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Study on the influence of plyometric training on the explosive power of basketball players

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Abstract
Based on the theory of sports biochemistry, exercise physiology and sports training, 36 basketball players from Gachon University were selected as the experimental subjects and divided into experimental group and control group randomly .18 people were included in each group. The training contrast experiment was carried out for 16 weeks. The influence of plyometric training on the explosive power of basketball players was analyzed by comparing the scores of 28-meter sprints, the three jumps and the vertical jumps of pre-training and post-training. The results show that after 16 weeks, the experimental group is obviously better than the control group in 28-meter sprint and vertical jump, but there is no significant difference in the three jumps. It can be seen that, although the regular training can be helpful to players' explosive power, the enhanced training is more effective and overall.

Keywords: plyometric training; three jumps; vertical jump; leaping ability; explosive power

1. Introduction
Basketball has the characteristics of high speed, high explosive power, high coordination, high opposability, high altitude advantage and high skill, which not only requires athletes to have a good team skills and tactical ability, but also the strong explosive power to jump higher and run faster[1]. Explosive power is the product of muscle strength and speed. Increasing muscle strength is the basic condition to enhance the explosive power. Plyometric training is widely used to enhance the athletes' muscle strength, explosive power and jumping ability [2]. Baechle and Earle argue that, "enhanced training" can be sustained by centrifugal contraction of muscle stretching. The storage and release of elastic potential energy generates fast and strong centripetal contraction to enhance the movement speed, explosive power and sensitivity of athletes [3-5]. Michael says that enhanced training can reduce the damage of muscles and ligaments and improve bone density in females [6]. American College of Sports Medicine also advise that enhanced training can accelerate muscle and nerve response, strengthen muscle, explosive power and bone, help control weight and reduce sports injuries [7]. Zhang Huiying and Lin Baocheng designed a set of vaulting box courses based on enhanced training to carry out a 12-week vaulting box training [8-10]. There is a significant difference between the experimental group and the control group (p<0.05), which could effectively improve the muscle strength, speed, explosive power and neuromuscular coordination of basketball players [11].

This study is conducted on the basis of the theory of sports biochemistry, sports physiology, sports training and experimental methods [12]. In this study, 36 basketball players from Gachon University were selected and randomly divided into experimental group and control group 18 people included in each group for a 16-week training contrast experiment to analyse the influence of enhanced training on the explosive power of basketball players[13]. So this provides the reference for strength training practice of basketball players [14-15].

2. Materials and methods
2.1 Experimental subject
36 basketball players of sports training basketball major of 2014 session from Gachon University were selected as the experimental subject. The average age was 18.22 (± 2.17) years. The average weight was 63.31 (± 6.62) kg. The average height was 172.28 (± 5.76) cm.

They were randomly divided into experimental group and control group including 18 people in each group for a 16-week training comparison experiment.

2.2 Experimental time and location

1. Experimental time:
(1) Testing time: pretesting time: September 6, 2016, post testing time: January 15, 2017. (2) Training time: from September 6, 2016 to January 15, 2017.
2. Experimental location: Gymnasium in Gachon University.

2.3 Experimental equipment

(1) Tape, stopwatch and 5 wooden boxes of 40 centimeters high, standing plane area of 45 × 60 cm.

2.4 Experimental steps and methods

In order to avoid the injury caused by improper strength for experimental subjects in the experiment, subjects were required to do warm-up on the main muscles of the lower limbs and back for 10 minutes and were then tested for the the following items:
(1) 28-meter sprint. When subjects stood before the starting line, after hearing the "Ready, Go", they went straight ahead quickly and ran through the 28-meter bottom line. There were a total of two measurements, taking the best score in seconds.
(2) Three jumps. Subjects stood before the starting line with their arms swinging and their feet drawing close to each other at the same time and jumped forward for three times continuously. Using measuring tape the distance from the starting point to the drop point was measured for 2 times and then taken the best score with centimeter as the unit.
(3) Vertical jump. First, the height of the fingers was measure when the subject was attached to the wall and lifted the arms naturally, and then measured the height of the vertical jump with the chalk in the middle finger, and then subtracted them from the actual height. There were a total of 2 measurements taken the best score with centimeter as the unit was noted.

2.5 Enhanced training ways and content

2.5.1 Enhanced training ways

36 basketball players were randomly divided into two groups----the experimental group and control group including 18 people in each group for a 16-week training contrast experiment, in which the experimental group of subjects adopted enhanced training in addition to 16-week regular basketball training courses and physical training with 2 times in a week, 3 groups for each time, 10 times for each group, 3-minute interval and 40-cm height of wooden boxes. The subjects in the control group receives only 16-week basketball training courses and regular physical training. Training intervention are shown in Table 1.

Table 1: Enhanced Training Intervention

Group	Experimental Group(18)	Control Group(18)
General Training	Basketball training course and enhanced physical training	Basketball training course and regular physical training
Training Period	2 times a week	-
Training Set	3 groups	-
Training Times	10 times	-
Interval	3 minutes	-

2.5.2 Enhanced training content

The wooden boxes were arranged in a row with 60cm distance between two boxes. Jump on one box and then the vertical jump. Complete 5 boxes at the fastest speed and turn back. There were a total of 10 boxes in a group back and forth and three groups to be completed.

2.6 Statistical methods

The testing scores of all subjects in this study are expressed as average number and standard deviation. The SPSS software is used for statistical analysis. The differences between the groups are analyzed by the t-test of the pairwise samples and the single-factor covariant analysis of the independent samples. The significant level of statistical test is $\alpha = .05$.

3. Methods

36 basketball players of sports training basketball major of 2014 session from Gachon University were selected as the experimental subject. The average age was 18.22 (± 2.17) years. The average weight was 63.31 (± 6.62) kg. The average height was 172.28 (± 5.76) cm. They were randomly divided into experimental group and control group including 18 people in each group for a 16-week training comparison experiment.

4. Results

1. Comparison of the results of the experimental group before and after the test

Table 2: t-test table of the pairwise samples before and after the test of experimental group

Category	Pre-test (n=18)		Post-test (n=18)		T
	M	SD	M	SD	
28-meter sprint	5.61	0.34	4.86	0.30	9.74*
Three jumps	556.72	46.25	623.61	39.33	-5.28*
Vertical jump	258.33	6.48	265.61	6.21	-13.92*

*p<0.5

From Table 2, it is found that the 28-meter sprint (t = 9.74), three jumps (t = -5.28) and vertical jump (t = -13.92) of the experimental group adopting enhanced training is significantly different.

4.1 Comparison of the results of the control group before and after the test

From Table 3, it is found that the 28-meter sprint (t = -2.15) and three jumps (t = -0.75) of the control group which was not conducted the enhanced training has a significant difference; the performance of the vertical jump is significantly different (t = -3.95).

Table 3: t-test table of the pairwise samples before and after the test of control group

Category	Pre-test (n=18)		Post-test (n=18)		t
	M	SD	M	SD	
28-meter sprint	4.78	0.52	4.96	0.40	-2.15
Three jumps	663.17	59.99	670.67	40.09	-0.75
Vertical jump	256.94	11.61	260.67	9.66	-3.95*

*p<0.5

4.2 Analysis of effectiveness of intra-group of enhanced training on explosive power

In the control group and the experimental group, the results of 28-meter sprint, three jumps and vertical jumps of the single-factor covariance analysis are as follows.

1. 28-meter sprint

Table 4: Levene test equation of the error variance according to the variable: 28-meter sprint of post-test

F	df1	df2	significance
. 193	1	34	.663

It is known from Table 4 that Levene's isomorphism is not significant. F (1, 34) = .19 and p = .66 indicates that there is no difference in the discrepancy between the two samples. The results of the covariant effect show that F (1, 33) = 7.44 and p = .01 reaches a significant level and the covariant is meaningful for the explanatory power of the dependent variable. (1, 33) = 13.94 and p <.01 indicates that different groups will affect the time of 28-meter sprint and the amount of η2 = .34. The comparison of results of the univariate and post hoc indicates that the posterior measurement of the number of seconds in the experimental group is significantly better than that of the control group. The variance analysis results are summarized in Table 5.

Table 5: Test the effect of the subjects according to the variable: 28-meter sprint after the test

source	Quadratic sum of Type I	df	Average quadraticsum	F	significance	Net related Eta squared
sprint	0.567	1	0.567	7.435	.010	.184
group	1.296	1	1.296	16.988	.000	.340
error	2.517	33	0.076			
sum total	872.763	36				

a. R square = .425 (R square = .390 adjusted)

Table 6: The error variance of the Levene test equation is dependent on the variable: test after the triple jump

F	*df*1	*df*2	Significance
3.524	1	34	.069

It is known from Table 6 that Levene's isomorphism is not significant, F (1, 34) = 3.52, p = .07, indicating that there is no difference in the discrete case of the two samples. The test of the covariant effect shows that F (1, 33) = 26.47, p <.01, reaching a significant level, indicating that the covariant is meaningful for the explanatory power of the dependent variable. The effect of the group was also significant, F (1, 33) = .242, p = .626, indicating that there was no significant difference between the two groups after three successive jumps, and the effect of the interpretation ability was η2 = .01. The variance analysis results are summarized in Table 7.

Table 7: The test of the effect of subjects is dependent on variables: test after the triple jump

source	Type I square sum	*df*	Average squared sum	F	Significance	Net correlation Eta square
Sprint	32608.217	1	32608.217	26.474	.000	.445
Group	297.815	1	297.815	0.242	.626	.007
error	40646.274	33	1231.705			
total	1.515E7	36				

a. R square = .447 (adjusted R square = .414)

Table 8: The error variance of the Levene test equation is dependent on the variable: Vertical jump test

F	*df*1	*df*2	significance
8.885	1	34	.005

It is known from Table 8 that the variational isomorphism of Levene has a significant level, F (1, 34) = 3.52, p = .01, contrary to the isomorphic hypothesis, indicating that the two samples have significant differences in the discrete case. The results of the covariant effect show that F (1, 33) = 68.16, p <.01, reaching a significant level, indicating that the covariant is meaningful for the explanatory power of the dependent term. (1, 33) = 6.95, p = .01, indicating that the different groups will affect the height of the vertical jump, the effect use to mark energy of the amount of η2 = .17. The results of univariate and post hoc comparison indicate that the posterior measurement of the vertical jump in the experimental group is significantly better than that of the (high height) control group. The variance analysis results are summarized in Table 9.

Table 9: The test of the effect of the subject

source	Type I square sum	*df*	Average squared sum	F	Significance	Net correlation Eta square
Vertical jump	872.260	1	872.260	68.156	.000	.674
Group	88.961	1	88.961	6.951	.013	.174
error	422.334	33	12.798			
total	87428.000	36				

R square = .695 (adjusted R square = .676); b. By variable: vertical jump after the test

Conclusion

According to the theories of sports biochemistry, exercise physiology and exercise training, 36 basketball players of Gachon University were selected as experimental subjects and randomly divided into experimental group (18 persons) and control group (18 persons). The training experiment was carried out for 16 weeks. The effect of enhanced training on the explosive power of basketball players was analyzed before and after the training was carried out. After the statistical analysis and discussion we obtained the following conclusions:

(1) After 16 weeks of intensive training, the experimental

group had a significant increase in 28 m sprint, three jumps and vertical jumps. This shows that enhanced training can effectively improve the explosive power of basketball players. (2) In the 16-week intensive training group, the experimental group was superior to the control group in 28 m sprint and vertical jump, but the triple jumps did not reach the significant level. Showing that ordinary training of the control although helped with the player's explosive force, but the enhanced training is more effective and comprehensive to improve the player's explosive force.

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