**ACS 2022 Surgeons and Engineers: A Dialogue on Surgical Simulation Meeting**

**Research In-Progress**

# A Soft Robotic Simulator for Transseptal Puncture Training

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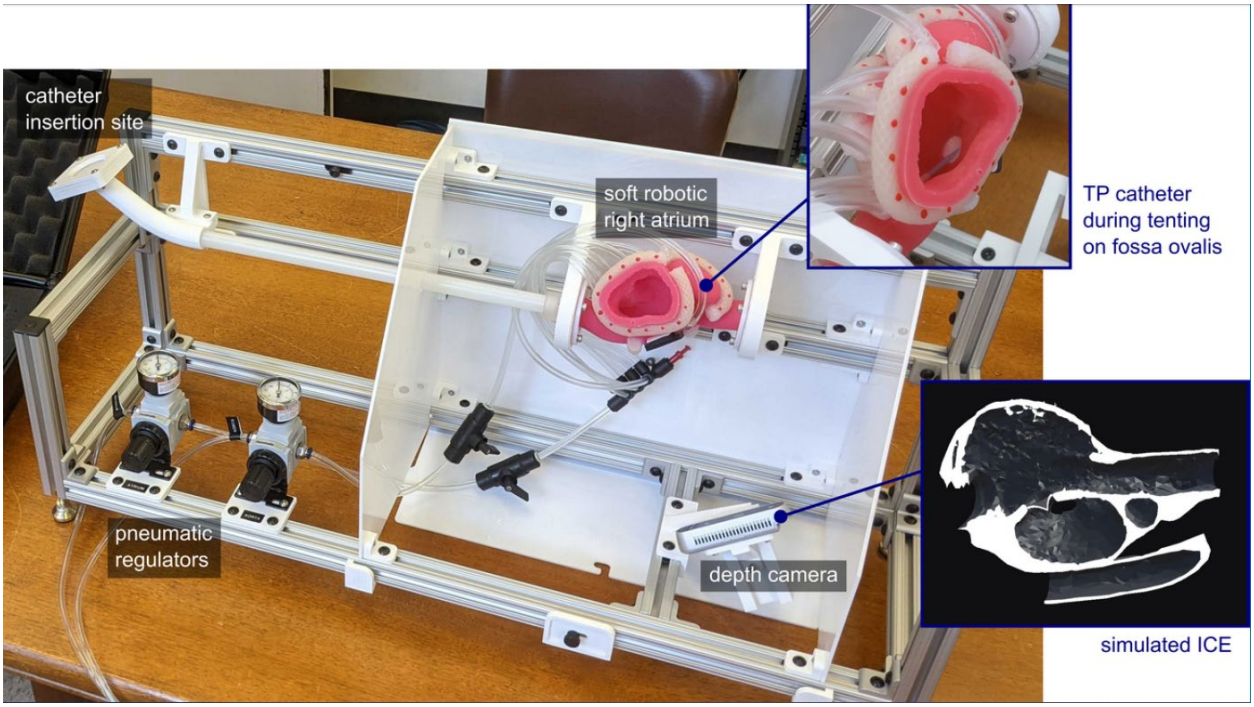
**Introduction**: Transseptal puncture (TP) is the technique used to access the left atrium of the heart from the right atrium via the interatrial septum in increasingly common catheter-based procedures such as atrial fibrillation ablation. Through repetition with actual patients, experienced TP operators develop manual skills to manipulate the TP catheter assembly inside the right atrium to their target on the fossa ovalis. To create low-risk training opportunities for new operators, we have developed a Soft Active Transseptal Puncture Simulator (SATPS), designed to match the dynamics, kinetostatics, and visualization of the heart during TP.

**Methods**: Safely navigating a patient's heart with a TP catheter includes three critical steps: (i) identifying and avoiding accidental puncture of the aortic mound during transit from the superior vena cava to the septum, (ii) using a combination of visual and haptic cues to correctly locate the fossa ovalis, and (iii) applying the correct force on the catheter during tenting and puncture. We sought to capture these steps in the SATPS by integrating bioinspired actuators, stretchable materials with similar mechanical properties to heart tissue, and visual simulation tools.

**Preliminary Results**: The SATPS includes three main subsystems: (i) A soft robotic right atrium actuated using fiber-reinforced elastomeric enclosures (FREEs) mimics the dynamics of the heart felt through the catheter assembly. (ii) A replaceable, puncturable fossa ovalis simulates the tissue properties of the real fossa to provide accurate kinetostatic force feedback during tenting and puncture. (iii) A simulated intracardiac echocardiography environment gives the user live visual feedback representative of an ultrasound monitor during an actual TP procedure.

**Next Steps**: The SATPS is undergoing face and content validation by experienced clinicians. Tuning the FREEs' pneumatic pressure during clinician review will allow for immediate re-evaluation of atrial dynamics. We will incorporate design improvements based on quantitative validation results and clinician feedback.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