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# EFFECT OF PLYOMETRIC TRAINING PROGRAM ON SPEED AND DYNAMIC BALANCE PERFORMANCES IN VOLLEYBALL PLAYERS

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**Abstract:**
The aim of this study is to examine the effect of plyometric training program on speed and dynamic balance performance of volleyball players. Twenty male volleyball players aged 18-23, who do regular volleyball training, participated in the study voluntarily. The subjects were randomly divided into two different groups as the experimental group (n = 10, age: 20.54 ± 2.14) and the control group (n = 10, age: 21.62 ± 2.17). The experimental group performed a plyometric training program 3 days a week for 8 weeks. Both groups continued their normal volleyball training. Exercises known as drop jump, box jump, squat jump, split squat jump, overhead slam and plyometric push-ups were applied to the experimental group. Speed (30 m) and dynamic balance measurements were made before and after the training started. Biodex Balance SD Isokinetic Balance Test was applied for dynamic balance measurement. Paired Sample t test was used for in-group comparisons for statistical analysis of the data, and Independent Sample t test was used for intergroup comparisons. The level of significance was set at $p<0.05$. When the pre-test and post-test measurements of the experimental group were examined, a significant difference was found in dynamic balance scores ($p<0.05$). There was no significance in the speed data ($p>0.05$). When the pre-test and post-test measurements of the groups were compared, a significance was observed in the right leg and left leg general dynamic balance scores in favor of the experimental group ($p<0.05$). As a result, it can be said that the plyometric training program applied to volleyball players improves the speed and dynamic balance scores.

**Keywords:** plyometric training, speed, dynamic balance, volleyball

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## 1. Introduction

The purpose of training in all sports branches is to develop the physical characteristics of the athlete in a continuous harmony and to increase their performance. Volleyball branch is a team sport that involves complex movements and requires skill. Therefore, important physical properties such as balance, endurance, speed, explosive strength, and quick strength are the basic characteristics that should be found in volleyball athletes (1). For success in volleyball, the biomotoric feature should be developed very well together with the technique. In volleyball, every dunk and block movement to be applied during competition or training requires a good jumping force and balance ability. Speed and balance are the most needed basic motoric features in volleyball (2). Exercises aimed at combining strength, speed and explosive force are defined as plyometric exercises (3). The purpose of plyometric training is to keep the ground contact time as little as possible while jumping or on the move. A stretching event occurs in tendons and connective tissues. This allows potential elastic energy to emerge. This energy is stored in the eccentric contraction and a great force emerges with the effect of gravity during the concentric contraction (4). Balance, speed, strength, leg strength and jumping strength, which are characteristic of volleyball, are important for sportive performance. Plyometric training can contribute to athletes with effective muscle contractions. It can be considered to use plyometric training as an alternative training system in the volleyball branch.

The aim of this study is to examine the effect of the 8-week plyometric training program on the speed and dynamic balance performance of volleyball players and to make suggestions to trainers and athletes on training planning.

## 2. Methods

### 2.1. Subjects

A total of 20 male volleyball players aged 18-23, who do regular volleyball training, participated in the study voluntarily. The subjects were randomly divided into two different groups as the experimental group (n = 10, age: 20.54 ± 2.14) and the control group (n = 10, age: 21.62 ± 2.17). A plyometric training program was applied to the experimental group 3 days a week for 8 weeks. Both groups continued their normal volleyball training. Speed (30 m) and dynamic balance measurements were taken before and after the plyometric training.

### 2.2 Research Protocol

Body weight, height, body mass index (BMI), speed and dynamic balance scores were measured before and after the plyometric training. Exercises known as drop jump, box jump, squat jump, split squat jump, overhead slam, and plyometric push-up were applied to the philometric training group. Dynamic balance scores were measured with the Biodex Balance SD Isokinetic Balance Test. Speed test (30 m) was applied.

Measurements were made in Gaziantep University Faculty of Sport Sciences Physiology Laboratory.

### 2.3. Plyometric Training Program

In addition to the volleyball training of the experimental group, a plyometric training program for 4 weeks (3 sets x 12 repetitions) for 4 weeks (3 sets x 15) for a total of 8 weeks was applied for the lower and upper extremities 3 days a week (5). Rest was given for 60 seconds between sets and 15 seconds between repetitions. The subjects were motivated by saying that the plyometric exercises should be done at the maximal level. The subjects were told not to do any exercise other than volleyball training and plyometric training.

### 2.4. Dynamic Balance Test

Dynamic balance performances were measured using the Biodex Balance System (Biodex Balance System, BBS; Biodex Inc., Shirley, NY). Dynamic balance test was performed in stance positions on the right leg and left leg, respectively. In this research, level 4 dynamic balance test was used. The tests were performed 3 times with 20 seconds and rest intervals of 10 seconds, and the scores were recorded.

### 2.5. 30 meter Sprint Test

Before the speed test, the subjects were given a 10-minute warm-up period. Two measurements were made in the 30 m speed test. 3 minutes rest interval was given between the measurements. (6, 7). The time for the athlete to finish the course was recorded in the athlete information form in seconds. Maximum scores were selected for evaluation at the end of the measurement.

### 2.6. Statistical Analysis

Statistical analysis of this study was performed using the SPSS statistical program (SPSS for Windows, version 20.0, SPSS Inc. Chicago, Illinois, USA). The Shapiro-Wilk Test was used to determine whether the data were normally distributed. Independent Samples T Test was applied to evaluate the significance between experimental and control groups. Paired Samples T Test was applied for intra-group comparisons. Statistical results were evaluated at 95% confidence interval and $p<0.05$ significance levels.

## 3. Results

**Table 1:** Descriptives

| | **Experimental Group** | **Control Group** |
|---|---|---|
| **Variable** | **Mean±SD** | **Mean±SD** |
| Age (years) | 20.54 ± 2.14 | 21.62 ± 2.17 |
| Height (cm) | 180.72 ± 4.29 | 181.26 ± 3.12 |
| Weight (kg) | 73.56 ± 2.28 | 74.52 ± 2.62 |
| BMI (kg/m$^2$) | 22.57 ± 0.84 | 22.92 ± 0.72 |

Descriptive information of the experimental and control groups are given in Table 1.

**Table 2:** Pre-test and post-test analysis results of the experimental group

| | **Pre-test (df:9)** | **Post-test (df:9)** | | |
|---|---|---|---|---|
| **Variable** | **Mean ±SD** | **Mean ±SD** | **t** | **p** |
| Right Leg Overall Stability Index | 0.94 ± 0.51 | 0.69 ± 0.19 | 3.124 | **0.001*** |
| Left Leg Overall Stability Index | 0.89 ± 0.09 | 0.76 ± 0.11 | 3.411 | **0.001*** |
| Speed 30 m (sec) | 4.75±0,24 | 4,24±0,14 | 3.126 | **0.001** |
| *p<0.05 | | | | |

In Table 2, comparison of the pre-test and post-test measurement results for the parameters taken after the plyometric training program applied to the experimental group. A statistically significant difference was found in the speed and dynamic balance scores of the experimental group (p<0.05).

**Table 3:** Pre-test and post-test analysis results of the control group

| | **Pre-test (df:9)** | **Post-test (df:9)** | | |
|---|---|---|---|---|
| **Variable** | **Mean±SD** | **Mean±SD** | **t** | **p** |
| Right Leg Overall Stability Index | 0.95 ± 0.53 | 0.90 ± 0.17 | 1.581 | 0.146 |
| Left Leg Overall Stability Index | 0.91 ± 0.17 | 0.88 ± 0.12 | 1.367 | 0.239 |
| Speed 30 m (sec) | 4.78 ± 0,32 | 4,69 ± 0,29 | 2.142 | 0.126 |
| *p<0.05 | | | | |

In Table 3, Comparison of pre-test and post-test results of control group was given. There was no significance in the values of the control group (p>0.05).

**Table 4:** Comparison of the experimental and control groups

| | **Experimental Group Difference (df:18)** | **Control Group Difference (df:18)** | | |
|---|---|---|---|---|
| **Variable** | **Mean±SD** | **Mean±SD** | **t** | **p** |
| Right Leg Overall Stability Index | 0.25 ± 0.17 | 0.05 ± 0.12 | 2.124 | **0.001*** |
| Left Leg Overall Stability Index | 0.13 ± 0.09 | 0.03 ± 0.11 | 2.045 | **0.012*** |
| Speed 30 m (sec) | 0.51 ± 0.54 | 0.09 ± 0.51 | 2.122 | **0.001** |
| *p<0.05 | | | | |

In the comparison between groups, a significant difference was found in the speed and dynamic balance scores in favor of the experimental group (p<0.05).

## 4. Discussion

In our study, after the 8-week plyometric training program applied to the experimental group, a significant difference was found in speed and right leg general dynamic balance and left leg general dynamic balance scores (p<0.05). No significance was found for the

parameters of the control group ($p>0.05$). In the comparison of the groups, a statistically significant difference was found in the speed and dynamic balance scores in favor of the experimental group.

One of the biomotoric features that determine sportive performance is speed. Its ability to be developed is more limited compared to other biomotoric features. It is a skill that is generally genetically dependent on physiological potential and can be improved (8). Plyometric training provides fast and effective muscle contraction and nerve-muscle coordination and strength development (9).

In our study, a significant difference was found at the $p<0.05$ level in the speed values of the experimental group after the plyometric training program. It has been reported that plyometric training combined with other training programs improve sprint speed (9). A statistically significant difference was found at the $p<0.05$ level in the speed values of the experimental group after the plyometric training program applied to young football players (5). In a study conducted with basketball players, an increase in sprint performance was found after 8 weeks of plyometric training in water and on land (10). In another study, it was found that strength training combined with plyometric training improved long jump, vertical jump, flexibility and 20 m sprint performances (11).

It was found that the sprint performance of college athletes who were applied a 12-week plyometric training program increased (12). Our study is similar to the information given in the literature. It can be said that the increase in speed in the experimental group in our study was due to the nerve-muscle adaptations developed by the plyometric training applied together with the regular volleyball training.

In our study, a significant difference was found in the right leg general dynamic balance and left leg general dynamic balance scores after the 8-week plyometric training program applied to the experimental group ($p<0.05$). No significance was found in the parameters of the control group ($p>0.05$). In the comparison of the groups, a significant difference was found in the general dynamic balance scores in favor of the experimental group.

Dynamic balance is extremely important in performing physical activities and sports skills (13). Yüksel et al. (2016) achieved an increase in dynamic balance efficiency of athletes after 8 weeks of core training applied to basketball players (14). In another study, after 8 weeks of different strength training applied to volleyball players, a significant difference was found in the general dynamic balance scores of the experimental group (15). Alikhani et al., found that the dynamic balance of female badminton players improved significantly after plyometric training (16). Majeed et al., They found that there was a significant difference in the dynamic balance of male badminton players after six weeks of plyometric training (17).

It is thought that the significant difference in the general dynamic balance scores of the right and left leg of the experimental group in the dynamic balance measurements in our study was due to the plyometric exercises performed by the athletes together with their volleyball training. It can be said that the improvement in dynamic balance

parameters is due to the increase in the working efficiency of intermuscular and intramuscular muscle groups depending on the development of muscle strength.

As a result, it can be said that the plyometric training program applied to volleyball players improves the speed and dynamic balance scores. In addition to volleyball training programs, plyometric exercises can be recommended for the development of speed and balance ability in volleyball.

**Conflict of İnterest**

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

**About the Authors**

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