EFFECTS OF THE DIFFERENT REBOUND EFFORTS ON THE TRICEPS SURAE MUSCLE DURING DROP JUMPS

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In the previous studies concerning the drop jump (DJ), subjects have been requested to rebound at maximal effort, and few studies have employed a sub-maximal rebound jump. In the present study, we examine the effects of the sub-maximal rebound efforts on the triceps surae muscle-tendon complex during DJ.

Three physically active men participated in this study. They performed bilateral drop jumps on a force-platform from a constant dropping height (0.3 m) but to the different rebound heights. The rebound heights were as follows: 1) 0 m (landing, NJ), 2) 0.1 m (0.1J), 3) 0.2 m (0.2J) and 4) maximal effort (MAXJ). The subjects were instructed not to include any counter movement with their arms and knees as far as possible. The DJ movements in the sagittal plain were video-recorded with a digital video camera. Body landmarks were digitized (60 Hz) and the coordinates were filtered with a Butterworth type 4th-order low-pass filter (cut-off frequency: 7-10 Hz). The lengths of the muscle-tendon complex (MTC) of the medial gastrocnemius (MG) and soleus (SOL) muscles were calculated from the knee and ankle joint angle. EMGs were recorded using bipolar surface electrodes with a sampling frequency of 1 kHz. Simultaneously, the vertical ground reaction force was recorded (1 kHz) by means of a force-platform. Longitudinal sectional images of the MG and SOL muscle were obtained by using a real-time ultrasound apparatus. The MG and SOL fascicles identified along their length from the superficial and deep aponeurosis were tracked continuously frame by frame. Assuming a linear continuation, we calculated the total fascicle length by estimating the part of the fascicle that was not visible. The fascicle angles in the MG and SOL muscles were determined as the angle between the deep aponeurosis and a line drawn tangentially to the fascicle. The instantaneous length change of the contractile component (CC) was calculated from the fascicle length and the fascicle angle. The length of the elastic component (EC) was obtained by subtracting the length of the contractile component from the MTC length.

In NJ, CC as well as MTC was lengthened after touchdown. This CC lengthening is likely to avoid the storage and recoil of elastic energy from the impact force. In 0.1J, MTC, CC, and EC underwent a stretch-shortening during the foot contact period. In 0.2J and MAXJ, although the MTC and EC stretched prior to shortening, the CC shortened throughout the foot contact period.

The present results showed that the CC behaved differently depending on the rebound height during DJs. This regulation of the CC behavior is likely to operate the utilization of EC effectively for rebounding the target height.

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