

Laparoscopic Kidney Clamp

Team Members

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Client

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Advisor

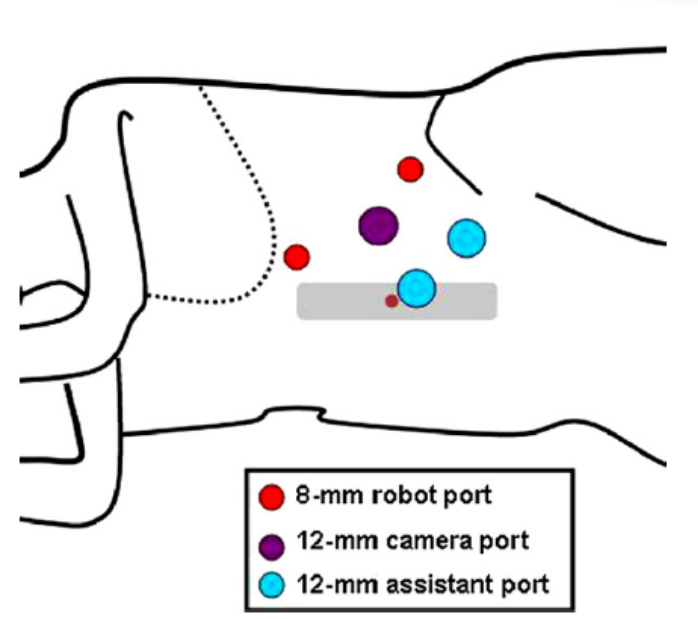
Professor Mitch Tyler
Department of Biomedical Engineering
UW - Madison

Overview

- Background
 - Client Description
 - Motivation
- Problem Statement
- Current Devices
- Designs Alternatives
 - 1) Bike Brake Flat
 - 2) Bike Brake Angled
 - 3) Loop
- Design Matrix
- Final Design
- Future Work

Client Description

- Dr. E Jason Abel
 - Department of Urology at UW – Madison
 - Special interest in localized advanced kidney cancer
- Performs open and laparoscopic surgeries
 - Use of daVinci robot
 - Philosophy: *“provide maximal quality of life to patients by using minimally invasive approaches to cancer therapy”*

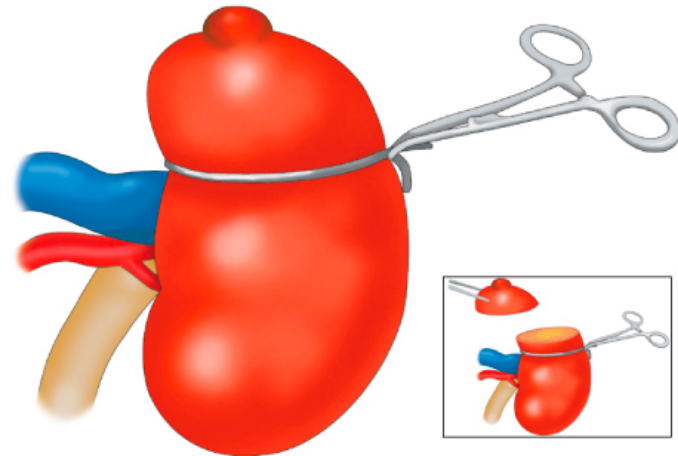
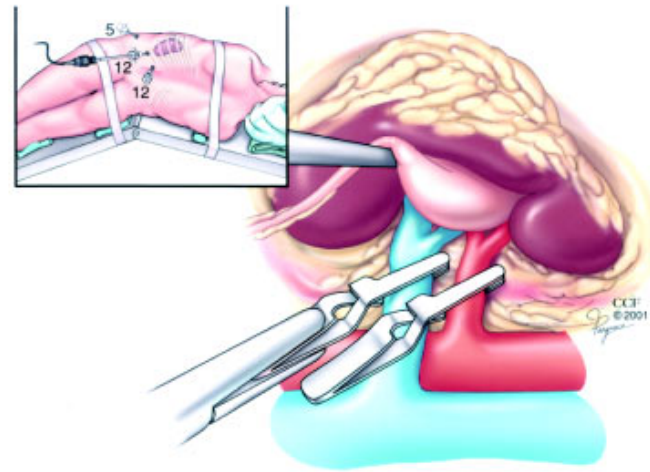


Davis P. Viprakasit, Hernan O. Altamar, Nicole L. Miller, and S. Duke Herrell.

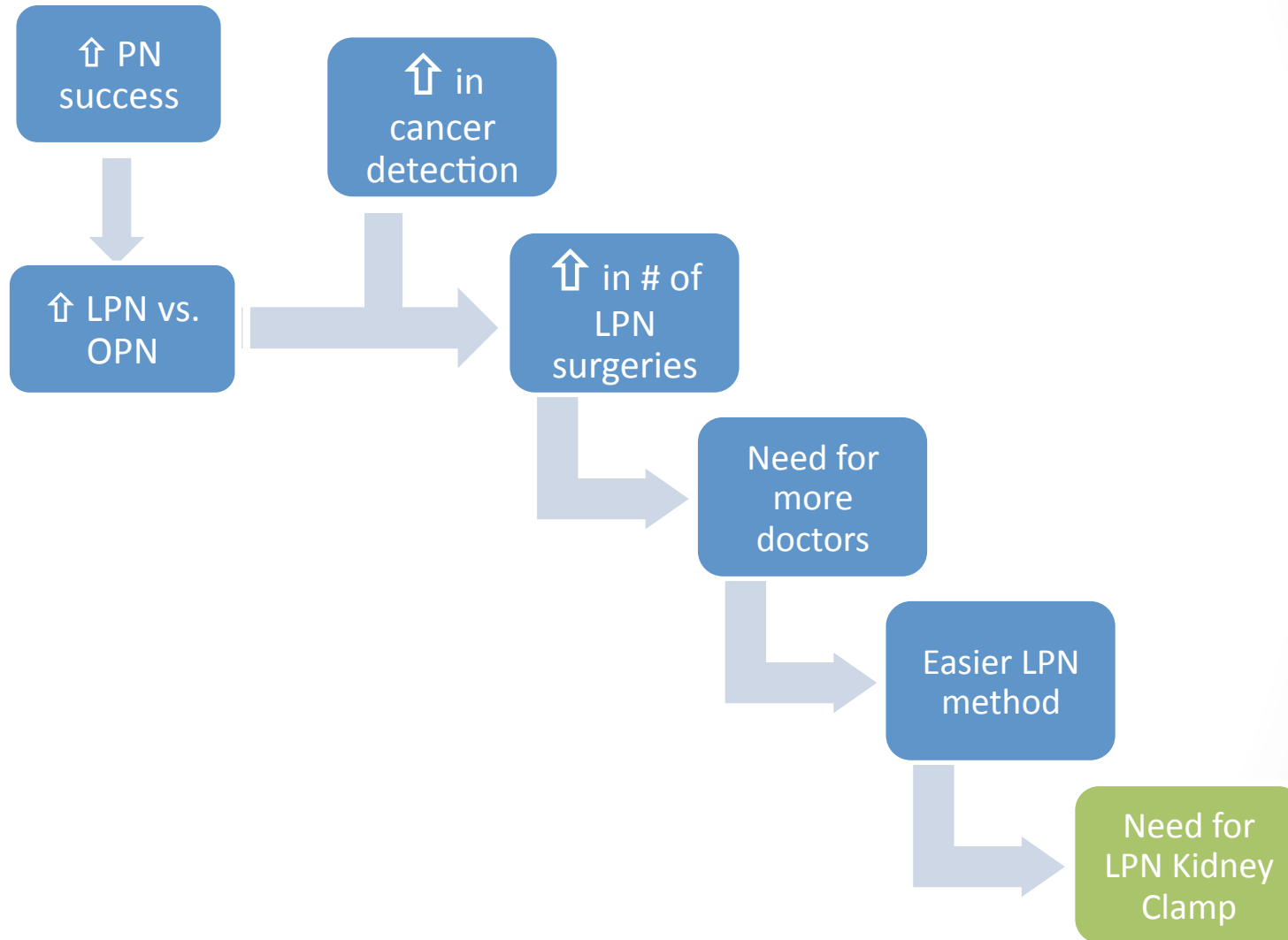
Selective Renal Parenchymal Clamping in Robotic Partial Nephrectomy: Initial Experience

Background

- Kidneys filter ~ 20% of blood per minute
- Blood flow occluded during Partial Nephrectomy (PN)
 - Currently clamped at renal artery and vein
 - Create global ischemia to kidney
 - Potential long term damage
- Need to create localized ischemia



Motivation



Problem Statement

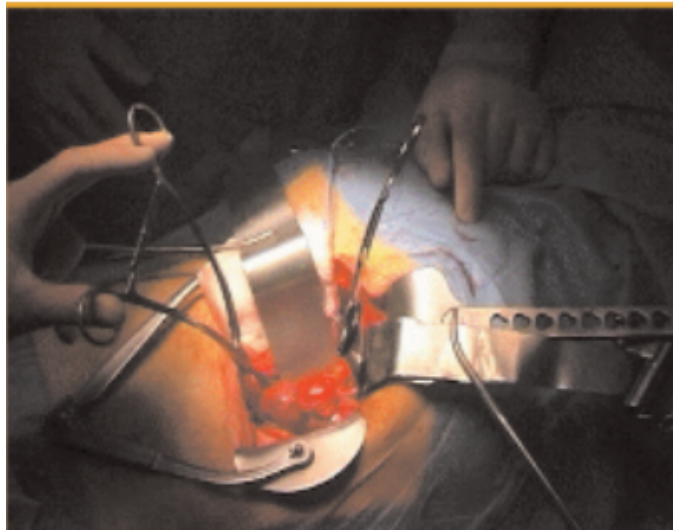
- Laparoscopic instrument
 - Must be able to fit through a 12 mm by 15 mm trocar
 - Flexible shaft
- Provide enough strength to occlude renal blood flow
 - Without causing harm to kidney
 - Adjustable, maintainable, evenly distributed
 - 5 – 30 mins
- Reusable
- Able to operate with one hand
 - Accommodate hand breadth ranging from 6.5 – 9.5 cm
- Not exceed cost of commercially available clamps

Satinsky Clamp

- Client's favorite clamp
- Cons
 - Not Laparoscopic
 - Difficult to operate with one hand
 - Lacking flexible shaft



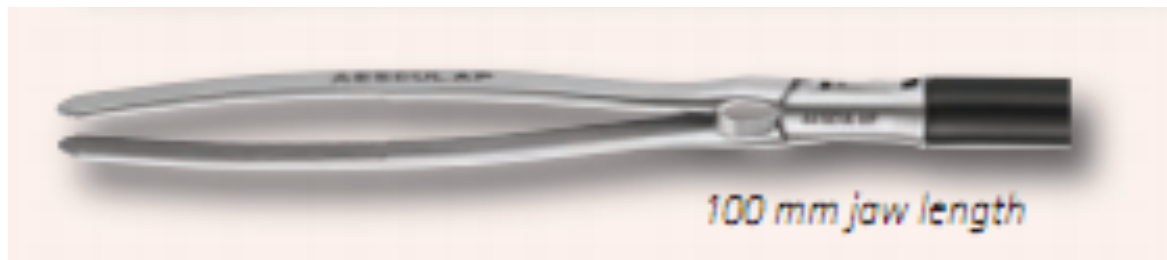
Reniclamp



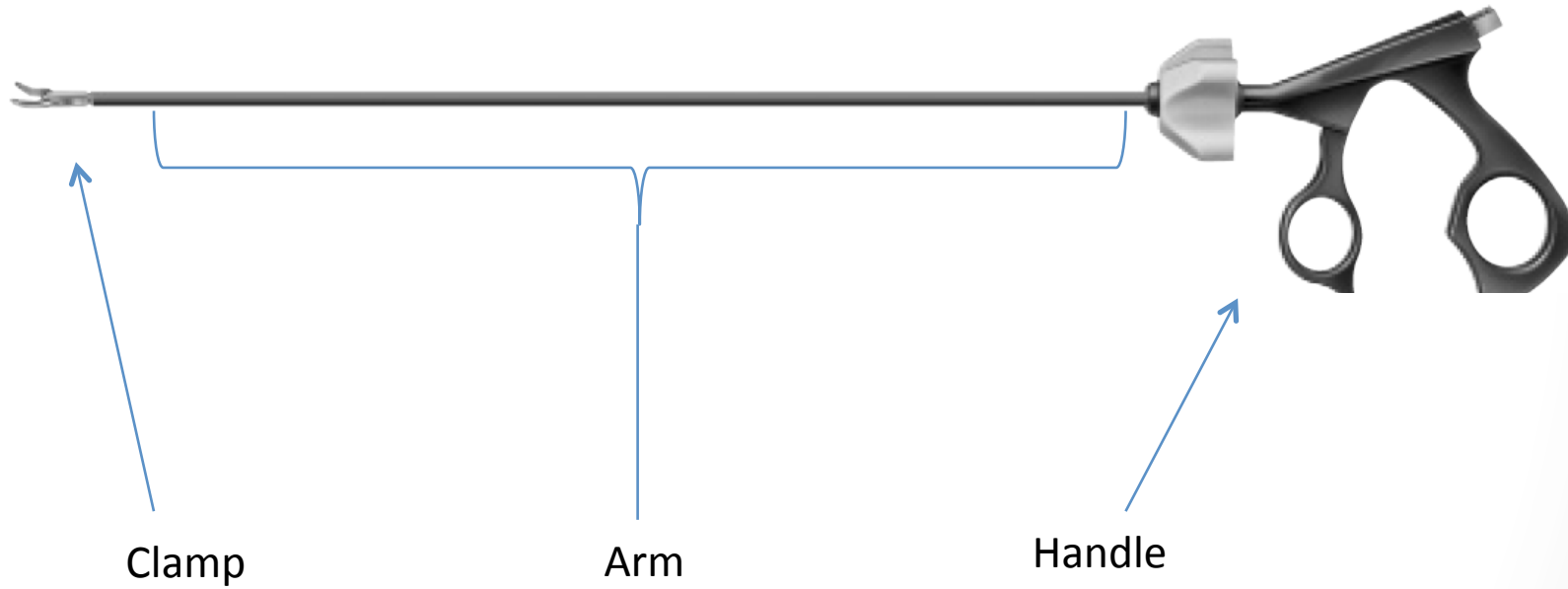
- Has been used to perform nephrectomies
- Cons
 - Not laparoscopic
 - Takes two hands to operate

Aesculap Surgical Clamp

- Has performed two successful surgeries
- Cons
 - Shaft is not flexible
 - Clamp rod is not long enough



Design Components



Clamp Handle

- Adjustable
 - Ratchet design
- Ergonomic
 - Easy on the hands
- Preferred by client

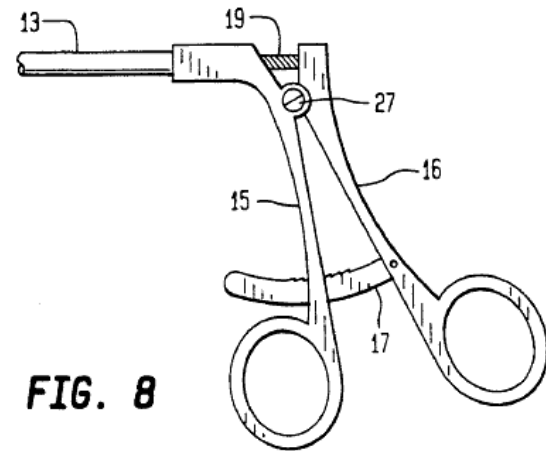


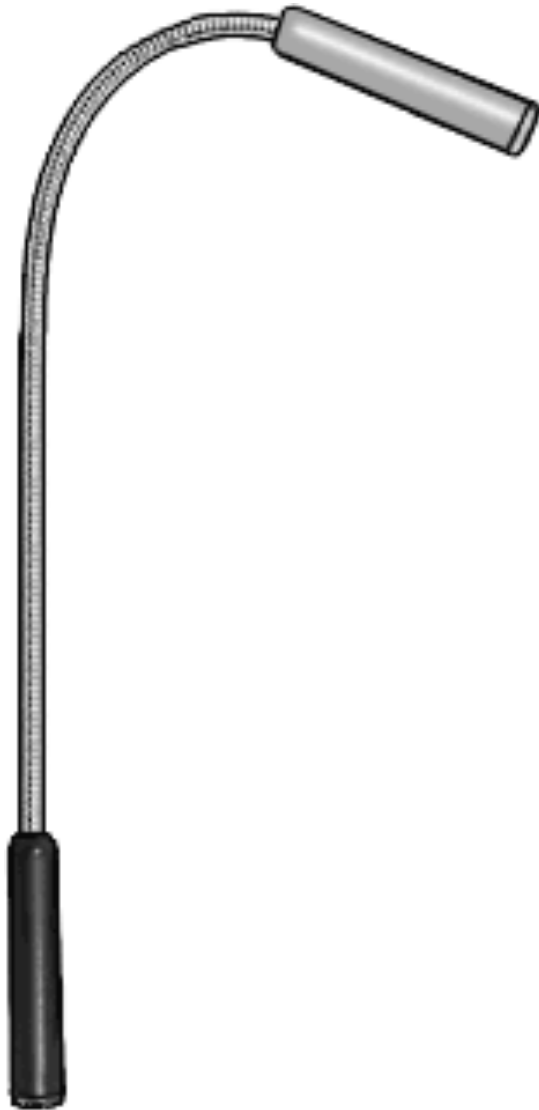
FIG. 8

El-Mallawany et al. U.S Patent #5304203, 19 Apr. 1994



Aesculap Surgical Technologies
Simon Renal Pole Clamp

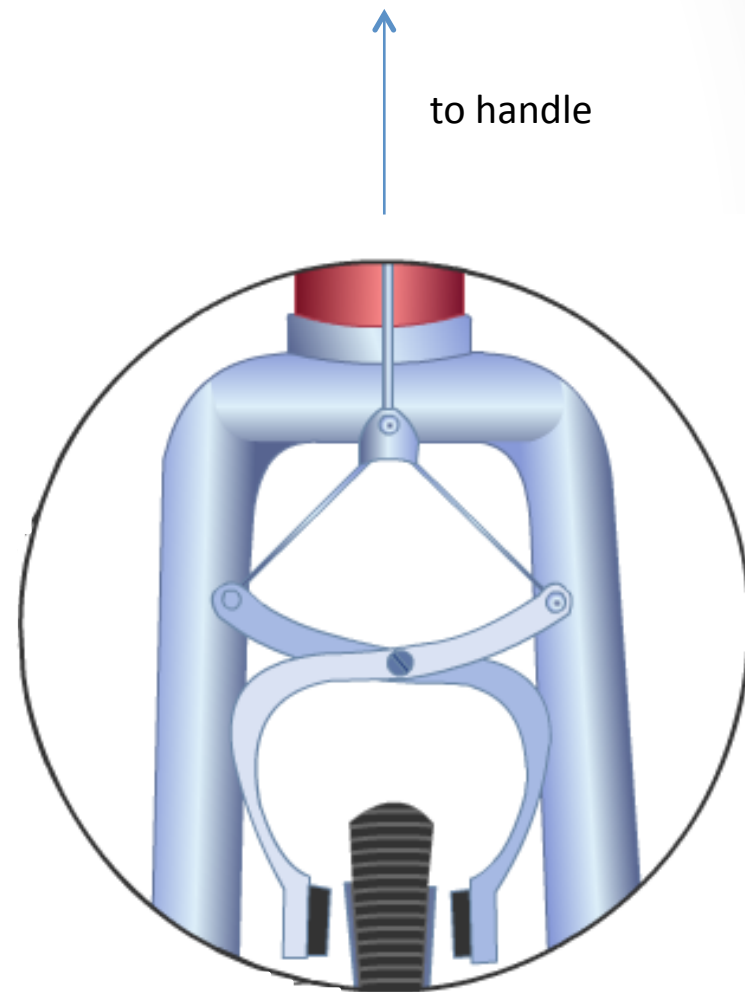
Clamp Arm



- Provides flexibility
- Fits through trocar
- McMaster-Carr
 - \$9.06
 - 17.5" long

Design 1: Bike brake mechanism

- System of wires connects to clamp arms
- With no force applied, clamp remains in open position
- When brake is pulled, clamp closes



Design 1A: Straight

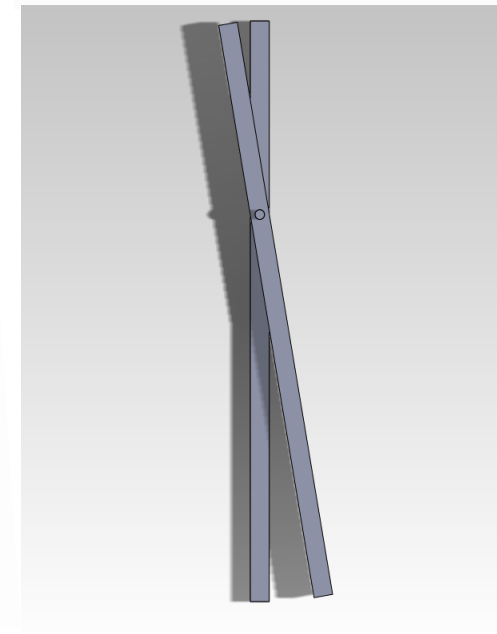
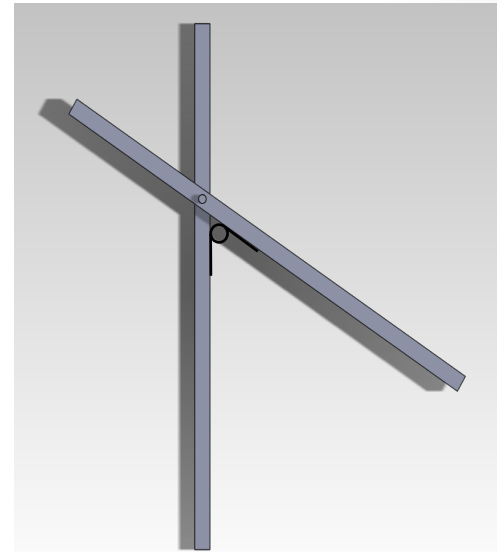
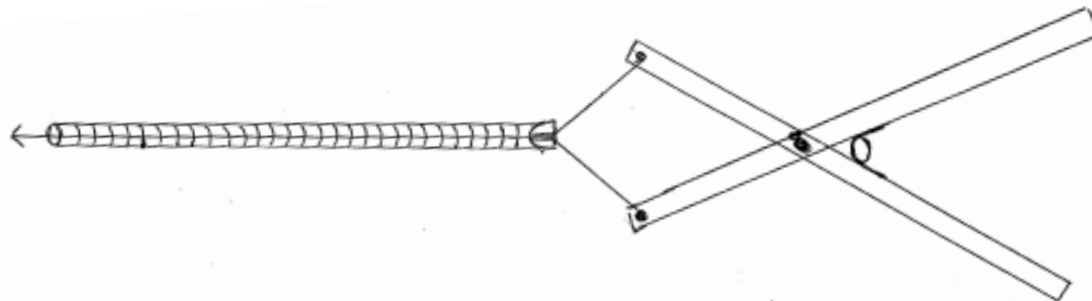
- Utilizes bike brake mechanism
- Straight clamp arms
- Spring keeps clamp in open position

PRO

Fits through trocar

CON

Force applied differs at proximal, medial, and distal locations



Design 1B: Angled

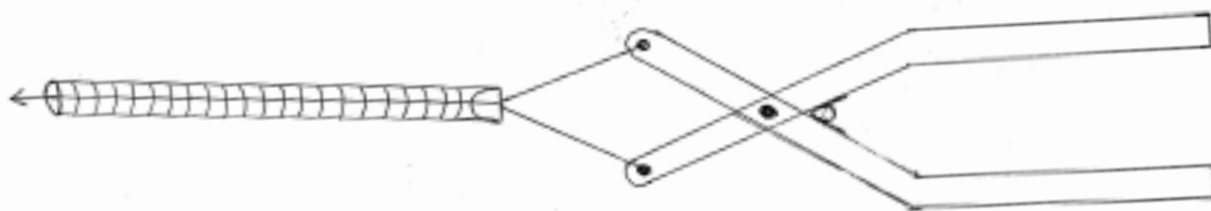
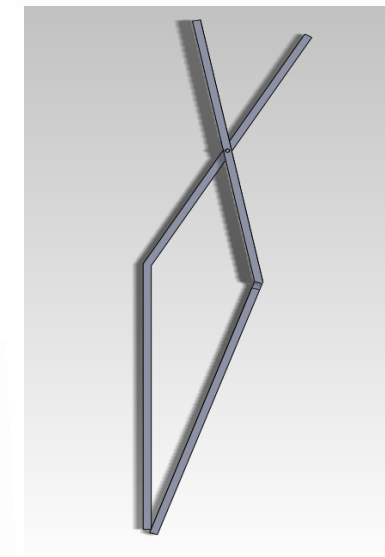
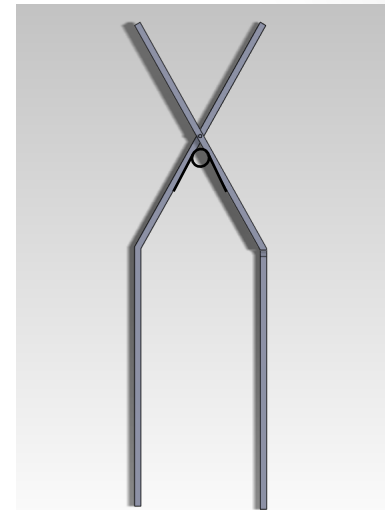
- Utilizes bike brake mechanism
- Angled clamp arms
- Spring keeps clamp in open position

PRO

More consistent force along clamp arms

CON

Currently, does not fit through trocar



Design 2: Loop

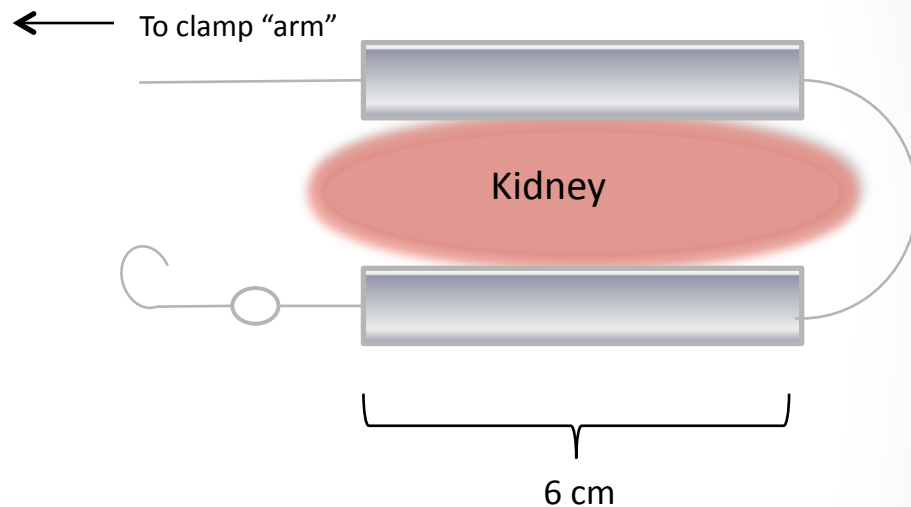
- Parallel clamp
- Circumferential approach
- Hook and eye closure

PRO

More consistent force along clamp arms

CON

Difficult to use

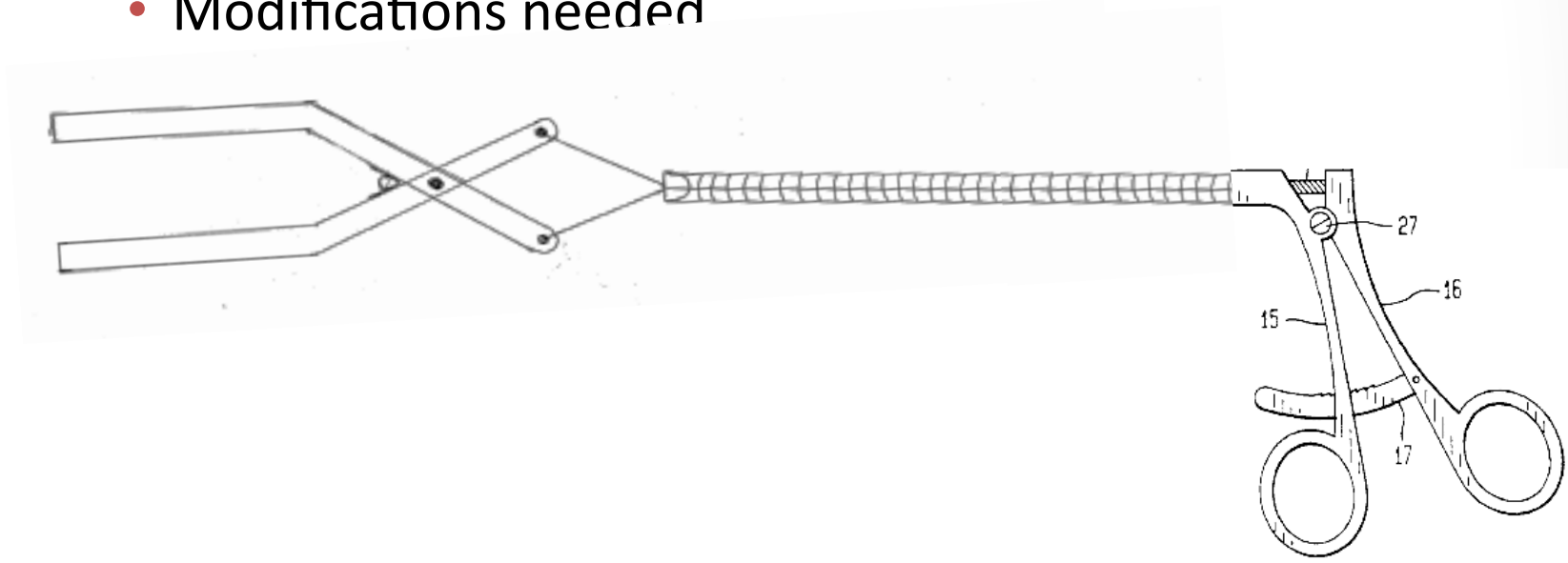


Design Decision Matrix

Criteria	Weight	Design Alternatives		
		Bike Brake Mechanism		Loop
		Straight	Angled	
Fabrication	10	10	8	5
Price	10	8	8	8
Ease of Use	25	25	25	15
Stability	25	20	23	25
Force Distribution	30	22	29	30
Total	100	85	93	83

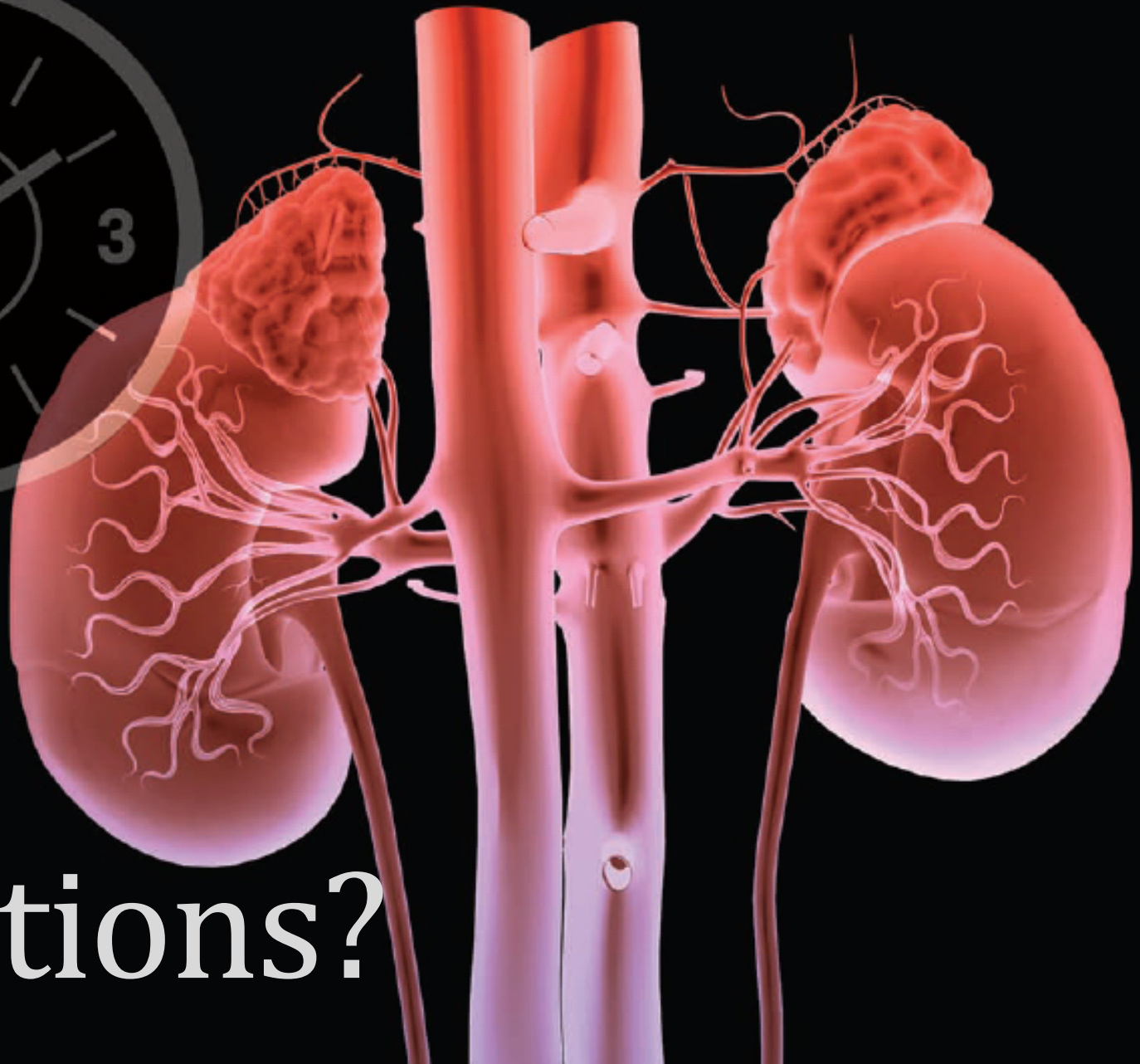
Final Design

- Design 1B
 - Angled Bike Brake Clamp
 - Modifications needed



Future Work

- **Modify bike clamp design**
 - Select spring with ideal spring constant
 - Add hinges for even force distribution
 - Adjust dimensions to fit through trocar
- **Fabrication**
 - Material selection
 - Order prototype handle, arm and materials for clamp
- **Testing**
 - Pig lab



Questions?

References

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