Functional Workspace of a Novel Single Port Surgical Robotics Platform for General Surgery

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Introduction

The enabling potential of robotics continues to increase in abdominal surgery

The functionality of a robotics platform is more than just the extent of the workspace that the end effectors can reach, but also the usability (or manipulability) to reach any point in that workspace.

Technology

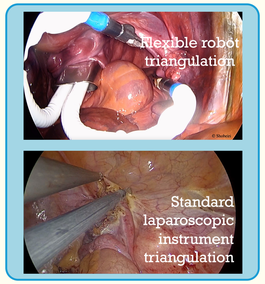
Novel robotics platform with unprecedented reach and articulation

- A novel robotics platform has been developed that allows all the articulation to occur inside the abdomen by 2 arms inserted through a single incision or natural orifice that can be made transabdominal, transvaginal, transoral or transanal, limiting the fulcrum effect.
- This system features miniature humanoid-shaped robotic arms that provide human level dexterity, multi-planar flexibility and 360 degrees of articulation.
- The biomimetic instruments are designed to replicate the motions and capabilities of a surgeon's arms, with shoulder, elbow, and wrist joints.

This study assesses the functional workspace of a novel natural orifice or single port robotics platform for general surgery



Methods



Unprecedented reach and articulation leads to optimal triangulation and visualization

Surgical procedure

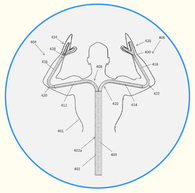
After insertion, the two robotic arms can then retroflex back towards the point of entry, or antegrade towards anatomy in the abdomen to perform procedures such as a hysterectomy, ventral hernia repair, inguinal hernia repair, colectomy, appendectomy, and cholecystectomy.



Robotic control unit and arms



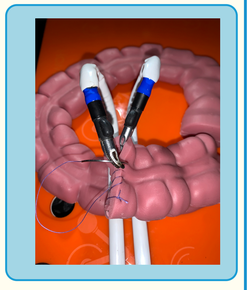
Various arm configurations



Humanoid arms mimic a surgeon's arms

This study

Measured the manipulability of this new robotic platform throughout its entire reachable workspace in the abdomen by first generating a set of 200,000 configurations of the robot arms and secondly calculating the manipulability index according to robotics literature.



Robotic suturing technique

Results

- The results show that, due to the shoulder, elbow and wrist joints of the arms that perform all of their articulation after entry, the reachable workspace encompasses the entirety of the average male and female abdomen from rectum to distal esophagus, across from abdominal sidewalls and from the anterior to posterior abdominal wall.
- Because the wrist joints have unlimited rotation and the shoulder and elbow joints allow the arms to function as they cross over each other, the manipulability index remains high (high usability) within the abdominal cavity and particularly around anatomy of interest such as the gall bladder, abdominal wall, inguinal canal, uterus and adnexa, lymph nodes, and appendix.

Conclusions

The design of this new robotic technology has the potential to provide surgical treatment to a broad array of abdominal anatomies through a single port or enable a more proficient approach to natural orifice transluminal endoscopic surgery (NOTES).

Currently FDA authorized for benign hysterectomy, with salpingo-oophorectomy, with salpingectomy, salpingectomy, oophorectomy, adnexectomy, ovarian cyst removal