A COMPARATIVE THREE-DIMENSIONAL ANALYSIS OF BREATHING AND NON-BREATHING IN FRONT-CRAWL SWIMMING

Gordon Hunter, Stelios G. Psycharakis and Ross Sanders

Centre for Aquatics Research and Education, The University of Edinburgh, UK

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INTRODUCTION: Only a few studies have examined the effects of breathing in the kinematics of front crawl swimming (e.g. Payton et al., 1999). Important limitations of previous studies were that they were conducted (totally or partly) with the use of two-dimensional (2D) analysis techniques, and that body roll was calculated based on the assumption that the trunk moves as a rigid part. However, Cappaert et al. (1995) reported not only different range of motions but also different timing of shoulder and hip roll. This indicated that the rigid trunk assumption is not tenable. Therefore, the purpose of this study was to examine the effect of breathing on the kinematics of the whole body centre of mass (CM) and roll of the shoulders and hips using three-dimensional (3D) analysis methods applied to a full body model.

METHOD: Eight competitive male swimmers swam 25m front-crawl with maximum effort under two conditions: non-breathing and breathing on the preferred side, while swimming through a 6.75m^3 space calibrated using the methods described by Psycharakis et al. (2005). The performance was recorded simultaneously by four under-water and two above-water synchronised JVC KY32 CCD video cameras at a frequency of 50Hz and with a shutter speed of 1/125s. A total of 19 anatomical points were marked on each swimmer. 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 Arial 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 of the CM and roll of the shoulders and hips.

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