Design of a Pressure-Sensing Laparoscopic Grasper

Grace S. L. Teo, Mattias S. Flander, Toomas R. Sepp, Manuel Corral, Juan D. Diaz, and Alexander Slocum
Massachusetts Institute of Technology

In order to improve dexterity and tactile feedback during grasping in laparoscopic surgery, a pressure-sensing, ergonomic laparoscopic grasper with parallel motion grasper jaws has been designed, prototyped, and tested to provide surgeons with a safer and more user-friendly instrument than what is currently available. Parallel motion grasping creates a uniform pressure distribution along the length of the grasper jaws. Moreover, a pressure sensor located in one of the grasper jaws helps surgeons control the pressure applied during grasping. Ease-of-use of the grasper was enhanced through ergonomic handle design. Results from force and motion testing of a 2x prototype of the design were consistent with analytical predictions. These improvements demonstrate that this new laparoscopic grasper can both improve the dexterity of grasping tasks and reduce the incidence of tissue injury during laparoscopic surgery.

A Hydraulically Controlled Nonoperative Magnetic Treatment for Long Gap Esophageal Atresia

Austin Oehlerking, James D. Meredith, Ian C. Smith, Phillip M. Nadeau, Teresa Gomez, and Zachary A. Trimble
MIT

David P. Mooney
Children's Hospital Boston

David L. Trumper
MIT

This paper describes a magnetic, nonoperative device and control system designed to treat long-gap esophageal atresia (LEA). This congenital disorder occurs in approximately 100 newborn infants every year and is characterized by a discontinuity in the esophagus between the mouth and stomach. Our device builds upon previous work investigating the use of internal permanent magnets to stretch the proximal and distal esophageal pouches together until anastomosis occurs. We implement a hydraulic standoff device for the proximal magnet assembly to control the distance between the two magnets independent of the esophageal gap size. The standoff allows for controllable, intermittent force between the two pouches and provides a layer of safety from runaway magnetic forces that could potentially damage delicate esophageal tissue. The proximal device comes in two variations: a convex tip for stretching the esophagus and a concave mating tip for meeting the distal end during anastomosis. A light emitting diode (LED) and phototransistor pair estimates the esophageal gap size for the duration of the procedure, and a fluid pressure sensor enables the force on the esophageal tissue to be calculated. The external control circuitry, physician interface, and pump are described that demonstrate the core functionality of the system.

