MODELING OF COMBINED TWIST AND BENDING DEFORMATIONS OF THE FEMOROPOPLITEAL ARTERY

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Peripheral arterial disease (PAD) is a narrowing or blockage of the femoropopliteal artery (FPA), leading to reduced blood flow to the downstream tissues. PAD is recognized as one of the most financially demanding vascular disorders to manage, primarily due to the high frequency of reconstruction failures that necessitate subsequent interventions. One of the reasons for the high incidence of PAD and poor treatment results can be attributed to the complex mechanical deformations that FPA experiences during routine activities. The high intramural stresses and strains that can result from severe deformations of the FPA may contribute to arterial injury and the development of diseases or restenosis following treatment. The combined impact of twisting and bending on the stresses experienced by the FPA is not fully understood so far. In the current study, a model with combined limb-flextion induced deformations was developed using flexible rings to apply twist in addition to a guiding catheter and surrounding tissues to apply bending and compression. The current computational model accurately simulated the combined deformations of the FPA that occur during the acute bent leg position. We found that the areas of strain concentration generated by bending deformations were non-uniform. Specifically, regions exhibiting acute kinks, i.e., close to the Adductor Hiatus (AH) and the popliteal artery (PA) below the knee, harbor intense stresses and strains. Furthermore, these regions are highly prone to the development of atherosclerotic disease, which implies a plausible association between elevated strains and intramural stresses, and the pathogenesis of atherosclerotic disease in the FPA.

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