THE RELATION BETWEEN KINEMATIC-DYNAMIC PARAMETERS ON STARTING BLOCK IN REAR-WEIGHTED TRACK START AND TIME TO 7.5 M AND 10 M DISTANCE

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Abstract:
A block start in swimming is one of the limiting factors that influence the sports performance in sprint disciplines where the victory is decided only in hundredths of seconds. The aim of the research was to analyse kinematic-dynamic parameters on starting block in rear-weighted track start and to find out the relation to time to 7.5 and 10 m distance. Eighteen performance male swimmers (age 23.4±2.1), specialised in sprint event, participated in this study. We used a dynamometric FitronicForce plate and FitronicForce 12 to measure kinematic-dynamic parameters on the starting block. Omega Timing registered the distances of 7.5 m and 10 m. The results of the research show that the values of vertical force are two or three times higher than the values of horizontal force during the take-off. The statistical significance between the observed kinematic parameters on starting block and the time to 7.5 m and 10 m distance was not proved. The results of the relations between the observed parameters suggest that the parameters of horizontal power ($p>0.05$, $p>0.01$) influence the achieved time to 7.5 m and 10 m distance after rear-weighted track start in much higher rate than the other observed kinematic-dynamic parameters and therefore there is the necessity to consider this problem in further research.

INTRODUCTION

About the winner in swimming, especially in sprint disciplines, is decided in hundreds of seconds. This is the reason, why there should be considered all the factors that can be considered as limiting factors of the result. One of such limiting factors that influence the sports performance is a block start (time to 15 m).

A block start is structured in following phases – basic position on the starting block, pushing phase, flying phase, entry into water, gliding phase and the first swimming movements. The movement on the starting block, either from kinematic or dynamic point of view, influences the phases and therefore it is important for every swimmer to have an optimal pushing phase [8].

The technique of the block starts in swimming has been developed for several years, whilst the basic techniques include – basic and track start, which are different especially because of the basic position of feet on the starting block. In the basic block start, the feet are in the front part of the block. In the track start, one foot is placed in the front and the other foot in the back of the block. This position is more effective for active involvement of upper and lower limbs during the block start [5,2].

Various studies have not shown [7,4,2] which of the above mentioned techniques is better, however, the track start has become more preferred. One of the reasons for this might

be a better stability on the start block, that lowers the risk of early start and disqualification [5,10].

Since 2008 there have been used new starting blocks from Omega with adjustable footrest on top swimming events in the world. This footrest can be adjustable in front and back direction in the back part of the starting block (5 positions) and it is at the angle of 30° (90 ° angle of the back foot), that helps to better push of the block. The studies have proved that the swimming start from this new block shortens the time of movement on the starting block [3,6,9], it also improves the horizontal velocity during the pushing phase [3,9], it improves time to 5 m [6], 7.5 m [3,6] and 15 m [9] in comparison to track start on blocks without the footrest.

Despite the fact that the new starting blocks are available on the most of the swimming competitions, there are still many swimming pools in Slovakia, either training pools or competition pools, where these starting blocks are not present. According to several studies [5,11], swimmers should practice on the blocks without footrest the technique of rear-weighted track start.

THE AIM OF THE WORK

The aim of our study is to analyse kinematic-dynamic parameters on starting block in rear-weighted track start and to find out the relation to time to 7.5 m and 10 m distance.

THE MATERIAL AND THE METHODOLOGY

The research group involved 18 performance swimmers in the age of 23±2,1 years from different swimming clubs in Slovakia. Swimmers are oriented only on swimming sprint disciplines and they have been swimming for more than 10 years in sports training. The testing of track starts took place at the end of the main season in summer of the annual training period. The testing took place in one day.

At the beginning of the measurement the swimmers had a short warm up on the side of the swimming pool and then short warm up in the swimming pool for 500 m. After the warm up there was a special warm up that consisted of three rear-weighted track starts.

During the testing, the swimmer stood on the starting block (there was placed the dynamometric plate Fitronic Plate – 1 kHz). On the command „take your marks“, the swimmer took basic position. After this on a signal from loudspeakers that were connected to computer and started programme Fitronic-Force 12, that monitored the kinematic-dynamic parameters during the pushing phase. The swimmer dived into water and glided 7.5 m and 10m distance where he touched the Omega Timing (1 kHz). The programme of the dynamometric plate and Omega Timing were synchronized. The distance 7.5 and 10 m were stated with respect to the length of flying phase, that follows the pushing phase and is followed by entering water and gliding. The track start was measured three times. In the results, there is presented only the best achieved time. After each attempt, the swimmer had 150 m swim to warm down.

We registered the following parameters by means of starting dynamometric plate with programme Fitronic-Force 12 and Omega Timing:

1. Kinematic parameters (ms):
   -reaction time – interval between the start signal and first movement on the block
   -movement time – interval between the first movement and the take-off from the block
   -start time – interval between signal and the take-off from the block
   -time to 7,5 m and 10 m
2. Dynamic parameters:
   -horizontal force (N)
   -vertical force (N)

-impulse force (Ns)

We used logical methods, basic statistical characters and pair correlation analysis to process and evaluate the data and to find out the level of relation between the variables. The values of force were evaluated in absolute and relative values.

RESULTS

When we compared the dynamic parameters of vertical and horizontal force on the block in rear-weighted track start on both distances we can state that the differences in maximal values in vertical force were two times higher and in average values of vertical force they were almost three times higher than the values of horizontal force. The time to 7.5 m was 2.6 s (2.9 m/s) and to 10 m 4.4 s (2.3 m/s), that means the difference between the times was 1.8 s (1.4 m/s). The decrease of swimmer's speed on a longer distance was caused by not kicking during gliding. We wanted to know not only the effectivity of the start but also the effectivity of the speed in water.

Table 1 Kinematic-dynamic parameters on starting block in rear-weighted track start and their relation with time to 7.5 m and 10 m (n=18)

				Time to 7,5 m	r with 7,5 m time	Time to 10 m	r with 10 m time
Kinematic parameters		RT	(ms)	179±25	n.s.	202±28	n.s.
		MT	(ms)	756±66	n.s.	735±44	n.s.
		SR	(ms)	935±70	n.s.	937±52	n.s.
		T	(ms)	2625±165		4364±356	
Dynamic parameters	**Vertical force**	Amax	(N)	1526±145	-0,520*	1531±178	n.s.
		Aaverage	(N)	1113±121	n.s.	1097±126	n.s.
		Rmax	(N/kg)	18,3±1,7	n.s.	18,3±1,5	n.s.
		Raverage	(N/kg)	13,3±1	n.s.	13,1±1	n.s.
		IS	(N.s)	854±132	n.s.	827±103	n.s.
	Horizontal force	Amax	(N)	737±112**	-0,798**	746±104**	-0,839**
		Aaverage	(N)	377±65**	-0,654**	384±66**	-0,632**
		Rmax	(N/kg)	8,8±1,3**	-0,681**	8,9±0,9**	-0,768**
		Raverage	(N/kg)	4,5±0,7*	-0,559*	4,6±0,6*	-0,520*
		IS	(N.s)	344±54**	-0,675**	376±88	n.s.

Legend: RT – reaction time; MT – movement time ; SR – start reaction; T – time; Amax- absolute values of maximal force; Aaverage – absolute values of average force; Rmax – relative values of maximum force; Raverage – relative values of average force; IS – impulse force

*p>0.05; **p>0.01; n.s. – statistically not significant

The relations between kinematic parameters – reaction time, movement on starting block, start reaction and time to 7.5 m and 10 m distance, were not significant. The results suggest that the time on the starting block – start reaction is not a determinant parameter for evaluating the quality of block start as many swimmers and coahces think. In the dynamic parameters of vertical force the only significant relation (p>0.05) was between absolute values of maximal force and time on both distances. Low statistical significance suggests that these parameters influence the time on the particular distance only very little.

Statistically significant relations were found between parameters of horizontal force and time on both distances almost in all parameters. The most significant relation (p>0.01) was between absolute values of horizontal force, relative values of horizontal maximal force and times on both distances. The horizontal impulse of force is a very important parameter during the take-off from the starting block, despite this, the statistical significance between this

parameter and the time on both distances was observed only to 7.5 m distance. Statistically significant relation on a 5% level was between relative values of horizontal average force and time on both distances. Similar results related to relations between parameters of horizontal force and time to 7.5 m distance present also other studies [1,11].

CONCLUSIONS

Statistically significant relations between observed kinematic parameters on a starting block (reaction time, movement on the starting block, start reaction) and time to 7.5 m and 10 m were not proved. This result suggests that the observed start reaction that is also shown in results on world competitions is not a relevant parameter to evaluate the pushing phase of the starting block.

The results in the statistical significance of the observed dynamic parameters on the starting block and time to 7.5 m and 10 m distance after rear-weighted track start suggest that the parameters of vertical force influence the time on the particular distance less than the parameters of the horizontal force. The very close relations were found between absolute values of maximal horizontal force and the time on the both distances.

Statistically significant relations point out a very important thing that the parameters of horizontal force limit the achieved time on a particular distance in the rear-weighted track start and therefore it is important to consider this parameter in competitions as well as in trainings.

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