control ability of 12weeks core strength training and blood biochemical indexes of University Basketball Players. Methods: Fourteen basketball players received 12 weeks of core strength training, three times a week for 90 minutes, separated by 1 week pre-training and 12 weeks after training. All subjects were tested for the balanced ability indexes and routine biochemical indexes which included movement area of standing on one foot, moving velocity, BU,CK,WBC,HB,T,C and T/C, when they open and close eyes. Results: The results indicate that when the subjects stand on one foot, the movement area and velocity of one foot are significantly reduced(P<0.01)after 12 weeks of core strength training. A significant decrease (P<0.01) of difference of bilateral center of gravity center movement area occurred at opening eyes. On the contrary, A significant increase (P<0.01) of difference of bilateral center of gravity center movement area occurred at closing eyes. Bu and CK were significantly lower than pre-training (P < 0.05), WBC, HB, T and C increased significantly (P > 0.05), while t / C decreased slightly (P > 0.05).Conclusion: Results provide preliminary evidence that twelve weeks of core strength training can improve the balance control ability of basketball Players, enhance the body's ability to adapt to the training load, and keep the body function at a better level.*

Keywords: *core strength training; Balance control ability; Static support; Blood biochemical indexes; Physical adaptation*

1. Introduction

Spinal stability theory of sports rehabilitation has become very popular in recent years, and there are many theoretical innovations, such as functional training, sports chain theory, neuromuscular proprioceptive training and so on, in the field of competitive sports[1]. The traditional strength training methods often focus on the strength training of large muscle groups or surface muscles of the body in the field of competitive sports. There are some disadvantages, such as the lack of stable trunk support for the distal part of the body, the occurrence and transmission of strength is not smooth, and so on.

In this case, a new strength training theory has come into being, which makes a breakthrough in strength training means, equipment and other aspects. "Core strength training method" has been introduced into the field of competitive sports in such a background. The training principle of "inside out" and "inside out" is used in core strength training, The core area of training is deep local stable muscle and surface overall motor muscle[2]. The proprioceptive training of regional neuromuscular system can avoid the constraints of traditional strength training effectively. Basketball is an antagonistic game dominated by physical skills. It puts forward higher requirements for the players to maintain their physical balance and throw the ball into the hoop in the fierce confrontation. Basketball majors have some problems generally, such as the lack of trunk core strength, the weak ability of single leg support to maintain body balance, the unstable center of gravity in the fierce body contact confrontation. Therefore, if we could promote the improvement of the muscle strength of the subjects in the core area of basketball training, it would help the stability and balance of the body gravity, the presentation of sports effect, the exertion of sports technology and the strength transmission between muscles, and then improve the performance[3].

The core strength enhancement can improve the body power state, thus bringing about the overall

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benefits. This study conducted a 12 weeks core strength training intervention on basketball college students, compared the lower limb balance control ability index and blood routine biochemical index before and after the training, and studied the significance of 12 weeks core strength training on improving the lower limb balance control ability and improving the physical function of basketball college students[4].

2. Materials and methods

2.1 Materials and instruments

Joinfit natural latex resistance band, Joinfit balance pad, joinfit Kettlebell and other training equipment are produced by Suzhou Jiayou sports and leisure products Co., Ltd; Beckman Coulter actdiff-2 blood cell analyzer and Beckman Coulter access 2immunossav system automatic biochemical analyzer are produced by Beckman Coulter Co., Ltd,; Reflotron sprint whole blood dry biochemical analyzer is produced by Roche Group of Switzerland; EDTA anticoagulant vacuum tube and heparin sodium anticoagulant vacuum tube are produced by Liyin precision medical products Co., Ltd., and the balance function test training system is produced by Changzhou Jingcheng medical rehabilitation equipment Co., Ltd.

2.2 Participants

The subjects of this study are 14 male college basketball player who participate in the Guangdong College Basketball League. They are health and have no sports injury. Their age is (21.57 ±09) years old and (183. 29 ±56) cm, body weight was (78. 21 ±20) kg, and the training period was (2. 36 ±50) years.

2.3 Training arrangement

Core strength training plan are scientifically arranged by special physical fitness coaches according to the characteristics of basketball events. The subjects were performed core strength training every Monday, Wednesday and Friday afternoon and the duration of each training was 90 min. Jogging and stretching activities (a total of 15 minutes) were carried out before each training, and then they were given static and dynamic core strength training for 12 weeks. The training content includes no instrument training and equipment training, each group was trained 6-8 times, with 40 s interval, the coach strictly implemented the training plan, and the subjects strictly implemented the coach's training arrangement, and signed the informed consent in the process of core strength training[5].

2.4 Routine biochemical index detection

White blood cell (WBC) and hemoglobin (HB) were detected by Beckman Coulter actdiff-2 blood cell analyzer. Blood urea (BU) and creatine kinase (CK) were measured by reflatron sprint whole blood dry biochemical analyzer. testos-terone (T), cortisol (c) and the ratio of testosterone to cortisol (T / C) were measured by Beckman Coulter access 2 im munossav system. The subjects was drew blood in the exercise physiology laboratory at 6:00 a.m. on the first week before core strength training and the next Monday after the 12th week of training. The subjects were not allowed to drink or smoke within one week before the test, and had enough sleep rest. 5.5 ml of elbow venous blood was drew by EDTA anticoagulant vacuum tube, 2.5ml blood was used to test Bu, CK, t, C and T / C and. 2 ml blood was used to detection of WBC and Hb.

2.5 Legs Balance ability test

Legs Balance ability test mainly detects the moving area and velocity of the body center of gravity in four standing positions.

It includes the moving area and velocity of the center of gravity in the standing position of left foot and right foot with eyes open, and the moving area and velocity of the center of gravity in the standing position of left foot and right foot with eyes closed.

The detection steps are as follows: (1) the personal information of the participants was written down into the system. (2) The participants took off their shoes and stood at the mark with "footprints" on the

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test system plate.(3) The participants ' arms dropped naturally and kept stable. They were tested for 30 s with eyes open and 30 s with eyes closed. (4) According to the action demonstration on the display screen, participants hold a leg raised by bending knee with both hands, stand with supporting foot in the middle of the plate, and then start to stand with one foot open eyes for 8 s.(5) The participants put their hands around a leg raised by bending their knees, and the supporting foot stood in the middle of the plate. After stabilization, they began to stand on one foot with eyes closed for 8 s. The relevant testers should pay attention to the protection work to prevent the subjects from falling down and being injured.

2.6 Statistical analysis

Data were analyzed by SPSS 17.0 statistical software and Microsoft Excel 2007 software, and the test results were based on the mean value ± Standard deviation (x) ± s) Expression. Paired sample t test was used to compare the differences of each index before and after training and at different time points.

3. Results

3.1 Changes in balance control ability

It can be seen from table 1 that the movement area and velocity of the gravity of the left and right feet in the eyes open and eyes closed state were significantly lower than those pre-training ($P < 0.01$, table 1) after 12 weeks of core strength training[6]. The change range of each index is large before and after training and the data were statistically significant.

There were significant differences and imbalances in the movement area and speed of standing on one foot before and after 12 weeks of core training ($P < 0.01$, table 2). After core strength training, the differences of bilateral movement area in open and closed eyes were decreased, and the differences of bilateral movement area in open eyes were statistically significant ($P < 0.05$).

Tab. 2 The difference in balance control ability between the two sides before and after core strength training (x±s,n =14)

Test index	Bilateral movement of open eyes(mm^2)	Speed of both sides of open eyes(cm/s)	Bilateral movement of closed eyes(mm^2)	Speed of both sides of closed eyes(cm/s)
Pre-training	111.20±42.99**	0.19±0.11**	386.95±151.01**	0.34±0.21**
After training	23.42±55.13**#	0.31±0.20**#	378.95±463.79**	0.75±1.05**

**P<0.01 the comparison between the left leg and the right leg; #P<0.05 vs pre-training

The difference of bilateral movement speed is larger than that before training. Movement speed in open eyes state was statistically significant ($P < 0.05$).

3.2 Changes of blood biochemical indexes

It can be seen from table 3 that the blood concentrations of Bu and CK in the recovery period of the subjects were significantly decreased ($P < 0.05$, table 3). The WBC and Hb levels of the subjects in the recovery period increased, but the difference did not reach a significant level at week 12 of core strength training ($P > 0.05$, table 3).

Tab.3 The of core strength training on blood biochemical indexes (x±s,n = 14)

Test index	BU(mmol / L)	CK(U / L)	WBC(109cell / L)	HB(g / L)	T(ng / dl)	C(μg / dl)	T / C
Pre-training	6.2±1.19	170.98±13.89	5.98±0.79	149.8±8.7	538.42 ±102.79	15.28±1.97	35.29±7.85
After training	5.10±0.95*	158.95±8.29*	6.01±0.59	153.98±9.85	557.98±81.59	15.98±3.89	33.89±8.28

*P<0.05 vs pre-training

4. Discussions

The ability of balance control is the ability to adjust and maintain the posture automatically when the human body is in a certain posture or in a stable state[7]. The physiological mechanism of balance control ability is the basic premise for human body to maintain posture and complete technical

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movements accurately and It is the body's ability to coordinate stimuli from vestibular organs, muscles, tendons, intra-articular receptors and vision[8].

A large number of studies have confirmed that core strength training can timely regulate the stability of spine and pelvis, coordinate the change of body gravity center and the adjustment of movement posture, improve the core stability, and then improve the balance control ability of the body[9].After 10 and 12 weeks of core strength training for the elderly, scholars found that the middle intensity of core strength training can significantly improve balance score of time and dynamic balance of standing on one leg with eyes closed[10]. Core strength training can significantly improve the lower limb balance ability of the elderly, prevent the risk of falls, and improve the quality of life.

Studies have shown that the dominant side and non dominant side legs of young students are less than 20 m ×5 and 20 m ×After 10 round-trip running, the swing amplitude increased significantly[11]. This study believes that the increase of weight will lead to the increase of the degree of damage in the left and right directions of the lower limbs, which will destroy the dynamic balance control ability of the lower limbs, and the core strength training will help to improve the body's ability to resist external forces and improve the core stability of the body[12].

In this study, the moving area and speed of the center of gravity of the left and right feet in the eyes open and eyes closed state were significantly lower than those before the training. The moving area and speed of the center of gravity of the left and right feet standing of eyes open and closed were significantly lower than those before training after 12 weeks of core strength training[13]. The core strength training includes resistance belt training, Kettlebell training, unstable surface training, Swiss ball and balance pad training[14]. Core strength training can better improve the muscle strength of the core area and lower limb muscle strength of the subjects, and improve the balance control ability of the lower limb support based on the core muscle force, which plays an important role in further improving the quality of the subjects' movements that need single leg support and maintain body balance in basketball. In addition, the difference of bilateral movement area between the open and closed eyes of the subjects decreased significantly after 12 weeks of core strength training[15]. This is consistent with the reduction of the movement area of the center of gravity of the subjects standing on one foot when they open and close their eyes[16].

When they open and close their eyes, the difference of movement area of participants was significantly lower than that before training, which was closely related to the 12 week core strength training intervention[17]. This shows that the trunk core stability of the subjects has been greatly improved after 12 weeks of core strength training, and the balance support control ability of the lower limbs has been greatly improved. Studies have shown that when the human body is stimulated by external training load, various physiological sex hormones in the body will also change accordingly. we can truly understand the internal changes of the body, better understand the internal condition of the body, and scientifically evaluate and diagnose the body function through the detection of blood biochemical indicators.

In addition, studies have shown that BU and CK of female rowers increased to a certain extent, while WBC, Hb and t decreased to a certain extent in the early stage of core strength training and special ability training[18]. After a period of training adaptation, BU and CK gradually recovered and decreased, while WBC, Hb and T gradually increased, which indicated that after 9 weeks of core strength training and special ability training, athletes' adaptability to training load and aerobic ability were improved, and their competitive state remained at a high level[19].

Some scholars believe that the basketball players' T and C levels show an upward trend in the whole training process, and the change characteristics of T and C are basically consistent with the training load, this shows that the athlete's functional state is in good condition during the whole training period[20].

5. Conclusion

In this study, the blood Bu and CK indexes of the subjects decreased significantly after the core strength training and WBC, Hb, t and C increased significantly. This shows that the participant's ability to adapt to the training load has been improved, and the body function is at a better level after 12 weeks of core strength training[21]. To summarize, 12 weeks of core strength training is helpful to improve the balance control ability of lower limbs of basketball majors, enhance the body's ability to adapt to the training load, and keep the body function at a better level.

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Tab.1 The changes in balance control ability of single foot standing before and after core strength training (x±s,n = 14)

Test index	The left foot with open eyes		The right foot with open eyes		The left foot with close eyes		The right foot with close eyes	
	The area of movement(mm^2)	The velocity of movement(cm/s)	The area of movement(mm^2)	The velocity of movement(cm/s)	The area of movement(mm^2)	The velocity of movement(cm/s)	The area of movement(mm^2)	The velocity of movement(cm/s)
Pre-training	313.40±61.98	2.2±0.49	201.00±71.02	2.1.89±0.32	2440.29±712.92	6.68±1.09	2019.00±749.82	6.27±1.12
After training	197.52±58.95**	2.08±0.49**	124.73±38.95**	1.69±0.31 **	1847.65±580.42**	4..79±1.01**	1467.98±504.13**	3.92±1.07**
Range of change	38%	11%	38%	15%	25%	30%	27%	36%

**P<0.01 vs pre-training