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Vladan Marković[1], Goran Pasic[2] Dejan Kulundzic[3]
[1]College of Sports and Health, Belgrade
[2]Faculty of Physical Education and Sports , University of Banja Luka
[3]PS"Bratstvo" Novi Pazar – Srbija

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ANALYSIS OF A SWIMMING STROKE IN THE 100M BREASTSTROKE SWIMMING EVENT IN ATHENS IN 2004

Summary

In comparison with other swimming techniques, the breaststroke is one of the most demanding techniques to train concerning the coordination of movement. In order to be successful while competing, swimmers work on and specialize their skills early on in the pioneer category. During the training and developing of the breaststroke technique, focus is directed towards legwork, stroke propulsion, flexibility, as well as the coordinating of leg and arms movements. The breaststroke is the slowest swimming technique, as during the carrying out of the arms and legs movements, the swimmer's body creates the greatest resistance. This paper analyzes the results achieved at the Olympic Games in 2004 in Athens. The analysis of the 100m breaststroke event encompasses the following parameters: final results time, time of start reaction, time for 15 and 50 meters, flip turn time (15 meters), and the time for the last 5 meters. Along with this, the following was also analyzed: the 25m breaststroke frequency, a further 25m breaststroke frequency, as well as the breaststroke frequency of the first and last 25 meters after the flip turn. Except for the frequency, the following were also assessed: breaststroke length of the first 25 meters, as well as the 25 meters to the flip turn, 25 meters after the flip turn and 25 meters to the finish line.

Key words: **swimming, breaststroke, frequency, amplitude, Olympic Games**

INTRODUCTION

It is considered that the progressing of the body through water by a synchronized, symmetrical movement of the arms and legs is the oldest method of swimming. Most theorists consider that all the other swimming techniques have developed from the breaststroke, so it is not unusual to say that the breaststroke technique is the "mother" of all swimming techniques. From its very introduction into swim competitions, the breaststroke technique experienced various technical changes in the aim of improving swimming speed. FINA (the International Swimming Federation) in 1908 brought strict technical regulations for breaststroke swimming: both hands are moved at the same time and extended forward underwater; the swimmer leans on the chest; the legs are bent in the knees so that the knees are spread apart,

then the water is pushed forward by the feet in eversion and the calves make an arc while the feet come together.

Today there are a great number of variants or styles of the breaststroke technique but they can be classified as the following: the flat (linear breaststroke) technique and the wave-style (with emphasized body movements) which occurred as an imitation of the body oscillations during the dolphin kick.

If viewed hydro-dynamically (in other words, streamline), the breaststroke technique is different from the other techniques, as moving has no continuity of arm work propulsion coordinated with simultaneous leg work. Frontal resistance is additionally increased due to a greater incursion angle - during breath intake and after a propulsive stroke. Thereby, the breaststroke technique is considered more complex in the sense of coordination, and thereby the slowest swimming method. The proportion of expedient effort and energy expenditure (swimming efficiency) with swimmers using the breaststroke technique amounts to 4-6%, and double that with the crawl technique.

METHOD

Swimming with a proper breaststroke technique is determined by the basic position of the chest, arm and leg propulsion, gliding and breathing. The movements of the arms and legs must be synchronized and simultaneous (the left and right arm) and carried out on a horizontal plane with no alternative movements. One cycle contains the following: one breaststroke with the arms and one movement with the legs, alternatively.

By lifting the FINA ban on underwater pull-down, there occurs a pulling down of the swimmer in the water during the stage of gliding in a streamlined position, and the pivot of the body starts to undulate and uses a wave motion on the water surface, which largely reduces resistance during movement.

The hands carry out the arms propulsion and push forward the water to below the chest in the active part of the breaststroke, and in the passive part, they reinstate the starting position above or underwater. The elbows are underwater in the passive part of the breaststroke.

As a consequence of the diverse anthropological build of the swimmers and the method of overcoming the resistance of the water and carrying out propulsion, there have appeared various styles of the breaststroke technique which are within the framework of the valid regulations, all having the aim to improve results.

The basic position of the body is almost streamlined in regards to the water surface. The hips and the legs are slightly bent in order to create conditions for an efficient propulsion of legwork. The cranial part of the body lies supine on the surface of the water, while the shoulders and head are the highest parts of the body. The angle of the body and the water surface changes, depending on the stage of movement and a constant oscillating of the body can be noticed.

A well-timed immersion of the head and a stretching of the arms contributes to a frontal resistance during the moving of the swimmer carrying out the breaststroke.

Leg work

In the breaststroke technique, the legwork propulsion is more dominant than the arm movements, while the legwork can be divided into three stages: pulling up the feet towards the posterior, eversion of the feet and the thrust.

The stage of pulling up the feet towards the posterior: the initial position is the streamlined position, and the feet are pulled up towards the posterior by bending the knees and thighs towards the back in the endeavor to diminish the occurring of the largest frontal resistance during the retropulsive stage of the legwork.

The preparatory stage (eversion of the feet): the second stage is the preparation for the thrust, in such a way that after flexing the knees, the feet are turned sideways (eversion). The knees are then turned inwards and separated by 15-35 cm, and the feet are entirely turned aside. It is very important for the feet to plunge into still water, in order to secure a more efficient thrust in the next stage.

The thrust stage: the third stage is the propulsive stage and is made up of a strong movement (a thrust) with the feet. During this movement, the calves are in a half-circle and the feet come together while propulsion is ended with a backward and downward movement which extends the propulsive effect of the legwork.

The arm movements

The arm movements in the breaststroke technique can be divided into two basic stages: ***propulsive stage*** (active stage) and the ***retropulsive stage*** (preparatory stage).

The propulsive stage is the stage of the active part of the breaststroke. The position of the body after the beginning and the turn endeavors to be as streamlined as possible ("like a torpedo"). The initial position – the beginning of the arm stroke; the arms are in an outsweep in the shape of a letter V, lying horizontally with the shoulders. This is followed by an insweep, and at the end the hands come together with facing palms in front of the chest. The entire arm stroke starts slowly, increases speed to the peak arm movement speed in the insweep phase, and slows down again during recovery. The goal is to produce maximum thrust during the insweep phase, and minimum drag during the recovery phase.

It is very important that the hands (the palms) are the first to "attack" the water, when the hands point down and push the water backwards. The elbows stay in the horizontal plane and the hands push back until they lie roughly vertical with the shoulders. At the end of the insweep, the hands come together with facing palms in front of the chest and the elbows are at the side at the body.

In the stage of arms propulsion, there is a retropulsive leg movement, a flexing of the knee joint and a preparation for a strong kick, while the body moves forward (slides) due to an innerving of the propulsive arms stage.

The retropulsive stage (preparatory) is the response stage of the stroke. It starts after the elbows reach the plane of the shoulders, as the arms and hands return to the initial position towards the water surface. The head and the shoulders "narrow down" and entry into the water is shallower. This is very important due to the lessening of the frontal resistance and waves in order to maintain body movement, as then the legs are found in the propulsive stage.

During the outsweep, the head is underwater which contributes to reducing the frontal resistance during movement, a more efficient gliding and a better preparation for a new breaststroke.

Coordination of legwork and arm movements

The main principle of swimming is that without good coordination there is no efficient swimming technique. This is especially valid for the breaststroke technique, as without good coordination of the arms and legs and proper breathing, there is no efficient breaststroke, and thus also no good results.

The first condition of good coordination is synchronizing the work of the arms and legs with breathing. The first stage starts with pulled up heels towards the posterior, which at the same time brings up the head with the aim of taking in air. In the second stage, the arms with the ending of propulsion are below the chest and are returned to the initial position near the water surface with the head being lowered and the body streamlined, which is when the legs thrust at the water and help the body in the stage of gliding.

The gliding position of the body creates conditions for a better water flow around the body of the swimmer. Gliding is of a huge relevance for the proper carrying out (coordination) of the breaststroke technique, in the sense of learning and improving the technique as well as learning the elements (the start, turn, underwater swimming). Along with coordination, there should also be a focus on the best possible hydrodynamic body position during swimming. The stage of sliding-gliding cannot be overlong and too deep in order not to lose the speed of the body obtained with propulsion during swimming.

Underwater breaststroke are the movements with which the swimmer starts a race after a start jump or turn.

Due to complexity, we can classify this into three stages:

Stage 1: It starts with the body entering the water. The body takes on a hydro-dynamic position (streamline) and enters the stage of sliding-gliding. The speed of the body moving is the highest in this stage (after the start or pushing off after the turn) but is gradually reduced, which is caused by an increase of the frontal resistance.

Stage 2: In order for the body not to halt due to water resistance, there are asymmetrical, synchronous arm movements from the streamline position thrown back. The arms are bent in the elbows in order for the thrust to be stronger and quicker, and for the hands to be closer to the hips. The body in that position carries out the second stage of sliding-gliding while the speed gradually decreases.

Stage 3: At the most optimal moment (until the speed is not overly reduced) the classical breaststroke starts by stretching out the arms and pulling up the feet towards the posterior and by bending the knees. The thrust of the body underwater is reduced and after a strong kick, the arms are extended straight forward and come out to the surface in the aim of breathing which marks the beginning of the first overwater breaststroke.

RESULTS WITH DISCUSSION

Analysis of competition parameters in the 100 m breaststroke event at the Olympic Games in Athens in 2004.

Table 1. Analysis of competition parameters in the 100m breaststroke time event at the Olympic Games in Athens in 2004.

100m BREASTSTROKE MEN

Last Name, First Name	Kosuke Kitajima JPN	Brendan Hansen USA	Hugues Duboscq FRA	Mark Gandloff USA	Vladislav Polyakov RUS	James Gipson GBR	Daren Mew GBR	Oleg Lisogor UKR	Mladen Tepavčević SCG
Final time (sec.)	60.08	60.01	60.88	61.17	61.34	61.07	60.83	61.07	63.34
Start reaction time	.72	.70	.73	.72	.80	.77	.79	.80	.86
Time for 15m	6.56	6.92	6.80	6.80	6.84	6.96	7.00	6.88	7.26
Time for first 50m	28.26	28.27	28.25	29.14	28.87	28.34	28.48	28.61	29.45
Turn time (15m)	8.44	8.32	8.68	8.68	8.40	8.04	8.32	8.12	9.38
Time for the last 5m	3.09	3.14	3.20	3.07	3.16	3.32	3.14	3.11	3.21

Tabela 2, Analysis of competition parameters in the 100 m breaststroke frequency event at the Olympic Games in Athens in 2004.

100m BREASTSTROKE MEN

Last Name, First Name	Kosuke Kitajima JPN	Brendan Hansen USA	Hugues Duboscq FRA	Mark Gandloff USA	Vladislav Polyakov RUS	James Gipson GBR	Daren Mew GBR	Oleg Lisogor UKR	Mladen Tepavčevic SCG

Breast stroke frequency for 25m	50.92	53.57	34.88	49.18	46.51	48.70	49.59	49.83	-
Breaststroke frequency of the second 25m	47.11	51.63	53.29	43.64	47.04	46.47	45.04	47.06	-
Breaststroke frequency of the third 25m	49.84	50.90	52.69	51.23	50.72	48.22	49.90	45.11	-
Breaststroke frequency of the fourth 25m	52.09	47.48	52.55	50.13	53.13	49.28	53.41	50.83	-
Total breaststroke frequency	49.90	50.89	53.35	46.05	49.35	48.16	49.48	48.21	46.50

Tabela 3, Analysis of competition parameters in the 100 m breaststroke length event at the Olympic Games in Athens in 2004.

100m BREASTSTROKE MEN

Last Name, First Name	Kosuke Kitajima	Brendan Hansen	Hugues Duboscq	Mark Gandloff	Vladislav Polyakov	James Gipson	Daren Mew	Oleg Lisogor	Mladen Tepavčević
	JPN	USA	FRA	USA	RUS	GBR	GBR	UKR	SCG
Breaststroke length of the first 25m	1.89	1.84	1.75	1.98	2.04	2.01	2.00	1.94	-
Breaststroke length of the second 25m	2.06	1.83	1.83	2.13	1.99	2.06	2.10	1.99	-
Breaststroke length of the third 25m	1.82	1.75	1.70	1.72	1.73	1.80	1,74	1.93	-
Breaststroke length of the fourth 25m	1.71	1.92	1.68	1.82	1.67	1.79	1.71	1.73	-
The total breaststroke length	1.87	1.83	1.74	2.00	1.85	1.91	1.88	1.89	1.99

The results analyses in Table 1-3 are the following: from swimming with the 100m breaststroke technique at the Olympic Games in Athens in 2004 it can be concluded that the results of the medalists and finalists are significantly equal and that the time difference is small. There are many surprises which occur when it comes to medalists and thereby this event is interesting for the public. Some of the greatest names come from the Hungarian school (N. Rozsa and K. Guttler), American (N. Dibel, J. Linn, E. Moses and B. Hensen) and the undisputed Japanese and double Olympic champion in Athens in 2004 and Peking in 2008 - K. Kitajima. Along with the evenly balanced results of the medalists, other analyzed parameters have fairly standardized values; only an increased dispersion can be noticed with the variables: start time (ST), reaction start time (RST), breaststroke frequency (BF), breaststroke length (BL), swimming efficiency (SE), time for carrying out turn (TCOT), time for carrying out finish (TCOF), anthropometric height (AH), anthropometric weight (AW). It can be seen from this analysis that swimmers swim with an evenly balanced speed, and tactics differ the most in carrying out the technical elements: time for carrying out the start (TCOS), time for carrying out turn (TCOT) and finish time (FT). The difference in technique is reflected in the dispersion of parameters: breaststroke frequency (BF), breaststroke length (BL) and swimming efficiency (SE).

Table 4. Results regression analysis for 100m breaststroke swimming in 2004 in Athens

VARIABLES	Unstandardized Coefficients		Standardized Coefficients	t	Sign.
	ß	Std. Error	Beta		
Constaunt	82. 613	10. 756		7. 681	.000
TSS	-30.009	2.772	-.789	-10.825	.000
SPD	2.635	1.425	.069	1.849	.070
ST	.027	1.09	.008	.251	.803
TPD	.311	.081	.245	3.847	.000
ST50	.108	.045	.061	2.376	.021
BF	.054	.031	.244	1.745	.087
BL	1.548	1.385	.241	1.118	.269
SE	-.125	.537	-.033	-.234	.816
TCOT	.169	.063	.080	2.702	.000
TCOF	.101	.092	.027	1.099	.276

A regression analysis of all the analyzed Olympic Game finalists of the 100m breaststroke concluded the following: free swimming time (FST), 50m lap time (LP50), time of carrying out turn (TCOT), while the following has a smaller significance on the result: the speed of pure swimming (SPD), the time of start reaction (TSR), breaststroke frequency (BF) and breaststroke length (BL). The parameters of swimming efficiency (SE), start time (ST) and finish time (FT), the anthropometric height (AH) and weight (AW), have no significant impact on the improving of the final result (Image 1). It can be concluded that with the 100m breaststroke swimming technique, the finalists have the following: a shorter time of pure swimming (with no impact from the start and turn), the reaction speed at the start and swimming to 50 m, the speed of carrying out a turn, as well as more efficient swimming techniques.

CONCLUSION

The breaststroke swimming technique is the technically most demanding skill, due to the coordination of the propulsive movements of the arms, legs, the position of the head and the body itself during movement.

Due to the complexity of this swim stroke technique, training and improving can last a long time, even during an entire career. One should be patient, tolerant, persistent and wait for the swimmer to form himself or herself psychologically and physically in order to give real results. An overstated desire for quick success (by the parents of the coach) and chasing results at any price can lead to errors during the proper forming of the breaststroke swimming technique which later on makes it difficult to correct due to movement automatizing.

With a proper selection and a choice of swimmer based on anthropological traits, genetic predispositions, talent, the desire to improve, and through proper training, it is possible to achieve significant results with which young swimmers in the earliest pioneer

period, if they are motivated, and acquire self-confidence and a desire for better results and success in their career.

The analyzed time segments in the breaststroke swimming technique at the Olympic Games in 2004 in Athens of the finalists and medalists can serve for similar research, as well as for comparing the same parameters in the training process and the work of future competitors.

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