EFFECTS OF PLYOMETRIC TRAINING PROGRAM ON VERTICAL JUMP AND SPEED IN MALE VOLLEYBALL PLAYERS

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Abstract:

Plyometrics is a type of training methodology that can increase power output and explosiveness. Plyometrics involves an active muscle switching from a rapid eccentric muscle action to a rapid concentric muscle action or from a rapid deceleration to a rapid acceleration. This action of deceleration to acceleration is known as the stretch-shortening cycle. Muscles that start in a static position can not generate as much force as those using the stretch-shortening cycle since the eccentric to concentric muscle action uses the elastic energy stored in the muscle. A greater power output can be found when the stretch-shortening cycle is used because of the efficiency gained by releasing elastic energy stored in the muscles. The muscles react to the sudden stretch by sending a signal to the central nervous system to resist the sudden stretch. In other words, the muscle is going to rebound rapidly from the sudden stretch. Considering this information plyometric training has the potential to develop quicker reaction times that lead to an increase in an athlete's speed and power. The study consisted of 30 male volleyball players from PSG College of Arts & Science, Coimbatore, their age ranged from 18 to 25 years. Subjects 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 vertical jump were validated: vertical jump right foot and vertical jump left foot. The data was processed using 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. 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 unfailingly 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 relevant 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 and speed.

Keywords: Plyometrics, Vertical Jump and Speed

Introduction:

Plyometrics are training techniques used by athletes in all types of sports to increase strength and explosiveness. Plyometrics consists of a rapid stretching of a muscle (eccentric action) immediately followed by a concentric or shortening action of the same muscle and connective tissue. The stored elastic energy within the muscle is used to produce more force than can be provided by a concentric action alone. Researchers have shown that plyometric training, when used with a periodized strength-training program, can contribute to improvements in

vertical jump performance, acceleration, leg strength, muscular power, increased joint awareness, and overall proprioception.

Plyometric exercises that involve stretching an active muscle prior to its shortening have been shown to enhance performance during the concentric phase of muscular contraction. Observed during the concentric phase, this enhancement has been attributed to the release of elastic energy stored in the series elastic elements of the muscle during stretch. The ability of a muscle to store and utilize elastic energy depends on the speed of the stretch, length of the stretch, force at the end of the stretch, and length of time the stretch is held.

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Most of the studies which assessed the effects of this type of training involved males. Only few studies have tested those effects on females. Hewett & al. (1996) have shown an increase in vertical jump ability in national level volleyball players who have pursue a plyometric training cycle. Giving the fact that this type of training appears to be beneficial for athletes working in a variety of sports, we wanted to assess the effectiveness of this type of training on tumblers. The general concept of power development during a technical skill has never been measured in tumbling. By measuring the contact time on the floor during acrobatic skills, information about the maximal speed developed by the subjects could be determined. A plyometric conditioning protocol was used to attempt to improve both upper and lower body power production. Very few studies have estimated the effects of such training on upper body power. We assumed that tumbler athletes needed to develop their lower as well their upper body power output because of the shifting between feet and hands impacts on the floor. That way they conserve their maximal speed achieved during the run sequence. In other words, we expected the gain to be transferred from general to specific parameters.

Methods and subjects:

The purpose of the study was to find out the effects of plyometric training program on measurements of power in male collegiate volleyball players. To achieve the purpose of thirty men volleyball players were selected from the PSG College of Arts & Science, Coimbatore. Their age was ranged from 18 to 25 years. Random group design was used for the present study.

In thirty male subjects were randomly selected and divided two group namely Experimental group-I plyometric training group and Control group. Each group consists of 15 subjects. The selected subjects were initially tested on the variables used in the study. After the completion of the initial test, the subjects 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 in total. 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 power at the initial and final measuring was carried out with the use of three measuring instruments which cover the area of explosive type strength. These instruments were labeled in the following manner:

1. Vertical jump
   a. Right foot
   b. Left foot
2. Speed

Vertical Jump

The explosive power was measured by the vertical jump with the help of the stand and reach test (Chu, 1996). The vertical jump test was completed from a 2-foot standing position without a step into the jump. The subject was asked to stand with side to the wall keeping both feet flat on the floor. He reached as high as possible with his middle finger touching the wall. This was his standing reach. Keeping color chalk powder on his middle finger he stood comfortable at a distance from the wall. On signal the subject swung both arms upward and jumped vertically extending his hand and touching the wall with the chalked finger. This jump must be taken without any preliminary feet movement such as hopping or stepping. The difference between standing hand reach and the jump reach were recorded. Out of three attempts the best reach was taken and recorded.

Speed (40 Yard Dash)

The test involves running a single maximum sprint over 40 yards, with the time recorded. A thorough warm up should be given, including some practice starts and accelerations. Start from a comfortable stationary 3-point stance position, a position that is most familiar to you and that you think will yield the best time. The front foot must be on or behind the starting line. This starting position should be held for 3 seconds prior to starting, you may lean across the starting line, and no rocking movements are allowed. The tester should provide hints to maximizing speed and encouragement to continue running hard past the finish line. Two trials are allowed, and the best time is recorded to the nearest 2 decimal places. The timing starts from the first movement (if using a stopwatch) or when the timing system is triggered, and finishes when the chest crosses the finish line and/or the finishing timing gate is triggered.

Training Procedures:

A 6-week plyometric training program was developed using two training sessions per week. The training program was based on plyometric exercises found in "Jumping Into Plyometrics," written by Dr. Donald Chu and on exercises developed specifically for volleyball by the research team.

The 6-week training program was held at a local volleyball training facility. The researchers and training group met at the facility twice a week, for four weeks, at 6:30am. Each researcher was responsible for supervising one of four specific exercise stations throughout the duration of the six-week training period.

The training program was based on increasing time and/or sets for each exercise administered throughout the six-week program. The training program in a week by week progression chart. The subjects were instructed to give their maximal effort for each exercise performed

All of the plyometric exercises were selected based on their similarity to volleyball movement used during regular season training and competition. All plyometric exercises for this program were selected to help improve and/or maintain the muscular strength, endurance, and technique necessary to compete successfully during a volleyball practice and competition. Subjects were randomized into two equal groups during the first of the six-week training sessions, and remained in the same group for the entirety of the four weeks. All groups were to perform each exercise station in a randomized order each session.

Plyometric training program

First and Second Week

Sl.No	Plyometric exercise	Repetition	Intensity	Each exercise	Sets	Rest in Between Exercise
1	**High Knees**	4 - 6	Low	1-2 minutes	2 Sets	1-2 minutes
2	**Butt Kicks**	4 - 6	Low	1-2 minutes	2 Sets	1-2 minutes
3	**Slalom Lunge Walk**	4 - 6	Low	1-2 minutes	2 Sets	1-2 minutes
4	**Jumping Jacks**	4 - 6	Low	1-2 minutes	2 Sets	1-2 minutes
5	**Skate Jumps**	4 - 6	Low	1-2 minutes	2 Sets	1-2 minutes
6	**Squat Jumps**	4 - 6	Low	1-2 minutes	2 Sets	1-2 minutes

Third and Fourth Week

Sl.No	Plyometric exercise	Repetition	Intensity	Each exercise	Sets	Rest in Between Exercise
1	**Split Squat Jumps**	6 - 8	Medium	1-2 minutes	2 Sets	2-3 minutes
2	**Left foot (low box)**	6 - 8	Medium	1-2 minutes	2 Sets	2-3 minutes
3	**Right foot (low box)**	6 - 8	Medium	1-2 minutes	2 Sets	2-3 minutes
4	**Both feet (high box)**	6 - 8	Medium	1-2 minutes	2 Sets	2-3 minutes
5	**Box Jumps**	6 - 8	Medium	1-2 minutes	2 Sets	2-3 minutes
6	**Cross over (low box)**	6 - 8	Medium	1-2 minutes	2 Sets	2-3 minutes

Fifth and Sixth Week

Sl.No	Plyometric exercise	Repetition	Intensity	Each exercise	Sets	Rest in Between Exercise
1	**High Knees**	8 - 10	Low	1-2 minutes	2 Sets	2-3 minutes
2	**Knee Tucks**	8 - 10	Low	1-2 minutes	2 Sets	2-3 minutes
3	**Backward Hamstring Walk**	8 - 10	Low	1-2 minutes	2 Sets	2-3 minutes
4	**Slow Lateral Shuffle**	8 - 10	Low	1-2 minutes	2 Sets	2-3 minutes
5	**Slalom Lunge Walks**	8 - 10	Low	1-2 minutes	2 Sets	2-3 minutes
6	**Line Jumps**	8 - 10	Low	1-2 minutes	2 Sets	2-3 minutes

Statistical Analysis:

The paired T-test was used to determine mean, standard deviation and significance. The independent variable was the plyometric training program. The dependent variables were the effects on the left leg vertical jump, right leg vertical jump, first 10 yard time 40 yard dash, anaerobic peak power. Pre-test scores were compared to the post-test scores to determine significance.

Results

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
VJ Right foot	Initial	14.67	2.89	15	-0.73	4.78	**.000**
	Final	15.40	2.85	15			
VJ Left foot	Initial	15.27	1.75	15	-1.33	10.58	**.000**
	Final	16.60	1.84	15			
Speed	Initial	6.02	0.42	15	0.28	6.98	.000
	Final	5.74	0.33	15			

*Significant at 0.05 level

Table – 2 indicates that the obtained 't' ratios were: 4.78 for vertical jump right foot, 10.58 for vertical jump left foot and 6.98 for speed. 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 vertical jump right foot (0.73; $p<0.05$), vertical jump left foot (1.33; $p<0.05$) and speed (0.28; $p<0.05$) 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
VJ Right foot	Initial	14.67	1.87	15	0.20	1.87	**0.07**
	Final	14.87	1.92	15			
VJ Left foot	Initial	14.53	2.17	15	0.20	1.81	**0.08**
	Final	14.73	2.22	15			
Speed	Initial	6.07	.396	15	0.03	0.76	**0.45**
	Final	6.04	.394	15			

*Significant at 0.05 level

Table – 3 indicates that the obtained 't' ratios were: 1.87 for vertical jump right foot, 1.81 for vertical jump left foot and 0.76 speed. 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 not significant. Resulting of these confirm that six week practice of control group produced a significant not improved in vertical jump right foot (0.20; $p<0.05$), vertical jump left foot (0.20; $p<0.05$), and speed (0.76; $p<0.05$) statistically not significant.

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 in the Chu research (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.

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.

Even though there were significant differences found in select variables, 24 to 36 hours prior to the post-training test session, the volleyball players were instructed by their coach to do a resistance training workout that consisted of multiple sets of squats. This may have limited the effectiveness of the results and may have had a significant effect on the athletes' performance on all of the tests administered in the post-training test session. Many of the athletes expressed issues of quadriceps, gluteal, and hamstring soreness prior to beginning the test session. Assuming that the squat workout session completed 24 to 36 hours prior to the test session had an affect on their performance, it could be said that differences may have been much greater. Throughout the duration of the study, it was assumed that the athletes were giving a maximal effort during the training sessions, and were also maintaining their normal daily routines.

Conclusion:

From the results of 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 vertical jump and speed. 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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