C62. Three-dimensional Structural Characterization Of Tissue-engineered And Native Ovine Pulmonary Valves

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OBJECTIVES: Efforts in tissue-engineered heart valves (TEHV) have shown increasingly equivalent mechanical/structural properties compared to native valves, though a literature gap exists regarding detailed structural information. This work was performed to provide such data of implanted TEHV, the native pulmonary valve (PV), and pre-implant scaffold to better understand developing TEHV.

METHODS: Dynamically-cultured in vivo samples ("pre-implant") and ovine TEHV PV in vitro samples ("explant") were produced based on previous techniques; ovine PVs were excised. Samples were stained with picrosirius red and resin-mounted. Using extended-volume scanning laser confocal microscopy (EV-SLCM), 1.5 x 1.5 x 0.4 mm full-thickness samples were imaged at 1 pixel/µm in 1 µm Z-direction steps. Custom software was used to process and visualize samples. Collagen, cell nuclei, and scaffold volume fractions were quantified; scaffold fiber trajectory and length were tracked using custom software.

RESULTS: In a scaffold representative volume (90 µm thick), 104 fibers were tracked with a mean fiber length of 137.94 µm 55.4 µm (Fig.1). A comparison between pre-implant and explant samples showed collagen volume fraction increasing from 76.6% to 85.9%, with nuclei and scaffold decreasing from 2.8% to 0.5% and from 5.9% to 0.8%, respectively. With the native collagen volume fraction measured at 70%, pre-implant and explant samples showed an increase in collagen.

CONCLUSIONS: This work captured important differences between in vivo/in vitro TEHV constituents; it is the first known work to utilize EV-SLCM on TEHV. A comparison to the native valve showed structural differences that could impact long-term functionality and improve design.

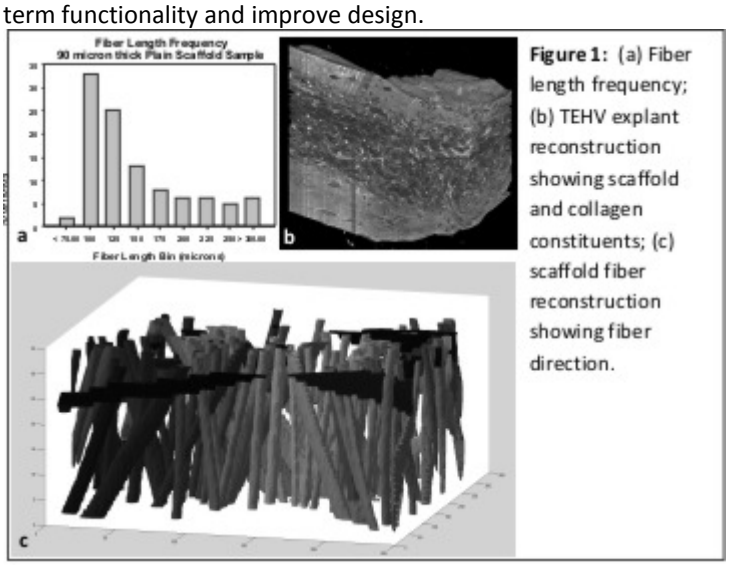

Figure 1: (a) Fiber length frequency; (b) TEHV explant reconstruction showing scaffold and collagen constituents; (c) scaffold fiber reconstruction showing fiber direction.