International Journal of Physical Education, Sports and Health 2016; 3(6): 143-147

P-ISSN: 2394-1685
E-ISSN: 2394-1693
Impact Factor (ISRA): 5.38
IJPESH 2016; 3(6): 143-147
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www.kheljournal.com
Received: 27-09-2016
Accepted: 28-10-2016

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Specific influence of selected plyometric training exercises on jump serve among inter collegiate men volleyball players

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Abstract
The jump serve is a peculiar kind of serve in Volley ball where the serving player increases power and serves at a height by jumping to hit the ball. The extra motion generated in a jump serve allows the server to put additional power on the ball and this can make the serve very difficult to handle for the receiving players. It has many similarities to the spike itself. The player strikes the ball with maximum force at the peak of his jump, and tries to place it so that the opposing player cannot receive it easily. It has been suggested that a successful spike is determined by three factors, which are likely similar to those of the jump serve: the position of the ball at impact, the speed of the ball after impact, and the direction movement of the ball after impact. Volleyball has developed into a highly competitive sport which requires a high level of physiological and psychological fitness. The game at a high level of competition requires quicker sudden movements and fast reaction. Plyometric is based upon the belief that a rapid lengthening of muscles just prior to the contraction will result in much stronger contraction. The added contraction strength is believed to be due to strength of muscle spindles involving the reflex and resulting in an increase frequency of motor unit discharge.

Keywords: Jump Serve, Plyometric training, Sports performance, Volleyball.

1. Introduction
Volleyball has changed beyond recognition in the past three decades from an unorganized sport into a highly competitive sport, requiring a high level of physical fitness, mental alertness and mastery over techniques. Volleyball has developed into a highly competitive sport which requires a high level of physical, physiological and psychological fitness. The game at a high level of competition requires quicker sudden movements and fast reaction. Volleyball matches have no time limit and matches can last for several hours, if the teams are evenly matched. Successful play in volleyball is not the outcome of power alone but it is the product of the combined display of power and tactical abilities. Modern game of volleyball is characterized by accuracy, concentration and cleverness.(Vidyasagar Sharma, H.A. Khan and C. Butchiramaiah 1986).

2. Volleyball and the Dynamics
In every tactical move in volleyball, one depends on team work and individual skills, good serve, passing, setting, spiking, jumping, controlling the ball, participation speed to the ball and keeping the eyes on the ball. Tactics succeed only through individual fundamental skills and with players thinking as a team. (Men's Volleyball 1974). The rapid progress made in the understanding of the mechanics involved in the adaptation of volleyball players to different training procedures has significantly contributed to the development of new training methods and techniques have been introduced to make them appropriate and to achieve specific programme objectives. Therefore, training methods and techniques are generally used according to the degree of the involvement of different elements of fitness in any sports performance. The serve marks the beginning of a rally in volleyball. A player stands behind the baseline and hits the ball, in an attempt to drive it into the opponent's court. His main objective is to make it land inside the court; it is also desirable to set the ball's direction, speed and acceleration so that it becomes difficult for the receiver to handle it properly. A serve is

called an "ace" when the ball lands directly onto the court or travels outside after being touched by an opponent.

2.1 Jump Serve in Volleyball

An overhand serve where the ball is first tossed high in the air, then hit with a strong downward movement of the arm, as in a spike; there is usually much topspin imparted on the ball. This is the most popular serve amongst college and professional teams.

The most important skill in modern volleyball is the jump serve, which provides an exciting and dynamic skill that is captivating for players and spectators alike. The player starts about five meters behind the end line of the court, uses a fast and explosive run up, a dynamic spike takeoff and an exciting spike action at the peak of their jump that sends the ball across the net at speeds of over 27m.s with heavy topspin and at a sharp downward angle. The jump serve has become a dangerous offensive weapon for the top volleyball teams of today, as a great jump server can produce a number of aces during the match. The jump serve is somewhat similar to the spike at the net, except the velocities after impact are somewhat lower for the serve when compared to the spike.

2.2 Plyometrics in Volleyball

According to Will and Freeman (1980), "the word plyometrics is defined from the Greek work 'plethyoin' which means equal length. Plyometrics (Plyo – more greater, metric – measured quantity) exercises are based upon the belief that a rapid lengthening of a muscle just prior to a contraction will result in a much stronger contraction. The term plyometric can be used to include both depth jumping, hopping and bouncing drills. They are very dynamic measurements which use gravitational force of the body and the contractibility and elasticity of muscle tissue to increase the force of stress on related muscles. Plyometric training may be viewed as an extension of the 'shock' method of strengthening muscles for athletes performance recommended by Verkhoshonki a Russian Jumping Coach (1966). The shock method advocated by Verkhoshonki consisted of rebounded jumps from a height to develop the reactive neuromuscular apparatus of the athlete.The term plyometric involves the muscles working both concentrically and eccentrically. Will and Freeman (1980) plyometric (plyo-more or greater, metric measure or quantity) exercise is based upon the belief that a rapid lengthening of a muscle just prior to the contraction will result in a much stronger contraction. Origin of the term 'plyometric' is derived from word plyetheyeim which means to increase or from the Greak word 'pilo' and 'metric' which means 'more' and 'measure' respectively. Other terms used in conjunction with plyometric are depth jumping, box jumping and jump training. The added contraction strength is believed to be due to a strength of muscle spindles involving the reflex and resulting in an increase frequency of motor unit discharge. Depth jump is one of the many plyometric exercises. In depth jumping, the athlete stands on a shelf generally 2mts., of height above the ground stepping of the self they immediately perform a maximum effort vertical or horizontal jump after consing on the ground (Will and Freeman, 1980).

Plyometric training is one of the best methods of developing explosive power in sports. Basically plyometrics provide a method of training for the optimum relationship between strength and speed which will ultimately manifest itself as explosive power. Today plyometric movements are performed in almost all sports. Basic strength level must be attained before starting plyometric training programme. The choice of exercise must correspond to age, sex and biological development of sports person. These should gradually increase the stress during a complete training cycle. Body weight should be the determining factor in assigning the value of jumps in work out. Generally the number of sessions to be devoted to the plyometric training is 2 or 3 times per week Plyometric exercise is a relatively new concept of training that applies the specific principle regarding the present strength conditions of the muscle prior to explosive contraction. The effect of plyometric exercises in increasing vertical jumping ability has beens studied experimentally, but no attempt has been made if they are more effective than the kinetic exercise (Will and Freeman 1980).

2.3 Sports Performance

Sports performance is the result and expression of the total personality of the sportsmen. Physical fitness, techniques and tactics along are not enough. In addition to that, the sportsman must posses certain cognitive, volitional and perceptual activities, certain personality traits, habits and above all positive beliefs, values, attitude, and interest of training and competition. The educational aspect of sports training is unfortunately overlooked by the coaches and physical education teachers in India. Performance improvement is stressed more at the cost of education of sportsman. The pedagogical aspect of sports training comes into sharp systematic training in almost all the sports has to start in childhood. Therefore, it becomes all the more important to educate the child and youth along with improving their performance through sports training (Cowell and France, 1963).

2.4 Jumping Ability

Jumping ability is one of the most important determinants of performance in volleyball. In the volleyball match game, vertical jumps (VJ) are performed frequently, Jump service, setting and attacking players perform at least one jumping movement during a rally. Moreover, front court players perform approximately four block jumps and three spike jumps, each of the players on an average handle 22 jump-landings per game, It was determined that players of better performing teams have higher VJ values, The VJ height (spike and vertical) also influences the performance of beach volleyball players and consequently the performance of their teams, Beach volleyball (BVB), similar to volleyball, is performed intermittently at moderate-to-high intensity with brief bouts of high intensity exercise interspersed by long low-intensity periods. Nevertheless, there are some biomechanical differences in movements performed on sand and solid surface. It was shown that jumping on sand surfaces was characterized by significantly smaller jumping heights during squat jumps, countermovement jumps, volleyball spikes, and block jumps, compared with jumps on rigid surfaces, Jumping height is significantly smaller on a sand surface than a rigid one due to compliance and instability of the sand, and this results in a reduction in maximum vertical forces, smaller maximum powers, vertical impulses and take-off velocity, As a result of the compliance of the sand surface, during the spike jump the BVB players slow down their movements, especially during the phase of transition from knee flexion to extension and during the extension phase During the sprinting performance on a sand surface, successful sprinters are characterized by a greater angle of trajectory at start take-off than in non-elite sprinters. As Lockie and Vickery suggested, this could be facilitated by a longer start time that allows for

more force generation, and a greater degree of hip flexion of the swing leg and trunk lean at start take-off,

Bishop, *et al*., (2009) [5] aimed to identify the effect of plyometric training (PT), when added to habitual training (HT) regimes, on swim start performance. After the completion of a baseline competitive swim start, 22 adolescent swimmers were randomly assigned to either a PT (n = 11, age: 13.1 +/- 1.4 yr, mass: 50.6 +/- 12.3 kg, stature: 162.9 +/- 11.9 cm) or an HT group (n = 11, age: 12.6 +/- 1.9 yr, mass: 43.3 +/- 11.6 kg, stature: 157.6 +/- 11.9 cm). Over an 8-week preseason period, the HT group continued with their normal training program, whereas the PT group added 2 additional 1-hour plyometric-specific sessions, incorporating prescribed exercises relating to the swimming block start (SBS). After completion of the training intervention, post-training swim start performance was reassessed. For both baseline and post-trials, swim performance was recorded using videography (50 Hz Canon MVX460) in the sagital plane of motion. Through the use of Silicon Coach Pro analysis package, data revealed significantly greater change between baseline and post-trials for PT when compared with the HT group for swim performance time to 5.5 m (-0.59 s vs. -0.21 s; $p < 0.01$) and velocity of take-off to contact (0.19 ms vs. -0.07 ms; $p < 0.01$). Considering the practical importance of a successful swim start to overall performance outcome, the current study has found that inclusion of suitable and safely implemented PT to adolescent performers, in addition to HT routines, can have a positive impact on swim start performance.

Thomas et.al., (2009) compared the effects of two plyometric training techniques on power and agility in young soccer players. Twelve males from a semi professional football club's academy (age = 17.3 +/- 0.4 years, stature = 177.9 +/- 5.1 cm, mass = 68.7 +/- 5.6 kg) were randomly assigned to 6 weeks of depth jump (DJ) or countermovement jump (CMJ) training twice weekly. Participants in the DJ group performed drop jumps with instructions to minimize ground-contact time while maximizing height. Participants in the CMJ group performed jumps from a standing start position with instructions to gain maximum jump height. Post-training, both groups experienced improvements in vertical jump height ($p < 0.05$) and agility time ($p < 0.05$) and no change in sprint performance ($p > 0.05$). There were no differences between the treatment groups ($p > 0.05$). The study concludes that both DJ and CMJ plyometrics are worthwhile training activities for improving power and agility in youth soccer players.

Vescovi (2008) [7] examined the effects of a plyometric program on peak vertical ground reaction force as well as kinetic jumping characteristics in recreationally athletic college women. Twenty college females who competed recreationally in basketball were randomly assigned to a training (n=10) or control (n=10) group. The absolute change values for vertical ground reaction force, counter movement jump height, peak and average jump power, and peak jump velocity. Comparisons were made using Mann-Whitney U tests. Vertical ground reaction force decreased in the intervention group (-222.8+/-610.9N), but was not statistically different (p=0.122) when compared to the change observed in the control group (54.6+/-257.6N). There was no difference in the absolute change values between groups for countermovement jump height (1.0+/-2.8cm vs. -0.2+/-1.5cm, p=0.696) or any of the associated kinetic variables following the 6-week intervention. Although not statistically significant, the mean absolute reduction in vertical ground reaction force in the training group is clinically meaningful. Eight of the 10 women in the training group reduced vertical ground reaction force by 17-18%; however, improvements in jumping performance were not observed. This indicates that programs aimed at enhancing performance must be designed differently from those aimed at reducing landing forces in recreationally athletic women.

Lees *et al*., (2004) [8] received a study on plyometric training. The vertical jump is a widely used activity to develop explosive strength, particularly in plyometric and maximal power training programs. It is a multijoint action that requires substantial muscular effort from primarily the ankle, knee, and hip joints. It is not known if submaximal performances of a vertical jump have a proportional or differential training effect on the major lower-limb muscles compared to maximal jump performance. Therefore, the purpose of this study is to investigate the contribution that each of the major lower-limb joints makes to vertical jump performance as jump height increases and to comment on the previously mentioned uncertainty. Adult males (N = 20) were asked to perform a series of submaximal (LOW and HIGH) and maximal (MAX) vertical jumps while using an arm swing. Force, motion, and electromyographical data were recorded during each performance and used to compute a range of kinematic and kinetic data, including ankle, knee, and hip joint torques, powers, and work done. It was found that the contribution to jump height made by the ankle and knee joints remained largely unchanged as jump height increases (work done at the ankle: LOW =1.80, HIGH = 1.97, MAX = 2.06 J.kg(-1), F = 3.596, p = 0.034; knee: LOW = 1.62, HIGH = 1.77, MAX = 1.94 J.kg(-1), F = 1.492, p = 0.234) and that superior performance in the vertical jump was achieved by a greater effort of the hip extensor muscles (work done at the hip: LOW = 1.03, HIGH = 1.84, MAX = 3.24 J.kg(-1), F = 110.143, $p < 0.001$). It was concluded that the role of submaximal and maximal jumps can be differentiated in terms of their effect on ankle, knee, and hip joint muscles and may be of some importance to training regimens in which these muscles need to be differentially trained.

Luebbers, *et al*., (2003) [9] had examined the effects of two plyometric training programs, equalized for training volume, followed by a 4-week recovery period of no plyometric training on anaerobic power and vertical jump performance. Physically active, college-aged men were randomly assigned to either a 4-week (n = 19, weight = 73.4 +/- 7.5 kg) or a 7-week (n = 19, weight = 80.1 +/- 12.5 kg) program. Vertical jump height, vertical jump power, and anaerobic power via the Margaria staircase test were measured during pretraining (PRE) and immediately post training (POST), and 4 weeks after training (POST-4). Vertical jump height decreased in the 4-week group PRE (67.8 +/- 7.9 cm) to POST (65.4 +/- 7.8 cm). Vertical jump height increased from PRE to POST-4 in 4-week (67.8 +/- 7.9 to 69.7 +/- 7.6 cm) and 7-week (64.6 +/- 6.2 to 67.2 +/- 7.6 cm) training programs. Vertical jump power decreased in the 4-week group from PRE (8,660.0 +/- 546.5 W) to POST (8,541.6 +/- 557.4 W) with no change in the 7-week group. Vertical jump power increased PRE to POST-4 in 4-week (8,660.0 +/- 546.5 W to 8,793.6 +/- 541.4 W) and 7-week (8,702.8 +/- 527.4 W to 8,931.5 +/- 537.6 W) training programs. Anaerobic power improved in the 7-week group from PRE (1,121.9 +/- 174.7 W) to POST (1,192.2 +/- 189.1 W) but not the 4-week group. Anaerobic power significantly improved PRE to POST-4 in both groups. There were no significant differences between the 2 training groups. Four-week and 7-week plyometric programs are equally effective for improving vertical jump height, vertical jump power, and anaerobic power when followed by a 4-week recovery period.

However, a 4-week program may not be as effective as a 7-week program if the recovery period is not employed.

3. Materials and Methods

The purpose of the study is to find out the effect of plyometric training on jumping serve among Inter-Collegiate men volleyball players of Visakhapatnam. For this purpose 20 volleyball players in the age group of 18 to 21 of various engineering colleges of Visakhapatnam District affiliated to JNTUK, Kakinada who participated at Inter-Collegiate competitions randomly selected as subjects for this study. The subjects were divided into two groups, i.e, experimental group and control group consisting of 10 in each. The subjects were oriented for the purpose of the study and all the subjects volunteered to undergo the training in selected plyometric exercises such as front box jump, lateral box jump, weighted lateral jump, medicine ball overhead throw and standing broad jump for improve the performance. The plyometric training programme was scheduled for six days per week i.e. Monday to Saturday in the morning between 6.30 a.m and 7.45 a.m for six weeks. Warm up 5-10 min. and warm down 5-10 min. Control group was not involved in any training. Materials/instruments such as 3 feet height box, 2 Kg. medicine ball, Chunnam, whistle, Volleyball court and 10 no. of Volleyballs were used for training programme.

4. Pre & Post -Test performance of Jump Serve

T-test was conducted for sample data of 10 players and tabulated their results of pre and post training performance in jump serve.

Table 1

S.NO.	Performance(Pre-Test) (x) (Out of 10 Serves)	Performance(Post-Test) (y) (Out of 10 Serves)	d(y-x)	d^2
1	3	6	3	9
2	2	5	3	9
3	1	4	3	9
4	2	6	4	16
5	3	7	4	16
6	4	7	3	9
7	2	4	2	4
8	3	5	2	4
9	3	6	3	9
10	2	5	3	9
			$\sum d = 30$	$\sum d^2 = 94$

$$t = \frac{\bar{d}}{s/\sqrt{n}} \quad ; \quad \text{Where } \bar{d} = \frac{\sum d}{n} = 3$$

and s = $\sqrt{\frac{(\sum d^2 - \bar{d})^2}{n-1}}$ =68.67; Hence t cal. = 0.138;

Therefore t cal. < t tab at 5% of accuracy hence null hypothesis is accepted.

i.e, there is a significant change in the performance among volleyball players after plyometric training.

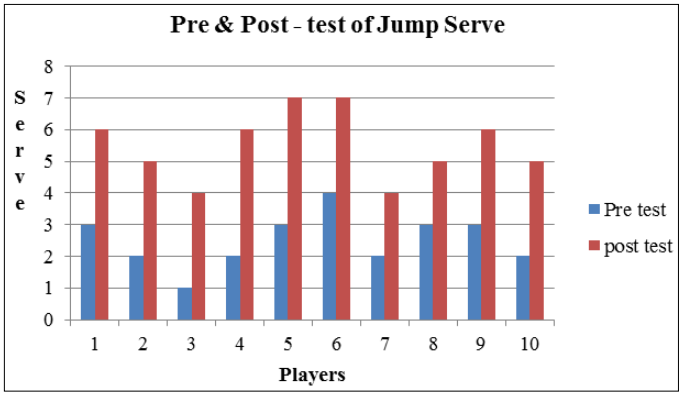

Fig 1: Bar diagram showing Jump serve of volley ball players

5. Results and Discussion

Before plyometric training players done up to 4 jump serves successfully out of 10 serves. After training players get succeeded up to maximum 7 jump serves i.e. 90% of the players hit from 5 to 7 serves successfully. This study clearly conveys that plyometric training gave enhancement in performance in jump serve. So Plyometric training played a vital role in improving performance in jump serve. These results in improvement not only in jump serve but also jumping ability, hitting, eye capture of the ball, landing and confidence. Plyometric training clearly shows there is an enhancement of performance recorded among volleyball players. After this training player realized the importance of jump serve to get good score in a game.

6. Conclusions

This study proved that plyometric training significantly improved jumping serve among inter collegiate men volleyball players compared to control group. After analysis of data it can be concluded that jumping serve plays a vital role to gain advantage in the game of Volleyball. Players to improve their jumping ability due to plyometric training.

7. Recommendations

1. Efforts may be taken by coaches, sports scientists and educational authorities to include the suggest Plyometric training schedules for inter Collegiate men volleyball players.
2. Adequate long term Plyometric training may be provided to inter Collegiate men volleyball players before their competitions for better competition preparations.
3. Advantages of Plyometric trainings may be popularized among inter collegiate men volleyball players for their allround development of motor fitness and skill levels.

8. Acknowledgements

I am very much grateful to Dr. R. V. L.N. Ratnakara Rao, our Research Guide Dept. of Physical Education and Sports Sciences, Andhra University, Visakhapatnam, Sri. K. Soma Sekhar, Assistant Professor of Physics and Dr. T Radha Krishna Murthy, Professor of English, VITAM College of Engineering, Visakhapatnam for their suggestions in inspiring this paper.

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