The Effect of Residual Stress on Stress-Modulated Growth in a Stented Artery

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Abstract

Growth plays a key role in many biological and medical processes, and often takes place under the stimuli of mechanics. Residual stress is known to exist in vessels when it is not under any mechanical loading. As a result, a stress-modulated growth is expected to be largely dependent on the initial stress state or the residual stress, particularly upon loading. In this talk we examine the impact of residual stress on the growth of a stented arterial wall using a finite element simulation, where the stress-modulated growth is implemented based on the multiplicative decomposition approach. The artery wall is modeled as an isotropic, hyperelastic tube. Open-angle and axial pre-stretch are applied to generate the residual stress in the artery wall. It is found in this study that different amount of residual stress can affect the stress distribution under a pressure load, thereby change the growth rate of the artery wall. The results indicate that the arterial stenosis might originate from an abnormal distribution of the residual stress. Future studies on multiscale simulations on the generation of the residual stress modulation will be discussed.

Keywords: residual stress, growth, stented artery, finite element