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ORIGINAL RESEARCH

EFFECTS OF PLYOMETRIC TRAINING ON THE DEVELOPMENT THE VERTICAL JUMP IN VOLLEYBALL PLAYERS

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Abstract:
The present study investigated the effect of plyometric training on development of the vertical jump of volleyball players. The study consisted of 30 male volleyball players from PSG College of Arts & Science, Coimbatore, their age ranged from 18 to 25 years. Participants articipants were randomly assigned Group I underwent plyometric training group and Group II control group. The plyometric training group carried out a set of plyometric exercises also designed by the researcher twice a week for six weeks. The control group was allowed to play their game, but they were not given any treatments. For the purpose of this research, two tests for the evaluation of the volleyball vertical jump were validated: the block jump and spike jump. The data was analysed using Paired t-tests which were used to test the effect of treatment groups individually between pre and post –tests, of all the groups, on variables used in the present study. The analysis of covariance was used to analsze the collected data. The result of the study reveals that there was significant difference in 0.05 levels. Based on the findings of the research and the discussion, one could conclude that the exercise model for the development of the vertical jump that had been used, as the fundamental factor of the experimental group, has contributed to the statistically significant difference in the increase of the vertical jump in comparison to the control group, which had used technically tactical contents to develop the vertical jump.

Key words: Plyometric training, Vertical jump

Introduction:

Volleyball is a sport played by two teams consisting of 12 players each on a playing court, divided by a net. The object of the game is to send the ball over the net in order to ground it on the opponent's court and to prevent the same effort by the opponent. The team has three hits or contacts to return the ball.

To play volleyball one has to be good at the vertical jump, known as explosive power. A volleyball match can be played for five sets which means a match can last about 90 minutes ,during which a player can perform 250 -300 actions dominated by the explosive type of strength of the leg muscles. The total number of actions as jumps takes up around 50-60% high speed movements and change of direction in space about 30% and as falls about 15%. The spike and block actions are dominated by the corresponding explosive type of strength which is referred to as a player's vertical jump which is usually the key to winning point. Volleyball is a dynamic, fast-paced game. The purpose of strength training for volleyball is not to build big muscles, but to develop the physical attributes necessary to improve a player's performance. So strength training is very important to volleyball and should not be developed independently of other abilities such as agility, quickness and endurance. When watching a good volleyball player, the one word that comes to the mind is "speed".

Everything the player does is short and fast. There are no long drawn out motions like sprinting in other sports. There is simply a succession of explosive bursts that keep the ball in play and control the flow of the game. The quickness that must be focused on, when training a volleyball player is not only quickness from side to side and front to back, but also quickness from up to down. Unique from other sports, volleyball players must be able to quickly change direction from the upward motion of a vertical jump to the downward motion of a point-saving dig (or vice versa). One of the most crucial phases of volleyball is how players perform at the net. To be successful, teams must be able to control play at the net both offensively and defensively. Since this is the case, two of the most valued traits in a volleyball player are height and jumping ability.

Both of these traits allow players to greatly influence the game because they can more easily go where the ball is inevitably going...Up! Since there is no way to train height (yet), the focus of training falls squarely on jumping ability. Developing an athlete's jumping skills allows them to elevate quicker and higher in order to take better shots themselves and to block more of their opponent's shots. Also, since the same skills that send an athlete up also create quick first steps, improving jumping skills will also positively impact other areas of a volleyball player's performance.

Plyometric is a term that describes exercises that help bridge the gap between strength and speed. It refers to human movement that involves an eccentric muscle contraction immediately and rapidly followed by concentric contraction. The main objective in plyometiric training is to improve speed through strength. The fast twitch or white fiber is responsible for explosive type of muscular contraction. Chu (1996) states that "Plyometric has undergone a considerable metamorphosis over the past few years. New ideas and techniques will lead the reader into the second generation of plyometric training. The coach or trainer who understands the options and opportunities available through plyometric will find new ways to train athletes".

The fundamental principle of the plyometric method lies in the speed of the shift from and to the eccentric and concentric muscle contractions. "The key to this lies in the time needed for one muscle to shift from a state of flexibility (the stretch) into a state of shortening (the return to its original position). This points to the fundamental principle of plyometric training: the measurement, the extent of the stretch (the degree), determines the use of the strength that allows flexibility and the transformation of chemical energy into energy used to move muscles" (Kostić, 1999).

Methodology

Selection of participants:

The purpose of the study was to find out the effect of plyometric training on the development of vertical jump of volleyball players. To achieve the purpose, thirty men volleyball players were selected from the PSG College of Arts & Science, Coimbatore. Their age was ranged from 18 to 25 years. A randomised group design was used for the present study. Thirty male participants were randomly selected and divided into two groups, the Experimental group-I plyometric training group and Control group. Each group consists of 15 participants. The selected participants were initially tested on the variables used in the study. After the completion of the initial test, the participants belonging to the experimental group-I was treated with plyometric training group carried out a set of plyometric exercises also designed by the researcher three days a week for six weeks. The control group was allowed to play their game, but they were not given any treatments.

The Variable Sample:

The process of developing and of establishing the state of the vertical jumping at the initial and final measuring was carried out with the use of two measuring instruments which cover the area of explosive type strength. These instruments were labeled in the following manner:

1. Block jump (BJ)
2. Spike jump (SJ)

The Block Jump:

The examinee stands facing the wall and resting both outstretched arms on the board next to the fixed measuring tape, so that they are on the same level. After noting the height within reach for the block jump, the examinee takes off with both feet, and touches the board that is next to the steel measuring tape with the fingers of both hands, which have previously been coated with magnesium. The evaluator should be standing on the wooden case so that his head is at level with the height within reach of that jump, so as to increase the accuracy of the results. Three jumps are made. Any incorrectly performed jumps are repeated. The height within reach for that jump is measured in centimeters, and then the height within reach is subtracted from it, and we get the height of that jump. Only the best attempts are actually used in the statistical analysis. No double take off is allowed. The examinee can jump either barefoot or in his sneakers, and his fingers are coated with magnesium.

The Spike Jump:

The examinee stands facing the wall and resting both outstretched arms on the board next to the fixed measuring tape, so that they are on the same level. After noting the height within reach for the spike jump, the examinee takes a step back, and with a running start of just one step, takes off with both feet, and touches the board that is next to the steel measuring tape with the fingers of both hands, which have previously been coated with magnesium. The evaluator should be standing on the wooden case so that his head is at level with the height within reach of that jump, so as to increase the accuracy of the results. Three jumps are made. Any incorrectly performed jumps are repeated. The height within reach for that jump is measured in centimeters, and then the height within reach is subtracted from it, and we get the height of that jump. Only the best attempts are actually used in the statistical analysis. No double take off is allowed. The examinee can jump either barefoot or in his sneakers, but his fingers should previously coated with magnesium.

Training Programme:

For the purposes of this research, the set of the special model for the development of the vertical jump at the cadet age level consisted of five exercises which were to increase the explosive type strength by means of the plyometric method. In their choice of exercises, the authors were guided by the findings of Chu (1991).

Table 1

Plyometric training program for first and second week

Sl.No	Plyometric exercise	Repetition	Intensity	Each exercise	Sets	Rest in between exercise
1	Overhead throw	4 - 6	50%	1-2 minutes	2 Sets	2-3 minutes
2	Chest pass	4 - 6	50%	1-2 minutes	2 Sets	2-3 minutes
3	Side throw	4 - 6	50%	1-2 minutes	2 Sets	2-3 minutes
4	Bunny hops	4 - 6	50%	1-2 minutes	2 Sets	2-3 minutes
5	Lateral over cones	4 - 6	50%	1-2 minutes	2 Sets	2-3 minutes
6	Bounding	4 - 6	50%	1-2 minutes	2 Sets	2-3 minutes

Third and fourth week

Sl.No	Plyometric exercise	Repetition	Intensity	Each exercise	Sets	Rest in between exercise
1	Power drop	6 - 8	60%	1-2 minutes	2 Sets	2-3 minutes
2	Side throw	6 - 8	60%	1-2 minutes	2 Sets	2-3 minutes
3	Catch and throw pass	6 - 8	60%	1-2 minutes	2 Sets	2-3 minutes
4	Single leg hop	6 - 8	60%	1-2 minutes	2 Sets	2-3 minutes
5	Depth jump	6 - 8	60%	1-2 minutes	2 Sets	2-3 minutes
6	Jump and reach	6 - 8	60%	1-2 minutes	2 Sets	2-3 minutes

Ffth and sixth week

Sl.No	Plyometric exercise	Repetition	Intensity	Each exercise	Sets	Rest in between exercise
1	Back ward throw	8 - 10	70%	1-2 minutes	2 Sets	2-3 minutes
2	Chest pass	8 - 10	70%	1-2 minutes	2 Sets	2-3 minutes
3	Over head throw	8 - 10	70%	1-2 minutes	2 Sets	2-3 minutes
4	Squat jump	8 - 10	70%	1-2 minutes	2 Sets	2-3 minutes
5	Single leg hopping	8 - 10	70%	1-2 minutes	2 Sets	2-3 minutes
6	Hurdle hops	8 - 10	70%	1-2 minutes	2 Sets	2-3 minutes

The Methods of Data Processing:

The following statistical techniques were used to find out the effect of plyometric training on the development of vertical jump of volleyball players. Paired t-tests were used to test the effect of treatment groups individually between pre and post –tests of all the groups on variables used in the present study.

Results:

The study was designed to find the effect of plyometric training on development of the vertical jump of volleyball players. The test the objective framed in the present study the data collected on block jump and spike jump. As one of the objectives of the present study was to test the effect of plyometric training on development of the vertical jump of volleyball players, the initial test means and final test means were tested treatment wise by using the paired sample t-test. The obtained 't' ratios of Plyometric training were postulated in the following tables 2.

Table 2

The difference between the results of the initial and final measuring the Plyometric training group

Test	Measuring	Mean	Std.dev.	N	Diff.	t	p
BJ	Initial	48.53	4.10	15	3.07	7.74*	**.000**
	Final	51.60	4.22	15			
SJ	Initial	55.40	6.31	15	4.00	5.16*	**.000**
	Final	59.40	5.85	15			

*Significant at 0.05 level

Table – 2 indicates that the obtained 't' ratios were: 7.74 for broad jump, for 5.16 spike jump. The obtained 't' ratios on plyometric training group. When compared with the critical value of 2.144 for degrees of freedom of 14 it was found that the mean gains and mean losses statistically significant. Resulting of these confirm that six week practice of plyometric training produced a significant improvement in block jump (3.07; $p<0.05$), spike jump (4.00; $p<0.05$), statistically significant and explained its effect positively.

Table 3
The difference between the results of the initial and final measuring the Control group

Test	Measuring	Mean	Std.dev.	N	Diff.	t	p
BJ	Initial	42.67	5.14	15	0.80	2.35*	**.034**
	Final	43.47	4.55	15			
SJ	Initial	51.67	3.99	15	0.73	2.58*	**.022**
	Final	52.40	4.07	15			

*Significant at 0.05 level

Table – 3 indicates that the obtained 't' ratios were: 2.35 for broad jump, 2.58 for spike jump. The obtained 't' ratios on control group. When compared with the critical value of 2.144 for degrees of freedom of 14 it was found that the mean gains and mean losses statistically significant. Resulting of these confirm that six week practice of control group produced a significant improvement in block jump (0.80; $p<0.05$), spike jump (0.73; $p<0.05$), statistically significant and explained its effect positively.

Discussion findings:

The plyometric exercises on the experimental group and the technically tactical training exercises on the control group, an increase in the explosive type strength of the leg muscles was brought about. The explosive type strength brought about an increase in the high jump as well as the long jump ability. Similar results were obtained by Chu (1991). A more considerable growth increase in the jumping ability was noted in the experimental group, so it is quite justified that these types of plyometric exercises be used in training.

The experimental group achieved an increase in the vertical jump of the spike and block which was in the 3.31 and 2.56 range. The achieved increase is numerically no different than the two to six centimeters which Hagl (2003) came up with in his research on a sample consisting of nine examinees.

Similar results in the research into the development of the vertical jump are to be found in the work of Blattner & Noble (1979), whose examinees increased their vertical jump by 5.2 cm over and eight-week period. With Polhemus & Burkherdt (1980) this increase was 8.12cm, and the highest values of the vertical jump (10.67) were published by the authors Adams et al.(1992), who had used a combined plyometric training on a sample consisting of 48 to 103 examinees, after a seven-week long training period. The statistical analyses determined the relevance of the achieved coefficients in the development of the high jump.

The majority of training studies conducted did not assess other variables that may have been influenced by the training program. Adams (1984) in a 7-week training study measured vertical jump ability via the Sergeant jump and did not assess changes in positive energy or the effects on elastic energy. Brown et al. (1986) evaluated the participants of their 12-week training study on a special platform but presented only vertical jump height means and did not discuss changes in positive energy or the effects of elastic energy.

Clutch et al. (1983), in their two-part training study, measured vertical jump ability on a timing platform and on a special apparatus attached to a basketball backboard. Again, they took no measurements of the effects of the training program on positive energy production or elastic energy utilisation. In an 8-week training study, Blattner and Noble (1979) used a jump and reach test for all participants before and after the training period.

There are general principles that apply to plyometric training regarding the muscular pattern of movement in the process of overcoming any strain, but each volleyball player requires an individual program. The vertical jump is an individual characteristic, and so one needs to select exercises and determine their intensity and extent accordingly. One of the significant conditions that come with using the plyometric method, are the characteristics determined by the age of each individual volleyball player.

Conclusion:

From the results of the comparative effect among the plyometric training and control group on volleyball players were made. It has been proven experimentally that an six-week training model using the plyometric method can have an effect on the statistically relevant increase in the explosive type strength of the leg muscles, which in turn leads to an increase in the block jump and spike jump. Due to this, the individual use of the plyometric method is recommended as more effective in the development of the vertical jump.

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