

## **P27**

### **Collagen fiber recruitment structural constitutive models for valvular tissues**

Michael Sacks

*University of Pittsburgh, Pittsburgh, PA, United States*

#### **Objectives:**

Advanced simulations of heart valve function requires more realistic and sophisticated structural constitutive models to predict the stress environment of cells for mechano-physiological questions and account for regional variations and layer properties. A structural model reflects the physiological structural kinematics of collagen fibers under deformation is thus presented here.

#### **Method:**

Whole porcine hearts were obtained and the aortic valve leaflets (AVL), mitral valve anterior and posterior leaflets (MVAL and MVPL) were then prepared removed and square specimens were dissected from each valve leaflets. Each specimen was preconditioned then subjected to an equi-biaxial strain state in order to determine the effective fiber ensemble stress-strain response, which was then fitted to an appropriate recruitment function.

#### **Results:**

In general, we observed that 1) heart valve tissues exhibit a long toe region due to small number of recruited fibers at lower strain level, 2) stress-strain curve becomes linear at high strain due to complete recruitment of the collagen fibers and 3) most fibers are recruited very quickly near upper bound strain limit. Most interestingly, the effective collagen fiber modulus for all three left side valve types was all ~68 kPa, with all fibers fully recruited by ~30% strain.

#### **Conclusions:**

Our purpose in the present study was to demonstrate that the constituent fibers of the left side valve leaflets can be simulated using a fiber recruitment model. Moreover, we demonstrated use of recruitment models can provide for more accurate simulations of valvular tissues at stress levels beyond those utilized in parameter determination.

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