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Effect of Sprinting Ability during Start on the Performance 100 meters: A Kinematic Study

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Abstract— The purpose of the study was to assess the effect of 2D kinematical selected variables on sprint start with Sprinting Performance of Novice Athletes. Six (3 National and 3 State level) athletes of Sports Authority of India, Guwahati has been selected for this study. The mean (M) and standard deviation (SD) of sprinters were age (17.44, 1.55), height (1.74. m, .84 m), weight (62.25 kg, 4.55), arm length (65.00 cm, 3.72) and leg length (96.35 cm, 2.71). Biokin-2D motion analysis system V4.5 can be used for acquiring two-dimensional kinematical data/variables on sprint start with Sprinting Performance. For the purpose of kinematic analysis a standard motion driven camera which frequency of the camera was 60 frame/ second i.e. handy camera of Sony Company were used. The sequence of photographic was taken under controlled condition. The distance of the camera from the athletes was 12 mts away and was fixed at 1.2-meter height. The result was found that National and State level athletes significant difference 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 National and State level athletes in their Linear Acceleration Knee joint on sprint start with sprinting performance. For all the Statistical test the level of significance was set at $p<0.05$.

Keywords— 2D Kinematic Analysis, Sprinting Ability, Sprinting Performance

I. INTRODUCTION

The most powerful nations of the world namely USA, Russia, France, Australia, China etc are strong enough not only in World Economics, Army Strength or in science technology but they are also advanced in the field of sports, therefore it is quite apparent that to exist strongly in world map nation has to be advanced in the field of sports also. To achieve the same adoption of new techniques and methodology is highly required in Sports Sciences and Physical Education. Sciences of applied mechanism are fulfilling these demands of high technological knowledge for the enhancement of performance in the field of sports.

Sprinting includes a rapid acceleration phase followed by a maintenance pace (constant velocity). During the early stage of sprinting, the runners have their upper body tilted forward in order to get ground reaction forces more horizontally. Sprinters, whose events are based on power, differ greatly from more economical distance runners in both physical appearance and running biomechanics. Sprinting is product of stride length and frequency of stride that emphasizes speed and power. Sprinting events are divided into three main phases: acceleration, maintenance, and deceleration. The acceleration phase is characterized by aggressive, powerful running form used to build the momentum needed to overcome inertia and achieve maximum velocity. In the last few decades, much has been added to ours scientific knowledge of biomechanics, a science concerned with the internal and external forces acting on the human body and the effects produced by these forces and activity of the muscles. At the highest levels of sports in which techniques play a major role, improvement comes so often from careful attention to detail that no coach can afford to leave these details to chance or guesswork. For such coaches knowledge of biomechanics might be regarded as essential.

II. MATERIALS AND METHODS

A. Subjects

A total Six (3 National and 3 State level) athletes of Sports Authority of India, Guwahati has been selected for this study. The mean (M) and standard deviation (SD) of sprinters were age (17.44, 1.55), height (1.74. m, .84 m), weight (62.25 kg, 4.55), arm length (65.00 cm, 3.72) and leg length (96.35 cm, 2.71).

B. 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 during sprint start in athletic.

C. Filming Procedure

Biokin-2D motion analysis system V4.5 can be used for acquiring two-dimensional kinematical data/variables on Sprint Start with Sprinting Performance. For the purpose of kinematic analysis a standard motion driven camera which frequency of the camera was 60 frame/ second i.e. handy camera of Sony Company was used. The sequence of photographic was taken under controlled condition. The distance of the camera from the athletes was 12 mts away and was fixed at 1.2 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 for at least 15 minutes by stretching all major muscle groups for better performing the sprint start. 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.

D. Data Analysis

The data was collected with the help of digital photography, the photography were analysed (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 during sprint start.

III. STATISTICAL ANALYSIS

To determine the effect of selected kinematic variables on sprint start with the sprinting performance of subjects. The data of this study was analyzed by using a t-test to infer the difference between national and state level Sprinters. The level of significance was 0.05.

IV. RESULTS

The purpose of this study was to determine kinematic difference between on sprint start with sprinting performance of sprinters of Sports Authority of India, Guwahati and find out those variables which are given positive contribution in sprinting ability and sprinting performance. The results and analysis of the data of the study have been presented on six sprinters. Independent t –test were used to find out differences and relationship between sprint start and sprinting performance.

TABLE 1 DESCRIPTIVE STATISTICS OF SELECTED KINEMATICAL PARAMETERS

Variables	State Level		National Level	
	Mean	SD	Mean	SD
TJK (m)	1.81	0.52	1.88	0.55
TJA (M)	1.88	0.59	2.28	0.46
DPK (M)	0.033	0.09	0.035	0.22
DDA (M)	0.035	0.09	0.003	0.12
LVK (m/s)	1.32	2.32	1.93	2.86
LVA (M/S)	1.37	2.17	2.32	2.82
LAK (m/s^2)	0.49	17.13	6.86	24.31
LAA (m/s^2)	1.45	30.11	10.84	37.16

TJK=Trajectory Knee, TJA= Trajectory Ankle, DPK= Displacement Knee, DDA= Displacement Ankle, LVK= Linear Velocity Knee, LVA= Linear Velocity Ankle, LAK= Linear Acceleration Knee, LAA= Linear Acceleration Ankle.

As indicated in Table-1 National level athletes have longer trajectory Knee Joint (1.88 m) and Trajectory Ankle Joint (2.28) as compare to state level athletes (1.81 m) and (1.88 m), that might be the reason the Linear Velocity Knee (1.93 m/s), Linear Velocity Ankle (2.32 m/s), Linear Acceleration Knee (6.86 m/s^2) and Linear Acceleration Ankle (10.84 m/s^2) is greater than state level (1.32 m), (1.37 m), (0.49 m/s^2) and (1.45m/s^2) athletes. The Displacement of Knee joint and Displacement of ankle joint in grater in National level athletes respectively.

As showed in the Table 2 there were significant differences found between National level and State level 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 National level and State level athletes in their Linear Acceleration Knee joint.

TABLE 2: INDEPENDENT 'T' VALUE OF SELECTED PARAMETERS BETWEEN NATIONAL LEVEL AND STATE LEVEL ATHLETES

Parameters	**Calculated 't' value**
TJK	3.23*
TJA	5.71*
DPK	4.34*
DDA	3.59*
LVK	3.13*
LVA	3.34*
LAK	2.45
LAA	3.53*

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

V. DISCUSSION

The main purpose of this study was to find out kinematical differences between National level and State level athletes of Sports Authority of India, Guwahati, Assam. The sequential photography technique was employed to record the kinematic variables. Result show that Trajectory, displacement linear velocity, linear acceleration of knee and ankle joints of the sprinters was is better position in quantitative evaluation. From the photographs, the stick figures were prepared by using Joint-point Method, and various kinematic variables were obtained at the moment start the sprinting.

The length and duration of acceleration was unwavering by the starting position of the knee and when the body is almost fully stretched. In other to attained quick acceleration sprinter adopts the correct knee bent angle during start at the beginning of the acceleration. In the case of National level and State level sprinters position of set was correct would have helped them to attain lower and lesser Trajectory, improved displacement and good velocity of the knee and ankle joint.

The National level athletes have longer trajectory Knee Joint (1.88 m) and Trajectory Ankle Joint (2.28) as compare to state level athletes (1.81 m) and (1.88 m), that might be the reason the Linear Velocity Knee (1.93 m/s), Linear Velocity Ankle (2.32 m/s), Linear Acceleration Knee (6.86 m/s^2) and Linear Acceleration Ankle (10.84 m/s^2) is greater than state level (1.32 m), (1.37 m), (0.49 m/s^2) and (1.45m/s^2) athletes. The Displacement of Knee joint and Displacement of ankle joint in greater in National level athletes respectively.

VI. CONCLUSION

Findings of this exploratory study suggest that the National and State level athletes significant difference 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 National and State level athletes in their Linear Acceleration Knee joint on sprint start with sprinting performance. For all the Statistical test the level of significance was set at $p<0.05$.

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