INTERACTION OF BALLOON CATHETER STENT SYSTEMS WITH Atherosclerotic Lesions: A Computational Study

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A methodology is proposed that identifies optimal stent devices for specific clinical criteria. It enables to predict the effect of stent designs on the mechanical environment of stenotic arteries. In particular, we show representative experimental results of the transient expansion of a commercially available balloon-expandable stent system and a computational analysis of that system with a patient-specific atherosclerotic iliac artery. Using a pneumatic-hydraulic experimental setup, the pressure-diameter diagram for a balloon-expandable stent is documented as well as typical measures such as the burst opening pressure, the maximum dog-boning and foreshortening, and the elastic recoil. The geometric arterial model is based on magnetic resonance images, while anisotropic material models are applied to describe the mechanical responses of the (four different) tissues at finite strains. In the simulations three different stent designs are studied. The performance of each stent is characterized by scalar quantities relating to stress changes in the artery, contact forces and changes in lumen area after stenting. The study concludes by suggesting two optimal stent designs for two different clinically relevant parameters.