

Factors influencing individual difference in the jump performance enhancement induced by counter-movement

Kuniaki Hirayama, Yasuo Kawakami

The execution of a counter-movement prior to the main exercise, during which the muscle fibers work almost isometrically by leaving the task of storing and releasing elastic energy to tendon (muscle-tendon interaction) enhances the performance outcome. The purpose of the present study was to reveal musculotendinous factors influencing individual differences in the performance enhancement. Sixteen healthy males performed jumps using only the ankle joint with and without a counter-movement. During the exercise, an ultrasonography technique was used to record the fascicle behavior of the gastrocnemius muscle, and the tendon length change was computed. These data were combined with tendon force to calculate the mechanical work done by the fascicles and tendon. The mechanical work done by muscle-tendon unit increased with the execution of the counter-movement, and its magnitude was correlated with the extent of increase in the elastic energy utilized by the tendon ($r=0.60$, $p<0.05$), but not with the size of difference in the mechanical work done by the fascicles. The elastic energy utilized by the tendon was not correlated with tendon stiffness determined separately. These results indicate that the greater performance enhancement by a counter-movement is derived from the better usage of elastic energy through muscle-tendon interaction during the stretch-shortening cycle, regardless of the tendon properties.