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Analysis of the Internal Mechanical Conditions in the Lower Limb Due to External Loads

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Abstract : Human soft tissue is loaded and deformed by any activity, an effect known as a stress-strain relationship, and is often described by a load and tissue elongation curve. Several advances have been made in the fields of biology and mechanics of soft human tissue. However, there is limited information available on in vivo tissue mechanical characteristics and behavior. Confident mechanical properties of human soft tissue cannot be extrapolated from e.g. animal testing. Thus, there is need for non invasive methods to analyze mechanical characteristics of soft human tissue. In the present study, the internal mechanical conditions of the lower limb, which is subject to an external load, is studied by use of the finite element method. A detailed finite element model of the lower limb is made possible by use of MRI scans. Skin, fat, bones, fascia and muscles are represented separately and the material properties for them are obtained from literature. Previous studies have been shown to address macroscopic deformation features, e.g. indentation depth, to a large extent. However, the detail in which the internal anatomical features have been modeled does not reveal the critical internal strains that may induce hypoxia and/or eventual tissue damage. The results of the present study reveals that lumped material models, i.e. averaging of the material properties for the different constituents, does not capture regions of critical strains in contrast to more detailed models.

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