THE DETERMINATION OF DRAG IN THE GLIDING PHASE IN SWIMMING

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INTRODUCTION: The hydrodynamic drag forces produced by the swimmer during the sub aquatic gliding have been analyzed appealing to experimental investigation methods (e.g., Lyttle et al., 2000). However, the obtained results varied, which can translate some of the main inherent difficulties involved in the experimental studies. Thus, through application of a numerical method of Computational Fluid Dynamics (CFD), we intended to study the hydrodynamic drag forces, created during the displacement of the swimmer in different gliding positions, attempting to address some practical concerns to swimmers and coaches.

METHODS: Two-dimensional models of the human body in steady flow conditions have been studied. For the achievement of this study, two-dimensional virtual volumes, had been created in CAD software: i) a ventral position with the arms extended at the front of the body; ii) a ventral position with the arms placed alongside the trunk; iii) a lateral position with the arms extended at the front of the body; iv) a dorsal position with the arms extended at the front of the body. The drag coefficients (Cd) and the drag forces (Fd) had been calculated between speeds of 1.6 m/s and 2 m/s (with 0.05 m/s increments) in a two-dimensional Fluent® steady flow analysis.

RESULTS/DISCUSSION: For all the studied positions the Cd values decreased with speed whereas the Fd values increased with the flow speed, as expected (e.g., Bixler et al., 2007). The positions with the arms extended at the front presented hydrodynamic drag values lower than the position with the arms aside the trunk. The lateral position was the one in which the drag was lower. The ventral and the dorsal positions presented similar values.

CONCLUSION: The positions with the arms extended at the front seem to allow a higher reduction of the negative hydrodynamic effects of the human body morphology: a body with various pressure points due to the large changes in its shape. Thus, this position (perhaps performed in a lateral position) must be the one adopted after starts and turns. For instance, considering the breaststroke turn, the first gliding, performed with the arms at the front, must be emphasized in relation to the second gliding, performed with the arms along the trunk. Nevertheless, this concern demands further research using three-dimensional CFD models.

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