Deformable Surgical Needle and Introducer

Children’s Hospital Colorado · University of Colorado Boulder · Design Center Colorado
Ian Sanford | Nic Rutkoski | Trey Nevitt | Catherine Rieke | Carl Savage | Jose Soto

Impact

“Deformable needles will have a significant impact on the surgical care we can provide.”
- Dr. Duncan Wilcox, Head of Surgery at Colorado Children's Hospital

Background

- Laparoscopy (key-hole surgery) is a surgical procedure that allows doctors to operate inside the body without making large incisions
- Advantageous to use the smallest port possible when operating on children
- Semi-circular needles are used to suture tissue inside the body
- The semi-circular needles require larger ports

Shape Memory Needle

- Shape memory alloys will recover their set shape after reaching a transition temperature
- Our needle will return to a semi-circular shape after being straightened within the introducer
- Shape setting requires heating Nitinol to 500°C

Requirements

- Create a deformable needle that can enter the body through various port sizes
- The needle must recover to a rigid semi-circular orientation inside the body
- The needle must be strong enough to suture tissue inside the body
- Create an associated introducer that will deform the needle into a near straight orientation
- All components must withstand sterilization (275°F)
- The materials must be biocompatible

Testing Results

- Stress strain curve for super elastic Nitinol
- Nitinol yield strength = 370 MPa
- Industry standard = 235 MPa
- Force to deform = 5 N
- Tensile test on super elastic Nitinol from bent to straight orientation
- Chicken Breast Suture Test Performed by Dr. Wilcox

Conclusions

- All customer requirements were achieved
- Laparoscopy market is projected to grow by 60% in the next 4 years
- We hope our design and research will advance future developments in the field of minimally invasive surgeries
- Design Patent Pending

FEA of Von Mises Stress

Yield strength of Delrin: 63 MPa
Load per face: 5 N