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Comparision of dynamic push- up training and plyometric push-up training on upper body performance test in cricket Player

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Abstract
Introduction: Plyometrics, however, are now being used during the final stages of sports rehabilitation to assure an adequate preparation of an athlete's muscle power functions and performance skills for the demands of their specific sport
Purpose of the study: to compare the effect of dynamic push-up training and plyometric push-up training on the performance of upper body.
Methodology: Thirty six healthy professional male athletes (cricket players) were recruited randomly and assigned to the dynamic push-up group (group A) and the plyometric push-up group (group B). One arm hop test and Medicine ball put test were used to measure the improvement in performance. Both groups were participated in the study three days in a week for six weeks and completed 18 training sessions, at a frequency of 3 sessions per week and with an interval of at least 48 hours between sessions.
Results: paired sample t-test within Group between Pre & post one arm hop test of right side showed significant difference. Paired sample t test was used to compare the data between the groups of one arm hop test showed no significance differences.
Conclusion: It was concluded from this study that Dynamic Push-Up Training and Plyometric Push-Up Training, both are effective for improvement of upper body performance.

Keywords: Dynamic Push-up, Plyometric Push-up, Upper body performance

1. Introduction

Plyometric exercise is a popular form of training commonly used to improve athletic performance. Plyometric training has been established as a training method that improves the muscle-tendon unit’s ability to tolerate stretch loads and the efficiency of the stretch-shorten cycle (SSC). During a plyometric drill, also known as stretch - shortening cycle drill, a movement to an intended direction is achieved by starting it with a movement to the opposite direction which is a nontraditional form of resistance training emphasizing the loading of muscles during an eccentric muscle action, which is quickly followed by a rebound concentric action. Some authors have found plyometric exercises to be a beneficial adjunct to traditional training methods, while others have found plyometrics to be of no advantage. Upper extremity rehabilitation programs have begun to incorporate plyometric activities to promote the restoration of comprehensive neuromuscular control and functional joint stability. In the upper extremity there are limited data available exploring the specific neuromuscular adaptations sought by clinicians. However, traditional strength exercises are initiated only through voluntary muscle activation. Plyometrics, however, are now being used during the final stages of sports rehabilitation to assure an adequate preparation of an athlete's muscle power functions and performance skills for the demands of their specific sport. Several studies used plyometric training and have shown that it improves power output and increases explosiveness by training the muscles to do more work in a shorter amount of time. The stretch-shortening cycle enhances the ability of the muscle-tendon unit to produce maximal force in the shortest amount of time, prompting the use of plyometric exercise as a bridge between pure strength and sports-related speed. Push up is a common strength training exercise performed in a prone position, lying horizontal and face down, raising and lowering the body using the arms. Various techniques of push-ups have been proposed, each claiming different advantages. Using different hand positions is one of the modifications that provide a significant difference in muscle activation. Freeman *et al*. reported the benefit of more shoulder muscle activation with the dynamic push-up (push-up with the hands on a wobbly surface). However, despite the many advantages of this exercise, it may also cause some adverse outcomes, such as neck pain, back pain and palm and wrist pain. Because throwing places so much stress on the upper extremity, the athlete must have adequate strength, stability, and mobility in order to return to activity after injury. If the athlete returns to activity too soon, re-injury may occur rather easily.

There are very few articles that provide information about effectiveness of plyometrics alone, because in most of the studies plyometrics are used in combination with some other training method. We have not gone through any study on comparison of dynamic push-up training and plyometric push-up training on upper body performance test. The objective of the study was to compare the effect of dynamic push-up training and plyometric push-up training on the performance of upper body.

2. Methodology

Thirty six healthy professional male athletes (cricket players) were recruited from Sukhdev Pahalwan Sports Stadium Azamgarh Utter Pradesh and were randomly assigned to the dynamic push-up group (group A) and the plyometric push-up group (group B). Study was performed in accordance with ethical consideration of the institute and their consent was taken prior to study. Participants were excluded when they complained about upper body and spine injuries. Both groups were participated in the study three days in a week for six weeks and collect the data prior to training program and after the end of training program. 15 minute warm-up exercises were performed before each training session. All the subjects were completed 18 training sessions, at a frequency of 3 sessions per week and with an interval of at least 48 hours between sessions. One arm hop test and Medicine ball put test were used to measure the improvement in performance. Adequate rest was provided between training programs in order to minimize the effect of fatigue. Progressions were made in each training group to challenge the adaptation in neuromuscular system.

2.1 Measurement of One Arm Hop Test

Prior to the test all subjects were given proper instruction and visual demonstration of one arm hop test. After instruction, subjects practiced the one-arm hop test for each upper extremity by assuming a one arm push-up position with his back flat, his feet and shoulders apart, and his weight-bearing upper extremity positioned perpendicular to the floor. A 10.2-cm step was placed immediately lateral to the subject's test hand. The step has a rubber coated upper surface and the test was performed on ground. The subject used the weight-bearing arm to hop onto the step and landed on the rubber portion of the step with the entire hand and the return his hand to the start position to complete 1 repetition. Subject repeats those movement 5 times as quickly as possible. Time was measure with standard stopwatch when the subject's hand left the floor on the first hop and stopped when the hand landed back onto the floor after the fifth hop. All subjects were repeated the procedure three times with time interval of 5 minutes and the mean value of three trials was used for the data collection. If the subject performed the test with improper technique, he rested for 1 minute, and then performed another practice test. An acceptable test was defined as a test in which the subject fully hopped onto the rubber portion of the step, did not use the other hand, did not touch down with a knee, and kept his back flat and his feet in the same position. After a 1-minute rest, the same maneuver was then performed with the contra lateral upper extremity.

2.2 Measurement of Medicine Ball - Put Test

The medicine ball put was performed using a medicine ball of three kilogram from a sitting position. Each subject was seated on an adjustable bench with his back oriented vertically against a back support, thighs horizontal, knees flexed at 90^0, and ankles fixed behind swivel pads at the base of the bench. Subjects were strapped to the bench in order to minimize trunk movements during the test. Subjects were instructed to hold the 3 Kg medicine ball (73 cm in diameter) in their laps with both hands, bring the ball up quickly to touch their chest at about nipple level, and then explosively perform a chest-type pass, pushing the ball outward and upward at an angle approximately 30^0 above horizontal. Distance was measured from the base of the bench to the closest edge of the medicine ball imprint. The farthest put was marked on the floor, to be used as a target distance. To account for slight variation between each put, the mean of 3 trials was used as the measure. A visual demonstration and trial were given before the actual test.

2.3 Dynamic Push-Up training

In the starting position the knees and toes were in the contact with the ground. The hands were positioned shoulder width apart over the ground and remain straight, supporting the body weight. From this position, the subject lowered his body until his chest almost touched the ground. Without pausing, the subjects straightened their arm and comeback in the starting position, by pushing the trunk upwards. During the exercise the knees and toes were remain in the contact with the ground. Subjects performed the push- ups approximately in 4 second (2 sec. down and 2 sec. up).

Table 3.1: Time sequence and training program used by both the dynamic push-up and the plyometric push-up groups Pretest

Week	Sets × repetitions
1	3 x10
2	3 x10
3	3 x11
4	3 x12
5	4 x10
6	4 x11

Posttest

2.4 Plyometric Push-Up Training

Plyometric push-ups were performed with the kneeling position where the knees and feet remaining in contact with the floor. Subjects started with their trunk vertical and their arms relaxed and hanging at their sides. From this position they allowed themselves to fall forward, extending their arms forward with slight elbow flexion, in preparation for contact with the ground. At contact, the subject gradually absorbed the force of the fall by further flexing the elbows and gradually stopped the movement with the chest nearly touching the floor. Immediately after stopping the downward motion, the subject reversed the action by rapidly extending his arms and propelling his trunk back to the starting position and the sets of repetition of exercises (Table 3.1)

3. Results

Data was analyzed using paired sample t-test within Group A between Pre & post one arm hop test of right side ($p = 0.033$), left side ($p = 0.003$) both showed significant difference, the medicine ball put test also showed significance difference when compared pre & posttest. [Table 5.2]

Title 3:1: Paired sample t-test within group A

	Variables	t- value	p – value
One Arm Hop Test	Pre(Rt)-Post	2.319	0.033
	Pre(Lt)-Post	3.415	0.003
Medicine Ball Put Test	Pre-Post	6.616	0.0001

Similarly within Group B between Pre & post one arm hop test of right side (p=0.004), left side (p=0.011) both showed significant difference, the medicine ball put test also showed significance difference when compared pre & posttest [Table 5.3]

Title 3:2: Paired sample t-test within group B

	Variables	t- value	p – value
One Arm Hop Test	Pre(Rt)-Post	3.297	0.004
	Pre(Lt)-Post	2.858	0.011
Medicine Ball Put Test	Pre-Post	4.621	0.0001

Paired sample t test was used to compare the data between the groups of one arm hop test in right side of pre test (p= 0.769), post test (p=0.295) and in left side of pre test (p=0.488), post test (p= 0.242) showed no significance differences. [Table 5.3] Similarly in medicine ball put test of pre test (p=0.174) and post test (p=0.168) also showed non significance.

Title 3:3: Independent sample t-test between group A and group B

	Variables	t- value	p- value
One Arm Hop Test	Pre(Rt)	0.286	0.77
	Post(Rt)	1.169	0.137
	Pre(Lt)	0.844	0.919
	Post(Lt)	1.512	0.934
Medicine Ball Put Test	Pre	1.505	0.306
	Post	1.484	0.966

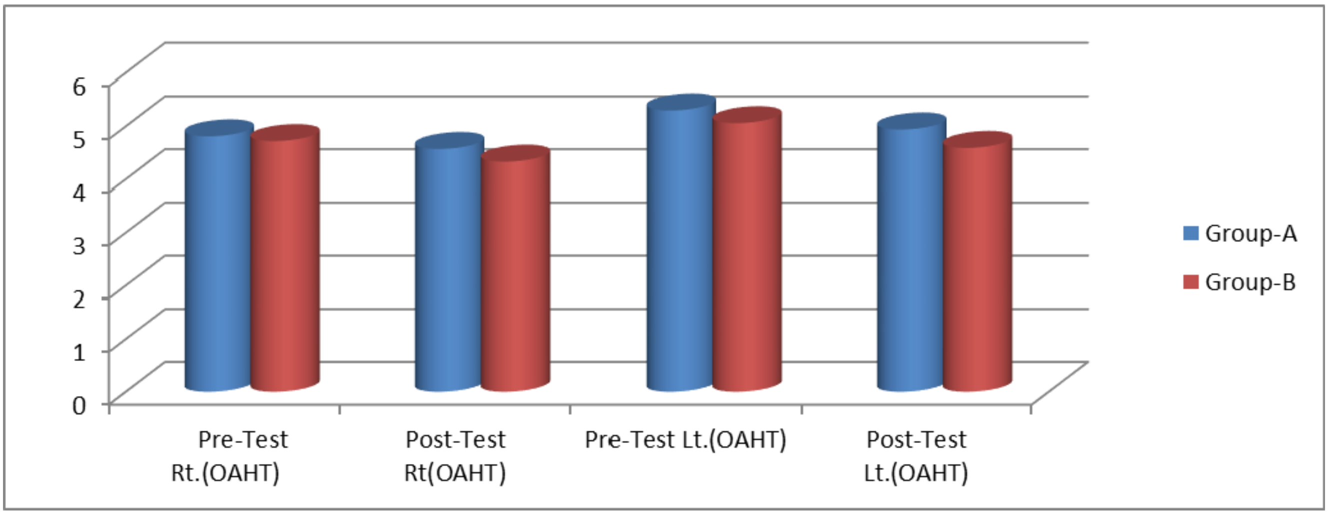

Fig 3.1: Comparison of Pre-intervention and Post-intervention data for right and left one arm test.

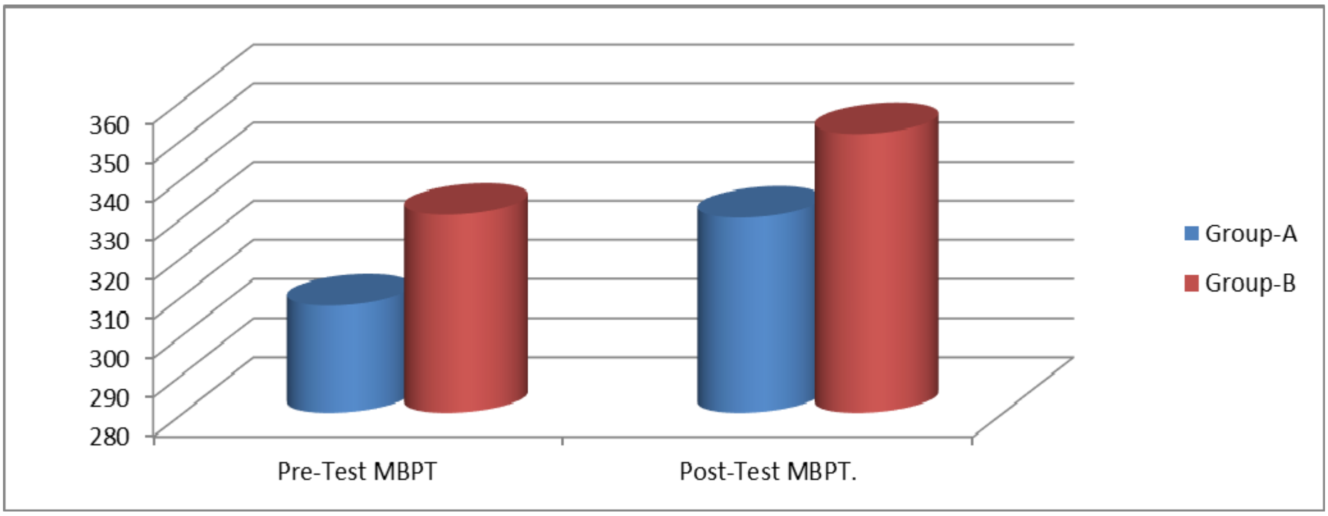

Fig 3.2: comparison of Pre-intervention and Post-intervention data for medicine ball put test.

4. Discussion

The result of the study suggests that the plyometric training is beneficial to improve performance is attributed to important factors that contribute to force production and rate of force development in plyometric push-up training program. As the muscle is rapidly stretched and then undergoes a powerful concentric action, additional force is derived from the storage of elastic energy and facilitation of the muscle contraction due to stretch reflex. The increased force production due to stretch reflex is directly proportional to rate of stretch rather than the amount of stretch applied to the muscle. It has been reported in the previous studies (Kawakami, *et al.* 2002) that muscle length change is restrained due to an increase in the level of activity during the muscle tendon complex stretch phase, increasing the change of the length of tendons in relation to the length of the muscle tendon complex. This mechanism has been shown as one in which muscles can exert great force during movement by enabling the tendons to store and reuse much of their elastic energy.

The training principle of specificity is an important consideration when designing resistance training programs. It is well known that different resistance training programs elicit different neuromuscular adaptations that are specific to the type of stimuli applied to the neuromuscular system in terms of muscle action type, movement pattern, magnitude and rate of force production, velocity of movement, and range of movement. In this study training was performed using free body weight rather than speed-controlled Isokinetic apparatuses, so that velocity of each lift may vary with each repetition performed as the weight of athlete's own body was maximally accelerated during upward movement phase of plyometric push-up exercise.

The findings of significant improvement in the plyometric push-up group may be credited to a greater workload experienced in the Plyometric push-up program. This greater workload is attributable to the momentum of the falling trunk, which contributes to the resistance provided by the individual's body weight and must be overcome by the upper extremities during the plyometric push-up. Because the kinetic energy the participant must overcome is a function of mass and velocity, the greater velocity of the falling trunk results in greater work to decelerate and then accelerate the body during the plyometric push-up. As per SAID principle imposed demand leads to adaptation against to training stimulus, thereby improvement in performance. A finding of this study is in agreement with observations of a study, in which authors studied plyometric and isotonic push-ups added to a weight training program. They used the medicine ball put as their test, and found the plyometric group demonstrated superior gains. However, the combined weight training program makes it difficult to isolate the contributions of plyometric push-up and isotonic push-up training to upper-body power.

Push-up exercise, as being closed kinetic chain exercise is a popular training method, which involves movement when the distal limb segment is fixed, body weight is supported by the extremities, or considerable external resistance is applied to the extremities. In this study the dynamic push-up group has demonstrated an increase in performance is result of increase in power and strength. It has been reported in several studies that isotonic exercise programs are suitable to improve muscular endurance. During a resistance training program, training stimuli trigger certain neuromuscular adaptations, which can then manifest themselves in increased strength and power. Behm DG 1993 suggested that the principal stimuli that elicit high-velocity-specific training adaptations are (a) the motor command and characteristic motor unit activation pattern associated with the intention to move explosively and (b) the high rate of force development of ensuing muscle actions.

Unlike hypothesized, comparison of results between the groups showed statistically insignificant improvement. In comparing plyometric push-up training and dynamic push-up training, the main difference is that of application of load i.e. athlete's own body weight. Both training programs involve stretch shortening cycle but group B performing plyometric push-up exercise, involves relatively more rapid stretch shortening cycle and faster velocity of body movement during push-ups.

Group A was instructed to complete the repetitions using relatively slow and controlled movements. This slow movement pattern used in dynamic push-up training program is unable to elicit stretch reflex, hence not able to get the benefit of stretch shortening cycle. Unlike group A, the plyometric group was expected to perform the push-ups in explosive and relatively in fast manner to get improvement in performance, over group A, because of advantages gained through stretch shortening cycle. But results of this study indicate no significant changes between groups. One probable reason behind such result may be long coupling phase (transition from eccentric to concentric contractions). The benefits of pre-stretching a muscle are lost if the movement continues over a longer time period characterized by long stretching phase and loss of elastic energy. Another reason for such the result may be the use of trained athletic population, because the training stimulus used in this study may not able to impose a greater demand to cause further adaptations. Results of this study support the findings of Heiderscheit's work in which they have concluded that plyometric training is not effective for increasing power output and functional throwing performance. The clinical Significance of the study is that athletes and coaches can use these training with proper care and precaution to get significant improvement in performance.

5. Conclusion

It was concluded from this study that Dynamic Push-Up Training and Plyometric Push-Up Training, both are effective for improvement of upper body performance but neither regimens was superior over each other.

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