



## Effect of Upper Extremity Plyometric Training on Strength and Accuracy in Archery Players

Authors

**Tushar Dhawale<sup>1</sup>, Ujwal Yeole<sup>2</sup>, Vaishnavi Jedhe<sup>3</sup>**

<sup>1</sup>Assistant Professor, Department of Physiotherapy, Tilak Maharashtra Vidyapeeth, Pune-411037, Maharashtra, India

Email: [tushardhawale@rediffmail.com](mailto:tushardhawale@rediffmail.com), 9665861968

<sup>2</sup>Principal and Associate Professor, Department of Physiotherapy, Tilak Maharashtra Vidyapeeth, Pune-411037, Maharashtra, India

<sup>3</sup>Intern, Department of Physiotherapy, Tilak Maharashtra Vidyapeeth, Pune-411037, Maharashtra, India

### Abstract

**Introduction:** Plyometric training improves the strength and power of upper extremity a pre requisite for archers. The study aimed on the effect of Upper Extremity plyometrics on strength and accuracy in archers.

**Materials & Methodology:** Using simple random method, 60 archers between 18-30 years of both genders were selected and divided into experimental and control group. 15 subjects in each group. Pre and post intervention of accuracy on score board, endurance using closed kinetic chain Upper Extremity stability test and 1RM for strength were compared. Intervention is based on plyometric training of primary archery muscles of shoulders and upper back for 3 days a week till 6 weeks.

**Results:** After comparing pre and post intervention data using paired t test, significant improvement in accuracy ( $p < 0.0001$ ), endurance ( $p < 0.0001$ ), 1RM Right ( $p < 0.0001$ ) and 1RM Left ( $p = 0.0001$ ) in archers were found.

**Conclusion:** There is significant effect of upper extremity plyometrics training on Upper Extremity strength and accuracy in archers.

**Keywords:** Archery, upper extremity plyometrics, accuracy, 1RM, endurance.

### Introduction

Archery is a recreational sport of strength and power. Art of sport is to, practice or skill of using a bow to shoot arrows. Archery is propelled with arrows and a bow to the target during shooting. Shooting in archery can be described as drawing the bow, aiming and releasing the arrow. It is necessary in archery to hold the pulling force of the bow isometrically till the release of the bow. Strength and power, which gives the ability to move quickly with great force, are the basic

requirements for archers. Elite players, coaches, and trainers depend on plyometrics to improve quickness, speed, jumping ability, footwork, body control, balance and overall performance for betterment of the archer.<sup>(1)</sup>

As there are very few studies done on the archery which helps to improve performance and accuracy of Plyometric training which improves the strength and power of upper extremity which is important pre requisite for of the archeries, hence there is need for study. Explosive movements of

the upper extremities are required by various sports and occupational activities<sup>(2)</sup> Power and strength improvement have been observed because of regular plyometric training<sup>(3)</sup> The term “plyometric” is a combination of two greek words, “plio” which means “extra” and “metric” which means “to access” repeated series of stretch-shortening cycles, provides maximal muscular force to the athletes. A burst of concentric muscular contraction is observed due to stretch-shortening cycle, when elastic loading, through an eccentric muscular contraction is provided.<sup>(9)</sup>

A form of exercise called plyometrics employs a quick, powerful movement involving a prestretch of the muscle, followed by a shortening, concentric muscular contraction, thus utilizing the stretch-shortening muscular cycle.<sup>(4)</sup> Plyometric exercise are very popular in upper-body strengthening programs. There are closed kinetic chain exercises, for which pectoralis major and triceps brachii are the principle acting muscles and the popularity of the plyometric exercise arises because it is easily learned requires no equipment, and is adaptable to different fitness levels.<sup>(5)</sup> Archery education programs should bring into limelight for proper Muscle strengthening to minimize chronic shoulder and back injuries.

### Materials and Methodology

Total number of 60 archery players between the age group 18-30 years of both genders were selected using simple random method. Accuracy testing on the score board, endurance testing using closed kinetic chain upper extremity stability test and 1RM for strength was used pre and post intervention. Intervention is based on plyometric training of primary archery muscles of the shoulders and upper back muscle group.

### Procedure

Permission was taken from the institutional ethical committee of Tilak Maharashtra Vidyapeeth, department of Physiotherapy. Prior to testing, the investigators will clarify and confirm everything, including inclusion and exclusion criteria. A

group of 60 archery players were approached and a written consent was taken from them, explaining the aims and objectives of the study. The participants were divided into 2 groups i. e group A (Experimental group) and group B (Control group). Group A was trained with upper limb plyometrics and Group B were given ergonomic advice along with conventional treatment. The demographic data was obtained using data collection sheet. At the beginning and the end of sessions their performance was assessed using closed kinetic chain upper extremity stability test, (this test was selected as a functional test of the upper extremity because it is currently the only test for the upper extremity that demonstrates a high test-retest reliability)<sup>(11)</sup> also 1 RM and accuracy testing using the scoreboard. Plyometric training frequency was 3 sessions per week lasting for 6 weeks. All the players were given a period of 10 minutes of warm up and then the treatment of approximately 30-40 minutes and then a session of cool down for 10 minutes.

### Upper Limb Plyometric Exercises

- i. Catching and throwing a weighted ball with a partner or against a wall. Bilaterally then unilaterally.
- ii. Stretch shortening drills with elastic tubing
- iii. Swinging a weighted object (weighted ball, bat)
- iv. Dribbling a ball on the floor or against a wall for wrist flexor
- v. Push off from a wall or countertop while standing
- vi. Drop push ups from a lower platform to the floor and back into the platform
- vii. Clap push ups
- viii. Bilateral side throw and catch using horizontal abduction and adduction of the shoulder and trunk rotation
- ix. Hand to hand overhead catch and throw
- x. Unilateral plyometric exercise for the shoulder joint (internal rotators) bounce a weighted ball in the prone lying position.<sup>(6)</sup>

**Statistical Analysis**

Microsoft office excels 2007 was used for statistical analysis and instat  
Average values for various parameters are calculated

Effect is tested using paired and unpaired "t" test.  
Level of significance was set at 5% (p <0.05)

**Results**

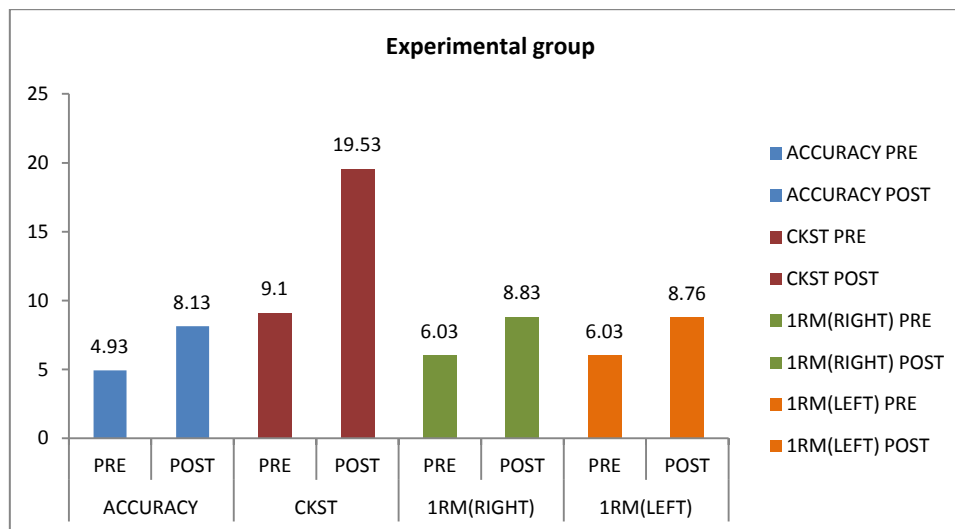
**Table no 1** Represents demographic data

group	Gender	Age (Mean±SD)	P value
Group A	Males-14	21.066±2.728	0.0069
	Females-16		
Group B	Males-17	23.3666±3.253	
	Females-13		

**Table no 2.** Represents pre and post values of accuracy closed kinetic stability test, RM1 (right) and (left) along with p values of both the groups

Outcome measures	Group A		P value	Group B		P Value	P values of group A and B	
	PRE	POST		PRE	POST		PRE	POST
Accuracy	4.93±0.73	8.13±0.86	0.0001	4.5±0.629	4.5±0.62	0.1247	0.0300	0.0001
<b>CLOSED KINETIC STABILITY TEST</b>	9.1±1.34	19.53±2.09	0.0001	7.63±1.09	7.633±1.09	0.0042	0.0300	0.0001
<b>RM1(RIGHT)</b>	6.03±1.75	8.83±2.10	0.0001	5.83±1.23	5.83±1.23	0.9999	0.54	0.0001
<b>RM1(LEFT)</b>	6.03±1.77	8.83±2.07	0.0001	5.83±1.23	5.83±1.23	0.9173	0.60	0.0001

**Graph -1**



**Interpretation-** Graph 1 shows the pre and post intervention values(Experimental group) of accuracy testing,Closed kinetic chain upper extremity stability test,1RM (Right) and 1RM (Left) and shows significant improvement with p value of 0.0001

**Discussion**

The purpose of this study was to check for the improvement in strength and accuracy in archery players because of plyometric training. Our study result shows that there is more improvement in

performance and accuracy in experimental group compared to control.

Kathleen et al found that plyometric activities may facilitate neural adaptations that enhances proprioception, kinesthesia and muscle

performance and significant neuromuscular benefits if they are implemented earlier into shoulder rehabilitation programs.<sup>(7)</sup> An integral role is played by the the shoulder complex in performing an athletic skill performance involving the upper extremity.<sup>(12)</sup>

Archery is a sport which requires strength, power, stability and accuracy. The basic goal of the clinicians and the coaches is to maximize these attributes in order to increase performance characteristics while concomitantly decreasing the likelihood of injury. Dynamic neuromuscular stabilization of the shoulder is essential in the prevention of shoulder injury<sup>(10)</sup> Most common injuries related to archery are contusion of forearm skin and subcutaneous tissue, laceration of a digital nerve and artery, de Quervain's tenosynovitis, bilateral medial epicondylitis and median nerve compression at the wrist, median nerve compression at the elbow, weakness and atrophy of left serratus anterior muscle.<sup>(13,14)</sup>

Archery instructors stated that force distribution between the hand and bow grip can have a considerable effect on arrow flight<sup>(15)</sup> Stanley Holtsclaw et al shows that The primary archery muscles of the shoulders and upper back are the rhomboids, levator scapulae, trapezius, deltoids, latissimus dorsi, and the rotator cuff muscle group, which including the supraspinatus, infraspinatus, and teres minor. To create the back tension mostly the rhomboids (major and minor) are two deep muscles of the back are used primarily and their basic action is to retract or pull the shoulder blades toward the spine. The rhomboids are accompanied by another deep muscle called the levator scapulae, which pulls the shoulder blade inward and also upward<sup>(8)</sup>

Also the trapezius muscle (all the fibers) helps in pulling the shoulder joint inward and upward, relying on the angle of the muscle fibers. As there is a need of maintaining a proper position, mainly during archery shooting, the upper limb muscles are the most active muscle compared to the lower-limb. As the upper muscle help to pull and hold the bow until released the arrow. Moreover, the

extremely vigorous muscular strength is required to pull and hold the bow in the forearm, in the appropriate position. The tiny muscles assisting in shooting are the flexor and extensor digitorum.<sup>(1)</sup>

Plyometric training for the upper body basically strengthens the rhomboids, teres minor and major, biceps, levator scapulae, trapezius, deltoids, latissimus dorsi, rotator cuff muscles, forearm and the core musculatures.<sup>(8)</sup> Moreover, maximum of these muscles are used in archery. Hence, there was improvement in the archers strength as well as their accuracy was improved by maintaining good stability in the shooting position.

### Conclusion

There is effect of upper extremity plyometrics training on strength and accuracy in archery players.

### Limitations

- 1) Can be consider level of competitors
- 2) More reliable method for accuracy

### Future Scope of Study

Different level of competitors

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#### Abbreviations

RM- repetition maximum

CCST-Closed kinetic stability test

PRE-Pre intervention POST-Post intervention