

# Automated Uretero-Intestinal Anastomosis with Absorbable Staples

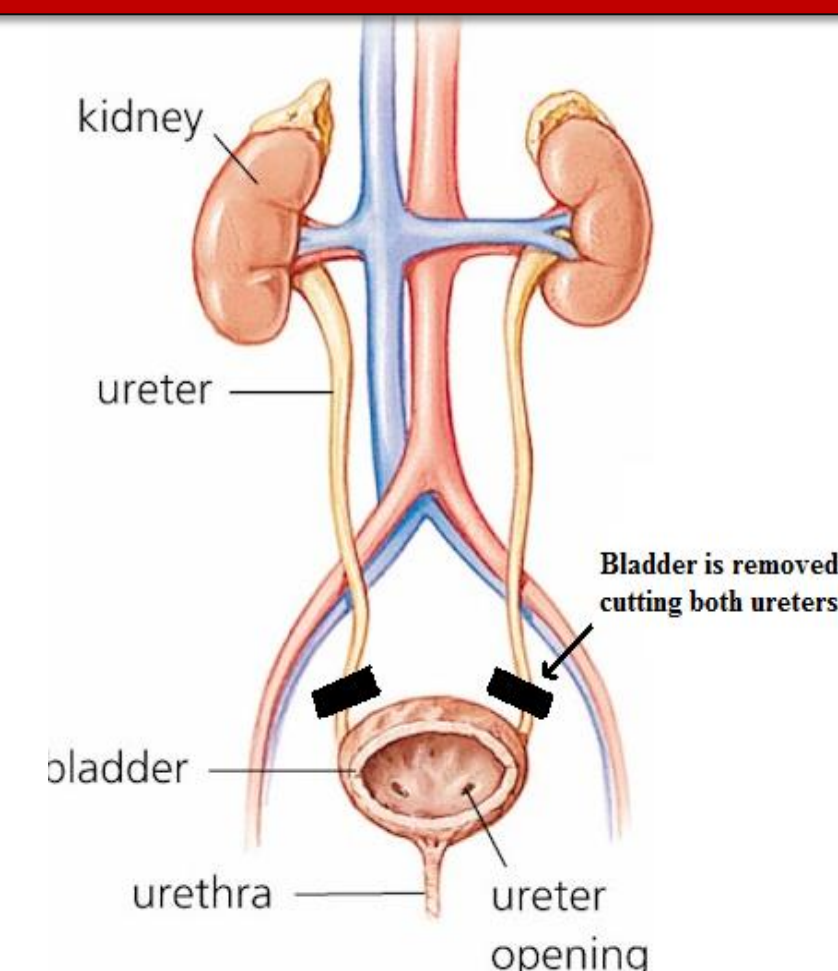
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## Abstract

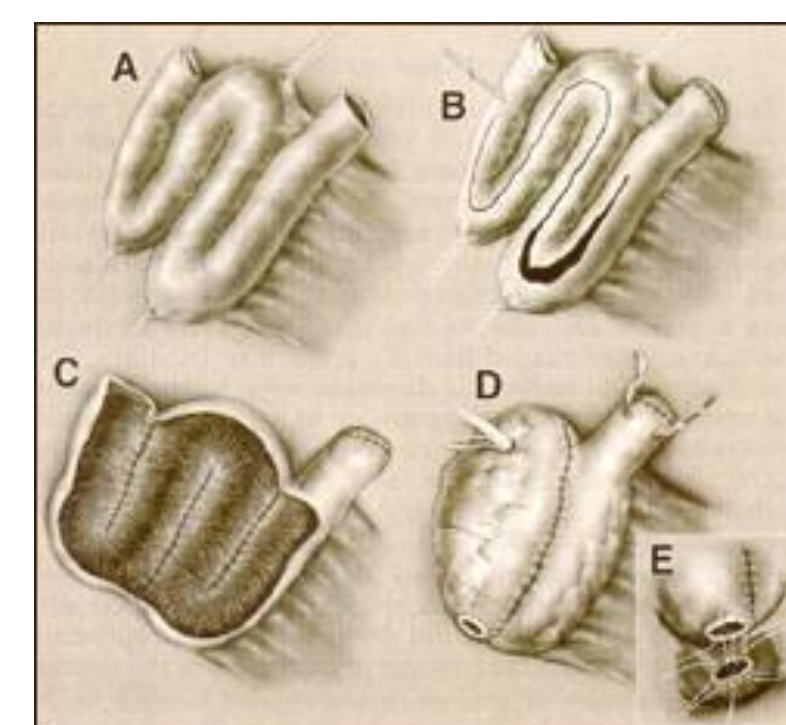
The goal of this project is to improve the procedure to secure ureter tissue to a neobladder. A neobladder is formed from intestinal tissue after a cystectomy surgery has been performed to remove the original diseased bladder. Our client requested that our team design and build a stapler that could safely and effectively attach the two tissues together in a single action. The stapler must be safe and easier for the surgeon than suturing. It must also create a water-tight seal between the two tissues. Additionally, we will develop bio-degradable staples to be used in the stapler. After several stapler design iterations, we selected and fabricated our stapler prototype. We will follow up with an absorbable staple design and testing of the two products together next semester.

## Bladder Cancer

- 5th most common cancer in US [1]
- 70,530 new cases and 14,680 deaths in 2010[1]
- Radical cystectomy
  - Required when muscle layer is invaded
  - Need to restore urinary system function - urine storage:
    - Urostomy bag
    - Neobladder

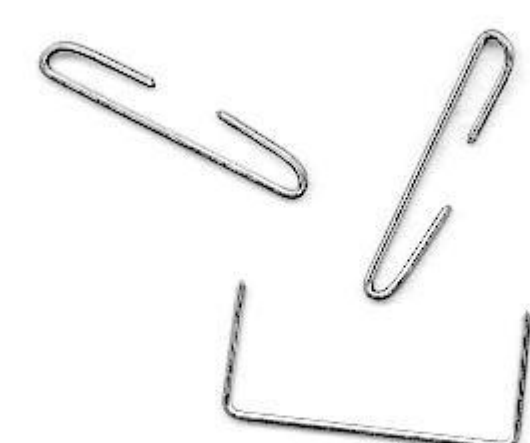


## Problem Statement



- Currently: Ureters connected to new bladder tissue via suture
- Lengthy/Intricate procedure
- Need stapler for more efficient surgery
- Metal staples => stones
- Goals
  - Semester 1: Small Stapler
  - Semester 2: Absorbable Staples

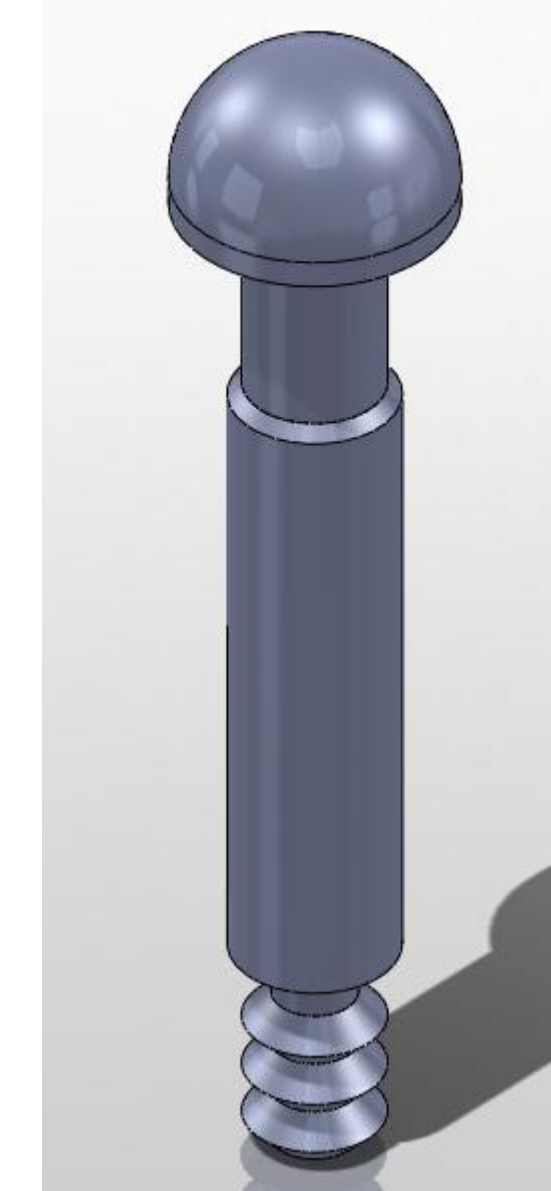
## Client Requirements



- Usable in open surgery
- Sterile
- 10mm diameter at ureter connection
- Can operate with a single motion
- Can create a water tight seal
- Will mitigate tissue damage

## Final Design

### Anvil



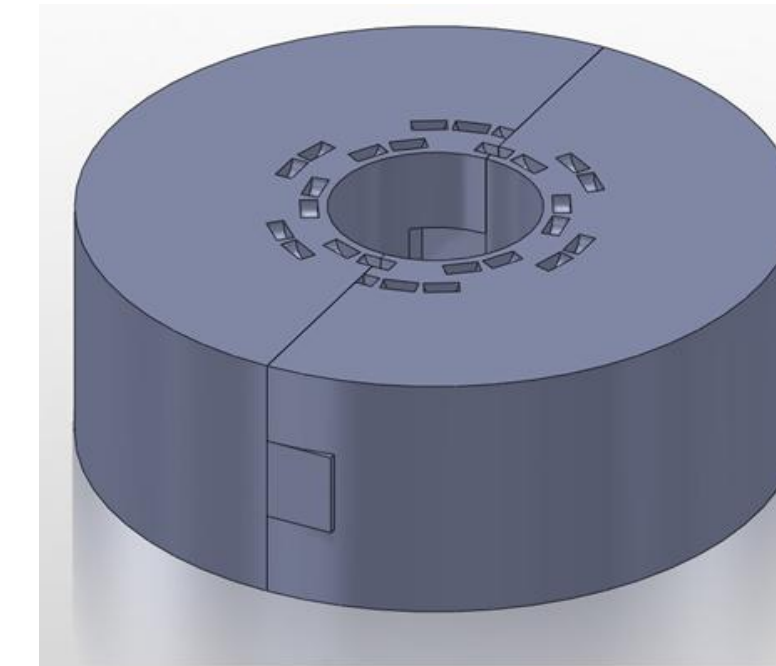
#### Dimensions:

- Head – 10mm diam.
- Neck – 5mm diam.
- Body – 6mm diam.
- Locking bulbs – 5mm diam.
- Total height - 41mm

#### Use:

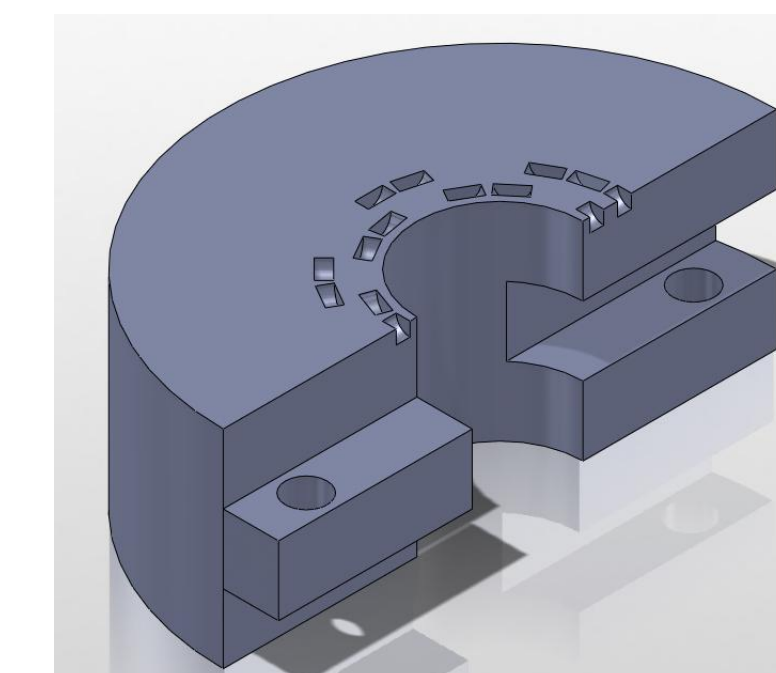
- Head inserted into ureter
- Pulls ureter tissue down through neobladder
- Secured to firing mech.
- Used as a guide for other parts to slide over

### Ring Clamp



#### Dimensions:

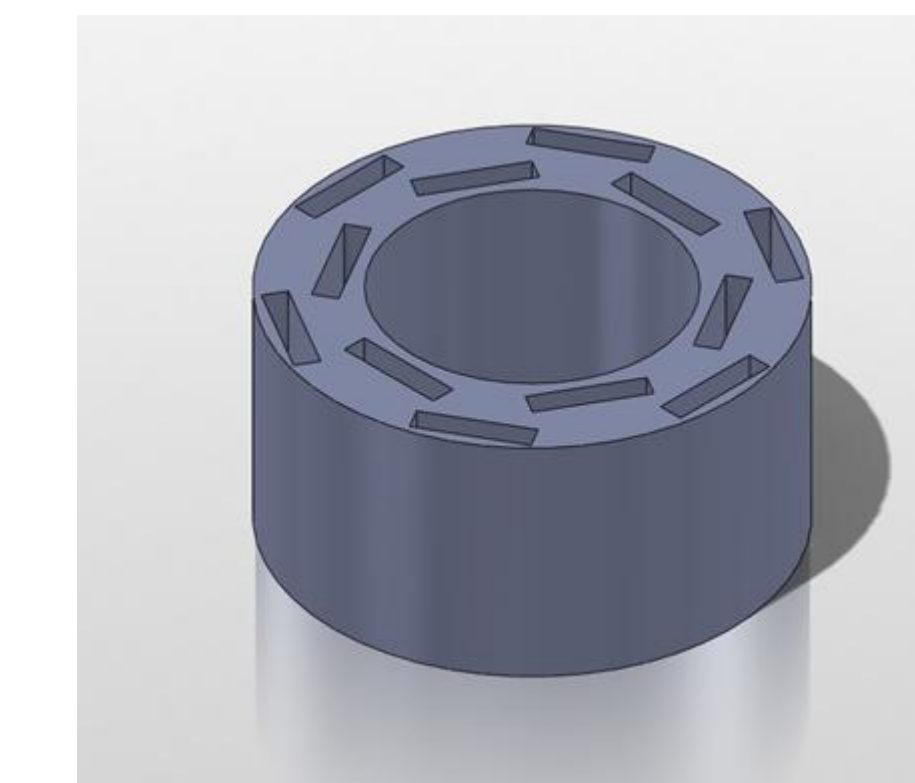
- Inner diam = 6mm
- Outer diam = 20mm
- Semicircular grooves to bend staples – 0.5mm deep, in pairs spaced 60° apart



#### Use:

- 2 sides clamp over ureter tissue onto anvil
- Secures tissue in place
- Serves as a staple firing base

### Staple Cartridge



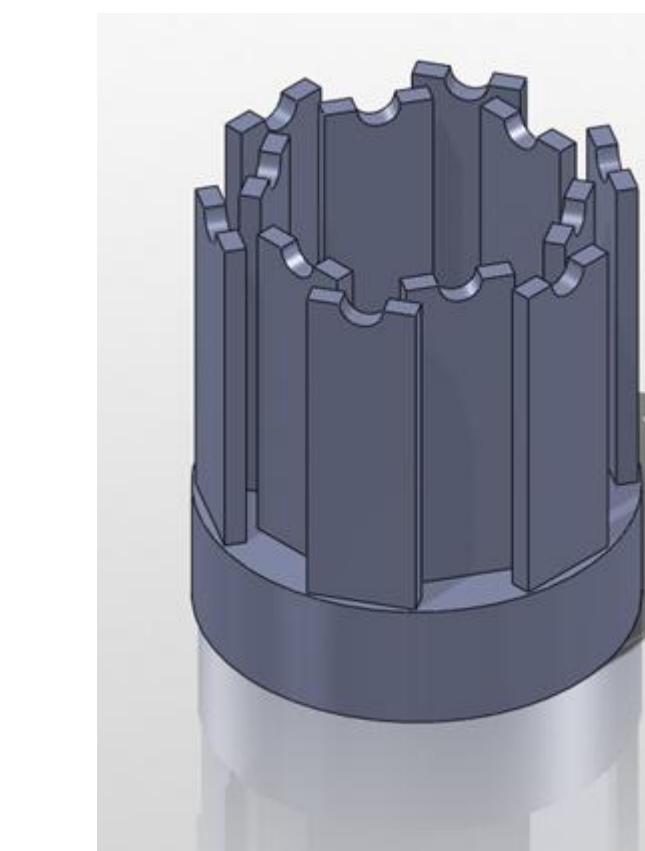
#### Dimensions:

- Inner diam. = 6mm
- Outer diam. = 10mm
- Holes = 0.6 x 2.7mm

#### Use:

- Holds 12 staples 2.5mm wide in 2 rows

### Staple Forming Teeth



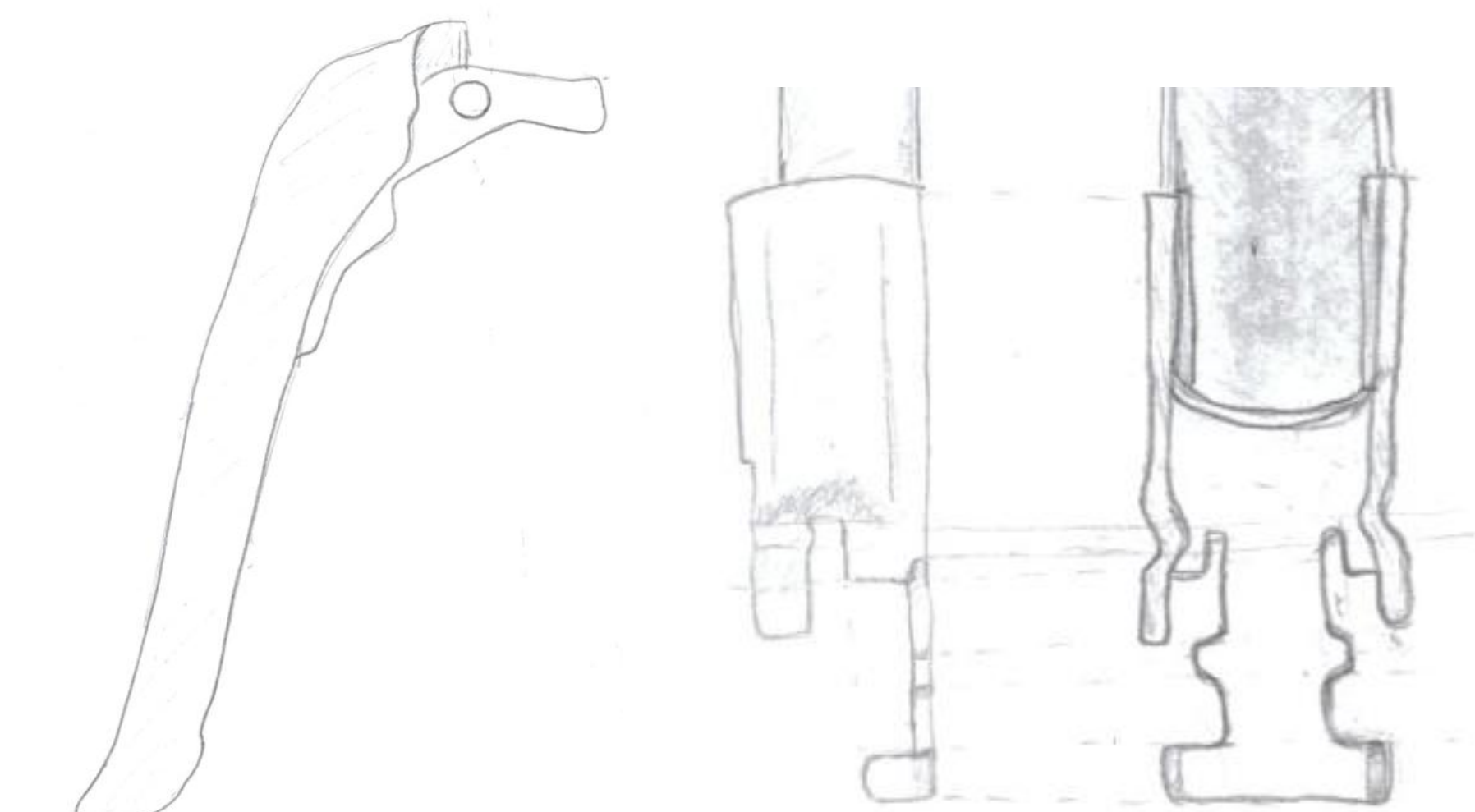
#### Dimensions:

- Inner diam. = 6mm
- Outer diam. = 10mm
- Teeth = 0.5 x 2.5 x 8mm

#### Use:

- Pushes through cartridge
- Fires staples through tissues and pushes them against ring clamp

### Firing Mechanism



#### Use:

- Mechanism involves a pin, handle, and actuator in order to perform translational movement
- Plastic casing surrounds and encapsulates the trigger components
- Translates ~1.2cm
- Cannibalized the Ethicon® stapler for casing and handle components

## Testing

#### Physician Testing:

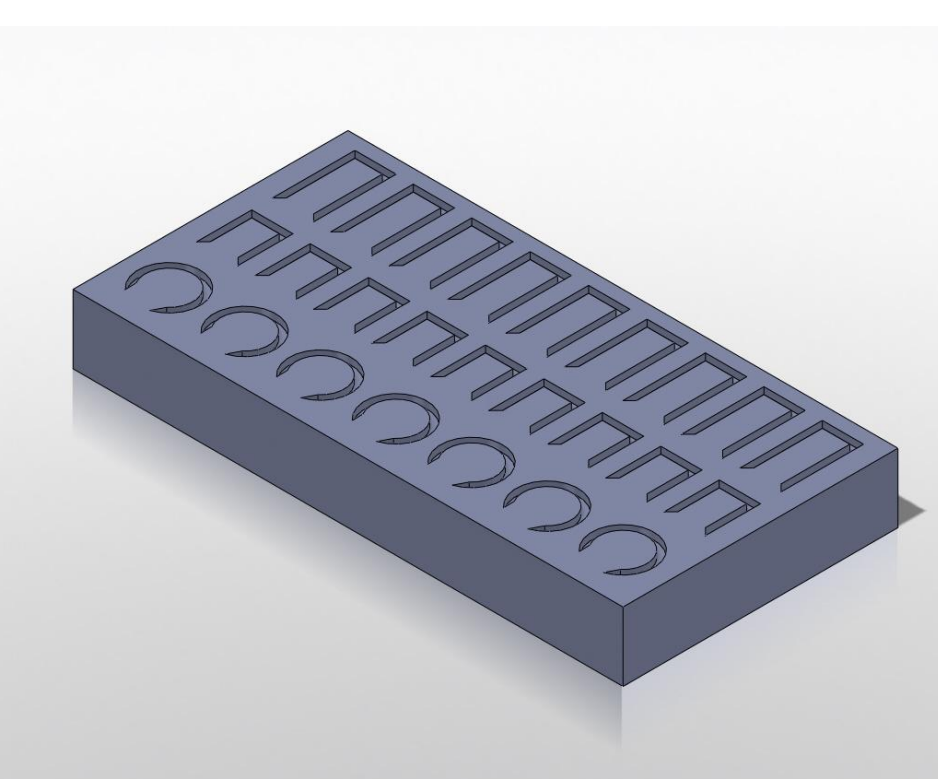
- Client qualitatively rated the individual parts of our design.
- Opinions were based on perceived functionality.
  - Ring clamp – 9/10
  - Anvil – 8/10
  - Firing mechanism – 8/10

#### Future Testing:

- Functionality testing with mock bladder tissue provided by our client
- Functionality testing with animal cadaver models
- Burst strength testing using bovine or porcine cadaver tissue

## Future Work

- Finalize stapler firing mechanism
- Test stapler with metal staples
- Have mold made for components of stapler mechanism
- Determine PLGA ratio for degradation profile of ~30 days
- Test staple material degradation on animal cadaver



## Cost Analysis



#### •Budget = \$3000 - \$5000

- Rapid prototyping using C-ideas = \$146.50
- Remaining budget will be use next semester to create molds of our final design after we confirm its validity with testing

## Acknowledgements/References

Dr. Wan Ju Li, Department of Orthopedics UW Madison  
 Dr. Tracy Downs, Department of Urology, UW Madison  
 C.Ideas rapid prototyping  
 Ethicon®

[1] National Cancer Institute. "Bladder Cancer." National Cancer Institute: U.S. National Institutes of Health, 2010. 19 November 2010.  
[www.cancer.gov/cancertopics/types/bladder](http://www.cancer.gov/cancertopics/types/bladder)