

## ACS 2024 Surgeons and Engineers: A Dialogue on Surgical Simulation Meeting

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### Research-In-Progress

#### A Device for Intra-Abdominal Clip Loading During Robotic Cholecystectomy

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**Introduction:** Cholelithiasis affects a significant portion of the US adult population. Cholecystectomy is the standard of care for symptomatic stones, and can often be performed robotically. During robotic cholecystectomy, ligation of the cystic artery and bile duct is time consuming. Three ligation clips are required for each vessel or bile duct, and they must be loaded into the robotic clip applier outside of the patient's abdomen. As a result, valuable operative time is spent waiting on the reloading process. This issue is exacerbated when additional cystic artery branches are present.

**Methods:** Using CAD software and 3D printing, we designed a clip cartridge compatible with existing robotic clip appliers that can be placed into a patient's abdomen through an 8mm port. Once introduced, the cartridge will be held by a robotic grasper. A surgeon can load a clip by navigating the robotic applier into the cartridge within the patient. After applying the clip to a vessel or bile duct, the surgeon can return to the cartridge to load another clip.

**Preliminary Results:** Early large-scale prototypes achieved individual mechanisms for clip applier loading and initial clip advancement within the cartridge. The former mechanism has been rudimentarily achieved on a scale compatible with the Da Vinci XI Large Clip Applier and Large Weck® Hem-o-lok® ligation clips. Unfortunately, additional device features cannot be discussed at this time due to the active pursuit of IP protection.

**Next Steps:** Future designs will optimize both mechanisms in an appropriately sized device. Testing will be conducted with a group of surgeons who will complete a simulated robotic vessel ligation procedure using our device and the traditional loading technique. We hypothesize that a final product will significantly reduce operative time.

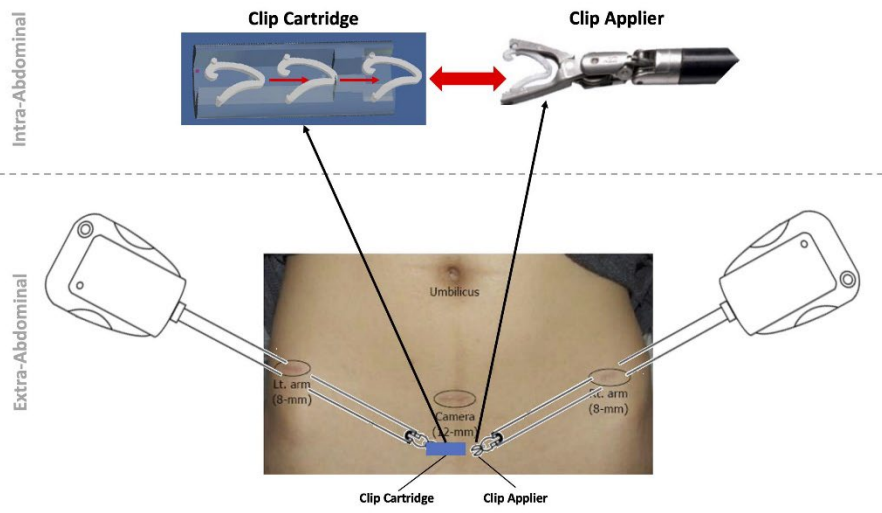


Figure 1.\* Schematic for intra-abdominal clip loading process.

*\*Image adapted from Kim et al's Robotic cholecystectomy with new port sites and Gupta's Application of Biomedical Engineering in Force and Tactile Sensing for Robotic MIS.*