Status of Selected Kinematic and Kinetic Parameters of Male Hockey Inmates of SAI Training Center

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ABSTRACT

Kinematic and kinetic parameters are widely being used to test the fitness of athletes for team as well as individual sports. For team sports like field Hockey, which require short bursts of running and sometimes sudden change of direction, throughout the game, it is necessary to access the ground reaction forces along with sprint timing and agility, to monitor the performance and to find out the basic loop holes in the performance. The purpose of this study was to compare selected kinematic (5m sprint acceleration run and agility) and kinetic (vertical jump on force platform) parameters of 22 male inmates of STC who participated in the study and were tested twice over a period of 6 months. Results of the successive testing revealed no significant difference in 5m sprint acceleration run and vertical jump performance, though their values are improved in the second phase of the testing. This shows improvement in the player's ability to apply force and accelerate quickly which is a prerequisite at every position in Hockey. However, the players recorded significant difference in the agility run during second phase of the testing as compared to the first one.

KEY WORDS

Kinematic, Kinetic, Agility, Sprint, acceleration, vertical jump, Take-off force, Take-off Velocity.

INTRODUCTION

Agility, Maximum running speed and acceleration are essential components in many different field sports including games such as Rugby, Football and field Hockey (Murphy et al, 2003 and Meir et al, 2001). Field Hockey is a sport, which has undergone quite rapid and radical changes within the past three decades. Today, Hockey is essentially a team game and has developed into a fast and highly skilful sport. The game includes short bursts of speed with rest, pauses or slow movements throughout the duration of the game. After the introduction of synthetic surface, the ball has started moving with a tremendous velocity. Accordingly, the players also have to be

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alert, quick, agile, having well developed co-ordination, postural reflexes, neuromuscular control and sufficient strength to generate optimum power and to prevent possible injuries. Although high-speed actions only contribute to about 11% of the total distance covered, they in fact constitute the more crucial moments of the game and contribute directly to winning possession of the ball and to scoring or to conceding of goals (Little & Williams, 2005; Reilly et al, 2000). A very high level of physical fitness is demanded of a player to exploit his individual skills to the full.

Running speed over short distances is a fundamental quality, necessary in various sports. A successful sprinter has to react quickly, accelerate for as long as possible, reach the highest possible running speed, maintain this for as long as possible and minimize the loss of velocity caused by fatigue (Smirniotou et al, 2008). However, Maximum Velocity is important in field sport performance, it is generally accepted that acceleration ability is of greater significance as players rarely cover large enough distances during sprint efforts to reach top speed (Murphy et al, 2003; Reilly, 1997; Reilly & Borrie,1992).Acceleration is physically defined as the rate of change in velocity. However, in a practical sense, particularly among applied sport scientists and coaches, acceleration ability is often referred to as sprint performance over smaller distances such as 5m or 10m, and assessed using sprint time or velocity (Murphy et al, 2003). During a game, professional field sport players perform about 50 turns, comprising sustained forceful contraction to maintain balance and control of the ball against defensive pressure (Wisloff et al, 2004).

Kinematic studies have established that this high-intensity activity occurs relatively infrequently during competition (Meir et al, 2001), these bursts of maximal effort tend to be concentrated around crucial match actions such as making a break away from the opposition or a during tackle (Rienzi et al, 2000; Meir et al, 2001). In particular, quickness over the first few steps of a sprint are viewed as being vitally important during a game (Penfold & Jenkins, 1996). Power is the basic element in striking and sprinting (Sleivert & Taingahue 2004). Increased strength causes increased ability to apply force. Therefore, if velocity remains constant, increased strength contributes to power (Harris et al, 2008). Strength contributes to agility, which is defined as ability to break the speed, change direction and accelerate again (Little & Williams, 2005). A great interest exists for developing field tests and specific training programs that can effectively measure and improve agility. The majority of tests supported to assess agility are tests based on change of direction speed [e.g., the T-test (Sassi et al. 2009 & Pauole et al, 2000), shuttle run test, the Illinois agility test, the 505 test (Sassi et al, 2009), the L-run test (Meir et al, 2001), and the zigzag test (Little & Williams 2005)]. The most used test to assess agility was the T-test (Gabbett et al, 2009; Miller et al, 2006; Peterson et al, 2006 and Pauole et al, 2000) and shuttle run test (Sassi et al, 2009). They are well accepted as a standard test of agility (Paul et al, 2016). They are simple to administer and requires minimal equipment and preparation. The Shuttle run involves speed with directional changes. It is moderately correlated with the speed tracking, force production and the vertical jump (counter movement jump).

Vertical jumping ability is of considerable importance in many field events. Coaches and physical educators have applied various training methods to improve this ability (Bobbert et al, 1986). Vertical jumping performance is determined by a complex interaction among several factors including maximal force capacity, rate of force development, muscle coordination and stretch shortening cycle (SSC) use (Arabatzi et al, 2010). The fact is well supported by Weyand et al, 2000 that faster top running speed are achieved with greater ground reaction forces not more rapid leg movements (Weyand et al, 2000). Even Hunter et al, 2005 has found a positive relation between ground reaction force impulse and Kinematics of sprint running acceleration. Vertical jump test on force platform is one of the most relevant test to measure ground reaction forces (Linthorne, 2001).

The purpose of the present study was to test 5m acceleration run, agility and ground reaction forces of male Hockey inmates from SAI training center with a view to identify their most critical parameters of fitness considered necessary for better performance on the field.

METHODOLOGY

Subjects

Total of 22 male Hockey trainees (n=22) from SAI (Sports Authority of India) training center, Patiala, were taken for the study. The mean age and weight of the participants were 14.8±4.63 years and 56.77±14.86 Kg, respectively, at the time of study. The study was designed to compare agility, 5m acceleration run and vertical jump performance among same participants from two successive testing conducted after the period of six months.

Equipment

The force platform (KISTLER 9281EA) was used to find out the force production during counter movement vertical jump. The force platform with inbuilt amplifier is connected to a computer through 16 ch DAQ System from where digital data can be extracted. Running timer (Swift speed light SL OPT-0101) was used to record the time at various distances during shuttle run.

Procedure

The participants and their coach was instructed regarding the procedure prior to the test. Participants were required to wear proper sports clothing including sports shoes. Five minutes warm up session was given to the participants before commencement of the test. The participants will be then instructed to perform 6x10 meter shuttle run and counter movement vertical jump (CMJ) on force platform.

For 6x10m shuttle run test, ten-meter distance was marked by two parallel line of 1.5m width. The participant stands behind the starting line at one end and on the signal, he had to run as fast possible to the other end of the marked track and touch the line with foot, turn and back to the starting line, touch it with foot again. Turn and repeat it for total of six times. Gates of Speed light running timer were placed at distance of 5m from the starting line, so that time taken to first 5m (acceleration run) is recorded. Shuttle run was followed by countermovement vertical jump (CMJ) on force platform which was set at the frequency of 200Hz. While performing vertical jump, participants were instructed to keep hands on their waist in order to minimize the use of arm swing for jump and to maintain the uniformity of the jump.

The data from running timer is recorded in the recording unit connected to gates via cable and RJ connector. Time taken for first 5m by the participants were recorded directly from the recording unit. The parameters of vertical jump were recorded from computer connected to force platform via Bioware software. The data were then extracted on data collection sheet for further calculations.

Statistical analysis

Statistical analysis was performed using SPSS software (version 21.0. SPSS. Inc., II,). Paired sample T-test (2-tailed) was used for mean comparison and level of significance between the pairs. The significance level was set at $p \leq 0.05$.

RESULTS & DISCUSSION

Table-1: Mean values and p values of the selected parameters tested twice on same participants.

S. No.	Variables tested	Testing 1 (Mean ± SD)	Testing 2 (Mean ± SD)	*t*-value
1	5m sprint acceleration run (s)	1.8650 ± 0.08	1.8605 ± 0.13	0.180
2	60m agility run (s)	17.1895 ± 0.63	16.4941 ± 0.62	4.942*
3	Take-off Force (N)	1218.42 ± 337.81	1276.07 ± 351.42	-0.940
4	Take-off Velocity (m/s)	2.1182 ± 0.14	2.22 ± 0.14	-2.377*
5	Jump Height (cm)	29.69 ± 4.31	31.60 ± 3.92	-1.472

* Significant at 0.05 level with df (21) = 2.074

Results of the successive tastings revealed no significant difference in 5m sprint acceleration run and vertical jump performance, though their values are improved in the second phase of the testing. This shows improvement in the player' s ability to apply force and accelerate quickly which is a prerequisite at every position in Hockey. However, the players recorded significant difference in the agility run during second phase of the testing as compared to the first one.

Table 1 shows the significance of mean differences between successive testing of same athletes. The obtained t-value for time taken at 5m, take-off force (strength), and jump height is not found to be significant at 0.05 level of significance while take-off velocity and time taken at 60m is found to be significant, as the t-value is more than the tabulated value i.e., 2.074.

Similar findings have been reported previously by (Wisloff et al, 2004 and McBride et al, 2009). A relationship between ground reaction force capabilities and sprinting abilities has been previously established (Hunter et al, 2005 ; McBridge et al, 2009). Thus, the strength of the lower-body musculature appears to play a role in maximal sprinting velocity. The data from these investigations further support the concept of maximizing lower body strength to improve sprinting ability in athletes. Sprint ability over short distance and longer distance are considered by many researchers and practitioners to require separate and specific strength qualities and therefore training techniques (Harris et al, 2008 ; Young et al, 2001).

It is generally considered that shorter sprints require greater contributions of concentric muscle contractions and knee extensor activity versus longer sprints that are characterized by greater stretch shortening cycle (SSC) and hip extensors activity (Harris et al, 2008).

Previous investigators like Hunter et al, 2005 correlates ground reaction forces and net impulse with sprinting velocity while McBridge et al, 2009 and WIsloff et al, 2004 reported strong statistically correlation between short distance sprint times and squat 1RM. There may be the scope of further investigation in the current study. Investigators provides additional evidence of the importance of lower body strength in maximal sprinting performance. The amount of evidence indicating the importance of lower body strength continues to increase. It is speculated that a focus of resistance training should be increasing lower body structural multiple joint movements of strength. These investigations clearly show that a substantial commitment to increased lower body strength has a high likelihood of contributing to increased on field sprinting ability.

The greater maximal frequency of runners could be achieved by reducing the portion of the stride, the foot is in contact with the ground rather than the portion taken to swing the limb into position for the next step. Similarly, longer stride does not necessarily require longer legs. At top speed, human sprinters take stride considerably longer than those of the non-sprinters. One mean of achieving longer stride would be to apply greater support force to the ground.

At any speed, applying greater force in opposition to gravity would increases a runner's vertical velocity on take-off, thereby increasing both the aerial time and forward distance travel between steps.

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