Indian J Physiol Pharmacol 2014; 58(2) : 133–136

Original Article

Effects of Short-term Two Weeks Low Intensity Plyometrics Combined With Dynamic Stretching Training in Improving Vertical Jump Height and Agility on Trained Basketball Players

Selvam Ramachandran[1]* and Binita Pradhan[2]

[1]Associate Professor, [2]Post Graduate Student
Department of Physiotherapy,
Sikkim Manipal Institute of Medical Sciences,
Sikkim – 737 102

Abstract

Sport specific training in basketball players should focus on vertical jump height and agility in consistent with demands of the sport. Since plyometrics training improves vertical jump height and agility, it can be useful training strategy to improve the performance of basketball players. A convenience sample of thirty professional basketball players were recruited. Following pre-intervention assessment, interventions using plyometrics training and dynamic stretching protocol was administered on the basketball players. The outcome measures were assessed before the intervention and at the end of first and second week. Statistically significant improvements in vertical jump height (31.68±11.64 to 37.57±16.74; P<0.012) and agility (16.75±2.49 to 15.61±2.80; P<0.00) were observed between pretest – posttest measures and no changes in muscle girth and isometric muscle strength. The study concludes that short term two weeks plyometrics training combined with dynamic stretching as a useful sport specific training strategy to improve vertical jump height and agility on trained basketball players.

Introduction

Basketball is a very demanding and challenging game which requires sustenance of maximum performance throughout the game. The basic requirementof the basketball play is the ability to generate lower body power that will include the adequate strength of the muscles; endurance of the muscles in sustenance of activity; speed of movement; power of the muscles in delivering the movement (sprinting and jumping); agility (exploratory power with changing and varied demands of the game) and the ability to make multi-directional changes. The specificity principle of sport training emphasizes that the muscular adaptations are very specific to the nature and type of exercises performed; intensity of exercises and the joint angle in which those exercises were performed; the overload principle specifies that the muscular power increases proportionately to the load with which it is trained. The corollary of these principles is that the sport specific training facilitates adaptations of the bodily systems very close to the demands of the sport.

Plyometrics training is one such training strategy to improve the performance of the basketball players as the training approximates theirbasic needs of agility and power; allows the muscle to reach

***Corresponding author :**

Selvam Ramachandran, Associate Professor, Department of Physiotherapy, Sikkim Manipal Institute of Medical Sciences, 5th Mile, Tadong, Gangtok, East Sikkim – 737 102; Email: rs79physio@gmail.com

(Received on July 11, 2013)

exponential increase in the maximum strength and speed of movement in the shortest duration.The training typically involves stretch-shortening cycle of muscle groups and those movements consist of eccentric, amortization and concentric phases. The shorter the duration of all three phases and more specifically the amortization phase, greater will be the development of exploratory power of the muscles being exercised (1-3). Several physiological adaptations were reported following plyometrics training. The adaptations include muscle hypertrophy (increase in the cross sectional area of muscle fibers and number of muscle fibers) resulting in increased muscle strength (4); increase in synchronous motor neuronal pool firing due to enhanced stretch reflex mechanisms resulting in increased musclepower; increase in ventilation and stroke volume resulting in endurance and increase in bone mass due to rapid mechanical loading.

Delayed onset of muscle soreness (DOMS) and soft tissue injuries increasingly remains the potential risks of long duration and high-intensity plyometrics training program that can have a detrimental effect on players' performance (5). The dynamic stretching incorporated in to the plyometrics training will help overcome the risk of DOMS and soft tissue injuries (6, 7). Further low to moderate intensity plyometrics training program is reported to have better gains in vertical jump height and agility than the high intensity plyometrics training program (8). This study aims to find the combined effect of short duration two weeks plyometrics training and dynamic stretching program in improving the vertical jump height and agility of the basketball players.

Materials and Methods

The research study adopted one group pretest – posttest research designand was approved by the IEC. A convenience sample of 30 professional basketball players was recruited. Prior to the recruitment and training, proper explanation on the type of training, duration, advantages and risks were explained to the players and informed consent for participation was sought. The subjects were provided with information booklet on interventions to compliment the study. The outcome variables measured were vertical jump height using a self-fabricated tape with calibrations mounted on a vertical flat board; agility 't' test using the time taken (measured by stop watch) to sprint across the agility cones placed at specific distances; muscle girth using an inch tape and isometric muscle strength using modified sphygmomanometer. The intervention included dynamic stretching-plyometrics-dynamic stretching for three alternate days per week for two weeks. The dynamic stretches were performed for ten minutes before and after the plyometrics and the plyometrics session was done for 30 minutes for each of the session. The summary of the intervention protocol are presented in Table I. Data analyses were done with student 't' test to evaluate the statistical difference between the pretest and posttest measures.

Results

The study group consisted of 18 male and 12 female professional basketball players and their mean age

TABLE I: The combined intervention of dynamic stretching and plyometrics training.

Training type	*Activity*	*Week 1* *Week 2*
Dynamic stretching(pre plyometrics)	Stretching of Hip flexors, Gluteus maximus, Quadriceps, Hamstrings and Calf muscles	Frequency: 6 days-3 alternate days/wk Duration: 1 and half min for each stretch with half sec rest in between. Total duration of 10 mins.
Plyometric drills	Ankle hops; Standing jump and reach; Front cone hops; Standing long jump; Split squat jump; Diagonal cone hops	Frequency: 6 days-3 alternate days/wk Intensity: Low (75-100) - low (100-150). Duration: 180 mins total- 90 mins/wk Mode: an-aerobic
Dynamic stretching(post plyometrics)	Stretching of Hip flexors, Gluteus maximus, Quadriceps, Hamstrings and Calf muscles	Frequency: 6 days-3 alternate days/wk Duration: 1 and half min for each stretch with half sec rest in between. Total duration of 10 mins.

TABLE II : Summary of pretest - post test measures on outcome variables.

Outcome Variable	*Pre test*	*Post test 1*	*Post test 2*	*'P' Value*		
				Pretest vs. Post test 1	*Post test 1 vs. Post test 2*	*Pretest vs. Post test 2*
VJH (cms)	31.68±11.64	35.77±16.61	37.57±16.74	0.820	0.000	0.012
Agility (secs)	16.75±2.49	16.03±2.61	15.61±2.80	0.000	0.031	0.000
MTG (cms)	45.07±4.76	45.21±4.78	45.20±4.76	0.259	0.555	0.287
Calf girth (cms)	35.12±2.82	35.15±2.78	35.13±2.77	0.618	0.494	0.907
IMS KF (mm Hg)	114.40±20.97	114.90±17.78	115.84±16.53	0.533	0.236	0.499
IMS KE (mm Hg)	112.80±27.49	130.20±27.23	114.20±24.49	0.192	0.268	0.266

VJH: Vertical Jump Height, MTG: Mid Thigh Girth, IMS: Isometric Muscle Strength, KF: Knee Flexors, KE: Knee Extensors. The 'P' value evaluated using Student 't' test.

(in years) is 20.4±1.734; weight (kg) is 64.1±12.606; Height (cm) is 173.073±9.603 and BMI ($kg.m^{-2}$) is 21.068±2.612. The measures of outcome variables were assessed before the intervention and at the end of first and second week.

Discussion

The study results indicated statistically significant improvements in vertical jump height (P<0.012) and agility (P<0.00) and no statistically significant changes in muscle girth and isometric muscle strength. Our study included standing jump and reach, ankle hops and split squat jump and reported statistically significant improvement in vertical jump height. The meta-analyses (9, 10) on the effects of plyometrics training on jumping enhancement recommends combination of different types of plyometrics (squat jump; countermovement jump and drop jump) rather than using only one form.

Our study reports statistically significant improvements in agility performance (sprinting and change of directions while sprinting) assessed with agility 'T' test. Our study has incorporated both frontal and sagittal plane plyometrics trainingviz. Front cone hops, standing long jump and diagonal cone hops. A meta-analysis on the effects of plyometrics training on sprint performance (11) also recommends such training strategies that incorporate greater horizontal acceleration (i.e., sprint-specific plyometrics exercises, jumps with horizontal displacement). The improved agility performance in our study as interpreted in reduced time in agility 'T' test also needs to be interpreted with improved ability to make change of directions while sprinting across the cones. A review of resistance training studies (12) on the ability to change of direction (COD), while sprinting,reports and recommends exercises such as horizontal jump training (unilateral and bilateral), lateral jump training (unilateral and bilateral), loaded vertical jump training, sport-specific COD training and general COD training.

The subjects in our study were followed up for two weeks duration and were asked to report any injuries anytime during the total duration of training sessions. But no injuries were reported. The dynamic stretching protocol adopted in our study has helped to prevent injuries associated with short term plyometrics training. The observation is consistent with a systematic review (13) that reports differential acute effects of stretch-shortening cycles (SSC) following different types of stretching. No negative acute effects of dynamic stretching were reported in the review. Further it reports improved flexibility and increased efficacy in inducing smaller gains without negatively affecting performance following long-term stretching. The dynamic stretching is also reported to have improvements in agility and sport performance (14).

In our study, there was no difference in the girth measurements and isometric muscle strength of knee flexors and extensors. The limitations of this study were that in our resource constrained setting we have used modified sphygmomanometer to assess the isometric muscle strength and hence the validity of the strength measurement remains implausible.

Further sample size and lack of control group could be attributed as main limitations of this study. The diet pattern and nutritional supplements of the basketball players could not be controlled in this study. Further studies are warranted to substantiate the effects of short term two weeks plyometrics training addressing the above mentioned limitations.

Conclusion

The short term two weeks plyometrics training program combined with dynamic stretching program shows statistically significant improvements in vertical jump height and agility and no changes in muscle girth and isometric muscle strength.

References

1. Santos EJ, Janeira MA. Effects of complex training on explosive strength in adolescent male basketball players. *J Stren Cond Res* 2008; 22(3): 903–909.
2. Carlson K, Magnusen M, Walters P. Effect of various training modalities on vertical jump. *Res Sports Med* 2009; 17(2): 84–94.
3. Matavulj D, Kukolj M, Ugarkovic D, Tihanyi J, Jaric S. Effects of plyometric training on jumping performance in junior basketball players. *J Sports Med Phys Fitness* 2001; 41(2): 159–164.
4. Burgess KE, Connick MJ, Graham-Smith P, Pearson SJ. Plyometric vs. isometric training influences on tendon properties and muscle output. *J Strength Cond Res* 2007; 21(3): 986–989.
5. Page P. Pathophysiology of acute exercise-induced muscular injury: clinical implications. *J Athl Train* 1995; 30(1): 29–34.
6. Shaji J, Saluja I. Comparative Analysis of Plyometric Training Program and Dynamic Stretching on Vertical Jump and Agility in Male Collegiate Basketball Player. *Al Ameen J Med Sci* 2009; 2(1): 36–46.
7. Behm DG, Chaouachi A. A review of the acute effects of static and dynamic stretching on performance. *Eur J Appl Physiol* 2011; 111(11): 2633–2651.
8. de Villarreal ES, González-Badillo JJ, Izquierdo M. Low and moderate plyometric training frequency produces greater jumping and sprinting gains compared with high frequency. *J Strength Cond Res* 2008; 22(3): 715–725.
9. de Villarreal ES, Kellis E, Kraemer WJ, Izquierdo M. Determining variables of plyometric training for improving vertical jump height performance: a meta-analysis. *J Strength Cond Res* 2009; 23(2): 495–506.
10. Markovic G. Does plyometric training improves vertical jump height ? A meta-analytical review. *Br J Sports Med* 2007; 41(6): 349–355.
11. Sáez de Villarreal E, Requena B, Cronin JB. The effects of plyometric training on sprint performance: a meta-analysis. *J Strength Cond Res* 2012; 26(2): 575–584.
12. Brughelli M, Cronin J, Levin G, Chaouachi A. Understanding change of direction ability in sport: a review of resistance training studies. *Sports Med* 2008; 38(12): 1045–1063.
13. Kallerud H, Gleeson N. Effects of stretching on performances involving stretch-shortening cycles. *Sports Med* 2013; 43(8): 733–750.
14. Shrier I. Does stretching improve performance ? A systematic and critical review of the literature. *Clin J Sport Med* 2004; 14(5): 267–273.