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Biomechanical behavior of the lower limbs and of the joints when landing from different heights
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Abstract
Landing from a jump is a challenging task as the energy accumulated during the aerial phase of the jump must be fully dissipated by the lower limbs during landing; the higher the jump height, the greater the amount of energy to be dissipated. In the present study, we aim to understand (1) how the biomechanical behavior is tuned as a function of the mechanical demand, and (2) the relationship between the self-selected landing strategy and the behavior of the joints. Fourteen subjects were asked to drop off a box of 10 to 60 cm height and land on the ground. The ground reaction forces and the kinematics were recorded using force plates and a motion capture system. A model was used to estimate the properties, i.e. stiffness and damping, of the lower limbs and of the joints. Our results show that, whatever the amount of energy to be dissipated (i.e. height of the jump), the lower limbs and the anke and knee joints behave first as a spring, then as a spring-damper system. However each joint plays a specific role: during the spring phase, the behaviour of the lower limb is associated with the stiffness of the ankle and with the landing constraints (i.e. force peak and loading rate), while during the spring-damper phase, it is associated with the stiffness of the knee and with the amount of energy to be dissipated. Our findings suggest that constraints and performance result from a distinct control of biomechanical parameters at the joints. © 2024

Author Keywords
Biomechanical model; Damping coefficient; Stiffness

Index Keywords
Antennas, Biomechanics, Damping, Joints (anatomy), Landing; Biomechanical behavior, Biomechanical model, Damping coefficients, Different heights, Energy, Force plate, Ground reaction forces, Lower limb, Mechanical, Motion capture system; Stiffness; adult, ankle, Article, athlete, biomechanics, controlled study, energy metabolism, force plate, ground reaction force, human, human experiment, joint, joint function, jumping, kinematics, knee, landing from a jump, lower limb, male, muscle function, musculoskeletal stiffness, normal human, young adult, biomechanics, knee; Ankle, Ankle Joint, Biomechanical Phenomena, Humans, Knee, Knee Joint, Lower Extremity

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