Development of a Prototype Articulating Laparoscopic Grasper
Dmitry Oleynikov, MD and Susan Hallbeck, PhD
Department of Surgery, College of Medicine, University of Nebraska Medical Center
Industrial Engineering, IDEA Lab, University of Nebraska - Lincoln

Introduction:
The Intuitool, an ergonomic articulating laparoscopic grasping tool was developed after consultation with expert laparoscopic surgeons revealed several shortcomings of current tools; primarily physical discomfort of the surgeon and lack of dexterity when using the tool. As a result, the tool contains several important features including an ergonomic handle with an intuitively controlled articulating grasper.

Problems with conventional graspers:
• Awkward wrist and arm postures
• Compression points on the fingers, thumb and hand
• Lack of dexterity with the tool
• Lack of articulating of grasper
• Not easy to use

The ergonomic handle was designed to address surgeons’ concerns about physical discomfort, specifically discomfort from awkward postures and pressure points. When surgeons use current laparoscopic tools, hard-to-reach tissues can require awkward finger, wrist, and arm positions, placing strain on the joints and muscles. Additionally, pressure points on the fingers and thumb from the scissor grip cause excessive pain to the surgeon. Therefore, the tool was designed for comfort and usability employing a comfortable contoured shape. The handle angle is optimal for accuracy when performing pointing tasks such as reaching and grasping tissue. The grip angle also relieves stress on the shoulder and wrist by allowing the surgeon to work in several different relaxed arm and wrist positions.

The tool was designed for one-handed use by left- and right-handed surgeons. Controls are placed such that surgeons can effortlessly reach them with only one hand, keeping the other hand free for other tasks or another tool. Controls were positioned to allow the tool to be operated from several different hand orientations. This ability to change hand postures reduces muscle fatigue on the fingers, hand, wrist, and shoulder and pressure points on the fingers and hands.

Surgeons consulted were primarily interested in increasing the dexterity of laparoscopic tools. Thus, the tool includes a novel articulation mechanism that enables 120º rotation of the graspers. The surgeon can pivot the graspers up to 60º from the shaft, including circumduction; in addition, the rotation of the shaft is unlimited and independent of the grasper articulation.

The control of the articulating grasper is simple and intuitive. Moving the control sphere forward/up moves the tip of the grasper jaw upward, and moving backward/down moves the grasper jaw downward. Likewise, moving the control sphere left and right moves the grasper left and right, respectively.

Results:
Ninety-two percent of laparoscopic surgeons indicated that the added articulation of the prototype tool would be either somewhat or very useful (the others were indifferent). Eighty-nine percent said they would be interested in trying the prototype tool once commercially available.

Conclusion:
This study demonstrates that good ergonomic analysis and design can improve a standard laparoscopic tool. It further demonstrates that given a choice between current tools and ergonomically designed tools, laparoscopic surgeons will select the more comfortable, more useful tool.

New laparoscopic instrumentation based on surgeon-centered design principles will reduce musculoskeletal discomfort.