

# THE HARTWELL FOUNDATION

## 2008 Individual Biomedical Research Award

### Review of Proposed Research

**Investigator:** Joyce Y. Wong, Ph.D.  
**Associate Professor**  
**Department of Biomedical Engineering**

**Institution:** Boston University

**Proposal:** Development of Tissue Engineering  
Solutions for Pediatric Vascular Surgical  
Repair and Reconstruction



Dr. Wong proposes a pioneering conceptual approach to tissue-engineered patches and grafts for children with congenital cardiovascular abnormalities, which when implanted will grow with the child and obviate the need for multiple surgical interventions. The approach employs innovative cell sheets that do not contain a biodegradable scaffold and that more nearly resemble native tissue by mimicking the natural spatial cellular organization found in blood vessels. To create a model system for small diameter blood vessels like the pulmonary artery, various types of cells derived from human tissues will grow on specific microscale patterned, stamped silicon wafers, which will impart guidance cues to control cell sheet structure, spatial arrangement, and ultimately cell function. Patterned sheets of the harvested cells, representing 3-dimensional patches or as rolled tubes will undergo conditioning treatment in a pulsatile flow bioreactor to determine their growth properties in response to physiologically relevant conditions characteristic of the growth period in children. The data for these grafts will generate a predictive computational model, relating the composition and structural properties to observed mechanical properties under defined biomechanical and biochemical stimulation. The arterial model is relevant because pulmonary artery hypoplasia (small pulmonary artery) is commonly associated with many forms of congenital heart disease and requires frequent surgical reconstruction. It is part of a more complex condition known as the tetralogy of Fallot, which occurs in approximately 1 out of 2,000 live births. Another, lethal cardiac abnormality if not surgically corrected, is hypoplastic left heart syndrome that occurs in 1 out of 5,000 live births, where a small aorta creates obstruction to blood flow out of the heart and synthetic grafts or allografts from cadavers are used in corrective surgery. Unfortunately, procedures using prosthetic grafts are prone over time to develop blood clots and hardening by calcification; none is able to grow with the child; and all require surgical intervention over the life of the patient. If successful, Dr. Wong will lead a new technology of widespread potential importance for tissue engineering and pediatric medical applications.