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Accurate estimation of mechanical loading on the musculoskeletal system during gait using biomechanics modelling

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The purpose of this presentation is to describe the integration of advanced experimental techniques commonly used in biomechanics with real-time *in vivo* imaging, in order to develop subject specific models aiming estimating the biomechanical load on the. To estimate mechanical load on musculoskeletal system we need to collect and integrate different types of experimental data: Motion capture data, obtained using a high-speed infrared camera system; force data, measured with force platforms, and muscles electrical activity, assessed through EMG. The analysis of these data is usually carried out carried out using the following biomechanics modeling software solving the inverse dynamics equations of motion in a second stage detailed musculoskeletal (MSK) biomechanics models can be used for the estimation of muscle forces and torques applied to human joints and musculoskeletal structures. In this work we used *in vivo* imaging techniques namely Magnetic Resonance (MRI) high speed ultrasound (US) and low level radiology (DXA) to obtained subject specify anatomical and functional information that was inputted on a subject specific biomechanical model develop under the OpenSim (1) software platform. Our model was applied to a set of biomechanical gait data from osteoarthritic patients to accurately estimate the mechanical load applied on the musculoskeletal system. Results were compared with the ones obtained using classical gait analysis inverse dynamics. Our results showed that osteoarthritic patients that have high level of soft tissue artifacts perturbing the direct estimation of moments of force in the coronal plane that apparently are overestimated when compared with the result obtained incorporating real pelvis dimensions, (obtained using DXA or MRI) to the biomechanical model resulting in inexactness on the knee adduction joint moments (KAM) calculations. This is particularly relevant because KAM is described as a marker for disease severity. An important additional consequence is that this inaccuracies resulting from non-specify musculoskeletal models will also failed to obtained correct muscle activations mainly in abductor and adductor muscles and this will lead to inaccurate estimation of bone on bone compression forces on both hip and knee joint that are severely influence by muscle tensions.

Biography

António Veloso completed is PhD in 2000 from the Technical U. Lisbon. He is currently working in Biomechanics laboratory at the University of Lisbon (UL). He is the Head of the Biomechanics Laboratory and the Sports and Health Department of the Faculty of Human Kinetics, University of Lisbon. He belongs to the Council of the International Society of Biomechanics (ISB) and published more than 52 papers in IF journals in the field of biomechanics.

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