A Comparison of Two Swimming Start Techniques from the Omega OSB11 Starting Block

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Abstract

Recently the world governing body of aquatic sport has approved the use of a new starting platform (Omega OSB11), and it is currently being used at all international events. Due to the recent approval, swimmers are modifying their start techniques to be able to maximize performance from the new platform. This study investigated the effectiveness of the grab and track competitive swimming start techniques off of the Omega OSB11 start block using a single-subject experimental design. A replica start block was constructed with an embedded force plate. Four subjects participated in this study; two males and two females. The protocol consisted of six starts; three of the track start technique, and three of the grab start technique. Using kinetic data collected from the force plate and signal from an electronic starter, the time to two-meters was predicted. A two-tailed paired t-test was used to determine if the track starts were significantly faster than the grab starts for each subject. Results show that all four subjects were faster to the two-meter mark using the track start technique than the grab start method. Our findings suggest that swimmers should consider using the track start over the grab start on the Omega OSB11 platform.

Introduction

Elite level swimming races are often won by fractions of a second. For example, at the 2008 Olympic Games, 0.01 seconds separated the first and second place in the women’s 50-meter freestyle final, and only 0.71 seconds separated the eight swimmers.¹ A swimmer’s start time comprises as much as 26% of their total race time.² Thus, improving start times may not only improve the swimmer’s race time, but could also improve race standings.

Competitive swimmers currently utilize one of two main starting techniques: the track start or the grab start (Figure 1); the major difference between them is foot placement on the starting block. In the track start, one foot is placed at the front edge of the block and the other near the rear; in the grab start technique, both feet are forward with the toes curled over the front edge of the block.

Despite these differences, published research shows that there is little difference between the two techniques.³,⁴,⁵,⁶,⁷,⁸,⁹,¹⁰,¹¹ Kinematic data analysis shows no difference in start times to fingertip entry, 6.07 meters, 10 meters, nor to 15 meters between the grab and track start techniques.³,⁵,⁹,¹⁰ Furthermore, there was no significant difference in split times between the techniques either.⁶ Jorgic et. al. studied eight swimming start parameters, including flight time and take-off velocity, yet found no significant differences between the grab and track starts except for the ascending angle off
the block.\textsuperscript{6} Other research suggests that the track start is faster to five meters when a female swimmer leans forward in the set position, but loses its advantage if the swimmer starts in a rear-weighted position.\textsuperscript{11} Differences were found in the impulse characteristics during track and grab starts. Track starts had higher values in the initial impulse phase, while grab starts showed higher values in the final stages of the impulse; however, overall there was no significant difference in impulse time or take-off velocity for the two techniques.\textsuperscript{7} Finally, other research suggests that differences in the efficiency of starting techniques are dependent on the individual swimmer.\textsuperscript{4}

Figure 1: The grab start (A) and track start (B) starting techniques used by competitive swimmers performed on the replica of the Omega OSB11 platform. The grab start has both feet starting at the front of the platform, where the track has the feet a staggered position.

Since the publication of these studies, the International governing body of competitive swimming, Fédération Internationale de Natation (FINA), approved the use of the Omega\textsuperscript{®} OSB11 starting block for competition (Figure 2). This new starting block features a kick plate on the rear of the block for swimmers to place their foot on when performing the track start technique (similar to the starting blocks used in Track and Field events). The surface of the block has an angle of nine degrees and a separate kick plate at a 30 degree angle to the surface of the block which is moveable into five different positions spanning a range of 0.2 meters.\textsuperscript{12} These features are new additions to the traditional starting platform and seem to be designed to the advantage of the track start, but few studies have been conducted to fully investigate their effects on start techniques.\textsuperscript{13}

A conference presentation showed that seven swimmers decreased block time and increased horizontal velocity when utilizing the Omega OSB11 compared to a previous model.\textsuperscript{13} Despite the low number of participants (seven total; three grab starters and four track starters) and low number of trials (three from the OSB11, and three from the previous model; six total), their kinematic analysis suggests the track start was significantly faster than the grab start from the Omega\textsuperscript{®} OSB11 starting block.\textsuperscript{13} The purpose of the current study was to compare both the track start and grab start from the new Omega\textsuperscript{®} OSB11 block to determine the faster start. Additionally, this study used a single subject study design, which enables the analysis of data for each subject, as opposed to losing the individuality of the subject in a group analysis.\textsuperscript{14} An individual swimmer will likely prefer one start style over the other and may perform better in their preferred style.\textsuperscript{9} Furthermore, there are many variables that may change from one swimmer to the next and the same start technique may not be fastest for every individual. We hypothesize that the track start will produce a faster two-meter time than the grab start.

**Methods**

**Subjects**

This study was approved by the University of Western Ontario's research ethics board. Four varsity level competitive swimmers participated in the current study (2
males and 2 females) and signed informed consent prior to any testing. The swimmers were preparing for varsity swimming championship competitions.

**Testing procedures**

After a warm up each swimmer performed six swimming starts (3 grab start, 3 track start) from a replica starting platform (Figure 1).\(^5,7,13,11,15\) The order of presentation of the start techniques were randomized to control for fatigue, and the kick plate was held in the third position to control for differences in preference of plate position between swimmers. All starts were performed similar to techniques described by Maglishco.\(^16\) A starter (Daktronics, Inc., Brookings, SD, USA) was used to replicate the starting signal used competition situations.

**Data collection**

A replica of the Omega® OSB11 was designed, built, and mounted to the bulkhead of the pool in place of standard blocks (Figure 1). The replica was instrumented with a force plate (OR6-WP-2000, AMTI, Watertown, MA, USA) beneath the starting platform. The voltages from the force plate and start signal from the starter were sampled at 1000Hz using a 16-bit analog-to-digital conversion board (DAQPad-6015 National Instruments, Austin, TX, USA). The digital signals were stored on a PC via a LabVIEW™ program (Version 8.6, National Instruments, Austin, TX, USA) and were processed offline. The voltage signals from the force plate were converted to forces using company supplied calibration factors. The force signals were then filtered using a low-pass Butterworth filter with a cut-off frequency of 25Hz.

Using the horizontal force-time curve, a take-off velocity, \(v(t)\), was calculated by the impulse-momentum relationship starting from when each swimmer was stationary until he left the block.\(^17,18,19\)

\[
v(t) = \int_{t_i}^{t_{to}} \frac{F(t)}{m} \, dt
\]

(Eq. 1)

Where \(t_i\) is the time of the start signal, \(t_{to}\) is the time of take-off, \(F(t)\) is the horizontal force and \(m\) is the swimmer’s body mass.

Assuming velocity in the air is constant (i.e. neglecting air resistance), the horizontal distance profile \(d(t)\) was developed via a second integration with respect to time.

\[
d(t) = d_i + \int v(t) \, dt
\]

(Eq. 2)

Where \(d_i\) is the initial position of the whole-body center of mass with respect to the edge of the pool at the start signal, and \(v(t)\) is the horizontal velocity of the swimmer’s whole-body center of mass that was calculated through equation 1 (Eq.1). The initial position of the whole-body center of mass with respect to the edge of the pool at the start signal \(d_i\) was calculated using center of pressure at the start signal. The total time to two meters was extracted from the horizontal distance profile as the time corresponding to the two meter distance. At this distance, all swimmers will have left the start blocks, yet no one will have entered the water; this isolates the dive performance. The track and the grab starts were compared using the calculated time to two meters.

**Statistical Analysis**

A single-subject statistical analysis was carried out using the two-tailed paired t-test to determine if the start times for the track were significantly different than for grab starts.\(^14\) This analysis was chosen because the optimal starting technique may not be the same for all swimmers. Cohen’s \(d\), with pooled standard deviations, was also calculated to determine effect size and estimate the strength of the relationship between track and grab starts for each swimmer.\(^20\)

**Results**

The average times to two meters for each swimmer are shown in Figure 3. Each swimmer exhibited a significantly \((p < 0.05)\) faster time to two meters when using the track start compared to the grab start. However, the absolute time to two meters differed between swimmers, as did the magnitude of the difference between the track and grab starts. Although there were only three dives per technique, variability was low and effect sizes were large for every swimmer; Cohen’s \(d\) was 5.34, 11.52, 9.18, 36.99, for swimmers one through four, respectively.
Design allowed us to determine the best start technique. Omega® the grab start for every swimmer (Murrell and Dragunas -). For example, each swimmer could change a swimmer's rank. Possible starting platforms offered increased benefit to the track start over the grab start. The case is more complicated when considering multi-joint muscles, such as the quadriceps and the hamstrings, which are used in the jumping motion of the start. Changes in the angles of the hips and knees as they move asynchronously through the starting motion cause the lengths of these muscles to vary; thereby changing the forces produced. Studies from Track and Field starts indicate that optimal ‘set’ positions include a front knee angle of about 90 degrees and rear knee, front hip and rear hip angles of 126, 39 and 77 degrees, respectively. Although these studies may not directly relate to swimming, it can be speculated that the optimal starting angles may be similar. The configuration of the Omega® OSB11 block may make it easier for swimmers to achieve these angles and may contribute to the faster starts with this new block.

The results of this study agree with other research that found shorter starting times for track starts than grab starts using the OSB11 block. Using previous start block models, the track start had a significantly shorter block time than the grab start; moreover, reaction times were faster in the track starts. Further research and analysis should be conducted to determine if one or both of these are the contributing factors to the faster overall start time found in our study.

These results are practically relevant because, if all other race elements remained constant, simply using the track start technique may have a big impact on a swimmer’s overall race. For example, each swimmer decreased on average 0.10 ± 0.03 seconds to two meters, by using the track start; in international competition this could change a swimmer’s rank. It is therefore suggested that swimmers consider adopting this technique when using the OSB11 block, if they have not done so already.

Limitations

These data should be interpreted with caution because of the following limitations. Although we only measured a relatively small number of dives for each swimmer, the variability was low and effect sizes were large; therefore, the trial size was adequate to support the findings of this study. Secondly, the kick plate position...
was held constant for all trials and it is likely that the track start can be further improved by optimizing the location of the kick plate. If this is true, then the performance of the track start may have been underestimated in this study. Furthermore, all of the participants preferred using the track start; this may have contributed to the track start’s superiority in this study. Skill acquisition was not considered in this study; however, the single subject analysis permitted us to evaluate the performances of each individual swimmer without assuming that the group would respond similarly. Finally, this study judged start technique effectiveness based solely on an overall time to two meters; while this is a straightforward approach, it does not consider the rest of the race, or other swimming start parameters such as reaction time, block time, air time.

Future directions

Another important parameter, which was neglected in this study, is take-off velocity from the block. This study incorporated the take-off velocity in the calculation of the time to two meters, but did not consider it beyond this (two meter time). A higher take-off velocity might allow the swimmer to enter the water with increased speed and have an advantage. The trade-off here is that swimmers may spend more time on the block trying to increase the impulse for increased take-off velocities, and therefore may have slower starts. The most effective start produces large take-off velocities with minimal block time; however, further research is required to adequately evaluate this trade-off.

Conclusion/practical applications

This study investigated two different competitive swimming starts (track start and grab start) from a replica of the new Omega® OSB11 starting platform. As hypothesized, the track start was significantly faster than the grab start for all four swimmers in this study (P<0.05). Given this result, it would appear that the track start is advantageous over the grab start when the block has the additional kick plate. It is therefore suggested that swimmers consider adopting or continuing to perfect the track start technique when performing starts from the Omega® OSB11. Use of this technique may help to decrease a swimmer’s overall race time and improve their ranking in competition.

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