Holding Your Heart in Your Hand: 3D-Printing a Mechanically Accurate Aortic Valve Model

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Each year, 251,000 patients die due to medical errors in the United States. In aortic valve replacement surgery, over 6% of patients die during or within 5 years of surgery due to medical errors. The solution to reducing these deaths lies within the effectiveness of the surgeon's ability to understand and anticipate the patient's heart. Current methods of preoperative planning are limited to virtual and hard plastic 3D-models. This limits what surgeons and medical device companies can do to prepare for the patient's surgeries. Due to these limitations, there is a need for lifelike, dynamic, and inexpensive heart models in the medical field. Our solution was to create a customizable 3D-printed organ model that is both mechanically and anatomically accurate. To create this unique model, a silicone molding material's composition was tailored to the correct mechanical and 3D-printing properties by balancing concentrations of additives. Furthermore, we pioneered a novel protocol for 3D-printing with a silicone molding material. This realistic model will both dramatically enhance the effectiveness of preoperative planning and serve as a tool for companies to test medical devices. Additionally, our model will be accessible, as it costs less than a dollar for the aortic valve region.We streamlined the printing of a high-quality, time-efficient model. We achieved our project goals to successfully engineer a manufacturing process for 3D-printing mechanically and anatomically accurate organ models at a low cost. We also created an accurate, high-resolution model of the aortic root region.

Awards Won:
National Anti-Vivisection Society: Second Award of $5,000