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Effectiveness Of Upper Limb Plyometrics On Upper Limb Muscle Endurance In Amateur Tennis Players: An Experimental Study

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Abstract

Objective:

The purpose of this experimental study was to investigate the effectiveness of upper limb plyometrics on upper limb muscle endurance in amateur tennis players. A total of 38 amateur tennis players underwent a 4-week upper limb plyometric training program. Pre- and post-test measurements of upper limb muscle endurance were taken using the push-up test.

Methodology:

Experimental study was performed from Oct22 to April 22. A purposive sampling technique was applied to select 38 participants.

Result:

Paired Test was done.

The result obtained for upper limb plyometrics exercises to increase upper limb muscle endurance in tennis players, endurance measured by push up test in players suggests significance as P value obtained was (<0.0001) and T value was (14.113)

Conclusion:

There is a significant effect of upper body plyometrics on upper limb muscle endurance in tennis players

Keywords: tennis, muscle endurance, upper limb, plyometrics

I. INTRODUCTION

Tennis is one of the most played racquet sports worldwide which is played either individually or in doubles¹. An amateur player is a person who has never competed for financial benefit or professional reason and plays for pleasure. Tennis athletes need a mixture of anaerobic skills, such as speed, agility, muscle endurance and power, combined with high aerobic capabilities². Tennis players require high performances in most components Force production in tennis, as in many other ground-based sports, involves the transfer of ground reaction forces through the ankle, lower- and body, trunk, upper body and eventually to the tennis racket. Therefore, the forces at the shoulder and arm in a tennis player result from the summation of the kinetic chain activity that starts with the ground reaction force in the legs and proceeds to the upper body, including the shoulder and arm. The hips and trunk function as a centre of rotation and as a transfer link for the large forces generated in the legs to be passed on to the shoulder and arm.²In order to increase the speed of the racket and ball during the service, the upper limbs should be very strong, flexible and coordinated to produce a high speed. It is very important to have the highest strength and technical capacity during the game.³ Tennis is a branch of sport which has physiological requirements

similar to team sports, can be played on different grounds, includes both aerobic and anaerobic energy metabolisms and in which anaerobic system is considered to be more dominant.⁴ A complete conditioning program designed to address both the demands of the sport and the individual player's musculoskeletal base is important in tennis, particularly at the Junior and professional levels. In the amateur player, physical development should begin with a sound program for physical fitness, including flexibility, cardiorespiratory endurance, general strength, and muscular endurance. Once a sound fitness base has been developed, the competitive junior players should progress to conditioning for sport specific movements and for injury prevention.⁵ Muscle endurance is the ability of a muscle to contract repeatedly against an external load, generate and sustain tension, and resist fatigue over an extended period of time. Muscular endurance is an important component of physical fitness⁶. Muscle Endurance can be improved by moderate resistance training, high intensity interval training, Pilates and plyometric exercises. Plyometric exercise starts with a rapid stretch (eccentric action) of a muscle followed by a rapid shortening (concentric action). The nervous system is conditioned to react more quickly to the stretch-shortening cycle. Plyometric training programs have been shown to be effective in adults and children for the motor ability of children to run, jump, hop, skip, kick, and throw⁷. The purpose of plyometric training is to increase the power of subsequent movements using both natural elastic components of muscle and tendon and the stretch reflex⁸. Plyometric training has been recommended for sports that rely on generation of high power output⁹. Plyometric exercises have been credited with inducing neuromuscular adaptations to the stretch reflex, elasticity of muscle and Golgi tendon organs. The stretch reflex is initiated during the, eccentric loading phase and can facilitate greater motor-unit recruitment during the ensuing concentric contraction. The series and parallel connective-tissue components of muscle also store elastic energy, which can generate additional force if a muscle recoils quickly in the form of a concentric contraction. The storing of energy is immediately followed by an equal and opposite reaction, using the elastic properties of the muscle to produce a kinetic energy system¹⁰.

II. NEED OF STUDY

Along with other components Endurance is the one of the main components for the enhancement of physical performance and for preventing injury in Tennis players. Plyometric plays an important role in improving the level of fitness in tennis players. There are studies regarding effectiveness of plyometrics on speed, power and agility. There are not many studies regarding upper body endurance training. This study is to find out the improvement of endurance of upper body by plyometric training in tennis players.

III. AIM

To study the effectiveness of upper limb plyometrics on muscle endurance in amateur tennis players

IV. OBJECTIVE

To find the effectiveness of upper limb plyometric to improve the endurance in tennis players using push up test at the end of 4 weeks.

V. HYPOTHESIS

Null Hypothesis (H₀): There will be no significant effect of upper body plyometrics on muscular endurance in tennis players.

Alternative Hypothesis (H₁): There will be significant effect of upper body plyometrics on muscular endurance in tennis players

VI. METHODOLOGY

Study design - Experimental Study

Sample size- 38

Sample method -convenient sampling

Study population- tennis players

Study setting- tennis courts in and around Pune §Study duration- 6 months

VII. MATERIALS

Pen

Paper

Consent form

Assent form

Stop watch

VIII. INCLUSION CRITERIA

Age group – 12 to 16 years

Amateur tennis players

Both male and female

Not involved in any other training program.

Willing to participate in the study

IX. EXCLUSION CRITERIA

upper and lower extremity Deformities

Fractures

Neurological conditions

Cognitive Impairments.

Not willing to participate in the study

X. PROCEDURE

The study has begun with the presentation of synopsis and Ethical clearance from the ethical committee of PES Modern College of Physiotherapy.

Participants were selected accordingly to inclusion and exclusion criteria and were explained about the study.

Consent form were taken from the participants.

Pre and post protocol data was collected and data analysis is done.

Demographic data, height, and weight will be recorded for data collection.

Push up test is done for endurance.

ICC - r = .99 (male) and r = 0.98 (female)¹¹

XI. EXERCISE PROTOCOL**Upper Limb plyometric training:**

- Frequency: Thrice a week
- Duration: 4 weeks
- Time: 45 minutes
- Rest Interval: 2 minutes after every set of exercise

Exercise 1- Pushup on floor

Step 1: Lie with your stomach on the floor.

Step 2: Place your hands on the floor outside your chest and under your shoulders. And toes on the floor as you would as regular push-up.

Step 3: Begin exercise by tightening your core and pushing up from the floor until your arms are fully extended, but not locked.

Exercise 2- Pushup against wall



Step 1: Place hands on a wall shoulder-width apart and at chest level. Step back with both feet to where your heels are off the ground. This is the starting position.

Step 2: Begin exercise by bending your elbows and lowering your upper body toward the wall. Try to lower down so that your upper arms become parallel with the wall (elbow bent 90 degrees). Inhale while doing so.

Step 3: Next, push yourself back up into the starting position as quickly as possible, exhale while doing so. This completes one rep.

Exercise 3 –medicine ball chest pass



Step 1: Grab a medicine ball and hold with both hands in front of chest. Palms should be facing each other and thumbs pointing toward your face.

Step 2: Stand with feet shoulder-width apart and knees slightly bent. Weight should be evenly distributed on your feet. Stand about 3 feet away from a concrete wall.

Step 3: Begin exercise by throwing the ball against the wall as hard as you can, extending arms straight out in front you (as if you are throwing a chest pass in basketball). Catch ball off the wall, bring back to chest and repeat.

Exercise 4- single arm overhead throws and catch

Step 1 -Stand with your feet shoulder-width apart, holding the medicine ball in one hand at chest height.

Step 2 -Explosively throw the ball forward and upward, while extending your arm fully and releasing the ball.

Step 3- Make sure to throw the ball high enough to give yourself time to move and catch it. Quickly move to where the ball is going to land, with your arms outstretched.

Step 4 - Catch the ball with both hands and bring it back down to chest height. Repeat the movement for the desired number of reps.

Exercise 5 – overhead throw and catch

Step 1- Begin standing while facing a wall or a partner.

Step 2- Using both hands, position the ball behind your head, stretching as much as possible, and forcefully throw the ball forward.

Step 3 -Ensure that you follow your throw through, being prepared to receive your rebound from your throw. If you are throwing against the wall, make sure that you stand close enough to the wall to receive the rebound, and aim a little higher than you would with a partner.

Exercise 6 – side throw and catch



Step 1: Grab a medicine ball and stand 3 feet away from a concrete wall with your left side facing the wall. Stand with feet wider than shoulder-width in an athletic stance.

Step 2: Hold the medicine ball straight out in front of chest. Arms should be straight and palms facing each other. Now, twist torso away from the direction of the wall (to the right in this case).

Step 3: Begin exercise by quickly twisting your body back to the left (toward the wall) and throwing the ball against the wall as hard as you can. Catch the ball off the wall and repeat as quickly as possible.

XII. Result

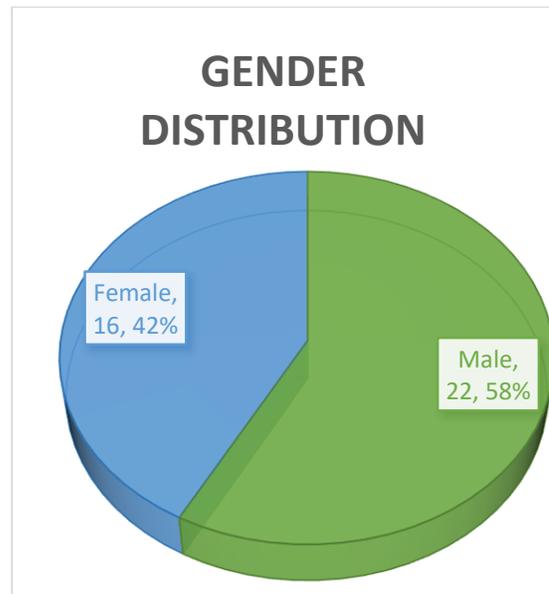
38 participants were included in the study.

Paired Test was done.

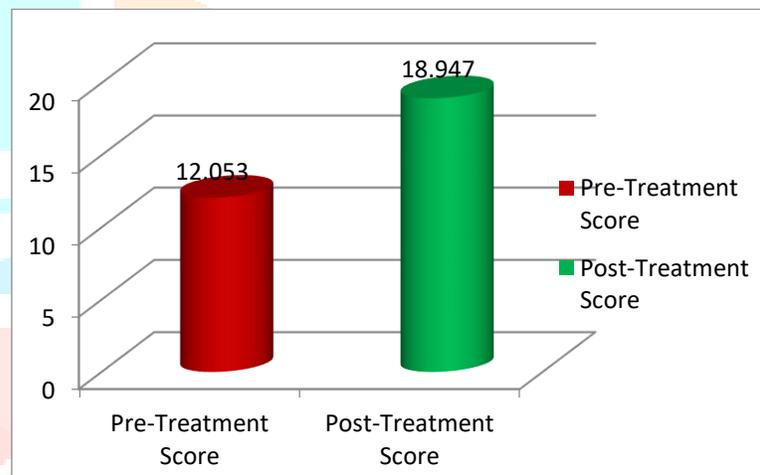
The result obtained for upper limb plyometrics exercises to increase upper limb muscle endurance in tennis players, endurance measured by push up test in players suggests significance as P value obtained was (<0.0001) and T value was (14.113)

PARAMETERS	PRE-TEST		POST TEST		T VALUE	P VALUE	RESULT
	MEAN	SD	MEAN	SD			
Push-up Test & Modified Push up Test	12.053	±4.997	18.947	±5.849	14.113	<0.0001	EXTREMELY SIGNIFICANT

Table no.1 – The comparison of pre and post muscle endurance values using push up test



graph no.1



Graph no.2 – comparison of pre and post endurance values

XIII. DISCUSSION

The aim of the study was to investigate the effectiveness of upper limb plyometrics on upper limb muscle endurance in amateur tennis players. Total 38 participants of age 12 to 16 were trained for 4 weeks to find the effectiveness of upper limb plyometrics on upper limb muscle endurance. The push-up test was done for males and modified push up test was done for females. The push-up test is a quick and inexpensive method for assessing endurance of the upper body muscles, particularly the chest, shoulders, and triceps. It is used to track changes in endurance over time and to compare the results to normative values for age and sex. Plyometrics involves rapid stretching and contracting of the muscles, which has been shown to improve muscle strength, power, and endurance. This type of training can also improve neuromuscular control, which can help tennis players to perform more efficiently and with greater precision. According to Sheng Yao Luo, et al PT has been shown to be effective in improving athletes' physical performance (e.g. Sprint, jump, muscle strength, balance, endurance, agility, and flexibility) regardless of age, gender, training experience, and competition level¹²The specific exercises used in the upper limb plyometrics training program in this study, such as medicine ball throws and push-ups, are known to target the upper limb muscles, including the chest, shoulders, and arms, which are heavily used in tennis. According to Pratik Ruparel, et al. There is effectiveness of upper extremity plyometrics training on agility and endurance in badminton players show that plyometrics exercises are extremely significant to improve endurance¹³. Another study by Hermassi et al. (2018) investigated the effects of an eight-week plyometric training program on endurance and sprint performance in young soccer players. The study found that the plyometric training program significantly improved both endurance and sprint performance in the soccer players¹⁴. According to Markovic, et al. Plyometric exercises involve rapid eccentric (lengthening) contractions followed by rapid concentric (shortening) contractions, which improves the coordination of muscle fibres and enhances the ability of the muscles to generate force over time. This means that the muscles become better able to use oxygen and fuel sources to produce energy and sustain contractions over time. This increased metabolic capacity can improve muscle endurance by delaying the onset of fatigue and allowing the muscles to maintain contractions for longer periods of time.

Plyometric exercises require precise coordination between the nervous system and the muscles to execute the movements with maximal power and speed¹⁵ According to Faigenbaum AD, et al. Muscular endurance can be improved during the childhood years and favor the prescription of higher repetition–moderate load resistance training programs during the initial adaptation period¹⁶

XIV.CONCLUSION

There is a significant effect of upper body plyometrics on upper limb muscle endurance in tennis players

XV.LIMITATIONS

Lack of long-term follow up

XVI.FUTURE SCOPE

Other age group can be considered

Future research should investigate the effectiveness of upper limb plyometrics on upper limb endurance in tennis players of different professional levels.

The studies did not compare the effectiveness of upper limb plyometrics with other training methods. It's possible that other types of training, such as traditional resistance training or endurance training, may be equally or more effective in improving upper limb endurance in tennis players. More research is needed to compare the effectiveness of different training methods.

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