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# THE IMPORTANCE OF START IN SPRINT SWIMMING RACE RESULT

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***Abstract:*** *The purpose of this study is to validate a method used for the improvement of the sprint swim race result, based on the starting technique of athletes. With the help of a video analysis with spatial and temporal perspective, the start objectification was developed through a study divided in accordance with the start phases. In addition to the Dart fish software analysis, the quantitative and qualitative tests of the start, carried out by specialists, were followed by an 8-week training to eliminate start errors. The improvement of spatial-temporal parameters influences the performance and evolution of technical parameters. The outcome of this method led to an improved sprint race result. The most significant aspect of this study, which was carried out by 4 Romanian elite swimmers, was the noticeable average increase of the sprint race result.*

***Key words:*** *swimming start, video analysis, start objectification.*

## 1. Introduction

The argumentation for the present research is based on the poor results registered by the Romanian swimmers at sprint swim races during international competitions. The objectification of the swimming start can lead to better results at sprint swim races. Knowing the technical and spatial-temporal kinematic parameters could correct the technique and objectify the start. Interdisciplinary sciences, biomechanics, biology and statistics will be applied to this purpose. By analyzing the sensorial data from the conditional analyzers specific to the swimming start, every single role involved in the motor execution of the start will be determined. The grab start implies multiple abilities such as concentration, attention, coordination, forward projection of the body, immersion as well as underwater activities of the body [7]. The underwater velocity is dependent on the horizontal velocity at water entry [2]. In addition, the horizontal velocity at entry is a result of horizontal velocity on air during take-off [3]. For this reason, the starting motion executed on the block-start is an important factor in performing a fast start [4]. On the other hand, only a few studies have taken into consideration the block-start conditions [4]. The block-start is a plane surface, angled at 9 degrees, on which both feet are placed during start. The starting velocity depends on the feet, hands and body positions [6]. During 50m and 100m sprint swim races, the start velocity has a significant contribution to the race result [1].

The start analyses should be focused on the block-start position, on flight phase and underwater phase, which have essential

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variables used to determine spatial-temporal parameters: distance, time, angle and start velocity, especially in the case of sprint swim races [5]. The achieved time race is significantly dependent on the start, on the turns but also on swimming rhythm.

The methodology applied for the start begins with the first phase and while reaching performance, it gets improved through a spatial-temporal evolution. There are various starting styles in swimming: the grab start, the asymmetrical one called "track start", the modern start, executed on the platform with a bent back plate, called "kick start", all possessing different spatial-temporal parameters. The biomechanical and kinetic analysis of the start showed that there are significant connections to the race and that for most of the events, no matter the start rhythm, the short races have different starts from the long races, for both females and males [8]. A study made in 2001 by the Edinburgh University compared the grab start with the track start on two groups of swimmers, with equal time for 50m [1]. There were no differences between the two groups for the time registered at 9.5m, nor for the time spent on the block-start, the flight time up to 5m, the water entry time, the horizontal and vertical take-off velocity. These results are also certified by the data obtained from the analysis of 2000 finals and semifinals of the Olympics, made by Cossor and Mason [3]. They reached the conclusion that one of the significant relative variables for the 15m time was the underwater distance covered by the swimmer.

The main objective of this research is focused on the objectification of the swimming start in order to carry out an efficient transfer of motor actions upon the specific technical content. The start objectification with the help of video means which can determine and eliminate start errors will be consolidated with the measurement of spatial-temporal start parameters. The quantitative and qualitative measurements will lead to an objective result used to monitor and evaluate the swimming start. We assume that the analysis of the start technique based on video means used to determine spatial-temporal parameters and track start errors up to 5m off the block-start, will objectify the start technique by eliminating errors and positively influencing the swim sprint race result.

## 2. Methods

The main methods used for this research are the observation method, the comparative experimental method, the mathematical analysis, statistics and graphic representations of data, based on spatial-temporal start parameters. Four athletes will take part in this research; elite swimmers aged 20-22, members of the national swimming team.

Data collected from the initial tests will be compared to the research results from the final tests. All this reference elements brought in comparison with the results from international competitions will allow us to continually monitor the efficiency of the undertaken activity so that the athletes' training for the swimming start is positively influenced. The qualitative indices monitored in the research carry additional data as they are repeated in time. On the observation slips used to analyze the technical content of the swimming start the remarks of Coach Dan Badescu, swimming specialist, were filled for both initial and final experiment. The methodical-technical phenomena manifested during start are based on the study of motor gesture as an expression of ability and capacity level and as action mean of standardized activities of the swimming track start. Biomechanical observation was used for the technique research, divided into the start phases: preliminary phase, flight phase, water entry phase. There are three phases of the start, each targeting two possible errors, making a total of six errors visible to the "specialist's eye". In our opinion, the Dartfish software helps the most to explain the objectives and the tasks based on the video analysis while allowing a close observation of the starting technique. The video analysis can correct the technique errors and improve the diversity of a competitive procedure. Dartfish offers detailed video feedback for athletes, trainers and researchers. The video experiment measurements aim the monitoring and evaluation of the following parameters:

- Flight distance: distance from the block-start up until the swimmer's hand touches the water, expressed in meters (m).
- Flight time: time off the block-start up to the first hand contact with water, expressed in seconds (s).
- Flight velocity: an indirect measurement calculated depending on distance and flight time, with the formula V=D/T.
- Water entry angle: angle between the horizontal axis of water and the athlete's body. This angle is calculated when the head enters the water (angle between the horizontal axis of water, head and hip), expressed in degrees.

The introduction of computerized methods and devices in sports and sports research supports the sportive objectification and development. The transfer of biomechanical analysis or of a complex motor action from a film to a computer, through measurable factors and with the help of a soft analysis for the human motility, can detect the biomechanical parameters of motion. After eliminating the observed errors, essential progress can be registered on the sportive motility. By inserting data into a computer, the required information can generate the mathematical pattern of a motion. This way, the executed pattern overlaps the diagram and as a result one can correct the errors or can enhance the muscle groups which can sustain a certain technical execution (interpretation after http://www.scrigroup.com/sanatate/sport/Modelul-antrenamentului-sporti14912.php, visited in July 2013)

## 3. Results

The observation slips of the start for the initial measurement, elaborated by specialist coach Dan Badescu with the author of the present paper, are summed up as follows in table 1:

Table 1

*Technical observation slip of the start, basic research, 4 subjects, initial measurement (Annotation: "YES"= error, "NO" = lack of error)*

| | **Interpretation coach Dan Bădescu** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Preparation phase** | | **Execution phase** | | **The final phase** | | **Assessment** | |
| | **Track starting position, feet at a distance of 30cm between them at shoulder width** | | **Push the extension piciarelor, detached from the block start, flight trajectory** | | **The angle formed input and The surface water body** | | **Analysis phase jump** | |
| Initial testing April 6, 2012 | Track starting position with CG exaggerated in front | Track starting position with exaggerated CG back | Flight exaggerated curved | Flight exaggerated flat | Join overly sharp angle in water | Sign in closed water exaggerated angle | Total possible errors evaluated | **START ERROR ASSESSMENT TOTAL REGISTERED** |
| Subiectul 1 | YES | No | NO | YES | NO | YES | 6 | 3 |
| Subiectul 2 | NO | YES | YES | NO | YES | NO | 6 | 3 |
| Subiectul 3 | NO | NO | YES | NO | YES | NO | 6 | 2 |
| Subiectul 4 | NO | NO | NO | YES | NO | YES | 6 | 2 |

The observation slips of the start for the final measurement, elaborated by specialist coach Dan Badescu with the author of the present paper, are summed up as follows, in table 2.

Table 2

*Technical observation slip of the start, basic research, 4 subjects, final measurement (Annotation: "YES"= error, "NO" = lack of error)*

| Final testing 15 jun. 2013 | Interpretation coach Dan Bădescu | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Preparation phase | | Execution phase | | The final phase | | Assessment | |
| | Track starting position, feet at a distance of 30cm between them at shoulder width | | Push the extension piciarelor, detached from the block start, flight trajectory | | The angle formed input and The surface water body | | Analysis phase jump | |
| | Track starting position with CG exaggerated in front | Track starting position with exaggerated CG back | Flight exaggerated curved | Flight exaggerated flat | Join overly sharp angle in water | Sign in closed water exaggerated angle | Total possible errors evaluated | START ERROR ASSESSMENT TOTAL REGISTERED |
| Subiectul 1 | NO | NO | NO | NO | NO | NO | 6 | 0 |
| Subiectul 2 | NO | NO | NO | NO | NO | NO | 6 | 0 |
| Subiectul 3 | NO | NO | NO | NO | NO | NO | 6 | 0 |
| Subiectul 4 | NO | NO | NO | NO | NO | NO | 6 | 0 |

The results of spatial-temporal parameters for the classic track start, subject 1,2,3 and 4 of the research, initial measurement, are presented in the below table 3.

Table 3

*The results of spatial-temporal parameters for the track start, basic research, initial measurement*

| Subjects/ Starts parametrers/initial | Flight time [s] | Flight distance [m] | Average velocity [m/s] | Water entry angle |
|---|---|---|---|---|
| | Track start | Track start | Track start | Track start |
| Subject 1 | 0.36 | 2.55 | 7.08 | 39.5 |
| Subject 2 | 0.32 | 2.51 | 7.84 | 39 |
| Subject 3 | 0.32 | 2.5 | 7.81 | 38 |
| Subject 4 | 0.32 | 2.4 | 7.5 | 36 |

The results of spatial-temporal parameters for the classic track start, subjects 1, 2, 3 and 4 of the research, final measurement, are presented in the below table 4.

Table 4

*The results of spatial-temporal parameters for the track start, basic research, final measurement*

| Subjects/ Starts parametrers/final | Flight time [s] | Flight distance [m] | Average velocity [m/s] | Water entry angle |
|---|---|---|---|---|
| | Track start | Track start | Track start | Track start |
| Subject 1 | 0.38 | 2.8 | 7.37 | 40 |
| Subject 2 | 0.34 | 2.75 | 8.09 | 39.5 |
| Subject 3 | 0.33 | 2.73 | 8.27 | 38.5 |
| Subject 4 | 0.35 | 2.7 | 7.71 | 37.5 |

The athletes' performances during the basic research, in the period 2010-2013, are presented in the table 5.

*Results of researched athletes* Table 5

| Athletes Evolution 2011-2013 | | | | |
|---|---|---|---|---|
| 100m Breaststroke | | | | |
| Ctr. | Name topic / year | 2011 | 2012 | 2013 |
| 1 | Subject 1 / U B | 1:10:15 | 1:08:68 | 1:05:30 |
| 100 m butterfly | | | | |
| Ctr. | Name topic / year | 2011 | 2012 | 2013 |
| 2 | Subject 2/ V D | 1:09:24 | 1:06:45 | 1:02:60 |
| 100m Freestyle | | | | |
| Ctr. | Name topic / year | 2011 | 2012 | 2013 |
| 3 | Subject 3 / A A | 1:00:15 | 0:58:32 | 0:55:75 |
| 100m Freestyle | | | | |
| Ctr. | Name topic / year | 2011 | 2012 | 2013 |
| 4 | Subject 4/ U C | 1:01:64 | 0:59:53 | 0:56:23 |

## 3. Discussions

Interpretation of subject 1 evolution during the research:

- 3 initial errors from 6 possible monitored, 3 eliminated in the end from 6 possible.
- Flight time, track start, initial value of 0.36s increases in the end at 0.38s.
- Flight distance, track start, initial value 2.55m becomes final value 2.80m.
- Flight velocity, track start, initial value 7.08m/s becomes at 7.22m/s in the end.
- Water entry angle, track start, initial value 39.50˚ reaches 40˚ final.
- Subject 1 had the best result on the 100m breast stroke race in 2012, 1:08:58. After the training carried out during January-June 2013, the time is improved to 1:06:30. The registered progress is of 2.28 seconds.

This progress means for subject 1, improvement race with 3.32% percentage.

Interpretation of subject 2 evolution during the research:
- 3 initial errors from 6 possible monitored, 3 eliminated in the end from 6 possible.
- Flight time, track start, initial value of 0.32s, final value 0.34s.
- Flight distance, track start, initial value 2.51m increases at 2.75m.
- Flight velocity, track start, initial value 7.84m/s becomes at a final value of 8.09m/s.
- Water entry angle, track start, initial value 38.0˚ reaches 39.5˚ final.
- Subject 2 had the best result on the 100m butterfly stroke race in 2012, 1:06:45. After the training carried out during January-June 2013, the time is improved to 1:02:60. The registered progress is of 3.85 seconds.

This progress means for subject 2, improvement race with 5,79% percentage.

Interpretation of subject 3 evolution during the research:
- 2 initial errors from 6 possible monitored, 2 errors eliminated in the end from 6 possible.
- Flight time, track start, initial value of 0.32s increases at 0.32s.
- Flight distance, track start, initial value 2.50m reaches a final value of 2.73m.
- Flight velocity, track start, initial value of 7.81m/s becomes at 8.27m/s final.
- Water entry angle, track start, initial value 38˚ reaches 38.50˚ final.
- Subject 3 had the best result on the 100m freestyle race in 2012, 0:58:32. After the training carried out during January-June 2013, the time is improved to 0:56:75. The registered progress is of 1.57 seconds.

This progress means for subject 3, improvement race with 2,69 % percentage.

Interpretation of subject 4 evolution during the research:
- 2 initial errors from 6 possible monitored, 2 errors eliminated in the end from 6 possible.
- Flight time, track start, initial value of 0.32s increases at 0.35s.
- Flight distance, track start, initial value of 2.40m reaches in the end 2.70m.
- Flight velocity, track start, initial value 7.5m/s becomes at a final value of 7.71m/s.
- Water entry angle, track start, initial value 36˚, and final value 37.50˚.
- Subject 4 had the best result on the 100m freestyle race in 2012, 1:06:45. After the training carried out during January-June 2013, the time is improved to 1:02:60. The registered progress is of 2.30 seconds.

This progress means for subject 4, improvement race with 3,86 % percentage.

## 4. Conclusions

Subject 1 registered three technique errors during the initial phase of the basic research:
- Preliminary phase: starting position, track style, the weight center too forward.
- Execution phase: exaggerated flat flight.
- Final phase of the start: the entry is too flat.

After filming the start, the movements were studied with the coach, the spatial-temporal parameters were analyzed with the Dartfish software and during 6 months the start errors were eliminated through sequence awareness.

Spatial-temporal parameters improved, the flight time, flight distance, the velocity and water entry angle increased and as a result the drag force was reduced as follows:
- Flight time, track start, increases with 0.02s
- Flight distance, track start, increases with 0.10m

- Flight velocity, track start, growth with 0.13m/s
- Water entry angle, track start, has grown with 0.05˚.

The performance for subject 1 was improved with 2.28 seconds, percentage for the race meaning 3.32%.

Subject 2 registered three technique errors during the initial phase of the basic research:

- Preliminary phase: starting position, track style, weight center too backward.
- Execution phase: exaggerated curved flight.
- Final phase of the start: the angle of water entry too steep.

After filming the start, the movements were studied with the coach, the spatial-temporal parameters were analyzed with the Dartfish software and during 6 months the start errors were eliminated through sequence awareness.

Spatial-temporal parameters improved, the flight time, flight distance, the velocity and water entry angle increased and as a result the drag force was reduced as follows:

- Flight time, track start, increases with 0.02s
- Flight distance, track start, increases with 0.08m
- Flight velocity, track start, growth with 0.22m/s
- Water entry angle, track start, has grown with 0.05˚.

The performance for subject 2 was improved with 3.85 seconds, percentage for the race meaning 5.79%.

Subject 3 registered two technique errors during the initial phase of the basic research:

- Preliminary phase: NU
- Execution phase: exaggerated curved flight.
- Final phase of the start: the angle of water entry too steep.

After filming the start, the movements were studied with the coach, the spatial-temporal parameters were analyzed with the Dartfish software and during 6 months the start errors were eliminated through sequence awareness.

Spatial-temporal parameters improved, the flight time, flight distance, the velocity and water entry angle increased and as a result the drag force was reduced as follows:

- Flight time, track start, increases with 0.03s
- Flight distance, track start, increases with 0.09m
- Flight velocity, track start, growth with 0.48m/s
- Water entry angle, track start, has grown with 0.05˚.

The performance for subject 3 was improved with 1.57 seconds, percentage for the race meaning 2.69%.

Subject 4 registered two technique errors during the initial phase of the basic research:

- Preliminary phase: NU
- Execution phase: exaggerated flat flight.
- Final phase of the start: the entry is too flat.

After filming the start, the movements were studied with the coach, the spatial-temporal parameters were analyzed with the Dartfish software and during 6 months the start errors were eliminated through sequence awareness.

Spatial-temporal parameters improved, the flight time, flight distance, the velocity and water entry angle increased and as a result the drag force was reduced as follows:

- Flight time, track start, increases with 0.06s
- Flight distance, track start, increases with 0.10m

- Flight velocity, track start, growth with 1.26m/s
- Water entry angle, track start, has grown with 0.05˚.

The performance for subject 4 was improved with 2.30 seconds, percentage for the race meaning 3.86%.

In conclusion, the hypothesis that the objectification start in swimming technique, based on the video, it will improve sprint race result was confirmed by improving race with an average of 3.91% for the four subjects of research.

As a consequence of the results obtained with the experiment, with the collected and processed data and also based on the technical-methodical conclusions of the training specialists, we recommend the use of the video analysis method for every sports training, particularly for the swimming start. The video analysis method has to act as an interactive tool during training; it has to supplement and explain the observations made by technicians, thereby teaching the optimum pattern for executing the technical procedures of a specific sport, in our case swimming. We recommend the evaluation of athletes with the help of video analysis. This facilitates the qualitative assessment of technical procedures and their constant orientation to the ideal execution pattern.

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