

A THREE-DIMENSIONAL ANALYSIS OF INTRA-CYCLE KINEMATIC PARAMETERS OF THE CENTRE OF MASS OF FEMALE BUTTERFLY SWIMMERS

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INTRODUCTION: The analysis of intra-cycle velocity fluctuations in butterfly swimmers has been the subject of several swimming studies. Despite the fact that swimming is not a planar activity, most studies have examined these fluctuations with the use of two-dimensional (2D) analysis techniques, for example Maglischo et al. (1989), thereby introducing important limitations in both the data collection and analysis. In addition, the assumption of bilateral symmetry is untenable due to asymmetric patterns in the technique and asymmetries in the anthropometric characteristics (Arellano et al., 2003). Furthermore, Barbosa et al. (2003) showed that the hip does not represent properly the intracyclic variation in the kinematics of the centre of mass. Therefore, the purpose of this study was to investigate the intra-cycle fluctuation of the displacement, velocity and acceleration of the centre of mass in competitive female butterfly swimmers using three-dimensional (3D) analysis methods.

METHOD: Ten competitive female swimmers swam 25m butterfly with maximum effort. The performance was recorded simultaneously by four underwater and two above water synchronised JVC KY32 CCD video cameras, with a frequency of 50Hz and a shutter speed of 1/125s. A total of 19 anatomical points were marked on each swimmer. A 6.75m³ frame was used to calibrate the above and below water space (Psycharakis et al., 2005). The 'elliptical zone method' (Jensen, 1978) was used to determine the body segment parameter data using a recently developed MATLAB program running on a PC (Deffeyes and Sanders, 2005). An Ariel Performance Analysis System was used to digitise the marked segment endpoints and to determine their 3D coordinates. A MATLAB program was written to calculate the 3D kinematics.

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