TEMPORAL ANALYSIS OF THE STARTING TECHNIQUE IN FREESTYLE SWIMMING

Raúl Arellano[1,2], Francisco García[2], Arantxa Gavilán[1], Susana Pardillo[3]
[1]Facultad Ciencias de la Act. Física y el Deporte. University of Granada. Spain
[2]Centro de Alto Rendimiento de Sierra Nevada. Granada. C.S.D. Spain
[3]Hospital Clínico. Granada. Spain.

INTRODUCTION

The starting technique in swimming is an important performance factor, especially in short-distance events. Hay (1986) defines starting time as the block time plus the flight time and plus the glide time. When the data for the three part times were correlated with the total starting time, it was found that the glide time was the most important of the three in determining the total starting time (Hay et al. 1983), with similar results for 10 m fixed distance (Arellano et al. 1994). Analyzing the results obtained in the Barcelona Olympic Games revealed values of r=0.93 male and r=0.90 females between the start time (10 m) and the race time in 50 m freestyle events (Arellano et al. 1994).

Our research aim was to find the relationship between some freestyle start and swimming variables and the times utilized to cover different distances of the start (5m, 7.5 m, 10 m and 15 m)

METHODS

Subjects: Sixty-nine male swimmers participating in a summer Camp at Centro de Alto Rendimiento (C.A.R.) of Sierra Nevada (Granada, Spain) in 1995 served as experimental subjects. This group was composed of the elite in each age group in Andalucía (age = 15.8±1.4 years, height 175.4±7.5 cm and weight 67.4±8.7 kg).

Instrumental: The data was obtained using the Temporal Swimming Analysis System (TSAS) developed by the Analysis of the Sport Movement Laboratory of the CAR of Sierra Nevada. The system was composed of five video-cameras connected to a S-VHS video-recorder (50 Hz) through a video-timer and a video selector. The image from the first two video-cameras was mixed to see the over- and under-water phases on the start in the same frame (until 10 m). A third camera was used to measure the 15 m time. A fourth camera was put in the middle of the swimming pool (25 m) to record at least two complete underwater stroke cycles and the 25m time (with the head). The fifth camera was placed at the end of the swimming pool for video-recording underwater the 7.5 m of the turn-in and turn-out. An electronic timing system was used to measure the 50 m time synchronized with the video-recording equipment.

Variables measured: The start time was measured for 5m (T5), 7.5 m (T7.5), 10 m (T10) and 15 m (T15) when the head of the swimmer crossed this reference lines. The duration of the block time (BT) , flight time (FT) and entry time (ET) were measured as well. Take-off angle (Toff: between the horizontal and the line traced from hip to the block edge), angle of entry (AE: formed by the line from hip to wrist and the water surface), angle of the hip in the entry (HE: formed by the trunk line and the leg line), leg angle at the hip entry (LA: formed by the water surface and the leg line, distance of the hands entry (DHE), distance of entry (DE: distance measured between hand entry and the feet entry) and underwater distance (UD:distance covered by the swimmer from the point of the hand entry until the point where the head broke the water surface). and mean underwater speed (MUS: underwater distance divided by the time between hand entry and when the head breaks the water surface). The 25 m time (T25), 50 m time (T50) and the mean speed (MS) between 15 m and 42.5 were collected as well.

Each swimmer performed 50 m plus turn with all-out effort simulating competitive conditions.

RESULTS

The means and standard deviations of all variables described were calculated (see Table 1) . The duration of BT was higher than FT and ET. The time passed between the starting signal and when the head of the swimmer crossed the 5 m line was more than a second shorter than the time passed between the 5 m and the 10 m line and between the 10 m and the 15 m line. This last two times were very similar (2,92 s and 2,98 s). The mean speed between 5 m and 10 m was 1.71 m/s and the speed between 10 m and 15 m was 1,67 m/s. Both speeds are higher than the MS (1,65 m/s). From the 5 m line, the speed of the swimmers decreased progressively until the MS in the middle of the swimming pool.

Table 1
Means and standard deviations of variables studied

Variables	Means	SD
BT	0,90 s	0,09
FT	0,37 s	0,06
ET	0,31 s	0,08
T5	1,87 s	0,14
T7.5	3,29 s	0,26
T10	4,79 s	0,31
T15	7,77 s	0,45
T25	13,64 s	0,71
T50	29,47 s	1,53
MS	1,65 m/s	0,08
Toff	37,35 °	6,23
HE	126,07 °	29,69
AE	43,65 °	7,89
LA	32,13 °	14,63
DHE	3,37 m	0,27
DE	0,89 m	0,35
UD	4,51 m	1,15
MUS	1,96 m/s	0,27

The Toff angle was smaller than EA (6,3 ° less). The body was flexed in the hip during the hand entry. The LA was smaller than the EA angle and the Toff angle. The DHE was 3.37 m but feet entry was at 2.48 m in front of the starting wall. The DE was similar than the half of the body length. The MUS was higher than MS.

Table 2
Partial correlation values obtained between some of the variables analyzed excluding the effect of the age

Var.	T5	T7.5	T10	T15
T7.5	0,738**			
T10	0,590**	0,849**		
T15	0,476**	0,758**	0,930**	
T25	0,385**	0,680**	0,851**	0,949**
T50	0,247*	0,555**	0,719**	0,930**
MS	-0,157	-0,441**	0,857**	0,730**

** p<0.01, * p<0,05

There was no significant correlation between BT, FT and ET on the one hand and the temporal variables on the other hand apart from BT and T5. When we used the shorter distances (T5 and T7.5) for measuring the ST the relationship with the longer distances measured (T25 and T50) and MS was low.

The Toff angle correlated with the FT (r=0,675**) and the DHE angle (r=0,497**). The TE correlated with the AE angle (r=0,593**), the LA angle (r=0,568), the DHE (r=-0,505**) and the DE (r=-0,791**).

Our results showed differences with the data obtained by Miller, Hay and Wilson (1984), in the contact-distance of the hand was 3.77 m in comparison with our 3.37 m. The age, competitive level, and the use of a more flatted entry can explain this difference. Meanwhile, the BT (0,82-*0,90*) , FT(0,38-*0,37*) were very similar.

The angle of entry obtained 43,65° was similar the published by Kirner, Bock, and Welch (1989) for the grab start hole entry (44.69°) and it was different of the grab start flat entry angle (35,73).

CONCLUSIONS

The influence of swimming technique in the start is greater if the swimming distance included in ST is longer. This was particularly so in the young groups studied where there were no long underwater phases. The start technique should play a bigger role than it does now in the final results, and, therefore, special training techniques for the start must be developed.

REFERENCES

Arellano,Brown,Cappaert, & Nelson, (1994a) Analysis of 50, 100, & 200m Free Swimmers at the 92 Olympics Jour. of Appl. Biom, 10, 189-199.

Arellano, Moreno, Martínez, & Oña (1994). A Device for Quantitative Measurement of Starting Time in Swimming. In VIIth Int.Symp. on Biom. and Med. in Swimming, 1 . Atlanta (Georgia)

Hay, J. G. (1986). Swimming. In Hay (Eds.), Starting, Stroking & Turning. Iowa Univ. ,83-86) (pp. 1-51). Iowa: Biomechanics Lab. Dep. of Ex. Sc.

Hay, Guimaraes, & Grimston (1983). A Quantitive Look at Swimming Biomechanics. In J. G. Hay (Eds.), Starting, Stroking & Turning, Iowa Univ.83-86)(pp.76-82).Iowa:Biomech. Lab.Dep. of Ex. Sc.

Kirner, K. E., Bock, M. A., & Welch, J. H. (1989). A comparison of four different start combinations. Journal of Swimming Research, 5(2), 5-11.

Miller, J. A., Hay, J. G., & Wilson, B. D. (1984). Starting Techniques of Elite Swimmers. Journal of Sports Science(2), 213-223.