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# Effect of plyometric training on the agility of male squash players

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**Abstract**
Different sports requires different ways of training. Squash is one of the sports which challenges the person's stamina, strength, reflexes, balance and agility. Agility is important in a sports like squash as in a single rally it requires multiple sprints, lunges, turns and changes of direction to hit the ball. Plyometric exercises are used in sport-specific training to enhance power and performance. The present study was carried out to study the effect of plyometric training on the agility of male squash players. 40 male squash players were included in the study and divided into two groups. Experimental group underwent regular training with added plyometric training and control group underwent regular training for a period of six weeks. Student's t-test was used to compare agility scores of the two groups. The results demonstrated significant difference in agility scores of experimental group ($p<0.0001$) as compared to control group ($p=0.17$). On comparing agility scores between two groups ($p<0.0001$) it demonstrated that experimental group had significantly better agility scores as compared to the control group. The study concludes that plyometric training along with conventional training yields better improvement in agility compared to conventional training alone.

**Keywords:** agility, plyometric, squash, sports, training

## 1. Introduction

SPORTS - is a combination of passion and enthusiasm. It day by day challenges the athlete to perform better. There are different sports requiring different ways of training. Squash is one of the sports which challenges the person's stamina, strength, reflexes, balance and agility. Agility is important in a sports like squash as in a single rally it requires multiple sprints, lunges, turns and changes of direction to hit the ball. Squash is a sport played by two or four players in a four walled court with a small, hollow rubber ball.

Agility is helpful for squash players as it is the ability to move and change direction and position of the body quickly and effectively while under control. It requires quick reflexes, coordination, balance, speed and correct response to changing position which take place in a rally. Sheppard and Young (2006) defined agility as a "rapid whole-body movement with change of velocity or direction in response to a stimulus".

Agility or nimbleness is the ability to change the body's position efficiently and requires the integration of isolated movement skills using a combination of balance, coordination, speed, reflexes, strength, and endurance.

Agility in sports is the ability to decelerate, accelerate, and change direction while maintaining good body control and without losing time in the transition. It has been said that outside of sport-specific skills, agility is the primary determining factor for success in sports.

Improved agility can mean better performance, faster response and it gives athletes an edge over their competitors.

Plyometric may help to train for agility in most of the sports in which constant running, jumping, squatting, lunges and changing position of body is needed to play that sport. In squash, a plyometric exercise can enhance power and performance of the player [1]. Plyometric is a combination of activities that enable muscle to reach maximal force in shortest amount of time. Plyometric exercises involving repeated rapid stretching and contracting of muscles (as by jumping and rebounding) to increase muscle power. Thus, these exercises are used in sport-specific training to enhance power and performance. These are the set of activities that enable a muscle to reach its maximal force in shortest time possible.

Plyometric is defined as activities which enables a muscle to reach maximal force in the shortest amount of time, according to the National Strength and Conditional Association.

Essentially, plyometric exercises enhance the series elastic component and the stretch reflex by using movements similar to those used in the athlete's sports [1]. There are different phases of Plyometric exercises: Eccentric phase, Amortization phase and Concentric Phase.

The eccentric phase, or landing phase involves the preloading of the agonist muscle group. During this phase elastic energy is stored and muscle spindles are stimulated [7].

The amortization phase, or transition phase, is the time between the concentric and eccentric phases. This phase of the stretch shortening cycle is perhaps the most crucial in production of power as the duration of amortization must be kept at a minimum. If the transition phase lasts too long, the energy stored during the eccentric phase dissipates, thereby negating the plyometric effect [2]. Then it becomes just a standard exercise.

The concentric phase, or take-off phase, is the response to the eccentric and amortization phases. During this phase, elastic energy is utilized to increase the force of the

subsequent movement or is dissipated as heat. Unloading the energy occurs next in the concentric phase, adding to the tension generated in a concentric muscle contraction. This is where the athlete releases the stored and redirected energy, required for the activity of the sport [3].

Thus, the study aimed to see the effect of plyometric drills on agility of male squash players by comparing the effects of conventional training versus conventional training with added plyometric drills.

## 2. Materials and Methods

After clearing the institutional ethical clearance 40 male squash players were selected using convenient sampling. Subjects were randomly assigned into two groups of 20 each: GROUP A and GROUP B. On the first day assessment of the agility of both the groups was done using T-TEST of agility and AFL AGILITY TEST after which the training commenced.

GROUP A comprised of experimental group which underwent regular training with added plyometric training and GROUP B was the control group which underwent regular training. The total training duration was of 6 weeks which included sessions of 3 days/week on non-consecutive days, after which agility of both the groups was re-assessed. The training progressed from low intensity to high intensity over 6weeks with increase in number of repetitions and less rest pauses.

## 3. Results

The mean age in years of Group A & B was 23 ± 2.86 & 22 ± 3.59 respectively. Students t-test was used to compare means of pre and post T-test of agility scores of experimental group which demonstrated significant difference in the agility scores ($p < 0.0001$) as compared to control group ($p=0.1713$). On comparing performance post training between the groups on T-test for agility there was statistically significant difference between the two groups ($p < 0.0001$).

The other test used for agility score was AFL agility test. On comparing within groups: Group A ($p<0.001$) demonstrated statistically significant difference on AFL agility Test scores pre and post training as compared to Group B ($p=0.096$). Comparison between two groups demonstrated significant difference between the two groups post training with $p<0.001$.

**Table 1:** Comparison of T-test of agility scores of Group A

| | Pre-test -group A | Post-test-group A |
|---|---|---|
| Mean | 12.4 | 10.895 |
| SD | 0.663 | 0.461 |

**Inference:** Means of pre and post T-test of agility values of experimental group shows significant difference in the agility scores stating that agility improved significantly following plyometric training ($p < 0.0001$).

**Table 2:** Comparison of T-test of agility scores of Group B

| | Pre-test -group B | Post-test-group B |
|---|---|---|
| Mean | 12.325 | 12.3 |
| SD | 0.640 | 0.618 |

**Inference:** Means of pre and post T-test of agility values of control group does not show a significant difference in the agility scores ($p=0.1713$).

**Table 3:** Between group comparison of T-test of agility scores post training

| | Post-test -group A | Post-test-group B |
|---|---|---|
| Mean | 10.895 | 12.3 |
| SD | 0.461 | 0.618 |

**Inference:** Means of T-test of agility scores of both the groups post training shows significant difference, stating that Group A agility improved significantly as compared to Group B ($p < 0.0001$).

**Table 4:** Comparison of AFL-test of agility scores of Group A

| | Pre-test group-A | Post-test group-A |
|---|---|---|
| Mean | 10.03 | 8.79 |
| SD | 0.493 | 0.643 |

**Inference:** Means of pre and post AFL-agility test values of experimental group shows significant difference in the agility scores stating that agility improved significantly following plyometric training ($p < 0.0001$).

**Table 5:** Comparison of AFL-test of agility scores of Group B

| | Pre-test group-B | Post-test group-B |
|---|---|---|
| Mean | 10.23 | 10.2 |
| SD | 0.440 | 0.432 |

**Inference:** Means of pre and post AFL-agility test values of control group does not show a significant difference in the agility scores ($p=0.0961$).

**Table 6:** Between group comparison of AFL-test of agility scores post training

| | Post-test group-A | Post-test group-B |
|---|---|---|
| Mean | 8.79 | 10.2 |
| SD | 0.643 | 0.432 |

**Inference:** Means of post AFL- agility test values of both the groups shows significant difference in the agility between both the groups stating that Group A agility improved significantly as compared to Group B ($p < 0.0001$).

## 4. Discussion

Plyometric exercises involve repeated rapid stretching and contraction of muscle to increase muscle power. Plyometric may help to train for agility in most of the sport in which constant running, jumping, squatting, lunges and changing position of the body is needed to play the sport [1]. This study intended to assess the effectiveness of plyometric exercises on the agility of male squash players. The plyometric training in this study was designed in such a way, that the intensity and complexity progressively increased over the weeks. It was given for 6 weeks, thrice a week on non-consecutive days as per ACSM recommendations [2].

There was greater improvement in the agility of group A that received plyometric training as compared to group B that received only conventional training. In particular, plyometric training significantly improved the agility, specifically it was found that the timing was improved in both T test and AFL-agility test.

Plyometric drills or exercises are based on stretch shortening cycle (SSC) [1]. A stretch reflex is utilized during many activities because most movements involve two phases of muscular contraction. Such components of stretch shortening cycle refer to a rapid eccentric muscle contraction followed by concentric contraction. During plyometric movement, the muscles undergo a rapid form of eccentric phase to concentric phase. This stretch shortening cycle decreases the time of the amortization phase that in turn allows greater than normal power production [6]. The muscle store elastic energy and stretch reflex responses are essentially exploited in this manner, permitting more work to be done by the muscle during the concentric phase of movement [2]. Plyometric exercises improves power output and increases explosiveness by training the muscles to do more work in a shorter amount of time. This is accomplished by optimizing the stretch-shortening cycle, which occurs when the active muscle switches from rapid eccentric muscle action (deceleration) to rapid concentric muscle action (acceleration) which goes hand in hand with studies of Adams *et al*, who also stated that Plyometric training is most effective in improving agility and performances as it enhances the ability of subjects to use the elastic and neural benefits of stretch shortening cycle [1]. In addition to the reliability of measurements in our study.

In the present study, a plyometric protocol comprising of drills mainly involving the trunk and lower extremities were used such as cone hops, single leg bounding, and jumps over barriers (with sudden direction changes) etc [6].

At the end of 6 weeks, there was an overall improvement in agility. The drills included sudden change in direction especially contributed to this such as hexagon drill, cone hops with change of direction, lateral jump etc., which probably lead to increase in components such as quicker reflexes, reduced reaction time, and increased rate of force development [7]. It enhances motor learning and neuromuscular efficiency promoting the excitability, sensitivity, and reactivity of the neuromuscular system to increase the rate of force production (power), motor-unit recruitment, firing frequency (rate coding), and synchronization, thereby contributing to increase in agility [2]. This is beneficial in playing a game like squash as to hit the ball the player needs to move all around the court to hit the ball which involves multiple sprints and change in direction.

The conventional training in the players that were part of the study comprised of basic ROM exercises, flexibility and sprints. The reasons for the increase in the agility of the control group that only received conventional training could be due to the flexibility and sprint training which are also components of agility, as well as indirect conditioning of the several other agility components during the matches played in this period [3].

Thus, Plyometric training plays an important role in improving agility and it should be a part of workout not only in squash but also in other sports where agility plays a key role.

Future studies can aim at observing long term effect of plyometric exercises on agility. Also, drills involving upper extremities may be incorporated.

## 5. Conclusion

This study shows that 6 weeks of both, plyometric training and conventional training are effective in improving agility. Although 6 weeks of plyometric training along with conventional training yields better improvement in agility compared to conventional training alone. Plyometric training plays an important role in improving agility and it may be considered as a part of workout not only in squash but also in other sports where agility plays a key role.

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