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The Comparative Study on Effectiveness of Plyometric Vs Pilates Exercises on Increasing Vertical Jump Performance among Basketball Players

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Abstract: ***Basketball is a team sport and it consist of five players each opposing one another on a rectangular court. The objective of these sport is to shooting a basketball through the defender's hoop mounted 10 feet high to a basketball at each end of the court, while preventing own hoop from opponent team. Purpose:- Purpose of the study was to compare the effectiveness of Plyometric vs Pilates exercises on increasing vertical jump performance. Subject: 30 subjects are selected, and divided in to group A and group B. all were tested in vertical jump and muscle strength prior to starting the plyometric and pilates training program. Method: All the subjects were underwent 6 weeks of training program and were retested. The subjects were divided in to two groups. Group A was given 3 days of plyometric training a week and rest of days strength training and Group B was given pilates training for 3 days and rest of days strength training. Result: The data collected was statistically analysed using paired and unpaired t test after intervention group A showed significant improvement in vertical jump height. Conclusion: The finding suggested that group A (plyometric) is more effective than group B (Pilates) in improving vertical jump height.***

Keywords: Basketball, Plyometric training, Pilates training, Sargent jump test

1. Introduction

Basketball is one of the most popular team based sport played game and watched throughout the world. The purpose of the game is for each team to defend a goal area while trying to score goals at the opposing end of the court.[1] Basketball is a game which relies heavily on explosive power of legs for gain maximum height of jumping. Vertical jumping capability is the product of muscular strength and speed. The capability to produce explosive lower body power of a player can be an important factor for attaining maximum height of jump. Specific training method is required to improve the vertical jumping ability of players [2].Vertical jump can be increases by the following training:-

Plyometric Training:- Plyometric training can be defined as stretch shortening cycle movements that uses a high intensity eccentric contraction occur immediately after a rapid and powerful concentric contraction [3]. plyometric training includes performance of various types of body weight jumping type exercise, like drop jumps, countermovement jumps, alternate leg bounding, hopping and other SSC jumping exercises [4]. Plyometric educate the muscles to pre-stretch prior to jumping. Pre stretching lead the muscles to store potential energy in them that aids to jump higher. Plyometric exercises have some specific sequence:

- A landing phase
- An amortization phase
- Take off

The **landing phase** commence at sight the muscles start to experience an eccentric contraction. The rapid eccentric contraction stretch the elastic component of the muscle and activate the stretch reflex. A high level of eccentric strength is required during the landing phase, the inadequate strength will result in a slow rate of stretch and less activation of the stretch reflex.

The **amortization phase,** is the most important part of a plyometric exercise. It typify the time from landing to take off and is important for power development.

The **take off** is the concentric contraction that follows the landing. During this phase the stored elastic energy is used to increase jump height and explosive power.[5]

Plyometric training improves strength, muscle power, coordination and players performance [6].

Pilates is a physical system developed in the early 20th century by joseph pilates [7].

The **Pilates training** method is based on the key principal of management of the center of gravity, concentration, control, precision, flow, and breathing.[8]Pilates exercises is the Body-Mind Exercises, where the focus is on movement, posture, and breathing pattern . Pilates exercises improves mental and physical well-being, increases flexibility, and strengthens muscles through controlled movements done as mat.Pilates increase flexibility, increase strength and develops control and endurance in the whole body. It puts

emphasis on alignment, breathing, developing a strong core and improving coordination and balance. [9]

Aim:
Aim of this study is to compare plyometric exercises with pilates exercises for improving vertical jump in basketball players.

Objective:
1) To evaluate the effect of plyometric exercise for improvement of vertical jump performance in basketball players.
2) To evaluate the effect of pilates exercises for improvement of vertical jump performance in basketball players.
3) To evaluate the comparation of effect of plyometric with Pilates exercises for improving vertical jump performance.

2. Material and Methods

Study design: Comparative study

Study duration: 6 Weeks

Sample size: 30 Subjects

Study setting: Basketball club Indore (M.P)

Inclusion criteria: Age 15-20 years, Sex Male, level:-club level players, MMT should be grade V, without musculoskeletal injury in last 6 month.

Exclusion criteria: Presence of neurological disease, Presence of cardiovascular disease, Presence of uncontrolled diabetes mellitus, Postural deformity, Recent surgery, Limb length discrepancy, Recent injury in both upper limb and lower limb (fracture, sprain, strain) less than 3 months.

Preparation and presentation of data:- An institutional ethics committee approval was obtained. A written concept from all the participants along with prior permission from the NBA Indore was obtained. 30 subject were divided in to two group, group A (Plyometric), and group B (Pilates). Group A received plyometric training for 6 weeks 3days in a week(Alternate days) remaining days are strength training. Group B received pilates training for 6weeks, 3days in a week(Alternate days) remaining days are strength training. Each group started with 10-15 minutes of warm up including jogging, stretching of upper limb and lower limb, and cool down period included waking, deep breathing and stretching of upper limb and lower limb.

Group A (plyometric):

Training weeks	Training volume	Plyometric drills	Sets/ repetitions	Training intensity
Week 1	85	Two foot ankle hops	2x15	Low
		Forward skip	2x15	Low
		Double leg vertical jump	5x5	Low
Week 2	110	Two foot ankle hops	2x15	Low
		Standing long jump	5x6	Low
		Lateral cone hops	2x15	Medium
		Double leg tuck jump	2x10	Medium
Week 3	115	Two foot ankle hops	2x12	Low
		Standing long jump	4x6	Low
		Lateral cone hops	2x12	Medium
		Double leg tuck jump	2x10	Medium
		Double butt kick	3x8	Medium
Week 4	105	Diagonal hops	4x8	Low
		Double tuck jump	2x10	Medium
		Lateral cone hops	2x10	Medium
		Double leg butt kick	3x6	Medium
		Single leg vertical jump	3x5	High
Week 5	110	Diagonal cone hops	3x7	Low
		Long jump with lateral sprint	4x5	Medium
		Lateral cone hops	4x6	Medium
		Single leg bounding	2x5	High
		Front cone hops	2x10	Medium
		Depth jumps	3x5	High
Week 6	100	Diagonal cone hops	2x7	Low
		Hexagon drill	2x12	Low
		Double leg hops	3x8	Medium
		Lateral cone hops	3x8	Medium
		Depth jump	2x7	High

Group B (Pilates):-
- (Linear sitting) lifting legs upwards.
- (Balance sitting) exchange the opening of legs.
- (Lying down aside) lifting arms and legs backward.
- (Lying down with arms aside), gathering legs with clapping backward.
- (Resting heels on a box and shoulders on another),with lowering rump.
- (Leaning lying down), exchange with lifting legs upwards.
- (Leaning lying down), exchange lifting the arm with the legs.
- (Lying down arms upward), exchange with lifting the leg.
- (Lying down lift) arm backward with lifting the adverse leg backward and upward.
- (Leaning lying down),with lift the leg aside.
- (Leaning lying down on the arm) the upper leg forward and upward.
- (Lying down two arms aside), with lifting the legs upward and backward.
- (Lying down two arms aside) lifting the legs forward, upward and backward with opening.

Outcome were assessed pre and post to the whole training protocol for 6 weeks. The variable in this study included of sargent jump test and spring balance value.

Figure 1: Sargent jump test

Figure 2: Plyometric training (lateral cone hop)

Figure 3: Pilates training (Exchange lifting the arm with the leg adversly)

3. Data analysis and Result

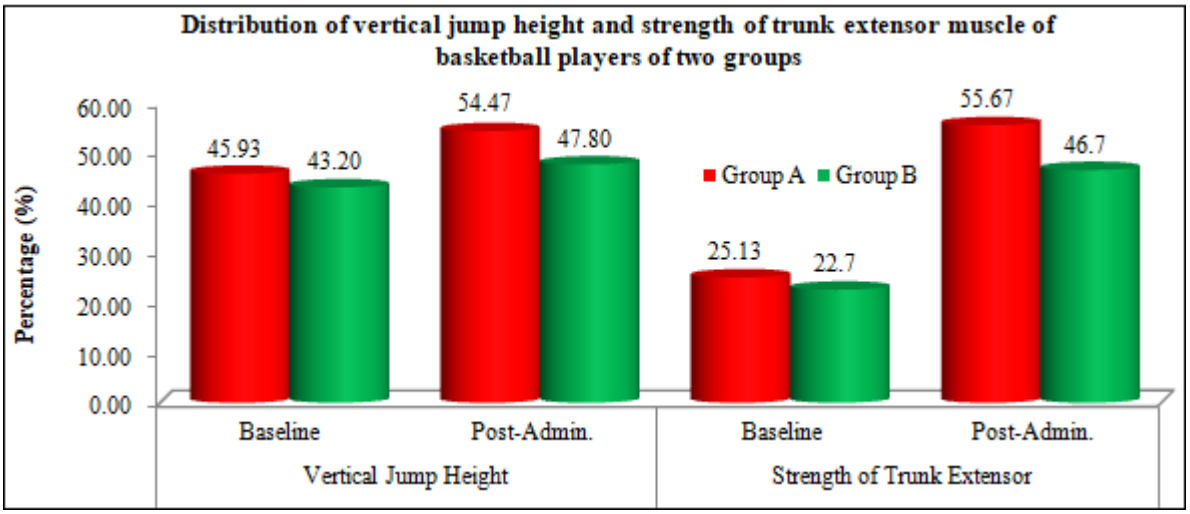
A total of 30 basketball players screened for the study and the responses from all thirty samples were entered into the computer database. However, the responses of frequencies were calculated and analyzed by using both, descriptive and inferential statistics. Results on continuous measurements are presented using Mean ± Standard Deviation (Min-Max) whereas results on categorical measurements are presented in numbers (%).The demographic information of basketball players such as age was collected as baseline stage. The sex wasn't identified as only male basketball players were consented, available and found to be feasible for present study.

However, age, vertical jump height, trunk extensor muscles lengthening, hip extensors, knee extensors and plantar flexor muscles lengthening at right and left sides among studied basketball players of both the groups. Significance of differences was carried out between and within the groups for selected continuous parameters. A parametric test, paired t-test used to determine the significance of mean differences of vertical jump height, trunk extensor muscles lengthening, and right and left sides of hip extensors, knee extensors and plantar flexor muscles lengthening among basketball players of two groups (group A and group B) between baseline and post administration of exercises. Independent sample t-test is used to observe the significance of differences of vertical jump height, trunk extensor muscles lengthening, and hip extensors, knee extensors and plantar flexor muscles lengthening at right side and left side between basketball players group A and group B.

Comparison of vertical jump height and strength of trunk extensor muscles between baseline and post administration stages in groups

Group and Parameter		Sampling Stage	Scatter Mean ± SD	Mean Diff	t-statistic	LOS
Group A	Vertical Jump Height	*Baseline*	45.93±7.02	8.54 Cm	12.38	$p<0.001^{\#}$
		Post	54.47±8.04			
	Strength of Trunk Extensors	*Baseline*	25.13±4.84	30.53 Kilogram	78.55	$p<0.001^{\#}$
		Post	55.67±3.72			
Group B	Vertical Jump Height	*Baseline*	43.20±5.93	4.60 Cm	10.59	$p<0.001^{\#}$
		Post	47.80±5.71			
	Strength of Trunk Extensors	*Baseline*	22.67±5.64	24.00 Kilogram	41.57	$p<0.001^{\#}$
		Post	46.67±5.21			

Comparison between mean differences indicated that the basketball players of group A had experienced significantly differed and more improved vertical jump height and trunk extensor muscles lengthening after intervention of plyometric exercises than basketball players of group B intervened with Pilates exercises.



Bar diagram showing the distribution of vertical jump height and trunk extensor muscle lengthening of selected studied basketball players of group A and group B.

4. Discussion

These finding showed that both groups for basketball players improved vertical jump and muscle strength to their sports. The reason behind increasing vertical jump in the group A due to contractile component of the act in and myosin cross bridges with the sarcomere plays an important role in motor control and force development during plyometrics. The plyometric exercise include the pre-stretch of the muscle-tendon unit physiological length-tension curve in order to enhance the ability of the muscle fibers to generate more tension and resultant force production.

Another reason behind increasing vertical jump in the group A due to proprioceptors of the body include the muscle spindle, the Golgi tendon organ (GTO), and the mechanoreceptors located in joint capsules and ligaments. Due to stimulation of these receptors which cause facilitation, inhibition, and modulation of both agonist and antagonistic muscles. Whenever the muscle fiber is stretched, there is an increase in afferent nerve firing. The strength of the impulse from the muscle spindle to spinal cord is dependent on the rate of the applied stretch. As the stretch rate of the muscle gets faster, the neurological signal sent from the muscle spindle gets stronger and as a result of that the efferent muscle contraction will be greater. The function of the golgi tendon organ is to act as a protective reflex preventing over-contraction or too much tension in the muscle. Thus, the GTO assists with modulating forces during plyometric exercises [10].

It is important to that improvements observed in the vertical jump could have been induced by neuromuscular adaptations, such as an increased neural drive to the agonist muscles, changes in muscle-tendon mechanical-stiffness characteristics, alterations in muscle size and/or architecture, and changes in single-fiber mechanics (de Villarreal et al., 2009; Maffiuletti et al., 2002; Potteiger et al., 1999; Thomas et al., 2009).

Other reason of neural adaptation to plyometric include:-

1) The changes in leg muscle activation strategies (or inter-muscular coordination) during vertical jumping, particularly during the preparatory (i.e. pre-landing) jump phase
2) The changes in the stretch reflex excitability (Bishop and Spencer, 2004; de Villarreal et al., 2009) [10].

5. Conclusion

Based on finding of this study, it was concluded that both groups, group A (Plyometric) and group B (Pilates) were effective in vertical jump height but group A (plyometric) shows significant improvement in vertical jump height as compared to B.

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