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ORIGINAL ARTICLE

BIOMECHANICAL ANALYSIS OF ATHLETIC STARTING BLOCK

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In track and field athletics, all athletes competing in races of 400m or less must, by rule, use starting blocks.

An extra wide pedals and block such as the Gill Fusion 1 will never slip.

INTRODUCTION

Since the commencement of the modern Olympic Games in 1896, there has been little overall change in the starting technique of elite sprinters (Mach, 1985, T & F Quart Rev, 85(2):11-14). Early sprinters used to dig holes in the track in which to place their feet when starting. With the innovation of synthetic track surfaces, starting blocks were invented to replace the start holes. While there have been some modifications over the years, the overall design of the standard starting block has not changed much, nor has the technique of starting.

Numerous studies have been carried out on the biomechanics of starting from blocks in attempts to identify the optimal start parameters (e.g., Henry, 1952, Res Quart, 23(3):301-318; Turner & Henson, 1985, T & F Quart Rev, 85(2):29-32; Schot & Knutzen, 1992, Res Quart Ex Sp, 63(2): 137-147), including some recent research examining new configurations for starting blocks (i.e., Parry et al., 2003, NSA, 18(1): 13-22).

In recent years, a different type of starting block has gained some support in the coaching community (McFarlane, 1993, Mod Ath & Coach, 31(2):13-15), but it has received little or no attention in the research literature.

The Moye block uses a large steep back pedal and a small low front pedal. The athlete places the full foot on the back pedal but only the heel of the foot goes on the front pedal with the forefoot resting on the track.

The athlete is supposed to assume a taller hip stance than in traditional blocks, and the block pedals are placed closer to the start line. Those who have argued for the use of the Moye technique state that it results in faster start times and requires less muscular effort than standard start techniques (McFarlane, 1993). To date, no published research has investigated the Moye starting technique.

Objective

The purpose of this research project was to examine the biomechanics of a sprint start from Moye blocks as compared to standard starting blocks.

Design

Quasi-experimental design.

Setting

University of Alberta, Edmonton.

Subjects

The subjects (n = 5) were members of the University of Alberta varsity track and field team (2 female, 3 male) who volunteered to take part.

All had extensive experience with standard starting blocks but minimal or no experience using Moye starting blocks.

Intervention/Main Outcome Measures

Each subject completed one day of practice and two days of testing. During the practice session, athletes were instructed on the use of the Moye block and received practise on them. On each of the two testing days, subjects performed two sets of five starts, one set from each type of block.

The order in which the types of blocks were tested was randomized by subject on the first day, and the order was then reversed on the second day to reduce any order effect in the testing protocol.

Each sprint start was 25m in distance, and subjects were given a minimum of 3 minutes between trials and five minutes between sets of trials. The distances of the block pedals from the start line were standardized based on a measure of foot length: two and three foot lengths for the standard blocks; and one and two and a half foot lengths for the Moye blocks.

Starting blocks provides athletes with a solid platform that allows them to explode forward right at the start of your race.

The start commands consisted of an automated voice ("on your marks" and "set") and a simulated gun sound; these were generated by a ReacTime unit (Lynx Systems Developers, USA) attached to the starting blocks. Reaction times (RT) to the millisecond were recorded from the ReacTime units.

A Laveg-Sport laser (JENOPTIK) was used to record linear displacement of the body; the laser was targeted on the low-back of the subject and recorded position to the nearest millimeter at 50 Hz. Subjects were also filmed in the sagittal plane by two JVC high-speed digital video cameras (120 Hz) with over-lapping fields of view. The APAS system was used to carry out a 2D kinematic analysis.

A total of 94 trials were analysed from the ReacTime and laser data. Performance measures included: RT; split times to 5m, 10m, 15m, 20m and 25m; and, instantaneous velocity at 5m, 10m, 15m, 20m and 25m. Average values were calculated for each subject from each type of block. These values were then assessed by paired t-tests (alpha = 0.05) to detect differences in group means between the standard and Moye starting blocks.

Subsequently, trials were selected from one male and one female subject to examine the total-body centre of mass (CM) location in the "set" position and the length of the first and second step from the blocks.

Main Results

Reaction times were 190 ms (±41) from the standard blocks and 153 ms (±31) from the Moye blocks, which was a significantly ($p<0.022$) faster average RT.

The split times to reach 5m (1.02s vs. 1.05s, $p<0.003$), 10m (1.74s vs. 1.77s, $p<0.005$), 15m (2.49s vs. 2.52s, $p<0.033$), and 20m (2.99s vs. 3.02s, $p<0.046$) were found to be significantly faster for the starts from the standard blocks, but not at 25m (3.47s vs. 3.50s, $p<0.062$). However, there were no significant differences in instantaneous running velocity at any of the interval distances (p-values from 0.101-0.919).

The location of the CM in the "set" position was determined from video for two of the subjects. While the height of the CM did not seem to be different between the standard and Moye blocks, the Moye put the CM horizontally closer to the start line by 5-10cm.

The length of the first step was longer from the Moye block by 25-35cm, but the length of the second step was approximately the same, so any advantage in step length seemed to be restricted to the first step.

CONCLUSION

The faster ReacTime (RT) recorded on the Moye block starts did not seem to translate into faster sprint times to any of the interval distances. It may be that the faster RT were caused by some artefact of the interaction of the Moye block and the Reac Time units.

In fact, only 3 out of 94 recorded trials were deemed to be false starts by the Reac Time units (and subsequently not included in calculations of average RT), and all three of these were during trials on the Moye blocks. It may be that something in the block configuration makes it result in faster recorded RT – this may have implications for athletes using the Moye block in competition since major competitions typically make use of false start detection equipment, like the Reac Time units used in this study.

Further research will be required to clarify this point.

Commentary

This study represent a preliminary assessment of the biomechanics of the Moye starting blocks, and further analysis will be necessary to more clearly identify differences as compared to traditional starting blocks – this will include the use of non sprint trained subjects to remove the effects of previous training on the standard blocks.