A BIOMECHANICAL EVALUATION OF DIVE START PERFORMANCE IN SWIMMING – FORCE DEVELOPMENT CHARACTERISTICS AND ANGULAR MOMENTUM

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INTRODUCTION: Dive start performance has been considered a major determinant for race swimming over short distances (e.g. Lyttle & Benjanuvatra at www.coachesinfo.com). This performance is based on chronologically interrelated subcomponents such as take-off performance on the block, flight performance before water contact, dive entry while immersing into the water, and gliding performance before the first swim stroke. In this "work in progress" report, we will focus on the take-off performance from the block. We will introduce a portable 2D-force measurement starting block which can be installed in different training centres and pool locations. Selected data on a research program for the biomechanical evaluation of dive start performance in swimming will be presented in order to show force development profiles from junior level swimmers. In addition, we will introduce data on the angular momentum at take-off. We will discuss some validation procedures in order to estimate the quality of the underlying calculations. To date, angular momentum has hardly been evaluated in biomechanical studies on the dive start in swimming. Nevertheless, angular momentum might play a crucial role for the angle of dive entry.

METHODS: A 2D-force measurement starting block and a video analysis were used to examine the take-off performance of junior level swimmers. The starting block was equipped with four strain gauges to measure horizontal reaction forces and four strain gauges to measure vertical ground reaction forces. All force sensors were located in a level plane slightly below the take-off platform on the block. A video camera (JVC 9600 series) was used to register the kinematic data throughout the take-off period plus the first instance of the flight phase. A video-analysis-system (Simi Motion, Germany) was used to register segmental data and to estimate the centre of mass coordinates. The data of two female junior level swimmers with two jumps each will be presented in this report. Force plate data and video data were synchronized in order to evaluate the moments acting upon the centre of mass during take-off. Horizontal and vertical force components were separately analysed. In addition, force signals were used to examine the origin of the resultant force vector in order to calculate the moment acting on the centre of mass. Numerical integration procedures were used to calculate the angular momentum at take-off. In order to examine the validity of the angular momentum calculations, two validation criteria were used to estimate the quality of the calculations.

RESULTS AND DISCUSSION: The results of our analysis show diverse force development characteristics in the swimmers. No systematic force development profiles were detected. Values for the angular momentum were clearly differing between subjects but not as much within subjects.

CONCLUSION: Results from the literature and results from our own study indicate that swimmers do not exhibit unitary force development profiles at take-off from the starting block. More studies are needed to evaluate the importance of angular momentum at take-off.

REFERENCES:

Lyttle, A. & Benjanuvatra, N., Start Right – *A Biomechanical Review of Dive Start Performance* (download from www.coachesinfo.com at 13.12.2004).