

P23

The Role of Physiological Biaxial Deformations on Cellular Mechanotransduction in the Native Pulmonary Valve: Implications for Heart Valve Tissue Engineering.

Christopher Carruthers, Michael Sacks

University of Pittsburgh, Pittsburgh, PA, United States

Objectives:

Recent valve leaflet *in-situ* studies show that using strip-biaxial cyclic tension (i.e. strain applied in circumferential direction while tissue is constrained in radial direction) alters phenotype and subsequent aortic valve interstitial cell collagen biosynthesis, while in the absence of mechanical stimulation there is a loss of *in-vivo* qualities. While yielding important qualitative information, cyclic-strip biaxial strain is non-physiological as it does not preserve fiber kinematics and thus cellular deformations. We hypothesize that *in-situ* physiologic biaxial strain of the pulmonary valve (PV) leaflet will induce physiological cellular deformations resulting in cellular activity that accurately models the *in-vivo* PV interstitial cell phenotype and biosynthetic activity.

Method:

A novel biaxial tension cyclic stretch bioreactor was developed to replicate the physiological directed biaxial strain states. Cyclic stretch was applied via four linear actuators operated by two controllers separating the actuators into two different groups: radial axis and circumferential axis. Phenotype, collagen biosynthesis, and the spatial distribution of the fibrosa, proteoglycans, and elastin are currently being assessed with quantitative morphologic and immunohistochemical approaches.

Results:

The design of the bioreactor allows for efficient simultaneous testing of multiple valve tissue samples. The bioreactor is durable for prolonged usage, environmentally sealed for contamination resistance, and transparent for observing tissue development. It fits into a standard size incubator. Studies are currently being conducted to quantify differences in the response of porcine aortic and pulmonary heart valves.

Conclusions:

Quantitative analysis of global physiological biaxial strain on cellular activity will provide directive for the development of site specific functionally equivalent tissue engineered constructs through physiological preconditioning regimens.

Acknowledgements: NIH/NHLBI R01 HL068816.