TISSUE STRAINS COMPUTATION WITH BIOMECHANICAL MODELS TO PREVENT PRESSURE ULCERS

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This invited lecture aims to present our most recent works on the development of subject-specific biomechanical models of human soft tissues to prevent pressure ulcers. Such models represent the geometry of tissues (foot, buttocks, sacrum) discretized into finite elements, whose mechanical properties should, if possible, be subject-specific. Numerical simulation then allows us to estimate tissue deformations when they interact mechanically with a support such as a shoe, a chair, or a bed. Pioneering work by Cees Oomens and collaborators (Eindhoven University of Technology) has shown that internal tissue shear strains are a relevant biomarker for estimating the risk of pressure ulcer development.

Together with several collaborators, our research team has demonstrated the sensitivity of the models to the values of the mechanical parameters defined in each anatomical structure modeled using finite elements, as well as the importance of subject-specific calibration. In particular, using MRI measurements, we have shown that internal strains of the sacrum soft tissues are simulated more accurately when tissue stiffnesses are obtained from in vivo measurements taken directly from the subject.

Even more recently, we have expanded the scope of prevention by focusing on modeling the mechanical interactions between wounds' soft tissues from one side and dressings from the other side, with or without consideration of cavity fillers. Tissue shear strains simulated by the models are here again studied as a biomarker, supplemented by other parameters such as the pressure exerted by the filler onto the wound bed.