

# **AUTOMATED URETERO-INTESTINAL ANASTAMOSIS WITH ABSORBABLE STAPLES**

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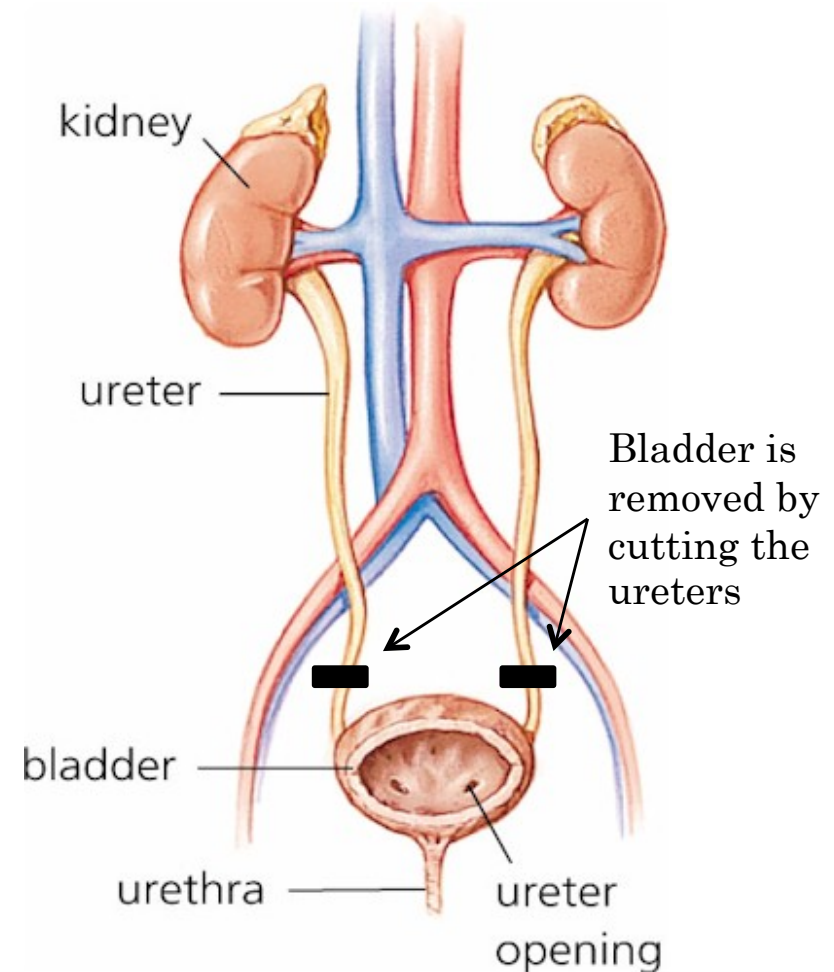
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# BLADDER CANCER

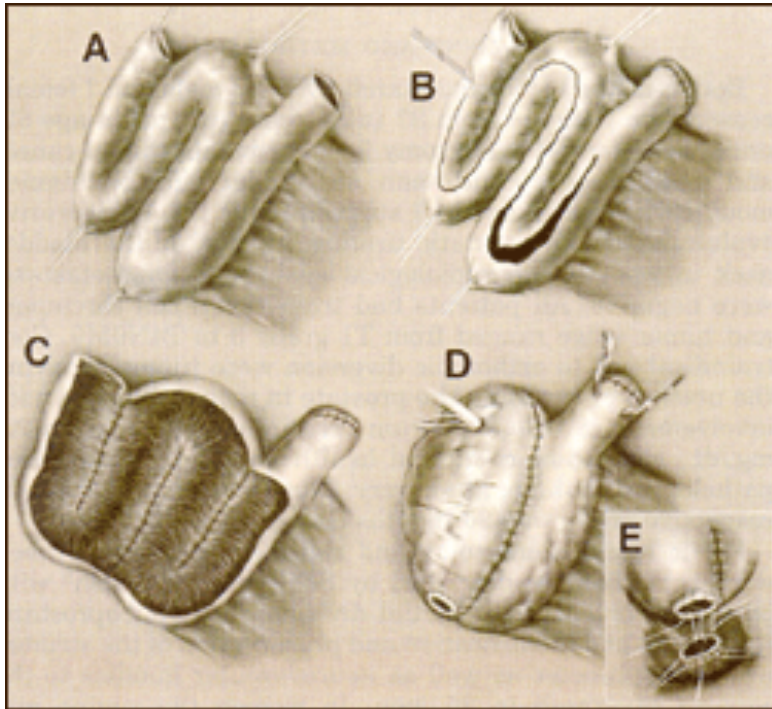
- 5th most common cancer in US
- 70,530 new cases and 14,680 deaths in 2010
- Radical cystectomy
  - Required when muscle layer is invaded
- Urine storage
  - Urostomy bag or neobladder



<http://www.cancerssociety.org/images/bladder.jpg>



# CURRENT TREATMENT: BLADDER CANCER



<http://www.ucurology.urologydomain.com/images/uploaded/whu/ileal1.gif>

- Bladder removed
- Neobladder formed from small bowel
- Two ureters attached via suture



# PROBLEM STATEMENT

- Ureters connected to new bladder tissue via suture
- Lengthy procedure time
- Metal staples = stones
- Goals
  - Semester 1: Small stapler
  - Semester 2: Continued stapler work with testing and staple research

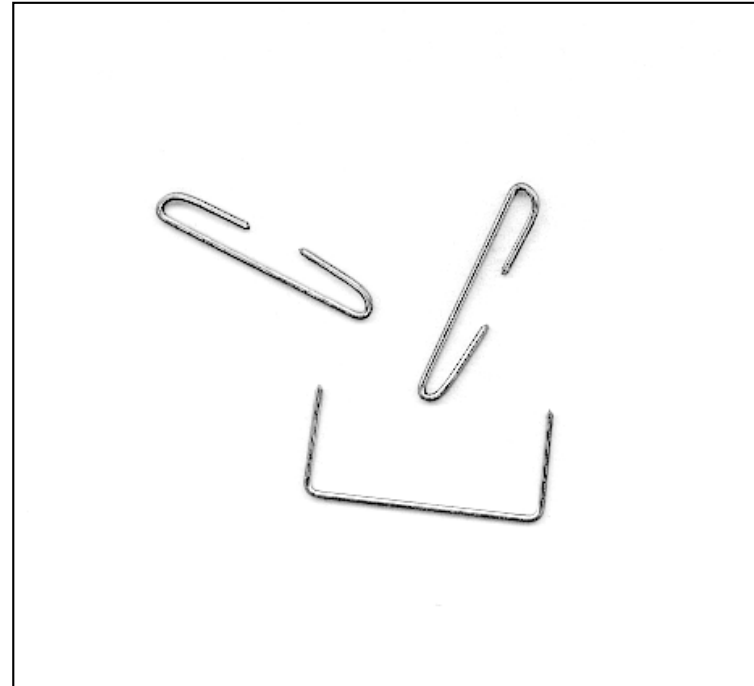


[http://www.swicofil.com/images/suture\\_needle.jpg](http://www.swicofil.com/images/suture_needle.jpg)



# DESIGN REQUIREMENTS

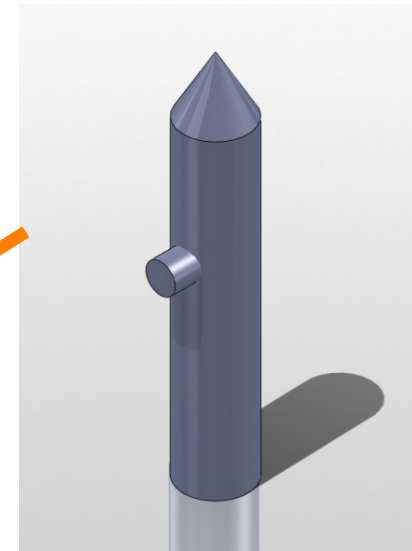
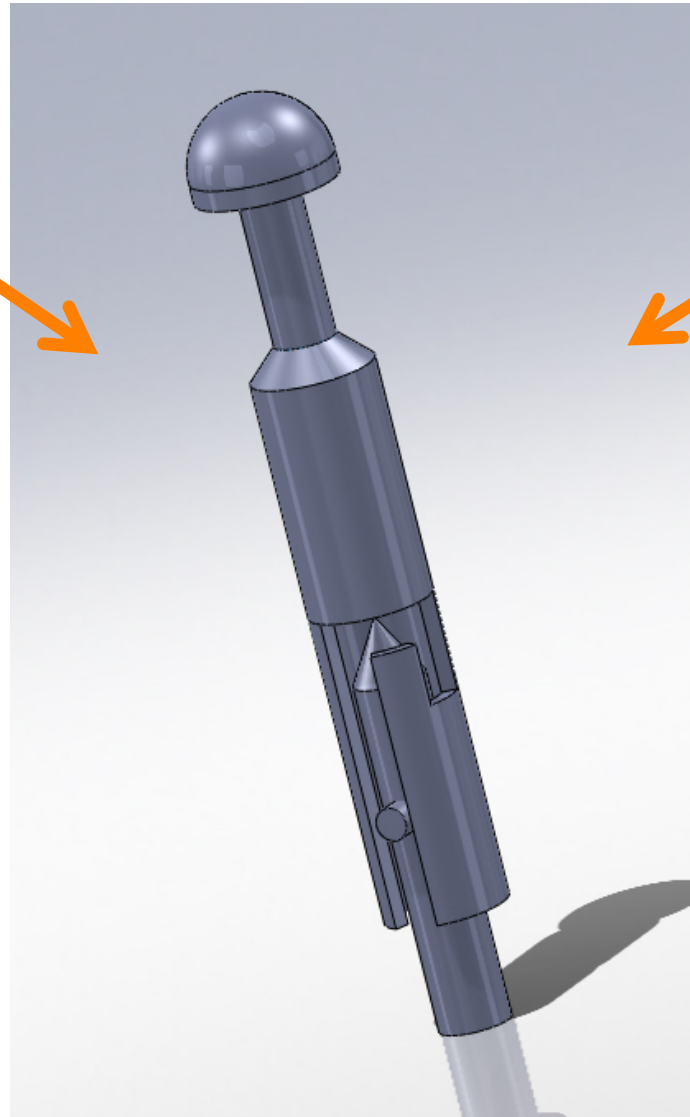
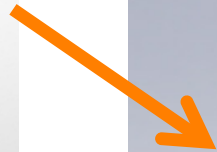
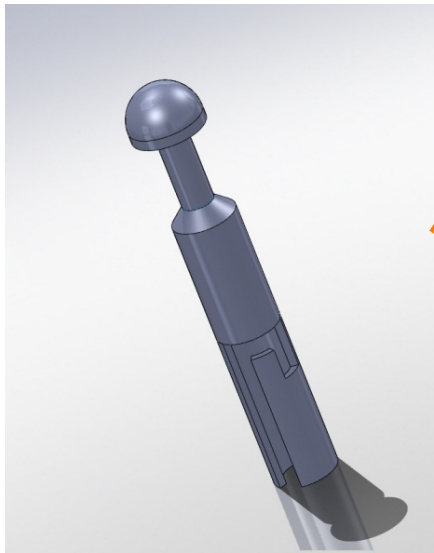
- Open surgery
- Sterile
- 0.7cm diameter
- Operate with single motion
- Must create a water tight seal
- Mitigate tissue damage



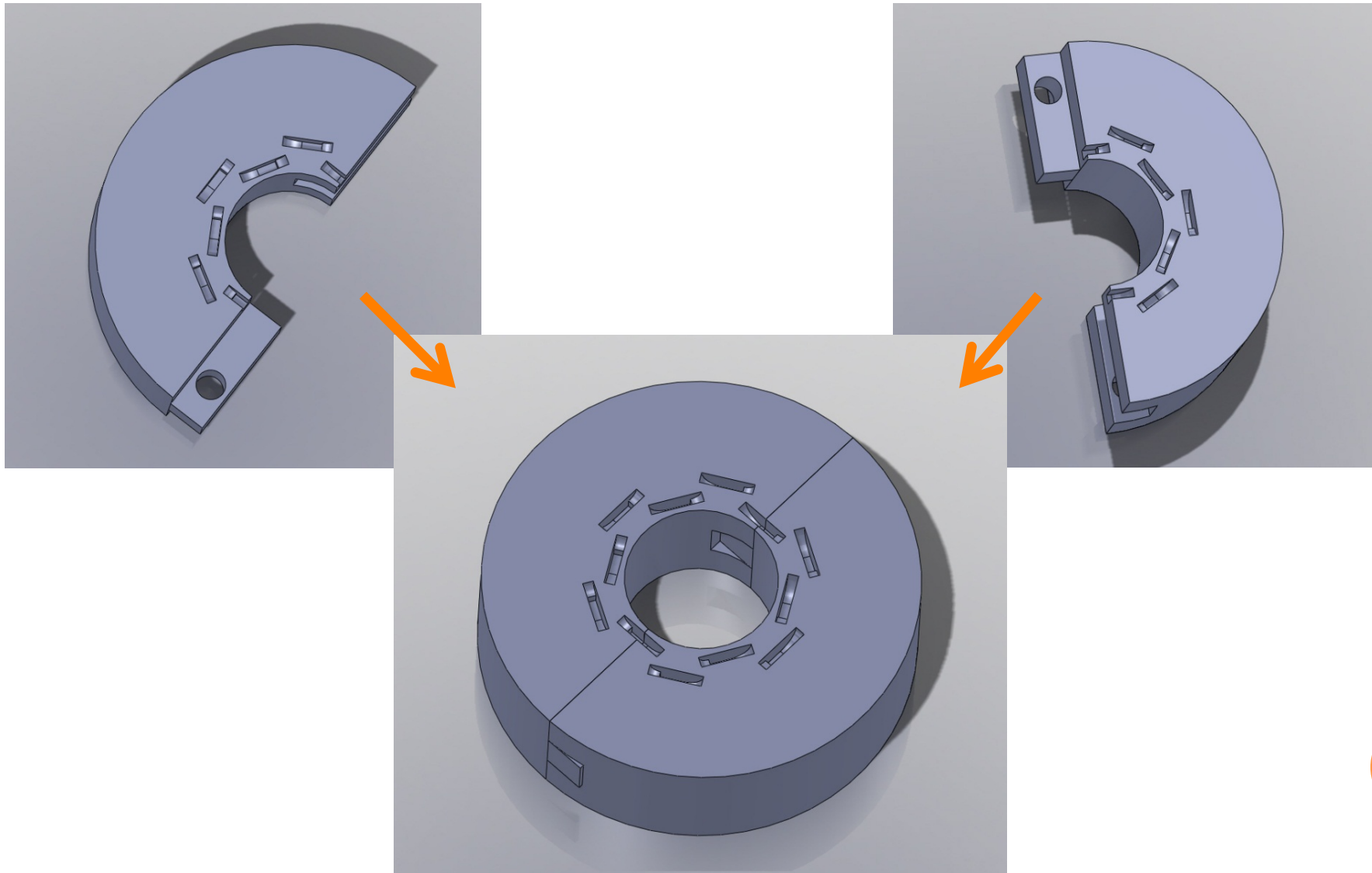
<http://bostinnovation.com/wp-content/uploads/2010/06/staple-icon.jpg>



# STAPLER PARTS : ANVIL AND NEEDLE

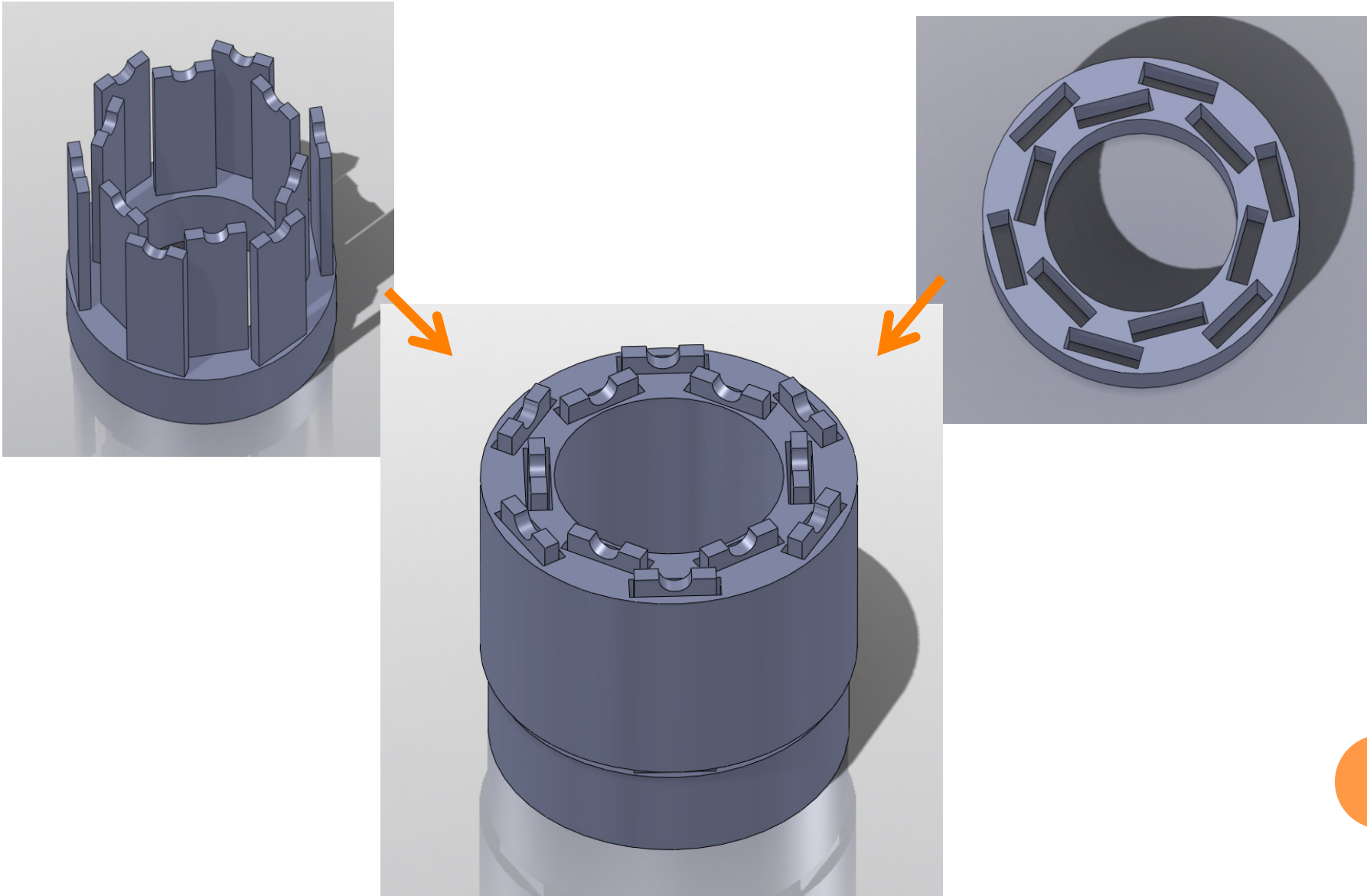


# STAPLER PARTS: RING CLAMP





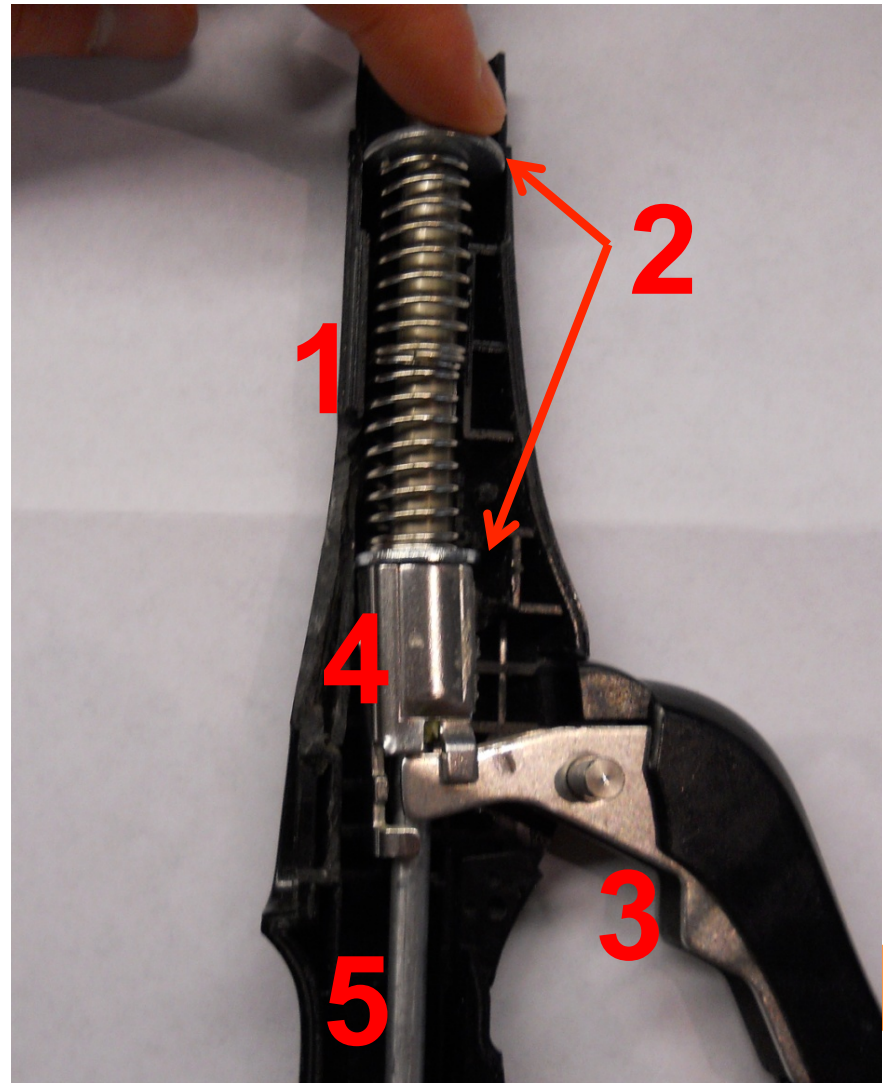
# STAPLER PARTS: TEETH AND CARTRIDGE





# STAPLER PARTS: FIRING MECHANISM

1. Two compressive springs
2. Washers
3. Lever and pin
4. Flange translator
5. Two concentric rods



# STAPLE RESEARCH: COMPOSITION

**Ideal properties:** rigid, but flexible; biodegradable

- Polylactic acid (PLA): imparts toughness and strength
- Polycaprolactone (PCL): imparts flexibility

**Mixing ratios:**

70/30 PLA:PCL with dicumyl peroxide (DCM)<sup>1</sup>

- Exhibits plastic properties similar to ABS or HIPS<sup>1</sup>
- Experiment with other ratios



# STAPLE RESEARCH: PROCESSING

- Creation of PCL/PLA polymer with DCP<sup>1</sup>
  - Twin-screw extrusion

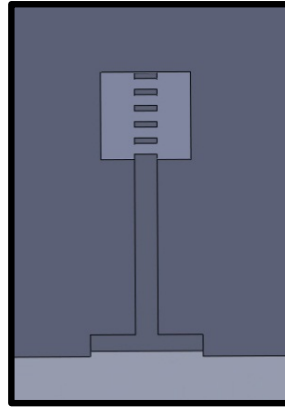


Fig 1. Top cross section

- Injection Molding
  - Forms polymer into staple shape for testing

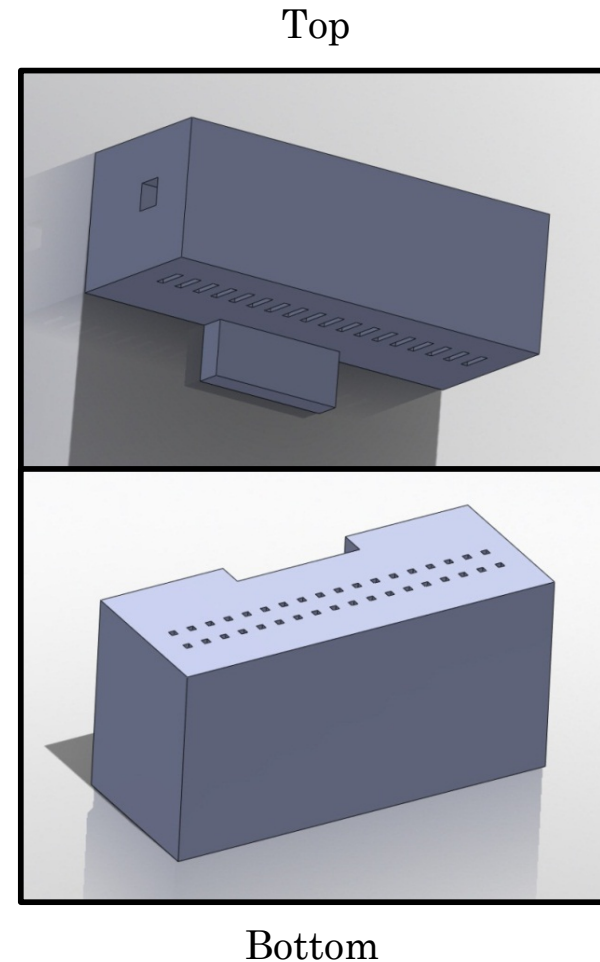


Fig 2. Injection mold

1. Semba, et. al. *Journal of Applied Polymer Science* (2006).

# STAPLE RESEARCH: SECURING TISSUE

- Bending testing
- Ultrasound polymerization of ends

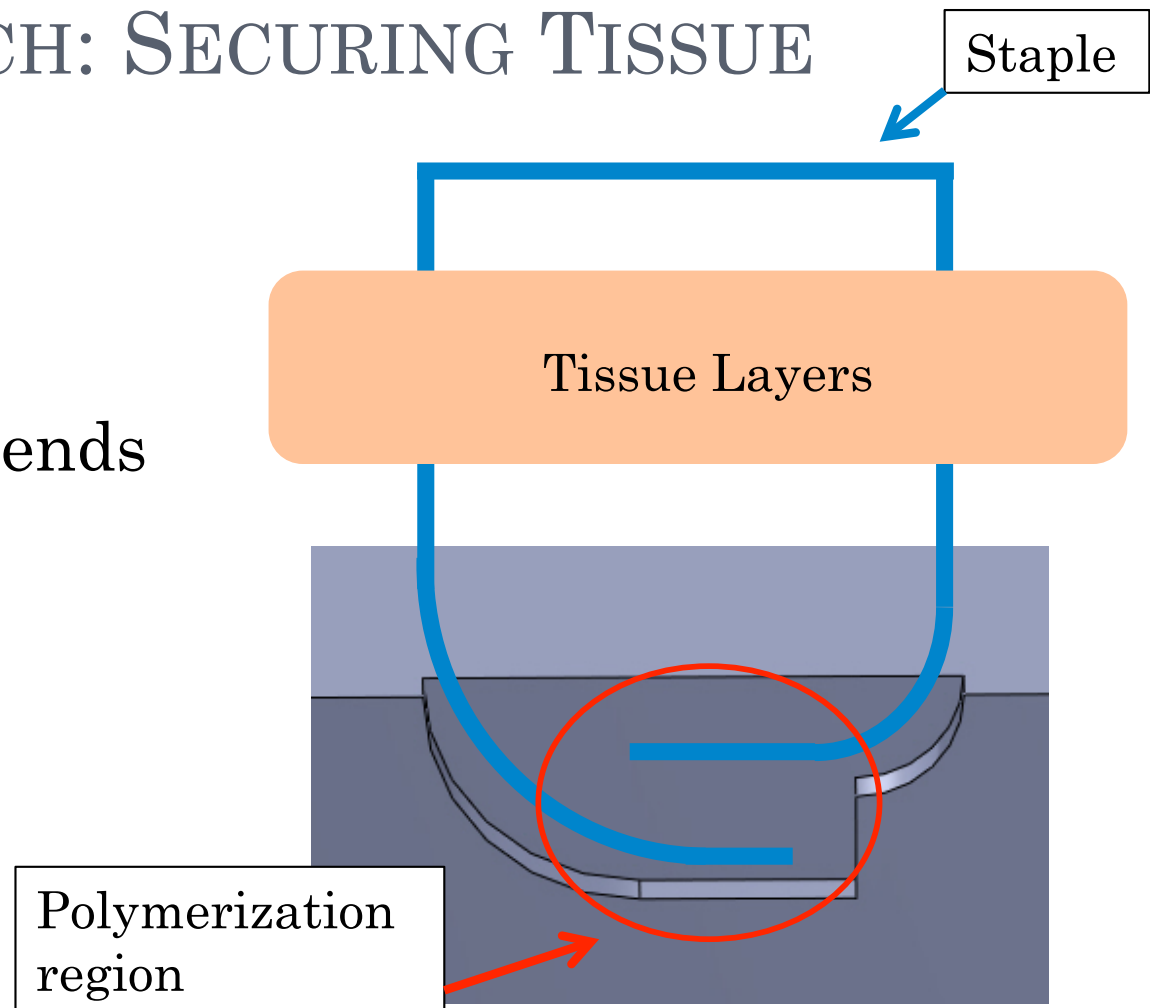


Fig 1. Staple being bent in ring clamp (cross section)



# TESTING

## Staples

- Testing multiple formulations
  - Qualitative – do they bend?
  - Tensile testing
    - Compare with sutures
  - Polymerization testing

## Stapler

- Prototype efficacy with metal staples
  - Synthetic material
  - Tissue explants
- Leak Testing



# FUTURE WORK

- Testing with Absorbable Staples
- Publication in Journal
  - Journal of Endourology
- Application into radical cystectomy procedure



# REFERENCES

- Semba, T, K Kitagawa, US Ishiaku, and H Hamada. "The Effect of Crosslinking on the Mechanical Properties of Polylactic Acid/polycaprolactone Blends." *Journal of Applied Polymer Science*, 101.3 (2006): 1816-1825.





# ACKNOWLEDGEMENTS

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- Dr. Wan-Ju Li



# QUESTIONS?

