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CIS II
Plan Proposal
Project #3
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Development of a comprehensive dissection and energy-cutting model for robotic surgery training

Stated Topic and Goal

This project surrounds the topic of implementing a blood vessel and tissue dissection simulation as well as a model for robotic surgery training. Further sub-topic will include the study of blood vessel histology as well as exploring and experimenting with synthetic biomaterial replication of human tissue and vasculature. Additionally, this project will incorporate and require a development of a basic understanding of energy-cutting electrosurgery and electrocoagulation. The goal of this project is to create an inanimate surgical training model for both sharp and blunt tissue dissection as well as blood vessel energy-cutting that is ultimately cheap, effective, potentially reusable, and long-lasting. User feedback from currently practicing surgeons through the Minimally Invasive Surgical Training and Innovation Center (MISTIC) will be incorporated to further develop a comprehensive dissection and energy-cutting model for future robotic surgery training.

Team Members, Mentor

Student: Shayer Chowdhury

Mentors: Dr .Gyusung Lee and Dr. Mija Lee (glee49@jhmi.edu, mlee204@jhmi.edu)

Statement of Relevance/Importance

Surgeons have expressed a desire for more practice before actually performing blood vessel dissections in an operating room. They have noticed a sufficient amount of preparation in simulating robotic suture tying, but a lack of practice in realistic blunt and sharp blood vessel dissection and electrocoagulation. Electrosurgery and electrocoagulation is a method of robotic surgery where an oscillating current is applied to the tip of a surgical tool. Accordingly, this current burns tissue away and coagulates blood vessels while minimizing blood loss compared to dissection and cutting with normal surgical tools. Current physical models in this area cost up to $75-80 per unit to make and are not meant for repeated and multiple use. As a result, the development of a cheap and effective physical dissection simulation is integral to prepare surgeons more comprehensively in robotic blood vessel dissection to gain proficiency.

Technical Summary of Approach

A significant amount of time will be spent collaborating with robotic surgery educators in the MISTIC program at the JHMI. We hope to begin by gauging interest and understanding the process of developing a more realistic physical blood vessel dissection model. We then will proceed to evaluate shortcomings of current models and use them as a basis from where we can develop a more successful model. The next step will be to search for different potential material and media to use for the phantom tissue creation, including gelatin, plastisol, silicone gel, latex, and even cotton stuffing. Additionally, we will evaluate each medium based on its cost, its effectiveness in replicating human tissue, and its potential to be reusable and to be long lasting. At the same time, we will proceed to search for tubing material that is conductive enough so that it will behave similar to a vessel in an energy-cutting model in terms of coagulation and

dissection. From there, we will create a blunt/sharp dissection model that focuses on maintaining realistic surrounding tissue and an energy-cutting model that focuses on realistic blood vessel coagulation. We then will proceed to test and observe how our model behaves by allowing practicing surgeons to use them. Afterwards, we will document the results and evaluate user feedback in order to modify the prototypes.

Deliverables and Key Dates

- Minimum: Blunt/sharp dissection robotic surgery training model prototype (March 25th)
- Expected: Modified blunt/sharp dissection model with improvements made based upon user feedback; energy-cutting/electrocoagulation model prototype (April 15th)
- Max: Fully developed blunt/sharp and electrocoagulation models; cheap and easy material to replicate and reuse; incorporation of models into future standard robotic surgery training practicums (May 4th)

Dependencies and Management Plan

- Access to mentors
    - Weekly meetings with Dr. Gyusung Lee and/or Dr. Mija Lee
- Access to lab space to create phantom media
    - Available lab space at MISTIC at the JHMI
- Cost to afford material
    - Material will be fairly inexpensive, since cheap and efficient is our goal anyways
    - Dr. Lee is in the process of obtaining a small grant to fund the project

- Access to relevant literature
    - Articles available online and at the MSE Library
- Access to surgeons who are willing to practice and evaluate the effectiveness of the model prototypes
    - Dr. Lee will arrange and work with surgeons at MISTIC who will participate in testing out prototypes and commenting on shortcomings and successes
- Management plan
    - Shayer Chowdhury: leader and project manager
    - Collaboration with several other surgeons and robotic surgery educators at MISTIC at the JHMI

Reading List

- C Schneider, C Kut, N Carter-Monroe, *Creation of Ultrasound Elastography Phantoms*
- GI Lee, MR Lee, T Clanton, E Sutton, AE Park, MR Marohn, *Comparative assessment of physical and cognitive ergonomics associated with robotic and traditional laparoscopic surgeries*
- DS Kopac, J Chen, R Tang, A Sawka, H Vaghadia, *Comparison of a novel real-time SonixGPS needle-tracking ultrasound technique with traditional ultrasound for vascular access in a phantom gel model*
- KB Lawrenson, FO Stephens, *The Use of Electrocutting and Electrocoagulation in Surgery*
- T Diamantis, M Kontos, A Arvelakis, S Syroukis, D Koronarchis, A Papalois, E Agapitos, E Bastounis, AC Lazaris, *Comparison of monopolar electrocoagulation, bipolar electrocoagulation, Ultracision, and Ligasure.*
- More as the semester progresses