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Research Article

The effects of grass and clay plyometric training on jumping, sprinting and agility in collegiate cricketers

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Abstract
Aim: The aim of the study was to compare the effects of Plyometrics on Grass Versus Clay Surface on Jumping, Sprinting and Agility in Collegiate Cricketers
Design: Pre test-Post test same subject group Experimental design.
Methods: After random allocation, 24 players' completed 4 weeks of plyometric training, 12 players on clay surface and 12 players on grass surface. Before and after training, vertical jump, 40 yard sprint time and agility were measured.
Result: Independent t- test was used for data analysis. No significant difference was found between the clay surface and grass surface groups and both the groups showed similar improvements in all the three variables viz vertical jump, agility and sprint time.
Conclusion: Both the surfaces can be used to improve the athletes' performances.
Keywords: stretch shortening cycle, agility, jumping, sprint

1. Introduction

Cricket is a team game and cricketers have to performed different role as a bowler, fielder or as batsman in a same game which consists of intermittent activity during which players are required to repeatedly perform striding, sprinting, turning and jumping, which place considerable demands on the physiological and neuromuscular system[1,2,3]. Therefore, lower limb muscles ability to produce power is an important component of fitness for cricketers[4]. Plyometric training has been an effective method for the improvement of agility, sprinting, and jumping ability[5,6,7] and it has also been reported to improve running economy, joint stability, increased joint awareness and overall proprioception and decrease the severity of knee injuries[8,9] .

Plyometrics are training techniques used by athletes in all types of sports to increase strength and explosiveness or power[10] and plyometric is typically consists of rapid stretching of a muscle (eccentric action or lengthening phase) immediately followed by concentric or shortening (shortening phase) action of the same muscle and connective tissue this whole process called as stretch-shortening cycle[11]. The dynamic nature of plyometrics exercise transient forces impact on the musculoskeletal system and can result in injuries to lower limbs[10,12]. And for this reason it was considered that plyometrics exercises perform on firm surfaces (e.g. grass and wood), but a more recent studies shown that plyometrics training on different surfaces have different effects on stretch-shortening cycle and athletes performance[7].

In an attempt to evaluate the effect of surface type on plyometric training, several studies have compared plyometric training on different surface such as aquatic based plyometrics significantly increases muscle power, vertical jump, sprint and produce less muscle soreness then land group[9,13,14,15,16,17]. Another research compare Grass versus sand surface and conclude that grass shows better improvement in counter movement jump where sand shows a good improvement in squad jump[7].

Moreover studies on the effect of different surface on plyometric training shown that the type of surface such a typical gym mat can significantly influence joint kinematics which could influence the SSC mechanism [18,19]. Plyometric training in the form of DJ and CMJ performed on mini-trampoline may have a greater effect on enhancing the SSC mechanism compared to jumps performed on the ground [5]. Some study also done during the game to know the effect of surface during play, study shows that the court surface like clay influences the player's physiological responses (e.g. increase heart rate, lactic acid and oxygen consumption etc.) when compared to other surfaces like hard and resin surface and therefore surfaces can choose for different training session and need [20,21]. With attention to the vague and different results from the effect of plyometric training on different surfaces like water, grass, mat and land, and effect of clay surface on physiological parameters, this question existing that, how plyometric on clay can be effective to improve performance?

Therefore, the purpose of this study was to evaluate the effect of plyometric training on clay versus grass on jumping, sprinting and agility in collegiate cricketers.

2. Methods

2.1 Study design and subjects

A Pretest-Post test same subject group Experimental design was used. A total Twenty four amateur cricketers 18-25 years of male participated in this study, descriptive characteristics were given in table 1. After baseline measurement all the subjects were randomly assigned into two experimental groups; plyometric training on clay (clay group n=12) and plyometric training on grass (grass group n=12). Each experimental group consists of 12 participants in this study.

All the subjects were informed about the nature, purpose, and possible risk involved in the study and an informed written consent was taken from them prior to participation. The study was approved by an institutional ethical committee (IEC) Jamia Millia Islamia University, New Delhi, India. All subjects were familiarized with all testing procedures and plyometrics training prior to the commencement of the study.

Table 1. Mean ± SD (standard deviation) of Age, height, weight and BMI of Clay Surface and Grass

Parameters	Clay Group n=12 (Mean± SD)	Grass Group n=12 (Mean± SD)
Age(years)	21.75±1.8	21.33±1.6
Height(cm)	171.6±4.7	172.2±5.0
Weight(kg)	64.17±5.2	65.17±4.2
BMI [weight(kg)/height(m)^2]	21.7±1.3	21.99±1.2

2.2 Procedure

All subjects agreed not to change or increase their current exercise habits during the course of the study. The plyometric training group participated in a 4-week training program performing a variety of plyometric exercises designed for the lower extremity which include vertical jumping, Bounding, Broad jumping, and Drop jump shown in (Table 2)

After the baseline assessment training was completed on grass surface (natural grass used in cricket game in India) and clay surface (orange/red court use in lawn tennis). The plyometric training sessions were completed 3 times in a week, in addition of their technical-tactical and aerobic training. All the athletes were asked to exert a maximal intensity during all the training sessions. Recovery time between repetitions and sets were 15-30 seconds and 1-2 minutes respectively. During the 4 weeks training period athletes trained three times in a week and competed once a week in their official match, but no plyometric exercises or sprint or agility training were completed.

Table 2. Four week plyometric training programme modified from Impellizzeri *et al*, 2008[18].

Exercise	Week 1	Week 2	Week 3	Week 4
	Number of sets (number of repetitions)			
Vertical jumping	2 (10)	2 (10)	3 (10)	3(10)
Bounding	2(10)	2(10)	3(10)	3(10)
Broad jumping	2(10)	2(10)	3(10)	3(10)
Drop jump	2(10)	2(10)	3(10)	3(10)

2.3 Testing procedure

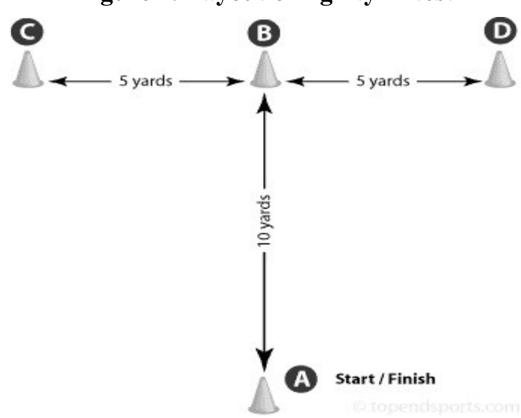
Participants attended a total of 4 data collection sessions. On the first visit a complete physical fitness was evaluated. Subjects who were suitable for participation in the study were requested to sign consent forms on the first day each participant attended an orientation session to become familiar with the testing procedures and warm up technique. The subjects performed 3 practice trials of each of the 3 functional tests to ensure proper technique. Three tests of functional performance, vertical jump, sprint and agility test were performed pre and post 4 weeks of plyometric training for both groups.

2.3.1 Jump test: Vertical jump test include sergeant jump test. The jump test was taken after a 15 minutes of warm-up consisting of low-intensity running, striding and self administrated sub maximal jumps. All jumps were taken with three trials of each jump test. The following procedure was used for each subject during data collection. The Vertical scale was adjusted to match the height of the individual subject by having them stand with the dominant side to the base of the testing devise. Their dominant hand was raised and the Vertical scale was adjusted so that their hand remains the appropriate distance away from the marker based on markings on the device itself. At that point, subjects perform a countermovement jump. starting from a standing position after which athlete was ask to jump as high as possible, Arm swings were allowed but no preparatory step was performed[22]. Jump height was estimate with the help of a wall mounted chart which marked with lines of 1cm apart that was fixed on the wall. The best result for jump will take for analysis. This test is reliable (r= 0.87) to measure the lower limb power [23].

2.3.2 Sprint test: 40-yard sprints (36.5m) sprint began with the subjects in a forward lunge position. Time was started when we said, "go" and stopped when the subject's foot touched the end line. Elapsed time was measured by hand, using a stopwatch accurate to 0.1 second. Subjects were instructed to perform test as fast as possible.[24]

2.3.3 Agility T-test was used to measure agility ability. In this procedure we Set out four cones as illustrated in the figure 1, (5 yards = 4.57 m, 10 yards = 9.14 m). The subject starts at cone A. On the command of the timer, the subject sprints to cone B and touches the base of the cone with their right hand. They then turn left and shuffle sideways to cone C, and also touch its base, this time with their left hand. Then shuffling sideways to the right to cone D and touching the base with the right hand. Then they shuffle back to cone B touching with the left hand, and run backwards to cone A. The stopwatch is stopped as they pass cone A. This test was taken after 30min of sprint test session with further warm-up consist of low intensity running. Three trials were taken and best one was used for analysis. T-test is reliable (R= 0.98 for 3 trails) to measure agility, power and speed of lower limb[25].

Figure 1. Layout of Agility T- test



2.4 Statistical analysis

Statistical analysis was done by using Microsoft windows (version SPSS 20). Mean and standard deviations (SD) of the demographic characteristics of age, height, weight, and Body Mass Index (BMI) were analyzed on application of independent t-test. The independent t-test was done to find the differences between the clay group and grass group for all variables i.e. agility, 40-yard sprints sprint and vertical jump test. Statistical significance was set a prior at $p < 0.05$.

3. Results

A total 24 male collegiate cricketers with mean ± standard deviation of age is 21.75 ±1.8 height 172.2 ± 5.0 and weight 65.17 ± 4.2. In the table 2 shows the results with mean ± standard deviation of the subjects of the clay and grass group in pre and post test phase. Vertical Jump height (cm), sprint performance (sec) and agility (sec) performance increases in both the groups but there was no significantly changes found in vertical jump, sprint performance and agility time between the group comparison significantly ($P<0.05$).

Table 3. Comparison of pre to pre test score and post to post test score between group (clay) to group (grass) with their t and p values

Test	Clay Group (Mean ± SD)	Grass Group (Mean ± SD)	t value	p* value
Agility T-test (pre)	12.29±1.01	12.70±0.9	-1.036	0.312
Agility T-test (Post)	12.08±0.9	12.39±0.86	-0.828	0.417
20 meters sprint (Pre)	3.46±0.26	3.49±0.26	-0.280	0.782
20 meters sprint (Post)	3.26±0.18	3.32±0.23	-0.795	0.435
Vertical jump test (Pre)	41.98±5.5	41.23±5.78	-0.325	0.748
Vertical jump test (Post)	44.65±5.4	43.3±5.75	-0.588	0.562

*level of significance was set at $p< 0.05$

The Mean ± S.D changes in variables of the subjects on the clay and grass group (pre and post test phase) showed that training surface had no meaningful difference on the vertical jump, agility and sprint performance between the experimental groups.

4. Discussion

The aim of this study was to compare the effect of plyometric training on clay versus grass on jumping, sprinting and agility in collegiate cricketers. In this study a 4-weeks of plyometric training programmed was done and all the three functional test was performed for both the group. The study showed that there is improvement in all the three performance within the group but there is no change between the experimental groups.

First finding of the study shows there is significant increase in vertical jump in both the groups that is clay group and grass group. Both group shows improvement in vertical jump when pre score of vertical jump was compared to post score of vertical jump. This result is in line with previous studies which found plyometric training improves vertical jump performance[8,26,27,28]. Plyometrics improved lower-body performance, especially in the areas of jump height and power[29]. And it is effective for increasing lower body anaerobic power like vertical jumping ability for both athletes and nonathletes[30,31,32,33,34]. Plyometrics exercises are not only effective in male it also effective in improving vertical jump in female[35].

The increase of vertical jump performance with plyometrics training is suppose to be due to plyometric training increases force and tension to the muscle cords and enhances motor unit recruitment, consequently improves leg extensor muscle activity and increases the counter moment jump[15]. Plyometric training modality results in an elevated maximum muscle fiber shortening speeds, which gain in maximum power production for isolated muscle fibers and increase briskness and created changes in muscle nervous system[34]. Neuromuscular factors (like changes in muscle fiber composition) related to efficiency of the stretch-shortening cycle and this induces different effects on athlete performance if related to different training surfaces[7] like plyometric training on sand produce less muscle soreness compared to training on grass[7].

The positive effects of plyometric training on jumping performance are a function of the stretch-shortening cycle phenomenon in which surface plays an important role[5]. However it was also seen that increase of two different vertical jump i.e. counter moment jump on grass surface improve more than sand surface and increase of squat jump on sand surface then grass surface [7], but this study did not show any influence of surface role on plyometrics training as both the groups improve similarly.

The second finding of this study demonstrate that plyometric training improve sprint time in both the groups. This finding is in line with Asadi et al, (2011) who found significant improvement in sprint (30 m) after plyometric training[15]. Several studies have suggested that plyometric training enhance sprint ability[36] it may be due to the use of SSC during jumping performance which has been shown to have a positively significant relationship to sprint[37]. In this variable (i.e.

sprint) study also shows no such difference found between the two surfaces, it may be because sprint improvement mainly depend upon type of exercises not the surface i.e., sprint-specific plyometric exercises like jumps with horizontal displacement can improve sprint performance to the same extent as standard sprint training, possibly by shortening ground contact time rather than using only one form of jump training[6]. The greatest improvement in sprinting will occur at velocity of muscle action that mostly closely approximates the velocity of muscle action of the plyometric exercise employed in training[38]. Other mechanism that improves sprint performance could be changes in stride length and stride frequency following plyometric training[38]. Biomechanical analyses of sprinting have shown that sprints greater than 50 m may depend upon elasticity of planter flexor muscles to a greater extent than do shorter sprints, which consist mostly of acceleration[15]. They further suggest that the acceleration phase is highly dependent upon reaction time and the athlete's ability to generate force and power during propulsion, and plyometrics increase strength and power[15].

Third finding of this study shows there is an increase in agility in both the clay group and grass group Plyometrics drills usually involve stopping, starting and changing direction in an explosive manner and these components can assist in developing agility [13,39,40,41,42] and plyometrics help in improving agility[40]. Agility training is thought to be a re-enforcement of motor programming through neuromuscular conditioning and neural adaptation of muscle spindles, Golgi-tendon organs, and joint proprioceptors[39]. Plyometrics training exhibit a marked improvement in all speed tests and vertical jump tests, leg strength and agility[28]. Miller et al (2006) has determined that plyometric training can be an effective training technique to improve an athlete's agility[40]. He said the plyometric training group reduced time on the ground on the posttest compared to the control group[40]. Both drop jump and counter moment jump plyometrics are worthwhile training activities that for improving power and agility[36]. The use of plyometrics training program is not only to break the monotony of training, but they can also improve the agility and strength of players[43].

Overall the main finding in this study is that plyometrics training performed on clay gives the similar improvement in sprint, agility and vertical jump performance as grass surface with no injury have occurred during the training and hence any of these surface can incorporated into cricket training regime to enhance the performance of athlete in terms of power, agility, and sprint by inducing the effects on neuromuscular factors related to efficiency of the stretch-shortening cycle.

5. Conclusion

The results of this study indicate that there is no significant difference in the effect of plyometric training on clay versus grass on vertical jump, agility and 40 yard sprint tests in collegiate cricketer. Plyometric training for both clay and grass group was equally effective in improving vertical jump, agility and sprint performance. Both the surfaces are shown to be significantly effective in performance enhancement of athletes. Consequently both surfaces can be used for improving power; agility and speed in collegiate cricketers. They can be also used as an alternative to each other.

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