Increasing the performance of techniques of rowing on yalks with a roll-up system based on kinematic analysis and computer simulation

UDC 797.12

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Received by the editorial office on 19.05.2024

Abstract

Objective of the study was to identify, on the basis of kinematic analysis and modeling, the effectiveness of using the developed rowing technique on yawls with a rolling system in the training process.

Methods and structure of the study. The work used methods of kinematic analysis and modeling using electronic digital models, processing of experimental results using methods of mathematical statistics. Athletes specializing in rowing at YaL-6 (n=32) took part in the pedagogical experiment (from April 2022 to October 2023).

Results and conclusions. It was found that kinematic analysis of digital layouts makes it possible to increase rowing efficiency on YaL 6. Changes made to the rowing technique based on kinematic analysis provide a statistically significant increase in rowing efficiency on YaL 6 (p≤0,05).

Keywords: *rowing on yawls, kinematic model, rolling system, YaL-6, sports.*

Introduction. Rowing is a cyclic sport, and efficiency improvements have been mainly achieved using traditional methods: photo and video recording, time control devices for covering the distance, duration of stroke phases, as well as physiological data from athletes: heart rate, respiration, and blood pressure. These methods are primarily empirical in nature, based on practical results. The research paper attempts to develop a rowing technique based on a prognostic method, including modeling, analysis, and a pedagogical experiment [1-3].

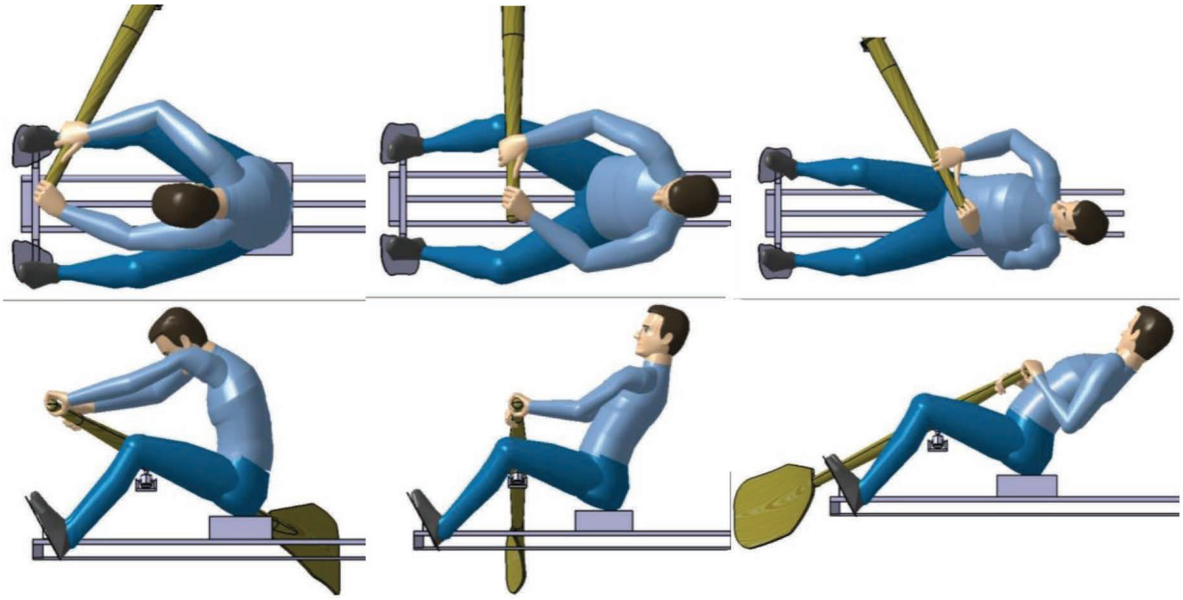
Objective of the study was to identify, on the basis of kinematic analysis and modeling, the effectiveness of using the developed rowing technique on dinghies with a rolling system in the training process.

Methods and structure of the study. The work involved the methods of kinematic analysis and modeling using electronic digital models, and processing the experimental results using mathematical statistics methods. The pedagogical experiment (from April 2022 to October 2023) involved athletes specializing in rowing on the YAL-6 (n=32), KG and EG boys/girls (8 rowers each). The time of passing the distance on the YAL 6 was recorded using a stopwatch according to GOST 5072, the parameters of performing exercises on the Concept 2 simulator were recorded using the means built into the simulator.

Results of the study and discussion. In order to improve the rowing efficiency on the YAL-6, a computational experiment was conducted on simulation models in the CATIA software environment, which includes modules for constructing three-dimensional models, kinematic analysis, and analysis of the interaction of a digital dummy with a three-dimensional model. When constructing a three-dimensional model, the X axis was directed along the longitudinal axis of the vessel, the Y axis was perpendicular to the longitudinal axis of the vessel horizontally, and the Z axis was upwards [5].

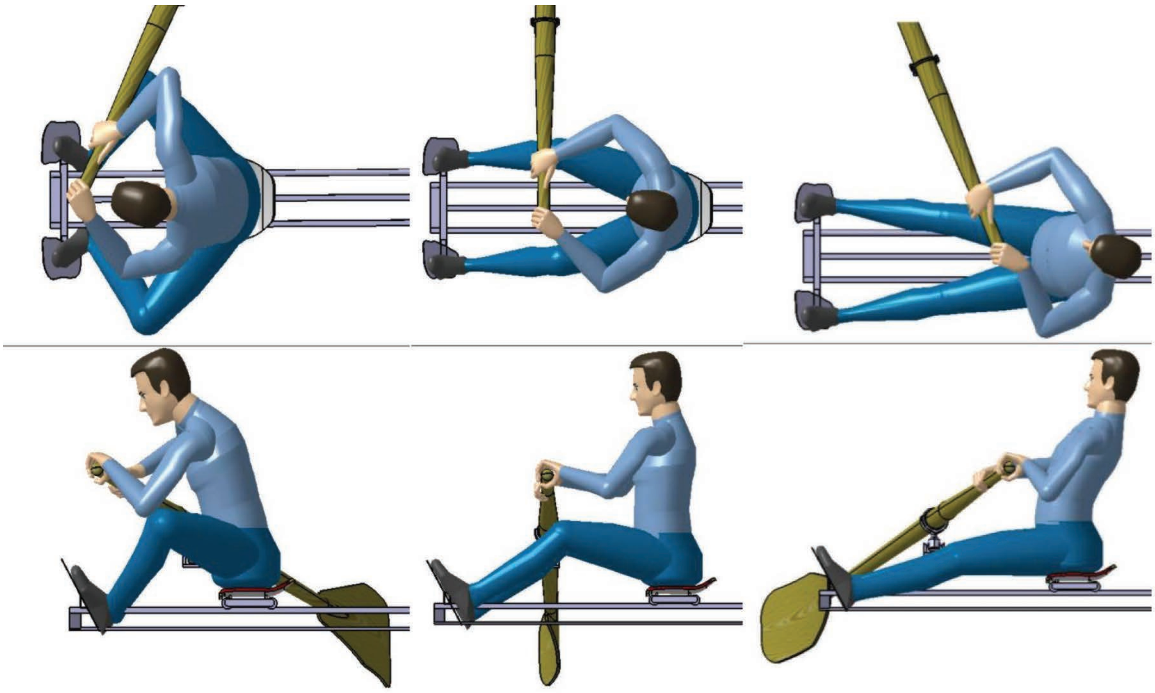
The search for the optimal rowing method was carried out using the following method:

1. Constructing a three-dimensional model



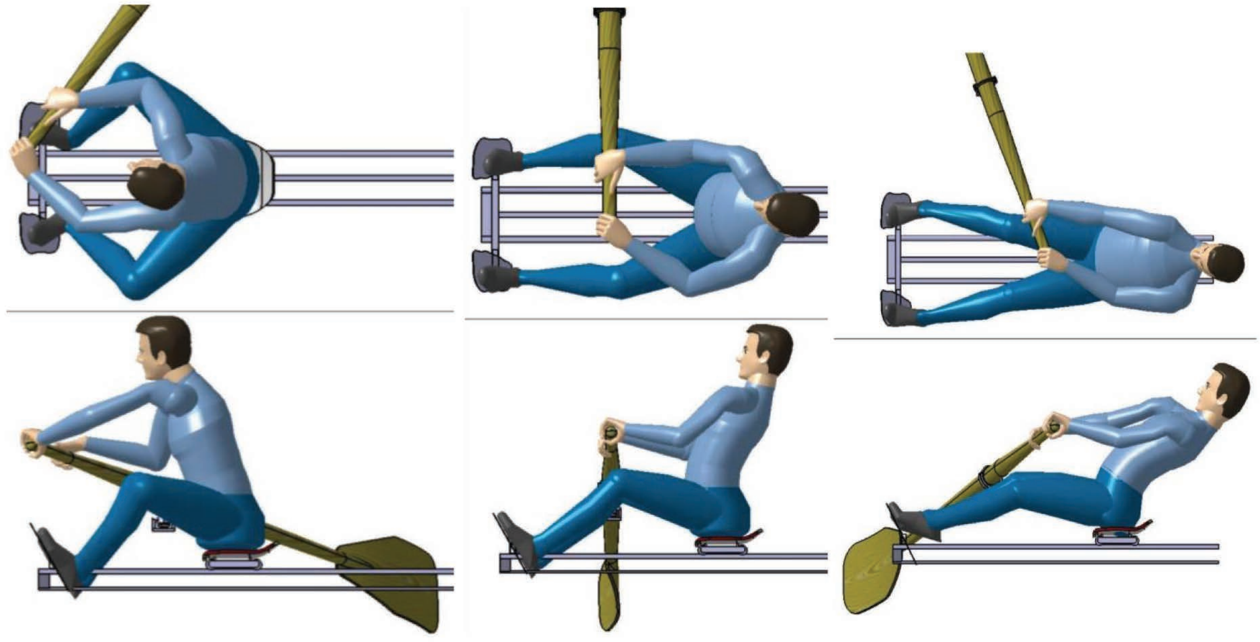
a) b) c)

Fig. 1. Characteristic moments of the power phase of the stroke on the YL-6 of traditional design with fixed seats-benches: a) – beginning of the stroke; b) – middle of the stroke; c) – end of the stroke.



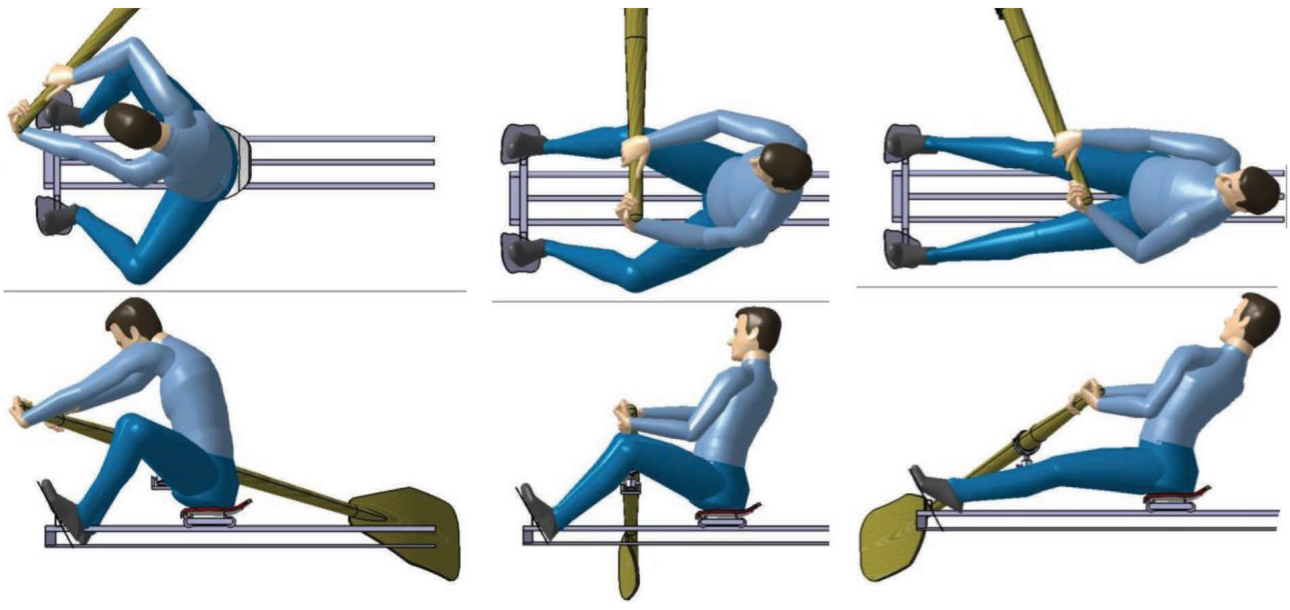
a) b) c)

Fig. 2. Characteristic moments of the power phase of the stroke in an academic boat: a) – the beginning of the stroke; b) – the middle of the stroke; c) – the end of the stroke



a) b) c)

Fig. 3. Characteristic moments of the power phase of the stroke on the YAL-6 with the installed rolling system:a) – beginning of the stroke; b) – middle of the stroke; c) – end of the stroke



a) b) c)

Fig. 4. Characteristic moments of the power phase of the stroke on the YAL-6 with the installed roll system and modified rowing technique: a) – beginning of the stroke; b) – middle of the stroke; c) – end of the stroke

that takes into account the main geometric features of the rower's location in the vessel (taking into account the position of the support elements, oars, etc.)

2. Kinematic analysis of the rower's movements taking into account the anthropometric characteristics of the digital dummy.

3. Correcting the movements of the digital dum-

my in order to make the power phase of the stroke as efficient as possible.

A digital dummy of a white man, 50% percentile, built into the application software package, was used as a dummy. The computational experiment included placing a digital dummy in the following conditions:

1. YL-6 of traditional design (fixed bench seat).

2. A typical academic boat with a movable bench seat.

3. YL-6 with a rolling system installed on it, including a movable carriage seat.

At this stage of the experiment, it was established:

1. When rowing on a YL-6 of traditional design with a fixed seat, the main work of the rower is performed by the muscles of the back and arms, the leg muscles are not used. To increase the length of the stroke, the rower is forced to lean back up to 30 ° relative to the horizontal plane (Fig. 1).

2. When rowing on an academic boat, mainly the leg muscles are involved, the back leans back slightly, up to 70 ° relative to the horizontal plane (Fig. 2).

The installation of a rolling system with movable seats on the YAL-6 allowed athletes to more fully exploit the possibilities of using stronger leg muscles (Fig. 3), but at the same time it was found that the rowing technique on the YAL-6 with a rolling system needed to be changed to achieve higher results. Changes in rowing technique are aimed primarily at increasing the length of the stroke by changing the grip of the hands, as well as turning the rower's body towards his side (Fig. 4) [4].

Fig. 5 shows the results of changing the passage of the 500 m distance on the Concept 2 rowing machine KG and EG of boys and girls at a pace of 16-18 strokes (training pace in the traditional YL-6). Fig. 6

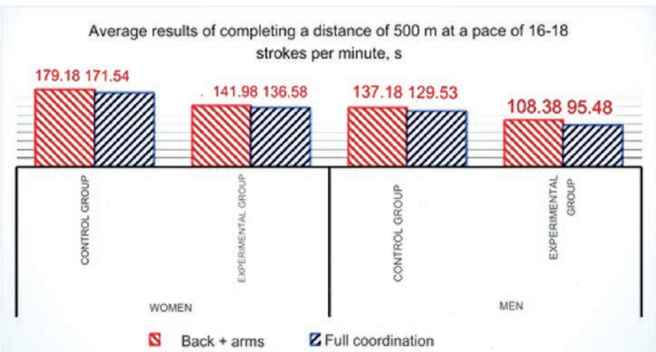


Fig. 5. Average results for passing the 500 m distance

and 7 show the results of changing the passage of the 1000 m rowing distance under different weather conditions among men's and women's teams.

The time indicators were recorded on a traditional yawl and on a yawl using a rolling system.

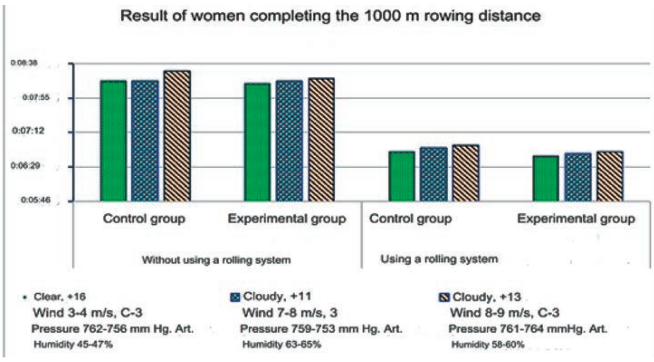


Fig. 6. Results of women's 1000 m rowing distance, m

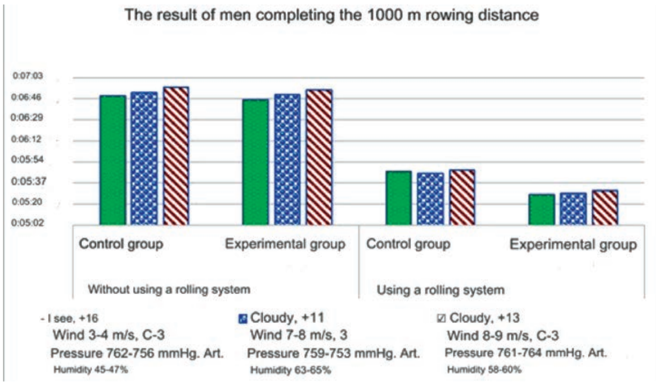


Fig. 7. Result of passing the 1000 m rowing distance by men, m

Conclusions. It has been established that the use of a prognostic method to improve the efficiency of rowing on the YL-6 using a rolling system gives a statistically significant reliable increase in the result ($p \leq 0.05$). To improve results in cyclic sports, it is advisable to use computer modeling of athletes' movements based on digital models with their subsequent analysis and adjustment of the methodology. The effectiveness of the adjusted methodology can be assessed by traditional methods, after which such a methodology, providing higher results, can be introduced into the training process to improve results.

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