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EFFECT OF CORE STRENGTH TRAINING PROGRAM ON ANAEROBIC POWER, SPEED AND STATIC BALANCE IN VOLLEYBALL PLAYERS

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Abstract:
The aim of this study is to examine the effect of the core strength training program applied to volleyball players on anaerobic power, speed and static balance. A total of 18 male volleyball players between the ages of 18-22, who regularly practice volleyball, participated in our study voluntarily. The subjects were divided into two different groups as the experimental group (n=9, age: 19.41±2.48) and the control group (n=9, age: 21.12±2.32). The control group continued their normal volleyball training. In the experimental group, in addition to volleyball training, a core strength training program was applied 3 days a week for 6 weeks. Core exercises are known as Mountain Climbers, Bicycle Crunch, Leg Raises, Russian Twist, Side Plank, Bridge, Abdominal Crunch, Jack Knife, Superman, Plank Jack were performed on the experimental group. Static balance scores were measured with the Biodex Balance System balance test device. A speed test (30 m) was applied. Anaerobic power was measured with the vertical jump test. Independent Samples T-Test was used for statistical evaluation between the experimental and control groups. Paired Samples T-Test was used for in-group comparisons. After the core training program was applied to the experimental group, significance was determined in the speed, anaerobic power and static balance scores ($p<0.05$). There was a significant difference between the groups in speed, anaerobic power and static balance scores in favor of the experimental group ($p<0.05$). As a result, it can be said that the core strength training program applied to volleyball players has a positive effect on speed, anaerobic power and static balance scores.

Keywords: volleyball, core training, speed, static balance

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1. Introduction

Volleyball is a sport that includes complex movements. In order to be successful in the volleyball branch, it is necessary to have advanced biomotor skills along with the technique. Biomotoric features such as speed, anaerobic power, balance, endurance and quick strength are important in volleyball athletes (1). Anaerobic power and balance skills are important in volleyball training and competition, especially in basic movements such as slam dunk and block (2, 3). Important elements that provide stopping, changing direction movements and controlling the body are balance. The feeling of the position during the competition by the athlete is called static proprioception, and the feeling of the applied movement is called dynamic proprioception. Athletes and individuals with developed prioceptive senses have less risk of injury (4). Speed, agility and balance are the most needed biomotoric features in volleyball training and competitions (5).

The meaning of the word core in sports is known as the center of gravity of the body. During the exercises, the muscle groups are in synergy and the core muscles take on the task of supporting the body (6). Developed core muscles support the spine during daily physical activities and strength training (7). The importance of core training in the volleyball branch is that it will contribute to the performance of the athletes by improving balance, strength, skill and anaerobic power along with effective muscle development. Core strength training can be an alternative method for trainers and athletes.

In the light of this information, our aim in this study is to determine the effect of a 6-week core strength training program on anaerobic power, speed and static balance in young male volleyball players.

2. Methods

2.1. Subjects

Eighteen male volleyball players between the ages of 18-22, who regularly practice volleyball, participated in the study. The subjects were randomly divided into two groups as the experimental group (n=9, age: 19.41±2.48) and the control group (n=9, age: 21.12±2.32). The control group continued their normal volleyball training. In the experimental group, in addition to volleyball training, core training was applied 3 days a week for 6 weeks. Before and after core strength training, speed (30 m), anaerobic power and static balance measurements were taken.

2.2. Study Design

Core strength exercises are known as Mountain Climbers, Bicycle Crunch, Leg Raises, Russian Twist, Side Plank, Bridge, Abdominal Crunch, Jack Knife, Superman, Plank Jack were applied to the experimental group. Static balance scores were measured by Biodex Balance SD device. A speed test (30 m) was applied. Anaerobic power was measured with the vertical jump test.

2.3. Core Strength Training Program

In our study, in addition to volleyball training, a core strength training program was applied to the experimental group for 60 minutes, 3 days a week for 6 weeks. The control group continued their normal volleyball training. As core exercises for the experimental group, 1-Mountain Climbers, 2-Bicycle Crunch 3-Leg Raises, 4-Russian Twist, 5-Side Plank, 6-Bridge, 7-Abdominal Crunch, 8- Jack Knife, 9- Superman, 10- Plank Jack movements were applied. Core exercises were applied as 2*12 (set*repeat) in the first 2 weeks, 2*15 in the second 2 weeks and 3*20 in the last 2 weeks. A rest period of 20 seconds was given between repetitions and 1 minute between sets. The number of repetitions in the applied training program continued to increase weekly according to the individual performances of the athletes. Before starting the core strength training, a warm-up period of 10 minutes was given (8).

2.4. Static Balance Test

Biodex Balance System (Biodex Balance System, BBS; Biodex Inc., Shirley, NY) balance test device was used to measure static balance scores. For the static balance test, measurements were taken on the right-left foot and on both feet. While performing static tests on one leg, care was taken to ensure that the other leg was 60°-90° bent and it was not allowed to touch the platform. During the static test measurement, from the subject on the fixed point on the screen; the students were asked to keep their balance backwards, to the right, to the left and to stay in a stable position. For the test, 3 repetitions were made, with a 20-second rest interval of 10 seconds, and the measurements were recorded (9).

2.5. Anaerobic Power Test

The distance the subjects could reach by standing sideways in front of the wall indicated in cm was measured. The subjects jumped up with their arms from where they were and touched the highest point they could touch. The value between the distance the subjects could reach and the jump distance was measured in cm. Each athlete was given three chances for the test and his best score was recorded. Lewis Nomogram was used to find anaerobic power (10).

2.6. 30 Meters Speed Test

Before the 30 m speed test, the athletes were warmed up. After the warm-up, when the athlete felt ready 1m behind the start line, they were asked to start. Two trials were performed on the subjects. The measurements were taken in seconds on the athlete information form and the high grade was recorded. A 3-minute rest interval was given between the trials (10, 11).

2.7. Statistical Analysis

SPSS (SPSS for Windows, version 22.0, SPSS Inc. Chicago, Illinois, USA) statistical program was used for the analysis of statistical data of this study. Shapiro-Wilk Test was applied to detect normality. Independent Samples T-Test was used for statistical evaluation between the experimental and control groups. Paired Samples T-Test was used for in-group comparisons. Statistical data were evaluated at a $p<0.05$ significance level.

3. Results

Table 1: Descriptives

Variable	Experimental Group	Control Group
	Mean±SD	**Mean±SD**
Age (years)	19.41 ± 2.48	21.12 ± 2.32
Height (cm)	182.41 ± 2.78	183.26 ± 3.29
Weight (kg)	74.58± 2.74	75.17 ± 2.94

The mean age of the experimental group was 19.41 ± 2.48 years, and the mean age of the control group was 21.12 ± 2.32 years. Body weight was measured as 74.58 ± 2.74 kg in the experimental group and 75.17 ± 2.94 kg in the control group. The height of the experimental group was 182.41 ± 2.78 cm, and the control group was 183.26 ± 3.29 cm.

Table 2: Pre-test and post-test analysis results of the experimental group (n:9)

Variable	Pre-test	Post-test	t	p
	Mean ±SD	**Mean ±SD**		
Speed 30 m (sec)	4.71±0.57	4.29±0,12	3.263	**0.001***
Anaerobic Power (kgm/sn)	128.62±9.52	134.47±8.78	-4.659	**0.001***
Right Leg Overall Static Balance Scores	0.81 ± 0.89	0.76 ± 0.21	2.614	**0.001***
Left Leg Overall Static Balance Scores	0.90 ± 0.36	0.68 ± 0.17	4.641	**0.001***
Double Leg Overall Static Balance Scores	0.47 ± 0.74	0.38 ± 0.24	3.623	**0.001***

*p<0.05

In Table 2, after the core strength training program was applied to the experimental group, significance was determined in the speed, anaerobic power and static balance scores ($p<0.05$).

Table 3: Pre-test and post-test analysis results of the control group (n:9)

Variable	Pre-test	Post-test	t	p
	Mean ±SD	**Mean ±SD**		
Speed 30 m (sec)	4.74 ± 0.52	4.62 ± 0.81	2.478	0.137
Anaerobic Power (kgm/sn)	129.54±7.19	130.41±7.24	-2.457	0.171
Right Leg Overall Static Balance Scores	0.82 ± 0.42	0.79 ± 0.19	2.184	**0.012***
Left Leg Overall Static Balance Scores	0.91 ± 0.17	0.90 ± 0.32	0.475	0.421
Double Leg Overall Static Balance Scores	0.45 ± 0.21	0.43 ± 0.26	1.214	0.198

*p<0.05

In Table 3, after the core strength training program was applied to the control group, a significant difference was found in the right leg overall static balance scores of the control group (p<0.05). No significant other values were found (p>0.05).

Table 4: Comparison of the experimental and control groups

Variable	Experimental Group Difference	Control Group Difference	t	p
	Mean ±SD	Mean ±SD		
Speed 30 m (sec)	0.42 ± 0.71	0.12 ± 0.51	2.378	**0.001***
Anaerobic Power (kgm/sn)	-5.85±2.57	-0.87±1,91	4.342	**0.001***
Right Leg Overall Static Balance Scores	0.05 ± 0.11	0.03 ± 0.14	0.617	0.741
Left Leg Overall Static Balance Scores	0.22 ± 0.21	0.01 ± 0.12	1.296	**0.001***
Double Leg Overall Static Balance Scores	0.09 ± 0.07	0.02 ± 0.10	2.201	**0.014***

*p<0.05

In Table 4, a significant difference was found between the groups in favor of the experimental group in terms of speed, anaerobic power and left leg and double leg overall static balance scores (p<0.05). There was no significance in the right leg overall static balance scores (p>0.05).

4. Discussion

In our study, a significance was found in speed, anaerobic power and static balance scores after the 6-week core strength training program was applied to the experimental group (p<0.05). Significance was found in the right leg overall static balance scores of the control group (p<0.05). No significant other values were found (p>0.05). In the comparison of the groups, a significant difference was found in the speed, anaerobic power and left leg and double leg overall static balance scores in favor of the experimental group (p<0.05). There was no significance in the right leg overall static balance scores (p>0.05).

Core strength exercises are important for strength development and posture in the diaphragm and trunk muscles. Core strength exercises increase the performance of athletes by providing an increase in strength together with the neural adaptation of the muscles and muscle hypertrophy (12). It is also known to have an effect on biomotoric features such as athletic performance, speed, balance, and explosive power (13).

Myer et al. (2005) stated that, as a result of the 6-week core exercise program, an increase was found in the vertical jump and sprint values of the athletes (14). In a study conducted with handball players, a significance was found in the speed values after core strength training (15).

Michal et al. (2009) stated that strength training is important in the development of anaerobic power and speed in young athletes (16). In another study, they found an increase in speed, strength and vertical jump values as a result of core strength training applied to volleyball players (17). Cressey et al., found a positive improvement in the vertical jump values of the athletes after the core training program (18).

Our study' result is similar to the information given in the literature. The general opinion in the literature is that core strength training has a positive effect on speed, vertical jump and anaerobic power values. In our study, a significance was found in speed and anaerobic power values after a 6-week core strength training program. Our study is similar to the information given in the literature. It can be said that the increase in the speed and anaerobic power data of the experimental group was due to the core strength training and nerve and muscle interaction with volleyball training.

Balance is an important element of sportive performance and physical activity. Static balance is the ability to keep the pressure in the support center centered (19). In a study on volleyball players, a significant difference was found in balance scores after 8 weeks of core training (20). It was determined that the exercises performed regularly for 12 weeks increased the static balance scores positively (21). In another study, after different strength training was applied to volleyball players, a significant difference was found in the static balance scores of the experimental group (22).

Studies in the literature generally show that there is a positive improvement in static balance ability after strength training. After the core strength training program was applied to the volleyball players in our study, a positive improvement was found in the right leg overall static balance and left leg overall static balance values in the experimental group. Our results support the literature. It is thought that the significant difference in static balance values in our study is due to core strength training in addition to volleyball training.

As a result, it can be said that the 6-week core strength training program applied to volleyball players positively affects their speed, anaerobic power and static balance scores. It may be recommended to include regular and planned core strength exercise programs in addition to volleyball training in training planning.

Conflict of Interest Statement

There are no potential conflicts of interest between the authors of this article.

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