EFFECTS OF AN ANGLED STARTING BLOCK ON SPRINT START KINEMATICS

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INTRODUCTION: The sprint start mechanics have changed over the years with the invention of the starting blocks. The most recent modification of the starting block developed by Gill Athletics was to create a 16 degree outward angle of the foot position in the block in order to match the 16 deg. oblique axis of the ankle. This study examined the effects of an angled foot position in the blocks, or effects of turning the sole of the foot outward when using an angled block prototype on the first four steps on sprint running kinematics.

METHODS: Six female sprinters in the middle of their outdoor season volunteered from the Indiana State University Track team read and signed an informed consent before they performed sprint starts from and standard block and a Gill angled starting block prototype. The prototype starting blocks were made with an outward 16 deg. angle of the foot pad in order to permit 100% of the foot force to be transmitted to the block instead of a component of the foot force vector. The subjects' height, weight, and age were recorded. From the height, the blocks were adjusted such that the leg knee was placed at a 1.75rad (100deg) angle and the subjects were permitted to practice using the new blocks for a 60min. period over 3 practices in a week. Prior to testing subjects jogged 400m, and then performed their regular sprinter stretches. Each subject performed 3 maximal sprint starts for 30m. using either the standard block or the angled block followed by the other block shown in Figure 1.

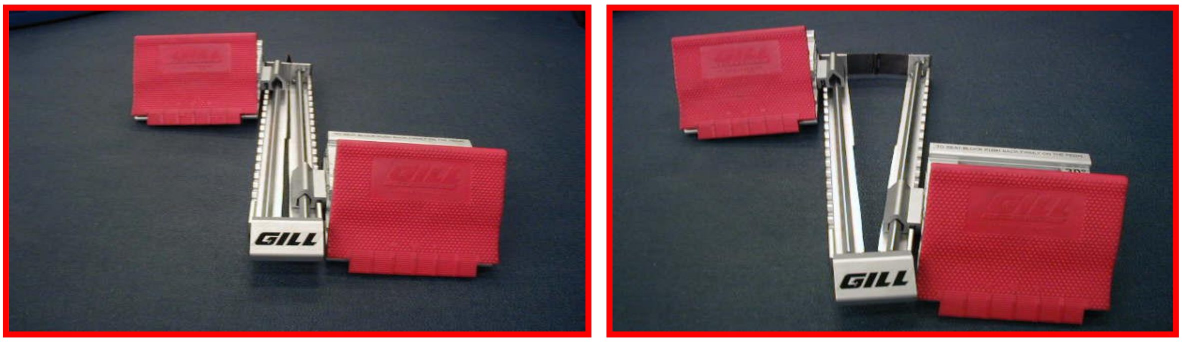

Figure 1. Traditional starting block & Gill angled starting block prototype

All sprint starts were recorded at 60Hz with a .001s shutter from a side, right rear, and front views,16 body markers were identified, and floor markers were placed at one-meter intervals. Markers were digitized, transformed using the 3D DLT, and digitally filtered at 10 Hz using the Ariel APAS. Kinematic variables of stride length, horizontal CM velocity, and the block clearance times were calculated and analyzed with an ANOVA with repeated measures.

RESULTS AND DISCUSSION: The mean age, height and weight of the subjects were 20.0$\pm$0.9 yrs, 165.1$\pm$8.0cm, and 59.9$\pm$5.0kg, respectively. The linear kinematic variables of stride length, CM horizontal velocity, and the block clearance time were calculated. The analysis found significant differences (p=.000) between the first 4 running stride lengths shown in Figure 2. The CM velocities were only significantly different for the stride factor (p=.000) and are shown in Figure 3. The angled blocks elicited slightly greater linear velocities but these were not statistically significant. Research conducted by Guissard (1992) found that by adjusting the block's medial/lateral angle to replicate the oblique ankle angle on the starting block significantly allowed for a greater sprint start velocities of 3.0 $cm*sec^{-1}$ in the first 4 strides.

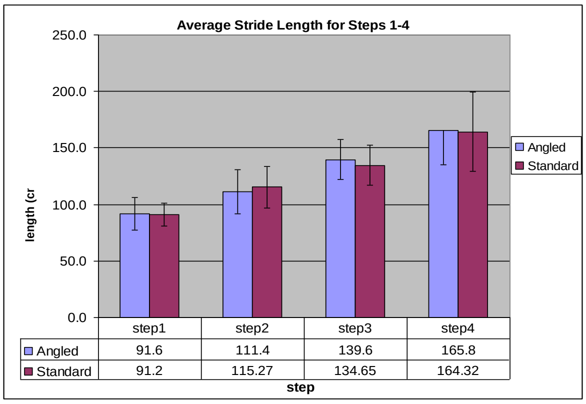

Figure 2. Four Stride lengths

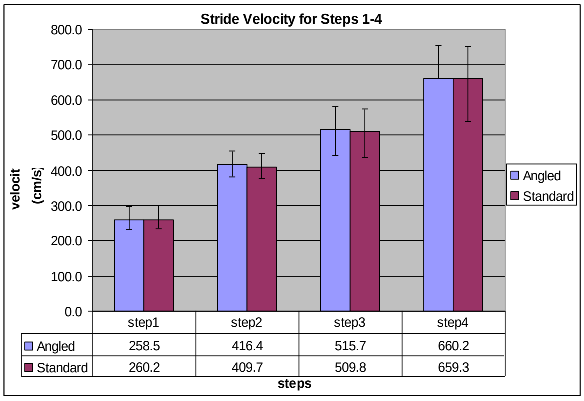

Figure 3. CM stride velocity using blocks

The block clearance time was measured when the trail foot passed the farthest point on the block. Non-significant (p=.334) mean block clearance times for the angled block of .482$\pm$.050s and .470$\pm$.038s for the standard starting block are shown in Figure 4. It was reported by Ozolin (1988) that sprinters take 0.3 to 0.4 seconds to react to the starting gun and clear the blocks. The longer time for force application against the angled block would provide a greater impulse even with similar forces and may be responsible for the slightly higher CM velocities seen in the 2nd and 3rd strides.

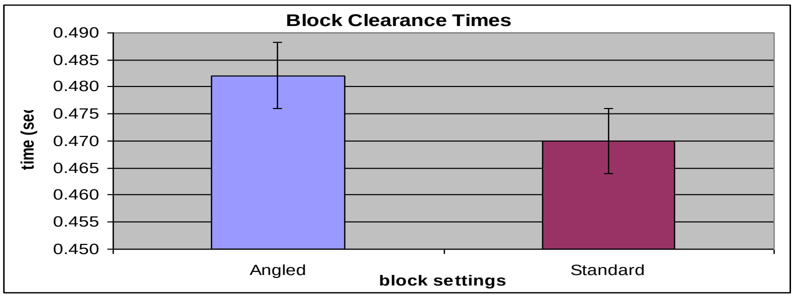

Figure 4. Block clearance time

CONCLUSIONS: A 16 deg. oblique angle on the block should have allowed for the athletes to put more maximal force against the block, producing a more explosive start, An increase in the runners' explosive impulse coming out of the blocks produced longer block clearance times, and slightly higher maximal velocities during the power phase (steps 2 & 3) of the sprint start. According to research conducted by Stevenson (1997), a longer stride resulted in a higher linear velocity at take-off, but hindered block clearance time. This study found the angled starting block produced slightly longer stride lengths for the first four strides, which resulted in higher linear velocities but slower block clearance times. The present study's lack of statistical significance in the velocity and clearance times may have been influenced by the .017s frame duration where minor adjustments in timing and velocities can occur in time intervals less than .001s. However, these slight differences could be beneficial for coaches and athletes, especially considering sprint races can be won or lost by milliseconds.

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