ACHILLES TENDON BEHAVIOUR DURING HUMAN JUMPING

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The elasticity of tendons in the legs and feet of many terrestrial animals can play an important role for saving and enhancing the work and power during locomotion (Komi 2000). It has been a long time wish and challenge among researchers to know how Achilles tendon (AT) behaves during human locomotion. The purpose of this presentation is to examine the muscle fascicle and AT behaviors as well as the muscle activity interaction during various human dynamic movements.

The high-speed ultrasonographic image scanning (169-199Hz, alpha-10, Aloka) for measuring the muscle fascicle length and displacements of muscle tendinous junction (MTJ) was performed together with electromyogram during jump exercises. Movements were recorded with the high-speed video camera (200 fps) to calculate the leg joint angles and to measure the distance between MTJ and the AT insertion on the calcaneus. Simultaneously, the reaction force to the movement plane was measured to estimate the Achilles tendon force (ATF). The AT length (ATL) was determined as the length from the gastrocnemius MTJ to the AT insertion on the calcaneus.

When the drop jumps (DJ) were performed with the same drop height (DH) and different rebound efforts, the initial precontact and the early braking phase activities and resulting AT responses did not differ across conditions. Thereafter, the AT behavior started to vary due to the EMG variation from the late braking phase depending on the rebound efforts. The AT stretching amplitudes correlated positively to the MG EMG activation during the late braking phase. On the other hand, when DJs were performed with different DH and a constant rebound height, the preactivation increased with higher DH. ATL at the initial contact was longer and the ATF stretch slope greater with higher DH. However, the stretch amplitudes did not increase with higher DH. These results imply that the fascicle length can be modified to prevent it from becoming greater than the values of the peak AT strain that should not reach the failure reign (>8%).

These results show further that the elastic utilization of AT takes place during the ground contact phase of human movements. The instantaneous AT stiffness and the effective utilization of tendon elasticity can be varied depending on situations when both DH (stretch load) and/or subsequent rebound efforts are varied (Ishikawa et al 2006).

REFERENCES

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