Technology Summary: Virtual Mitral Valve Repair Simulation

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Surgical repair of the mitral valve (MV) is a therapeutic option for leaking or regurgitating heart valves. Selecting an appropriate surgical procedure for MV repair is dependent in part on the nature of the MV disease and the MV's geometric parameters, which are measured by diagnostic imaging (e.g. echocardiography). Due to complex tissue geometries and variances in the MV rings that are implanted during a MV repair, it is not uncommon for multiple surgeries to be performed on a single patient before achieving success. To assist in the success of MV surgeries, investigators at The University of Texas Health Science Center at Houston and the University of Iowa have developed a surgical simulation that assist physicians in their pre-operative planning using each patient's unique MV imaging data.

Technology Overview

Researchers in cardiovascular medicine and biomedical engineering have developed a MV repair simulation that is designed to help physicians prepare for detailed MV surgical procedures. Using each patient's individual clinical imaging data, this simulation creates a 3D MV model that allows physicians to perform virtual MV repair using a variety of surgical techniques, including virtual suturing, annuloplasty ring implantation and artificial chordae attachment. Once the virtual surgery is complete, physicians can view the biomechanical and physiologic characteristics of pre- and post-MV function, including tissue stress-strain relationships. Multiple surgical simulations can be run prior to surgery to assist the physician in choosing the best option.

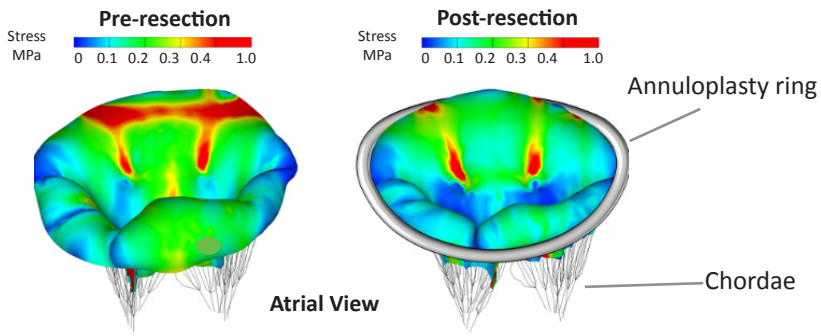

Image description: Virtual representations of a patient's MV before and after undergoing reparative virtual surgery. The simulation is able to quantitatively predict stress distribution and leaflet coaptation of the MV, shown by heat map. ***A threshold stress value was imposed on the simulation data above so that stress values larger than 0.4 megapascals (MPa) are displayed in red, notice that tissue stress is reduced post-resection and annuloplasty ring implantation.***

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Intellectual Property Status:

- Patent application pending
- Portfolio available for licensing

Stage of Development:

A functional computational protocol has been developed. The developed protocol has been used to retrospectively create surgical simulations using clinical 3D transesophageal electrocardiographic data.

Associated Publications:

- Personalized Computational Modeling of Mitral Valve Prolapse: Virtual Leaflet Resection; PMID: 26103002.
- Evaluation of mitral valve dynamics; PMID: 23489540.

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