It has been suggested that tendon stiffness decrease with aging in humans (Kubo et al., 2003). This decreased stiffness could be considered to be beneficial in stretch-shortening cycle (SSC) locomotion, which is the natural type of muscle function, since it allows greater strain for a given load and therefore better utilization of tendon elasticity. However, the metabolic cost of movement is increasing with increasing age (Mian et al., 2006). In addition to the mechanical properties of the muscles, the neural activation can play an important role in complex SSC exercises. Age-specific activation profiles may exist during dynamic movements, which can, together with the mechanical properties of the muscles, affect the stiffness regulation during the braking phase of SSC action and subsequently influence the following rebound.

This study was designed to compare the behaviors of the muscle-tendon unit, tendinous tissue (TT) and fascicle of the gastrocnemius medialis (GM) muscle as well as electromyogram (EMG) between the young (YOUNG) and elderly (ELDERLY) subjects in drop jumps (DJ). Twelve YOUNG and thirteen ELDERLY performed maximal squat jumps and DJs with maximal rebound effort from three different dropping heights on a sledge apparatus. Ankle and knee joint angles, reaction force (Fz) and EMG from the soleus (SOL), GM and tibialis anterior (TA) muscles were measured together with the GM fascicle length by ultrasonography.

The results showed that the measured ankle joint stiffness (AJS) during the braking phase correlated positively with the rebound speed in both age groups (YOUNG \( p<0.01 \) and ELDERLY \( p<0.001 \)) and that both parameters were significantly lower in ELDERLY than in YOUNG. Although the TT stiffness and averaged EMG (aEMG) in SOL correlated positively with AJS in both groups, AJS in ELDERLY was further associated with the GM activation \( (r=0.55, p<0.01) \) and the coactivation between GM and TA (TA/GM \( r=-0.4 \) \( p<0.05 \)) during the braking phase. In addition, as compared to YOUNG, ELDERLY showed significantly lower GM aEMG in the braking phase and significantly higher aEMG in the push-off phase, indicating less utilization of TT elasticity. These different activation patterns are in line with the mechanical behavior of GM showing significantly less fascicle shortening and relative TT stretching in the braking phase in ELDERLY than in YOUNG.

These results suggest that there are age-specific muscle activation patterns as well as mechanical behaviors during DJs. They further suggest that ELDERLY do not/cannot utilize tendon elasticity efficiently even if they may have more compliant tendons.

REFERENCES
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