KINEMATIC, DYNAMIC AND ELECTROMYOGRAPHIC CHARACTERISTICS OF A SPRINT START

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INTRODUCTION: The aim of the study was to establish the major kinematic and dynamic parameters as well as the EMG activation of muscles in a sprint start as the first derivative of sprint velocity. The subject of the analysis was block velocity, the production of force in the front and rear starting blocks, the block acceleration in the first two steps and the EMG activity of the following muscles: the erector spinae, gluteus maximus, rectus femoris, vastus medialis, vastus lateralis, biceps femoris and gastrocnemius–medialis.

METHOD : One international-class female sprinter participated in the experiment. She performed eight starts in constant laboratory conditions. The 3-D kinematic analysis was made using a system of nine cameras operating at a frame rate of 60 Hz. Dynamic parameters were established by means of two separate force platforms (Kistler Type 9286A, AG Winterthur, Switzerland) to which the starting blocks were fixed. A 16-channel electromyograph (BTS Pocket EMG, Myolab) was used to analyse EMG activity. It consisted of two units: a mobile unit (HP Ipaq 4700), capturing all EMG signals and transmitting them to a stationary unit by wireless technology (Wi-Fi). Superficial EMG activity was detected by bipolar electrodes (Ag-AgCl, Fiab S.p.A.) fastened to a specific location of the motor unit of the muscles following thorough skin preparation.

RESULTS AND DISCUSSION: It was established that the block velocity depended on the absolute force produced in the front and rear starting blocks and that it was 2.84 ± 0.21 $m.s^{-1}$. The maximal force on the rear and front blocks was 593 ± 25 N and 1023 ± 30 N, respectively. In view of the total impulse (210 ± 11 Ns) the force production/time ratio in the rear and front blocks was 34%:66% The quality of the performance of the start depended on the total reaction time, defined by the pre-motor reaction time and time of clearing the rear and front blocks, which in the case of the study subject was 491 ± 24 ms. The erector spinae, vastus lateralis and gastrocnemius–medialis generate the efficiency of the sprint start. The block acceleration in the first two steps primarily depends on the activation of the gluteus maximus, rectus femoris, biceps femoris and gastrocnemius–medialis.

CONCLUSION: A sprint start is a complex motor stereotype requiring a high degree of integration of the processes of central movement regulation and an optimal level of biomotor abilities. Throughout the time cycle, which lasts for 856 ± 18 ms and includes the start and execution of two steps, a generally high degree of muscle activation of the gastrocnemius - medialis of the left and the right legs can be established in all three phases of the motor task, which is important for the production of force in the start and in the block acceleration.

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