Hydrodynamic Assessment of Small Intestinal Submucosa Tubular Valves

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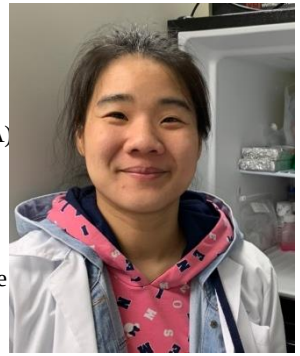
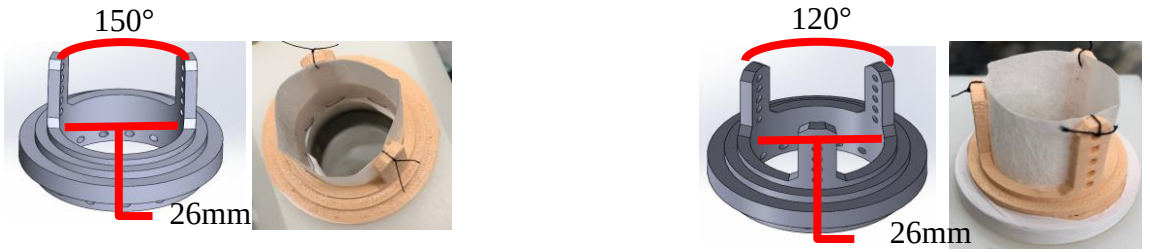
For children with critical valve defects and older patients who are contraindicated for receiving mechanical and bioprosthetic valves, treatment options are extremely limited. The purpose of this study is to determine whether tubular porcine small intestinal submucosa (PSIS) bio-scaffold valves can facilitate robust aortic and mitral valvular hydrodynamic functions and serve as potential treatment options. 26-mm PSIS tubular valves (CorMatrix Cardiovascular Inc., Roswell, GA) were sutured to a custom, 3D-printed valve holder along its ring and posts on the distal end. Three posts at 120 degrees apart were used for the aortic valve position, and two posts at 150 degrees apart were used for the mitral valve position. Hydrodynamic tests were performed using a pulse duplicator system (Vivitro Labs Inc., Victoria, Canada) filled with 0.9% saline solution. A flow probe was affixed between the aortic and ventricular chambers to measure the aortic outflow, and between the atrial and ventricular chambers to measure the mitral outflow. Three pressure transducers were inserted in the atrial, ventricular, and aortic locations. Tests utilized a stroke volume of 71.4 mL, 70 bpm, and an input flow waveform comprising of a 35% systolic-65% diastolic configuration (S35, Vivitest, Vivitro Labs). The tubular PSIS valves placed in both aortic and mitral positions appear to facilitate robust hydrodynamic valve function and may concomitantly serve as a scaffold for de novo valvular tissue growth by the host after implantation. Further studies involving seeding tubular PSIS valves with valvular cells and conditioning them in bioreactors will be conducted to assess the effects of both mechanical and biochemical stimuli on valve performance.





Cylindrical valves sutured onto customized valve holders (Mitral: A & B, Aortic: C & D), which are 3D printed with thermoplastic polyurethane (TPU) material.