ON THE BIOMECHANICS OF NATIVE AND ENGINEERED VALVULAR TISSUES

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Our laboratory has pioneered morphologically-based constitutive models for native and engineered cardiac tissues. For engineered tissues, the scaffolds utilized require advanced biomechanical models to clarify how their intricate microstructure and the concomitant complexity of mechanical interactions occurring between scaffold, cellular, and extracellular matrix constituents all work together in an engineered tissue construct. We have extended our mathematical models that simulate the composite mechanical behavior of the scaffold and the developing tissue, which are intended to facilitate the design of engineered tissues and mechanical conditioning regimens. Such models could thus play a pivotal role in the design and development of engineered soft tissues. Applications to state-of-the-art elastomeric scaffolds will be presented and demonstrate how they can be designed for cardiovascular applications. Computational implementation of these models represents the major next step in the understanding of biological tissues, and is essential for the understanding of the underlying processes for growth and remodeling, and hence the mechano-growth governing laws. Recent results of these approaches will also be presented.