

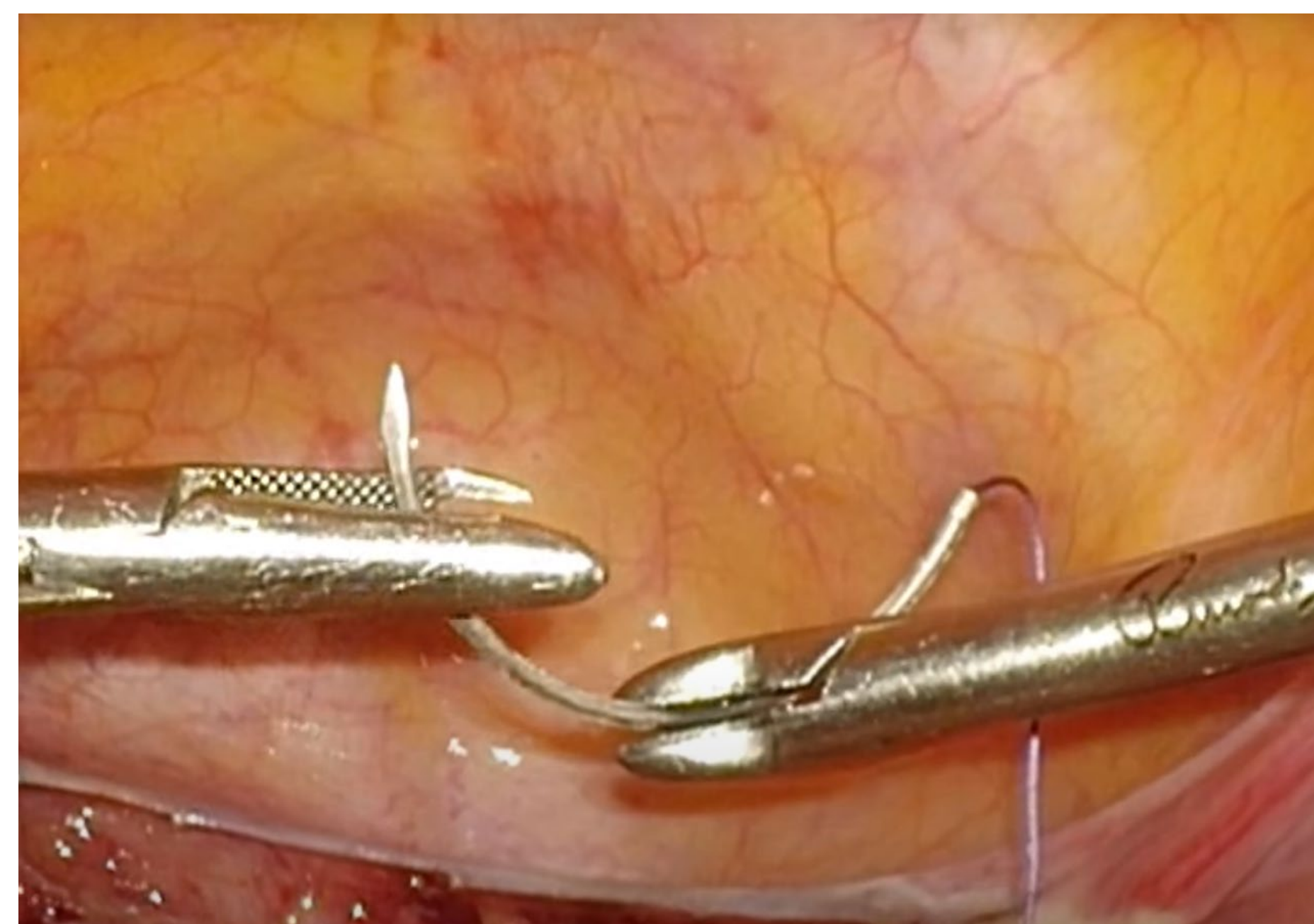
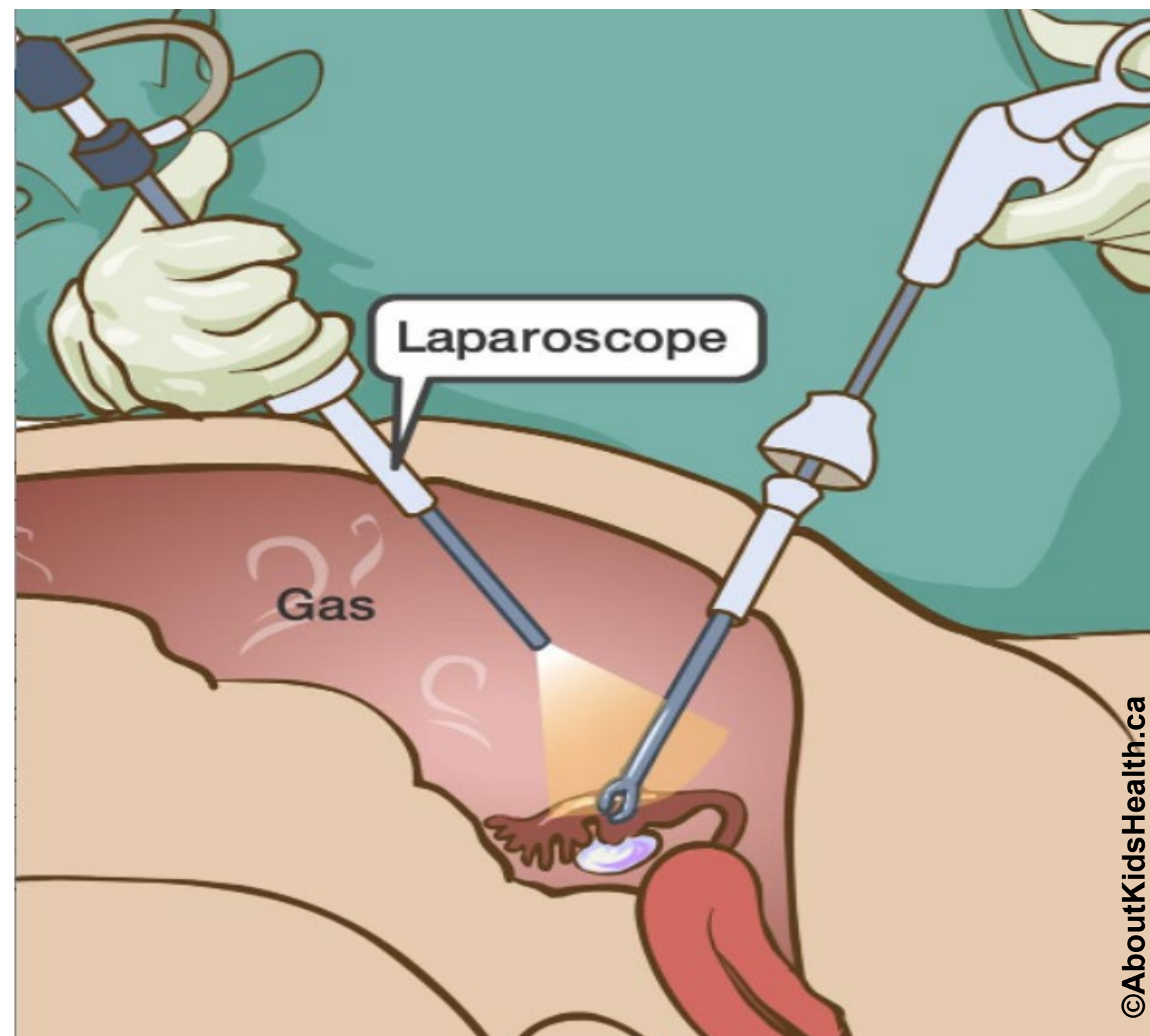
# Deformable Surgical Needle and Introducer

Children's Hospital Colorado · University of Colorado Boulder · Design Center Colorado

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## Background

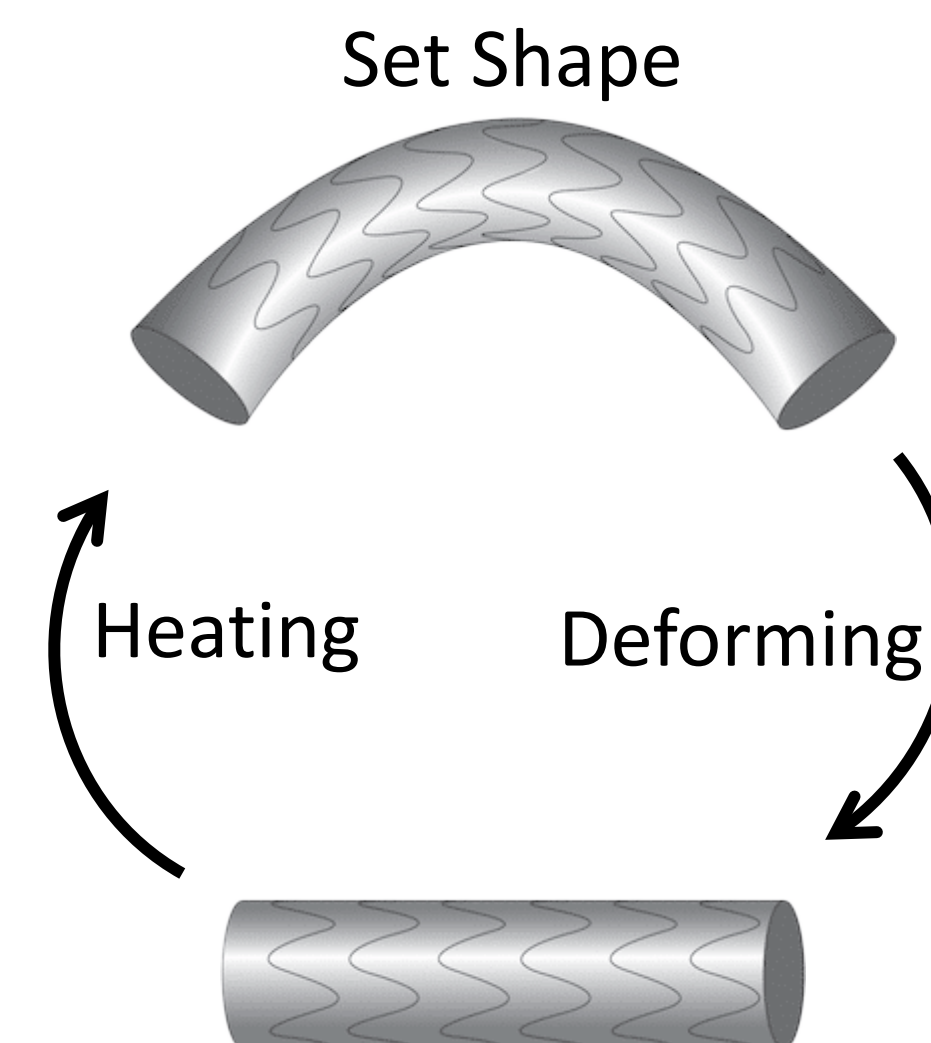
- ❖ Laparoscopy (key-hole surgery) is a surgical procedure that allows doctors to operate inside the body without making large incisions
- ❖ Advantageous to use the smallest port possible when operating on children
- ❖ Semi-circular needles are used to suture tissue inside the body
- ❖ The semi-circular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



## Requirements

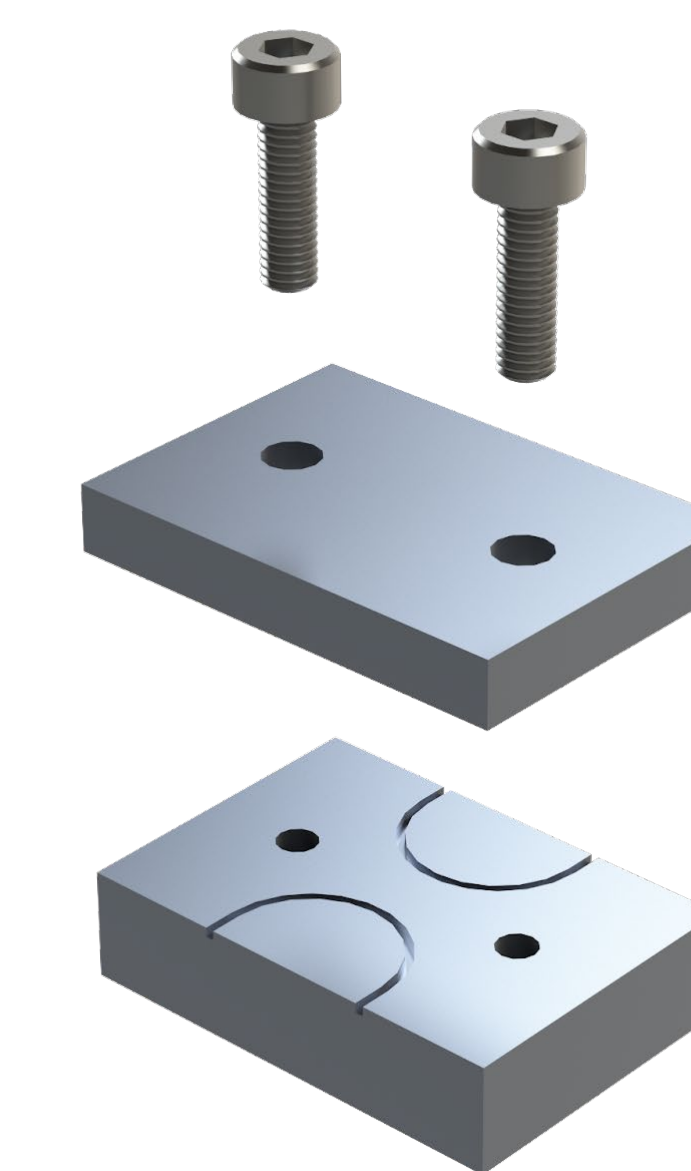
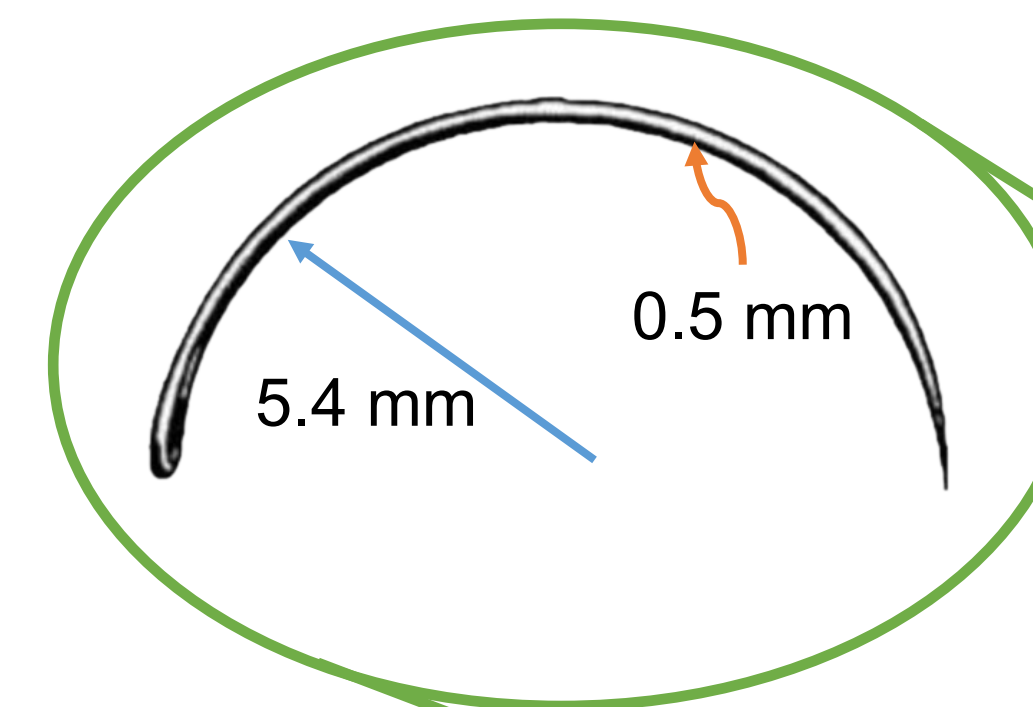
- ✓ Create a **deformable needle** that can enter the body through various port sizes
- ✓ The needle must recover to a rigid semi-circular orientation inside the body
- ✓ The needle must be strong enough to suture tissue inside the body
- ✓ Create an **associated introducer** that will deform the needle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

## Shape Memory Needle



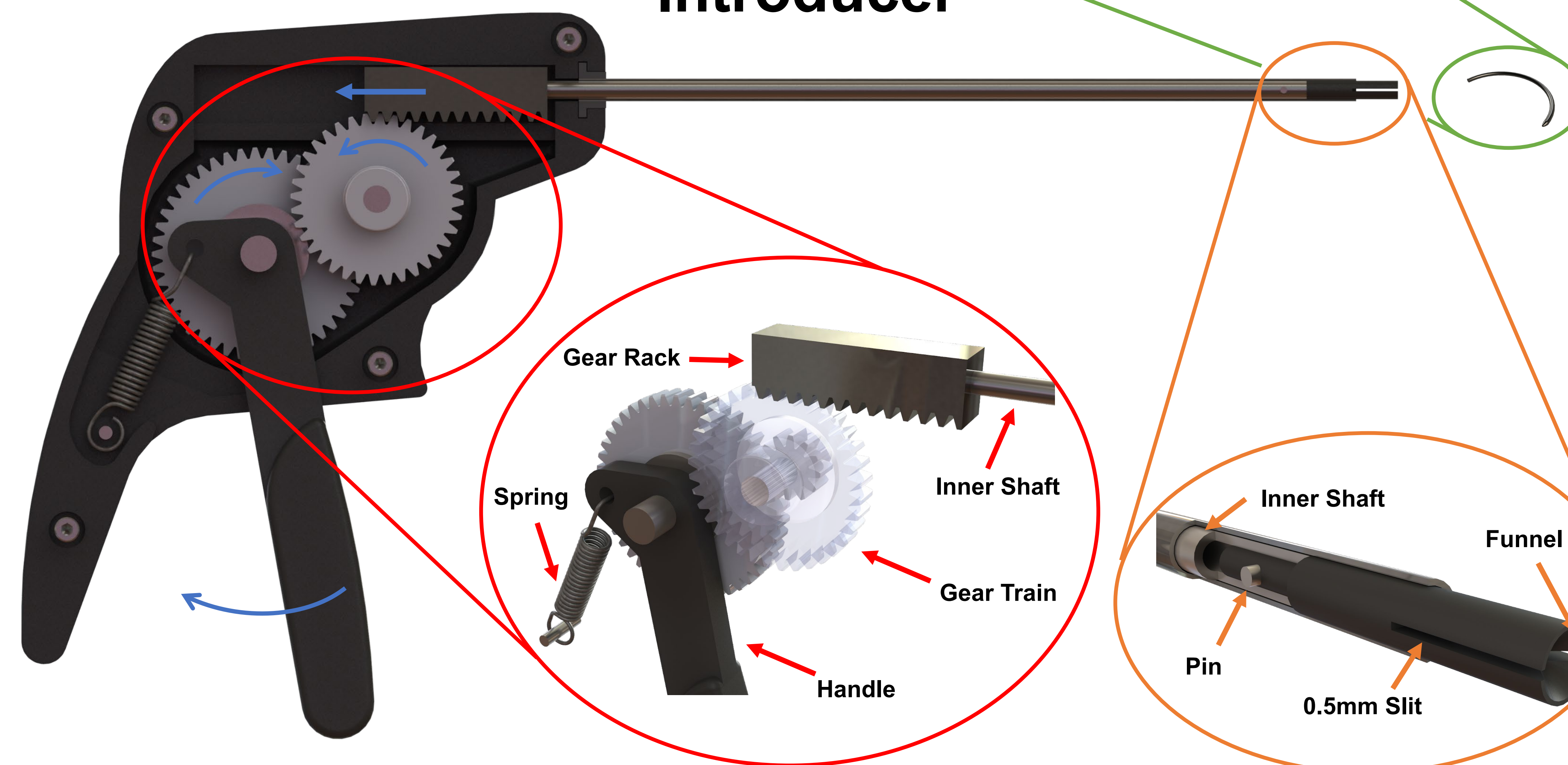
Nitinol: Nickel and Titanium alloy

- ❖ 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



Shape Setting Block

## Introducer



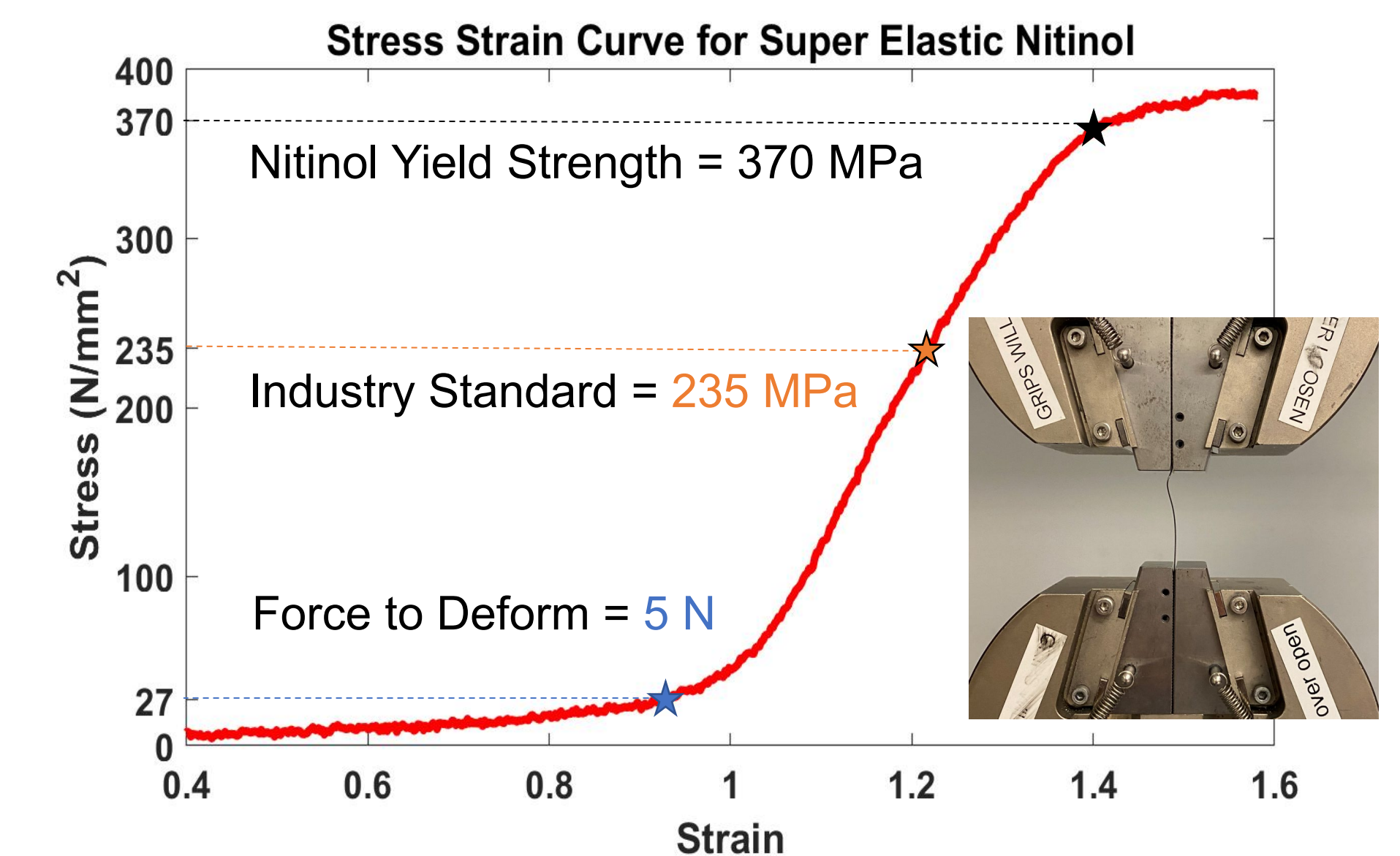
### Gear System

- ❖ The gear system allows for 35mm of linear motion with only 30° of handle rotation
- ❖ The spring enables a slow and controlled release of the needle out the end of the introducer
- ❖ The case is designed to restrict and guide the movement of the shaft to axial translation

### Clamp

- ❖ The clamp is responsible for grasping the needle
- ❖ As the inner shaft is pulled back, the needle is forced into a near straight orientation
- ❖ The funnel allows a surgeon to easily guide the needle into the introducer

## Testing Results

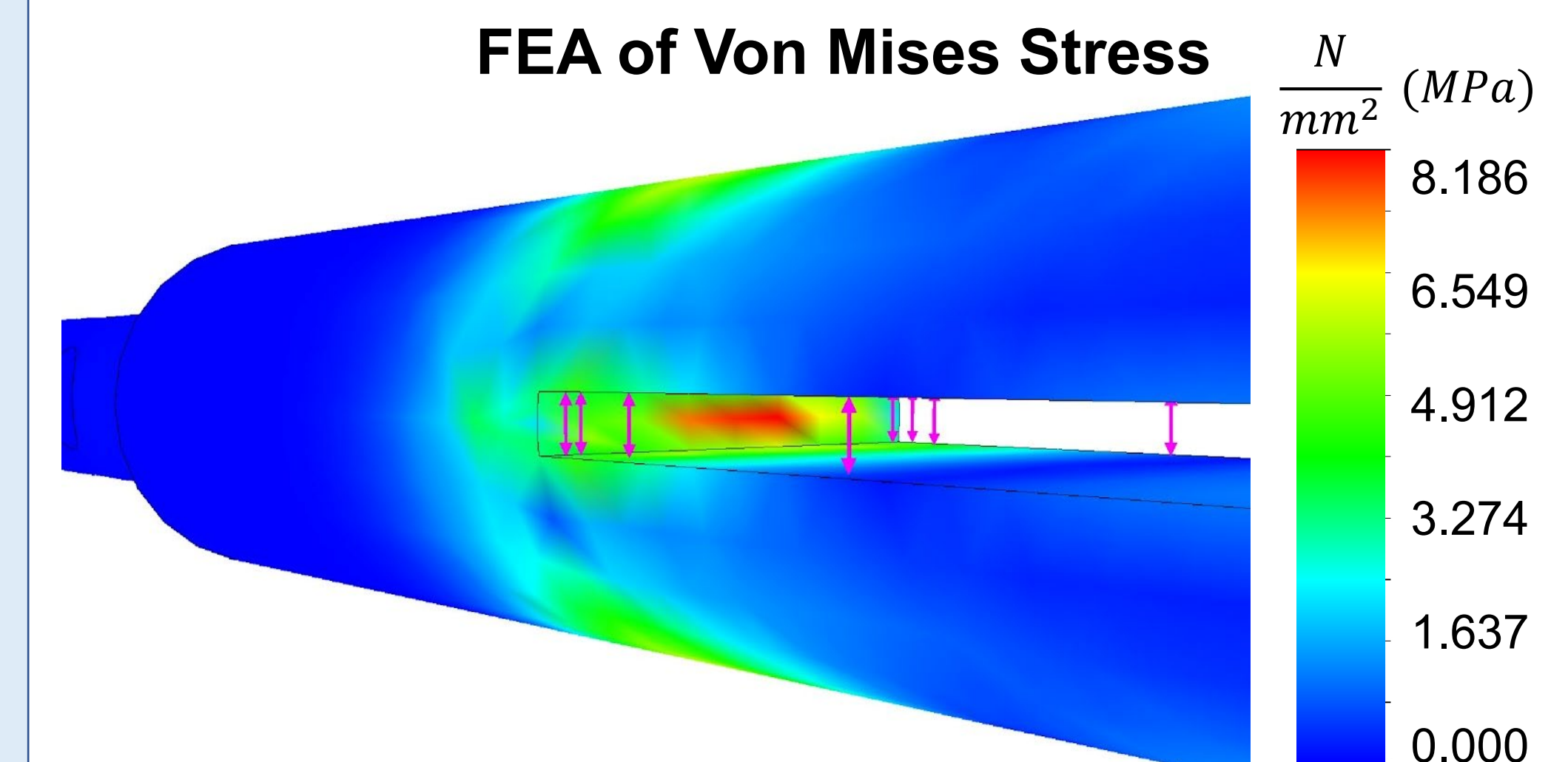


Tensile Test on Super Elastic Nitinol from bent to straight orientation



Chicken Breast Suture Test Performed by Dr. Wilcox

### FEA of Von Mises Stress



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

## 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**

## 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