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The effect of special exercises for some biomechanical variables of the rotation phase of 100 m freestyle for the swimmers of the national team (16-18 years old)

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Abstract

The aim of the research through study, analysis and clarifying the differences for the swimmers that the freestyle swimming style is preferred by most of the swimmers of the Iraqi national team, as the need for research and investigation has increased to solve the issues related to spinning performance and identify the values of some biomechanical variables of the spinning phase, swimming for 100 m freestyle swimming and the research issue lies due to the difficulty of directing swimmers during spinning performance in the water and the difficulty of communication between the coach and swimmers to give them accurate instructions during their spinning performance. The experimental method adopted the experimental design (pre-test, post-test for one group) to suit the nature of the research problem and the number of (6) swimmers representing 100% of the original population, which are the players of the Iraqi national team (16-18 years) and the experiment was conducted on the experimental group for (8) consecutive weeks at (3) times a week and after the completion of the application, the data were collected and the SPSS system processed the results to be the conclusions It is necessary to explain the importance of the biomechanical variables as indicated simply and to increase the culture and awareness of swimmers through the mediation

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and how the use of angles, distances, and appropriate force affects the economy of effort to create a developed sports generation to raise the level of sports for the better.

Keywords: Exercises, kinetic variables, rotational phase, freestyle, 100-meter freestyle.

Introduction

Freestyle swimming is the basis of the four swims, as this type is favored by all swimmers because of the speed and fun, which depends heavily on the motor performance of all parts of the body with high-level compatibility, Olympic swimming is one of the important sports in the schedule of Olympic sports, which includes several swimming styles (butterfly, back, breaststroke, freestyle), because freestyle (Salman, 2015) has a great importance in the schedule of international competitions, as it is unique in its many races compared to the rest of the methods that range from (50 m to 1500 m) due to the ease of performance in it (Salman, 2015) It is unique in its many races compared to the rest of the methods that range from (50 m to 1500 m) due to the ease of performance in it, as for the (100 m) freestyle event, the rotation stage is one of the most important stages in this event, Changing the momentum before and after the turn with a minimum value is necessary to sustain the momentum of the race speed on the approach and after the push to gain an advantage and outperform the other swimmers. Pushing the wall should be strong at the same time by moving the legs together to help increase the pushing force, which is affected by the change in momentum, the pushing force should be implemented horizontally and not upwards, and the biomechanical variables are factors that influence motor performance directly, as we can determine through technical and biomechanical analysis and biomechanical analysis can identify the strengths and weaknesses of swimmers and then provide sufficient information for the coach to have a base full of accurate information to work to enhance the strengths, work to develop them and avoid weaknesses and then develop the digital achievement of the swimmers (Abdulkarim, Majeed, and Hadi, 2024). The performance of movement between body parts needs compatibility to determine the movement of the body according to certain trajectories of body parts, certain angles of body joints, and specific times as well as several other variables (Amer et al., 2024).

Materials and Methods

The researchers used the experimental method in the experimental design method (pre-test, post-test for one group) The selection of the research sample comes within the basic and important points in the research procedures adopted by the researchers to reach results with high credibility, so the researchers deliberately selected a random sample consisting of (6) swimmers representing (100%) of the population of origin, which are the players of the Iraqi national team (16-18 years old) in the event of The importance of the study lies in the

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importance of the mechanical positions that the swimmer must take in the rotation and after the 100 m, which gains the body the highest linear momentum and the least possible decrease, These mechanical positions during the rotation prepare the swimmer for the appropriate motor field. Studies and analyses indicate that the freestyle style is the preferred style for the majority of swimmers on the Iraqi national team After clarifying the differences between different swimming styles (Hussain et al., 2022), the need for research and investigation has increased to solve issues related to the rotation phase as indicated (Hamid, Al-Shamaa, and Haider, 2024) Identify the values of some biomechanical variables of the rotation phase, swimming for 100 m swimming and the study hypothesizes: There are st\atistically significant differences in some biomechanical variables affecting the rotation phase in the (100 m) freestyle swimming between the pre-test and post-test as the experiment lasted from 24/2/2024 to 14/4/2024 with (24) training units of (3) training units per week in the Olympic People's Pool and after the completion of the experiment and the application of post-tests, the researchers verified the results using the statistical package system (spss).

Biomechanical variables of the rotational phase in swimming

1. **Angular velocity:** It is the rate of angular travel of an object over a specified time, (Omar, Hussein Mardan; Rahman, Iyad Abdul, 2011, p. 34).

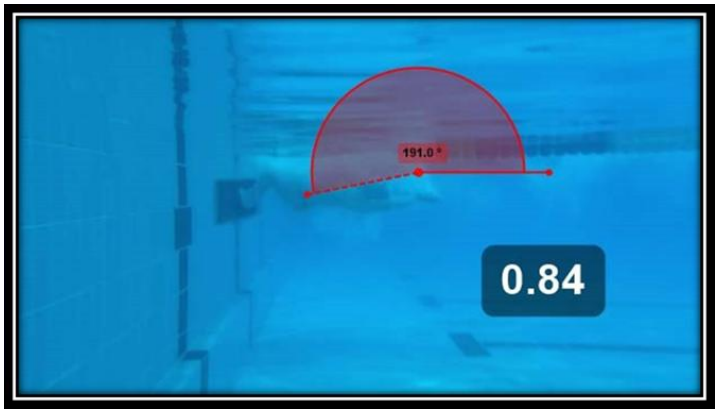

Figure (1): shows the angular velocity

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2. **Knee angle:** It is measured at the moment of maximum flexion, which is the angle between the thigh and the leg and is measured from the side towards the flexion. (Najah and Thamer, 2015, p. 85).

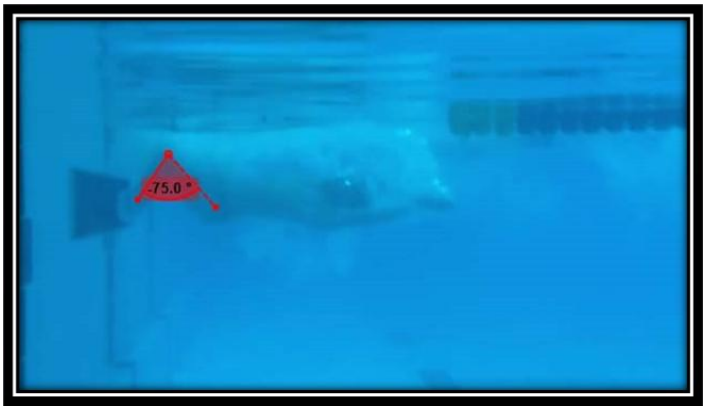

Figure (2): shows the Knee angle

3. **Directional angle:** It is the angle between the horizontal line and the line passing through the center of gravity of the object at the moment of thrust (the moment of last contact with the wall) during rotation.

Figure (3): shows the Directional angle.

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4. **Flow velocity:** the distance between the last touch of the wall, over time.

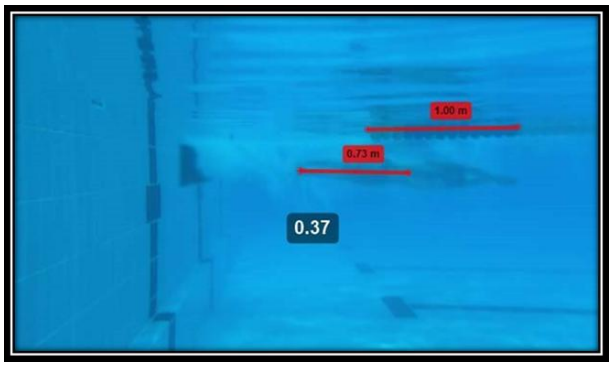

Figure (4): shows the flow velocity.

The two researchers adopted the technical performance test of the rotation skill in freestyle swimming, as the performance of the rotation phase of swimming was filmed and the performance was analyzed by the (Kinovea) program for movement analysis, using a single camera at a speed (120 p/s) placed at a distance of (1.50 m) underwater and a distance of (11.5 m). from the swimmer, the pre-test was conducted for the sample and according to the movement analysis to extract the biomechanical variables of the rotation phase of the swimmers and present them to the coach to correct the movement in the rotation phase for each swimmer according to what he needs to develop the performance after the group finished the training units in which the movement was corrected, the swimmer is filmed and the performance is analyzed again to complete the post-test in conditions similar to the conditions of the pre-test. The analysis of rotational performance was performed using rapid video filming of the national team swimmers (16-18 years old) and variables were extracted for the rotational phase.

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Results

Table (1): Shows the mean (μ), standard deviation (σ), and differences of the mean (μ.Difference) and standard deviation (σ.Difference) of the pre and post-test of the biomechanical variables of the Rotational phase in (100m freestyle) swimming

Biomechanical variables	Unit	Pre-test		Post-test		μ.Difference	σ.Difference	T	Sig Value
		μ	+σ	μ	+σ				
Angular velocity (C.O.M)	d/s	226.13	12.90	240.008	14.121	-13.878	2.956	-11.491	0.000
Knee angle	d	74.666	1.632	78.888	2.366	-3.333	0.816	-10.000	0.000
Directional angle	d	86.000	1.4142	92.500	1.378	-6.500	2.167	-7.344	0.001
Flow velocity	m/s	1.640	0.231	1.901	0.201	-0.261	0.098	-6.482	0.001

Discussion

We notice from the above table that there are statistically significant differences and therefore we notice from the analysis has significantly affected the results of the swimmers and therefore the process is reversed whenever the training is done correctly on the rotation We notice from table (1) the values of the differences for the arithmetic means of the biomechanical variables of the rotational phases of the 100 m freestyle swimming, where it was found that the differences between the arithmetic means of the variables under study for

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the pre and post-tests were significant in favor of the post-test, and the reason for the significance of the differences between the arithmetic means of the variable of angular speed between the pre and post-tests in favor of the post-test. The significance of the differences between the arithmetic means of the angular velocity variable between the pre-test and post-test in favor of the post-test as a result of increasing the speed in the direction of the horizontal vehicle during swimming before performing the rotational movement, which helped the swimmer to transfer the kinetic energy from the horizontal vehicle to the vertical vehicle more quickly, which increased the value of the angular velocity of the rotation of the body's center of gravity, which led to a reduction in the time required to perform this phase (Tarsh, Kazim, and Kazim, 2018) (Abdulkareem et al., 2017)

The decrease in the value of the time variable resulted from the motor adaptation of the swimmers, as we find that the differences also appeared significant for the knee angle variable at maximum flexion, as we find that the value of the angle increased for most of the swimmers, which reduced the time required to extend the legs during the performance of the push (Hammood et al., 2024).

We also find a change in the value of the direction angle variable after pushing, as significant differences appeared between the pre and post-tests as a result of using the proposed device as an aid to correct the motor path taken by the swimmer after performing the rotation, as we find that the angle measurement was above the horizontal line passing the center of gravity of the swimmer at the last touch with the wall, while it was modified to be below the horizontal line passing the center of gravity of the body at the last touch, which helps in increasing the flow distance (Najah and Thamer, 2015).

We notice from table (1) that the flow velocity that we appeared with significant differences between the values of the arithmetic mean of the pre and post-tests, which reflected positively in increasing the value of the flow velocity variable, as it is known that the water resistance is less due to the value of surface resistance, as the value of the resistance imposed on the swimmer's body is reduced due to the lack of load currents imposed on the swimmer, which is large when swimming on the water surface due to the turbulent movement of the liquid due to the movements performed by the swimmer, which moves the water (Alwan and Fadhli, 2012, page 130), increasing its effect on the swimmer's body (Alwan and Fadhli, 2012, p. 130).

Conclusions

1. Changes in the biomechanical variables associated with the rotational phase of the swimmer have led to the development of a significant increase in rotational speed.

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2. Differences between swimmers in the use of biomechanical variables related to the rotational performance of swimming according to the individual differences between the sample members.

Recommendations

1. Explain the importance of biomechanical variables in a simple way and increase the education and awareness of swimmers on how the use of proper angles, distances, and force can affect the economy of effort to create an advanced athletic generation for the betterment of the sport.

2. Increase the emphasis on the rotational phase of swimming during training, and include it in the training units due to its effective role in improving the level of achievement.

Appendix

Sample training units during the week and days to add special exercises for the rotation phase of training
Special preparation period and competitions
Volume: 20-25 km
Number of modules: 3 per week

	SATERDAY	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
MORNING	**En3 +sp2 Start + turn 3 Km**	**Rest**	**Rest**	**Sp3 + En2 4 Km**	**Rest**	**Sp3 + start 3 Km**	**Rest**
AFTERNOON	**Rest**	**Sp3 + En1 Pull + Fins 4 Km**	**En1 + Sp3 Turn+start 4 Km**	**En3 +sp1 3 Km**	**Sp2 + En2 Start + turn 5 Km**	**Test 8×25m (5s)**	**Rest**
Out Water	**Lastic + run + Barbell**	**Rest**	**fitness**	**Rest**	**Lastic + run + Barbell**	**Rest**	**Rest**
KM / DAY	**3**	**4**	**4**	**7**	**5**	**3**	

Note: Special exercises have been inserted into the training modules marked in green

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