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Research-In-Progress

Advancing Minimally Invasive Surgeries: An Ergonomic Laparoscopic Grasper for Comfort and Precision

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Introduction: Laparoscopic surgery is a minimally invasive surgery (MIS) used for a wide range of medical conditions, such as hernia repairs, gallbladder disease, gastrointestinal conditions, endometriosis, appendicitis, and bariatric surgeries. Benefits of MIS include smaller incisions, reduced postoperative pain, shorter hospital stays, faster recovery times, and improved cosmetic outcomes can lead to improved patient, caregiver, and provider satisfaction. However, laparoscopic instruments have limited dexterity and range of motion when compared to robotic assisted surgery and open surgery. This can lead to procedures switching modalities and providers effectively performing two separate procedures instead of one.

Methods: A grasper with two sets of endoscope motions was created utilizing SolidWorks and Fusion360 with the following components: a grasper tip, six “flex” joints to create an endoscope-like motion, a direction adapter to ensure 360-degree range-of-motion, and a handle with a manual lever steerer. The components were printed with polylactic acid (PLA) using a fused deposition modeling (FDM) printer and strung together using an elastic cord.

Preliminary Results: A works-like prototype utilizing endoscopic joints was 3-D printed and fitted with elastic cords to control the direction of motion (Figure 1). It achieved 360 degrees of motion.

Next Steps: In further iterations of the prototype precision of the grasper motion can be improved. We would also like to explore a prototype utilizing a multidimensional pivot for motion. This would allow for a wrist-like motion, and could be controlled with a thumb pedal. Finally, as a next step solution, the updated graspers will be under electronic control using a video game controller. This would allow for improved dexterity, better ergonomics and precision, and ideally would improve provider comfort, decrease procedure times, and increase overall utilization and satisfaction with and of minimally invasive surgeries.

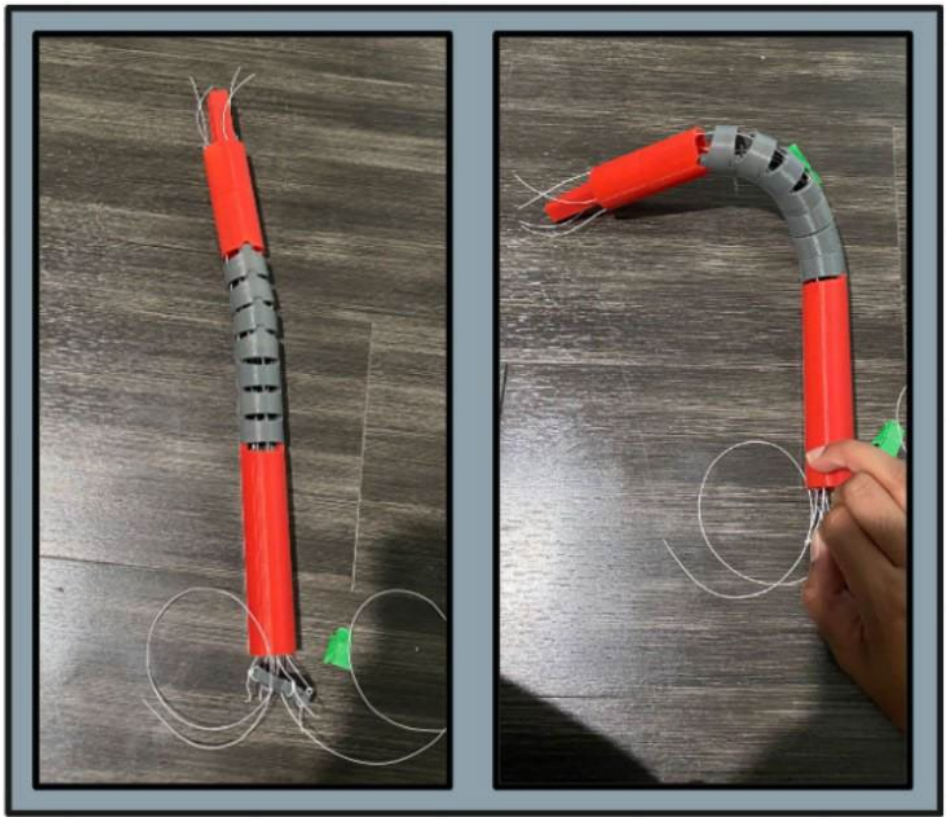

Figure 1: Prototype demonstrating 360-degree motion of the grasper.