FINITE ELEMENT ANALYSIS: BONE AND EYES

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Biomechanical analyses of hard and soft connective tissues have often used continuum representations of the structures. In order to account for porous materials, the continuum representations have incorporated material information including the volume fraction and the "fabric" of the material. Examples for analysis of cortical and trabecular bone will be presented in which "tissue-level" continuum-based analyses have been successful. However, as interest shifts to understanding the mechanical environment at the cellular level of biological structures, efforts are being directed to very large (100M element) representations of structures, many using “voxel-based” meshes. Examples from the literature will be shown for analyses of these types.

The similarity of trabecular bone structures to the lamina cribrosa (in the eye's optic nerve head) will be described as well as our efforts to analyze these structures using continuum models. In addition, our work in progress to generate and analyze microFE models for the lamina cribrosa will be described as well as strategies we are exploring to solve the resulting large sets of equations, and the benefits to be expected from these of analyses.