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Effect of Block Spacing on Acceleration Speed

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Abstract: Sprint is considered as a form of running where an individual runs the race with maximum possible speed. In track and field athletics sprint is considered to be an important area of competition at different levels. Proper and technically correct start at the initial phase is of immense importance for an efficient sprinting. For the races from 100m to 400m the athletes are forced to use crouch start in competition. There may be a number of variations in crouch start depending upon the foot spacing. They are identified as bunch, medium and elongated. The purpose of the study was to analyze the effect of foot spacing in crouch start on the initial acceleration of a sprint race. A total of 20 boys and 12 girls were selected as subjects for the present study. Among boys ten were trained athletes and ten were untrained. Among girls six were trained athletes and six were untrained. For collecting data three different feet spacing namely 12 inches, 16 inches and 20 inches were selected. In order to determine the initial velocity of the athletes the time taken to cover first 5 meters and 10 meters from start were recorded. From these distance and time information velocity at 5 meters and 10 meters were calculated. These velocities from different foot spacing were analyzed statistically to reach conclusion. It was seen from the study that medium (16 inches) start produced better results in case of boys where as in case of females elongated (20 inches) start produced better results.

Key Words: *Sprint, Block Spacing and Crouch Start.*

Introduction:

The basic techniques of sprint involve start, running proper and finish. According to rules the race should be started from a motionless position. So, the starting technique is very important

to begin the race. It is agreed that if a runner can come out of the starting position a fraction of second earlier, he will definitely win the race when the other contestants are of similar caliber. There are two different types of starting techniques used by the runners. They are – standing start and crouch start. In standing start the athlete assumes a stationary standing position to start a race. According to rules standing start can be used only for the races more than 400 meters. In sprint race crouch technique of start is mandatory. To make this start effective athletes use starting blocks. There are three different types of block spacing used by athletes. Selection of block spacing for an individual athlete depends on his neuro-motor ability as well as physical structure. In general, the rear block is placed at a distance of about 3 feet from the starting line. When the front block is placed in such a way that the distance between starting line and front block becomes longer (20 inches) and the distances between two blocks becomes 1 feet, it becomes a bunch start. When on the other hand, the distance between two blocks becomes equal (15-18 inches) to the distance between starting line and first leg, it becomes a medium start. In elongated start the front foot is placed comparatively nearer to the starting line at a distance of 12-14 inches behind the starting line. The distance between two blocks remains 20-24 inches.

A lot of research works have been completed in the area of biomechanical analysis to analyze the effect of different types of start on the initial velocity and acceleration in the sprint race. Experts opined that the effects of these three different block spacing on initial acceleration of the athlete are different. According to the available knowledge the bunch start helps the athletes to get out of the block in a fastest manner possible but the athlete finds difficulties to maintain balance after start. On the other hand, with elongated spacing the athlete gets out the block slower but is able to apply leg power and maintain balance during initial phase of sprint race. The medium spacing is the compromise between these two in respect of achieving initial velocity and acceleration as well as maintaining balance. There are factors which influence the selection of the type of start among which leg length. Leg explosive power, coordinative ability of the runner is important. In spite of a number of attempts already completed it is still required to investigate the effect of foot spacing on the initial velocity of sprint race.

Methodology:

The subject- A total of 20 boys and 12 girls were selected as subjects for the present study. Among boys ten were trained athletes and ten were untrained. Among girls six were trained

athletes and six were untrained. They have practical activity session for one hour in the morning and two hour in the afternoon on five days in a week. The athlete group of subjects was from the specialized activity group of track and field athletics. The untrained athlete subjects were from other activity group of specialization swimming.

Experimental protocol-To study the effect of foot spacing on the starting velocity of sprint race the subjects took start using three different foot spacing. The angle of the blocks remained same for all the foot spacing. The selected foot spacings were 12 inches, 16 inches and 20 inches.

At first the subjects of a group completed the start of 12 inches foot spacing. Timekeepers were posted at the distance of 5meters and 10 meters from the start. Each subject completed three trials for this foot spacing. The mean timing for the distances of 5 meters and 10 meters were considered as the performance of the subject for that foot spacing. The total procedure was repeated for the other foot spacings that is, 16 inches and 20 inches. For collected data a synthetic standard track was used. The data for the different groups was collected in four successive training sessions. The environmental condition was same for all the cases.

Analytical procedure-The collected data were analyzed using appropriate statistical procedure. The mean was calculated to analyze the central tendency. The standard deviation was calculated to study the variability of the subject.The difference among the mean values was tested by using one way Analysis of variance (ANOVA). The exact location of the difference was identified by using post hoc test.

Result and Discussion:

In the present study there were four groups of subjects- trained athlete group (boys), untrained athlete group (boys), trained athlete group (girls), and untrained athlete group (girls). For better understanding the data of different groups have been presented separately.

While analyzing the mean values of the time and velocities of trained athlete (boys), it appears that the group mean to cover 5 meters with foot spacing of 12 inches, 16 inches and 20 inches were 1.28±0.93sec, 1.31±0.13sec and 1.29±0.16sec respectively. The mean velocity at 5 meters with these foot spacing were $3.93\pm0.27ms^{-1}$, $3.85\pm0.38ms^{-1}$ and $3.91\pm0.45ms^{-1}$ respectively. Similarly the mean value of the time taken to cover 10 meters distance with foot spacing of 12 inches, 16 inches and 20 inches were 1.97±0.13sec, 1.97±0.15sec and 1.94±0.15sec respectively. The mean velocity at 10 meters with these foot spacing were $5.05\pm0.43ms^{-1}$, $5.09\pm0.37ms^{-1}$ and $5.18\pm0.37ms^{-1}$ respectively. The result suggests that the adoption of medium block spacing is preferred. The sprinter must be

capable of developing a high force rate combined with a high maximum force, especially in the horizontal direction. This ability to create high force underlies other important indicators of starting performance such as minimum block clearance time, maximum block leaving velocity and maximum block leaving acceleration. The result was identical with the work conducted by Harland et al (1997).

In case of untrained athlete (boys), it appears that the group means to cover 5 meters with foot spacing of 12 inches, 16 inches and 20 inches were 1.55±0.08sec, 1.33±0.17sec and 1.32±0.15sec respectively. The mean velocity at 5 meters with these foot spacing were 3.23±0.18ms^{-1}, 3.82±0.51ms^{-1} and 3.77±0.42ms^{-1} respectively. Similarly the mean value of the time taken to cover 10 meters distance with foot spacing of 12 inches, 16 inches and 20 inches were 2.31±0.10sec, 2.24±0.16sec and 2.21±0.07sec respectively. The mean velocity at 10 meters with these foot spacing were 4.35±0.20ms^{-1}, 4.48±0.33ms^{-1} and 4.53±0.14ms^{-1} respectively. In order to obtain significant difference among various group means Anova was done and the F value was significant. It is seen from the post hoc test that the mean velocity for 12 inches foot spacing was significantly lower than both of 16 inches and 20 inches values. However, there is no statistically significant difference between the mean velocity of 16 inches and 20 inches foot spacing.

While analyzing the mean values of the time and velocities of trained athlete (girls), it appears that the group mean to cover 5 meters with foot spacing of 12 inches, 16 inches and 20 inches were 1.38±0.04sec, 1.41±0.14sec and 1.32±0.03sec respectively. The mean velocity at 5 meters with these foot spacing were 3.62±0.09ms^{-1}, 3.57±0.36ms^{-1} and 3.81±0.09ms^{-1} respectively. Similarly the mean value of the time taken to cover 10 meters distance with foot spacing of 12 inches, 16 inches and 20 inches were 2.12±0.09sec, 2.14±0.13sec and 2.06±0.06sec respectively. The mean velocity at 10 meters with these foot spacing were 4.73±0.18ms^{-1}, 4.70±0.32ms^{-1} and 4.87±0.13ms^{-1} respectively. Similar study was conducted by Schot et al (1992) and the results indicated that the elongated starting positions resulted in greater horizontal displacement, greater propelling impulse, increased first step toe-off velocity, and greater average velocity.

In case of untrained athlete (girls), it appears that the group mean to cover 5 meters with foot spacing of 12 inches, 16 inches and 20 inches were 1.53±0.15sec, 1.40±0.22sec and 1.44±0.14sec respectively. The mean velocity at 5 meters with these foot spacing were 3.30±0.33ms^{-1}, 3.64±0.58ms^{-1} and 3.51±0.38ms^{-1} respectively. Similarly the mean value of the time taken to cover 10 meters distance with foot spacing of 12 inches, 16

inches and 20 inches were 2.40±0.14sec, 2.25±0.15sec and 2.24±0.06sec respectively. The mean velocity at 10 meters with these foot spacing were 4.17±0.24ms^{-1}, 4.47±0.32ms^{-1} and 4.48±0.13ms^{-1} respectively.

Conclusion:

On the basis of the results obtained in the present study the following conclusions were drawn:

1. For athlete group (boys) 12 inches foot spacing appears to be the quickest one to develop higher velocity at 5 meters from start. But the 16 inches foot spacing appears to be the best for velocity at 10 meters from start.
2. For untrained boys the 16 inches foot spacing produces better result for velocity at 5 meters. But the 20 inches foot spacing produces better result at 10 meters point.
3. For trained girls 20 inches foot spacing produces better result at both 5 meters and 10 meters distances.
4. For untrained girls the 16 inches foot spacing produces higher velocity at 5 meters. But 20 inches foot spacing produces better result at 10 meters.
5. The trained boys produce more velocities with all the foot spacing at both 5 meters and 10 meters distance than the untrained boys.
6. Similarly, the velocities of the trained girls at 5 meters and 10 meters were greater than the untrained girls for all the foot spacings.
7. The velocities at 5 meters and 10 meters for boys with all the three foot spacings are more than the girls both for trained and untrained groups.

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