Advances in Physics Theories and Applications
ISSN 2224-719X (Paper) ISSN 2225-0638 (Online)
Vol.38, 2014
www.iiste.org

Two Dimensional Kinematic Analysis of Set position to First Step with Sprinting Performance of University Athletes

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Abstract
The purpose of the study was to assess the effect of kinematical selected parameters of set position to first step with sprinting performance of University athletes. Six (3 Intervarsity and 3 Intercollegiate level) athletes of Lakshmibai National Institute of Physical Education, NERC, Guwahati has been selected for this study. The mean and standard deviation (SD) of sprinters were age (20.64, 1.64), height (1.73.13 cm, 5.84), weight (61.14 kg, 3.44), arm length (62.00 cm, 3.72) and leg length (93.33 cm, 2.71). For acquiring two-dimensional kinematical data, each subject was asked to warm-up for at least 15 minutes by stretching all major muscle groups for better performing the first step during block start. Biokin-2D motion analysis system V4.5 can be used for kinematical analysis of Set position to First Step on Block Start Sprinting Performance. A standard motion driven camera i.e. handy camera of Sony Company, which frequency of the camera was 50 frame/ second. Even though this camera register photograph, at the moments from set position to first step was selected for the purpose of analysis. The photographic sequence was taken under controlled condition. The distance of the camera from the subjects was 10 mts away and was fixed at one-meter height. The alpha level of significance was set at $p<0.05$ for all statistical tests. The result was found that Intervarsity and Intercollege athletes in there, Trajectory Knee, Trajectory Ankle, Displacement Knee, Displacement Ankle, Linear Velocity Knee, Linear Velocity Ankle and Linear Acceleration Ankle whereas insignificant difference was found between Intervarsity and Intercollege in their Linear Acceleration Knee joint of set position to first step with sprinting performance.
Keywords: 2D Kinematic Analysis, Set Position to First Step, Sprinting Performance

1. Introduction

The biomechanical analysis constitutes today a revolutionary assisting means for recording analysis both qualitative and quantitative and improvement of human movement. With the development of photography, it becomes possible to capture image sequences which reveal details of human motion that are not noticeable by watching the movement with naked eye. The improving performance trends in the sprint event are to some extent the result of improving block starting and running technology. Biomechanics is an applied form of mechanics, and consequently the methods used to investigate it must be derived from those of mechanics. However the mechanics have not developed in the wake of mechanics, but a bordering science in other scientific discipline such as anatomy, physiology and the techniques of sport (Gerlord**,** 1984).

So, people who are working in this field should have a basic knowledge about how a body moves, what are the major groups of muscles, joint and in what proportion and degree they are to be used to get an optimum output. The approach can provide an understanding of the nature of any skill, their economic way of execution, and their dependent factors, which in turn, can build into an awareness of the larger scheme of economic movement (Cloude et al, 1992).

Over the years, new techniques in filming and timing having been perfected to aid the research in achieving accurate time measurement of both simple and complex locomotion patterns(John et al, 1971).

Sprinting involves a quick acceleration phase followed by a velocity maintenance phase. During the initial stage of sprinting, the runners have their upper body tilted forward in order to direct ground reaction forces more horizontally. In the sport of track and field, athletes that compete in running events are considered either sprinters or distance runners. Sprinters, whose events are based on power, differ greatly from more economical distance runners in both physical appearance and running biomechanics (Bushnell, 2004).

Sprinting is characterized by any event that emphasizes speed and power (Cloude, et al, 1992; Mero, 1992).

Sprinting events are divided into three main phases: acceleration, top speed, and deceleration (John et all, 1971; Novacheck, 1998).

The acceleration phase is characterized by aggressive, powerful running form used to build the momentum needed to overcome inertia and achieve maximum velocity. (Bushnell, 2004; Mero, 1992; Novacheck, 1998; Markovic 2007 and Eggerth 2010).

2. Methodology

2.1 Selection of Subjects

A total Six (3 Intervarsity and 3 Intercollegiate level) athletes of Lakshmibai National Institute of Physical Education, NERC, Guwahati has been selected for this study. The mean and standard deviation (SD) of sprinters were age (20.64, 1.64), height (1.73.13 cm, 5.84), weight (61.14 kg, 3.44), arm length (62.00 cm, 3.72) and leg length (93.33 cm, 2.71).

2.2 Collection of Data

The data collected by the help of Biokin-2D motion analysis system V4.5 method and the sprinting performance of the subject in athletic.

2.3 Filming Procedure

Biokin motion analysis can be used for kinematical analysis of Set position to First Step on Block Start Sprinting Performance. A standard motion driven camera i.e. handy camera of Sony Company, which frequency of the camera was 50 frame/ second. Even though this camera register photograph, at the moments from set position to first step was selected for the purpose of analysis. The photographic sequence was taken under controlled condition. The distance of the camera from the subjects was 10 mts away and was fixed at one-meter height. The performance of sprinters were measured manually hand timing with stopwatch for each subject. Before data acquisition subjects were asked to go for complete warm-up. After warming up all the athletes have to perform 100 meters sprint and the time recorded in 1/1000 of the seconds for each athlete was selected for further analysis.

3. Data Analysis

The photographs as obtained by the use of digital photograph were analyzed (1/1000 sec) by standard analysis method. With the help of Biokin-2D motion analysis computer software we can measure the dimension of each photograph with the help of which various kinematical variables were calculated.

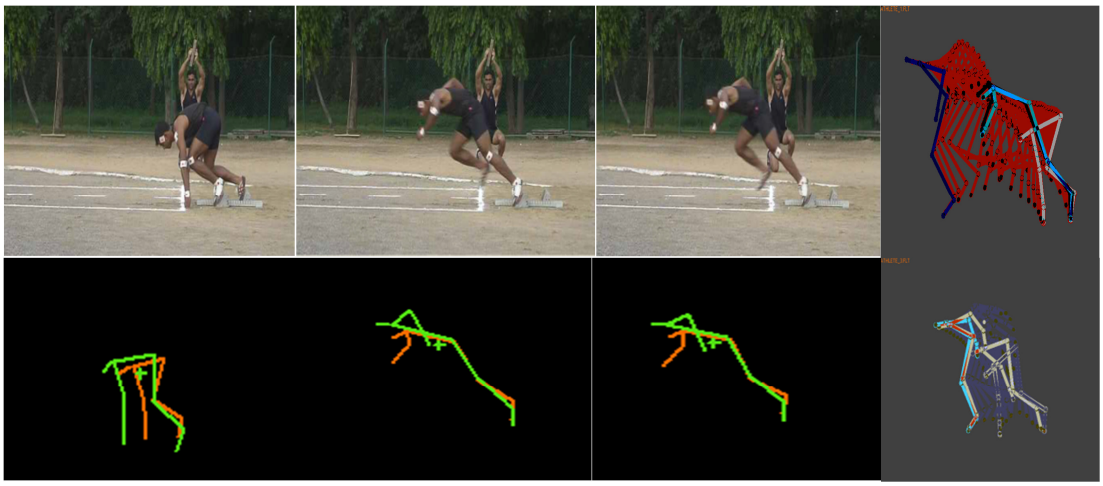

Figure 1 Photo and Stick Figure from Set Position to First Step

4. Statistical Analysis

To infer any endeavour there is a requirement of an appropriate statistical treatment. In this study a t test was used to analyse the data and to infer the difference between intervarsity and intercollegiate male sprinters.

5. Results

The main purpose of this study was to determine kinematic difference between set position and first step on block start with sprinting performance of Lakshmibai National Institute of Physical Education and find out those variables which are given positive contribution in sprinting performance. The analysis of the data and results of the study have been presented on five sprinters. T –test were used to find out differences and relationship between Start and sprinting performance.

Table 1 Descriptive Statistics of selected kinematical parameters

Group	Mean/ SD	Kinematical Variables							
		TK (m)	TA (M)	DK (M)	DA (M)	LVK (m/s)	LVA (M/S)	LAK (m/s^2)	LAA (m/s^2)
Intercollegiate	Mean	1.85	1.98	0.031	0.038	1.31	1.34	0.53	1.25
	SD	0.51	0.57	0.07	0.09	2.31	2.07	18.13	32.17
Intervarsity	Mean	1.95	2.22	0.031	0.003	1.91	2.31	7.86	11.85
	SD	0.45	0.46	0.20	0.11	2.85	3.88	26.30	39.19

TK=Trajectory Knee, TA= Trajectory Ankle, DK= Displacement Knee, DA= Displacement Ankle, LVK= Linear Velocity Knee, LVA= Linear Velocity Ankle, LAK= Linear Acceleration Knee, LAA= Linear Acceleration Ankle.

As indicated in Table-1 Intervarsity athletes have longer trajectory Knee Joint (1.95 m) and Trajectory Ankle Joint (2.22) as compare to Inter college athletes (1.85 m) and (1.98 m), that might be the reason the Linear Velocity Knee (1.91 m/s), Linear Velocity Ankle (2.31 m/s), Linear Acceleration Knee (7.86 m/s^2) and Linear Acceleration Ankle (11.85 m/s^2) is greater than Intercollege (1.31 m), (1.34 m), (0.53 m/s^2) and (1.25 m/s^2) athletes. The Displacement of Knee joint and Displacement of ankle joint in grater in Intervarsity athletes respectively.

Table 2: Independent 't' value of selected parameters between intervarsity and intercollege athletes

Parameters	Calculated 't' value
TK	3.43*
TA	7.71*
DK	3.34*
DA	3.39*
LVK	3.11*
LVA	3.44*
LAK	2.56
LAA	3.23*

***Significance at 0.05 level of confidence with 4 df Tab 't' = 2.77**

As showed in the Table 2 there were significant differences found between Intervarsity and Intercollege athletes in there, Trajectory Knee, Trajectory Ankle, Displacement Knee, Displacement Ankle, Linear Velocity Knee, Linear Velocity Ankle and Linear Acceleration Ankle whereas insignificant difference was found between Intervarsity and Intercollege in their Linear Acceleration Knee joint.

6. Discussion

The main purpose of this study was to determine kinematical differences between Intervarsity and Intercollege athletes of Lakshmibai National Institute of Physical Education, nerc, Guwahati, Assam. Result show that Trajectory, displacement linear velocity, linear acceleration of knee and ankle joints of the sprinter, one boy and one girl was is better position in quantitative evaluation. The result was visualized using graphs, stick figures and videos simultaneously on screen to measure and distance or angle. Sequential photograph had showed qualitative evaluation.

The length of acceleration was determined by the starting position of the knee and when the body is almost fully stretched. In other to achieved best acceleration sprinter adopts the correct knee bent angle in set position at the beginning of the acceleration. In the case of Intervarsity and Intercollege sprinters set position was correct would have helped them to achieve lower Trajectory, better displacement and good velocity of the knee and ankle joint.

The Intervarsity athletes have longer trajectory Knee Joint (1.95 m) and Trajectory Ankle Joint (2.22) as compare to Inter college athletes (1.85 m) and (1.98 m), that might be the reason the Linear Velocity Knee (1.91 m/s), Linear Velocity Ankle (2.31 m/s), Linear Acceleration Knee (7.86 m/s^2) and Linear Acceleration Ankle (11.85 m/s^2) is greater than Intercollege (1.31 m), (1.34 m), (0.53 m/s^2) and (1.25 m/s^2) athletes. The Displacement of Knee joint and Displacement of ankle joint in grater in Intervarsity athletes respectively than previous study reported by (Bartlett 2012, Nichol 2005, and Mosquera et al, 2007) indicate approximately good technique.

7. Conclusions

Trajectory Knee, Trajectory Ankle, Displacement Knee, Displacement Ankle, Linear Velocity Knee, Linear Velocity Ankle and Linear Acceleration Ankle whereas insignificant difference was found between Intervarsity and Intercollege in their Linear Acceleration Knee joint of set position to first step with sprinting performance.

8. Acknowledgements
Authors would like to thank department of sports Biomechanics, Lakshmibai National Institute of Physical Education, Gwalior (Madhya Pradesh) for providing assistance in collecting the relevant information for undertaking quality research.

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