

Liver Retractor for Single Incision Laparoscopic Surgery

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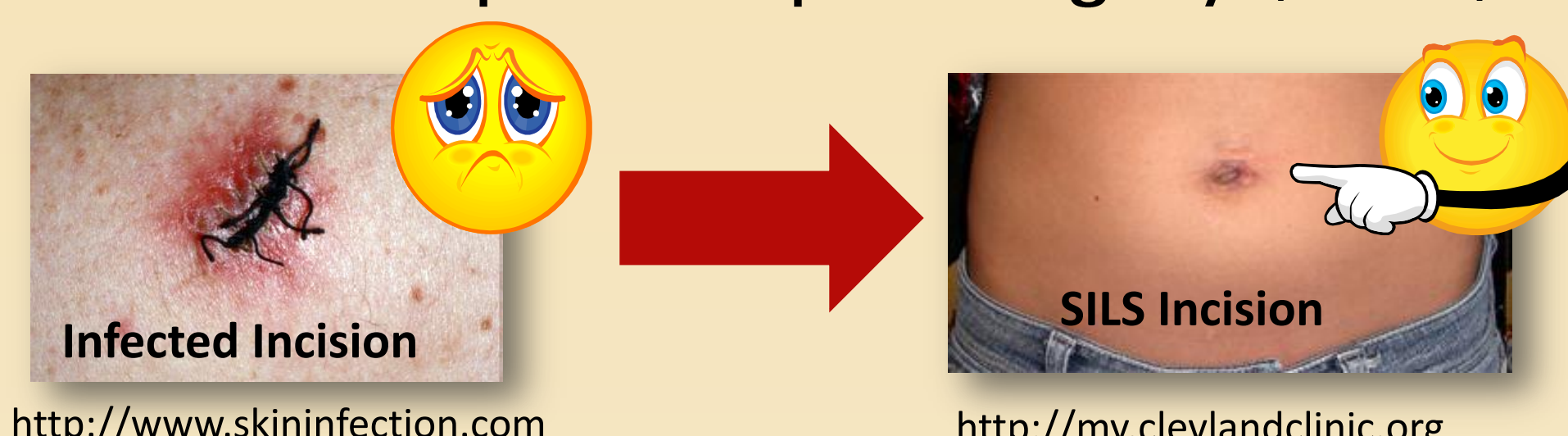
Abstract

A deployable liver retractor was developed to allow Single Incision Laparoscopic Nissen Funduplications to be performed. The shape of this device was validated in pig labs. Subsequently, an adequate hinge design was developed to allow for the insertion of this device through a laparoscopic port.

Problem Definition

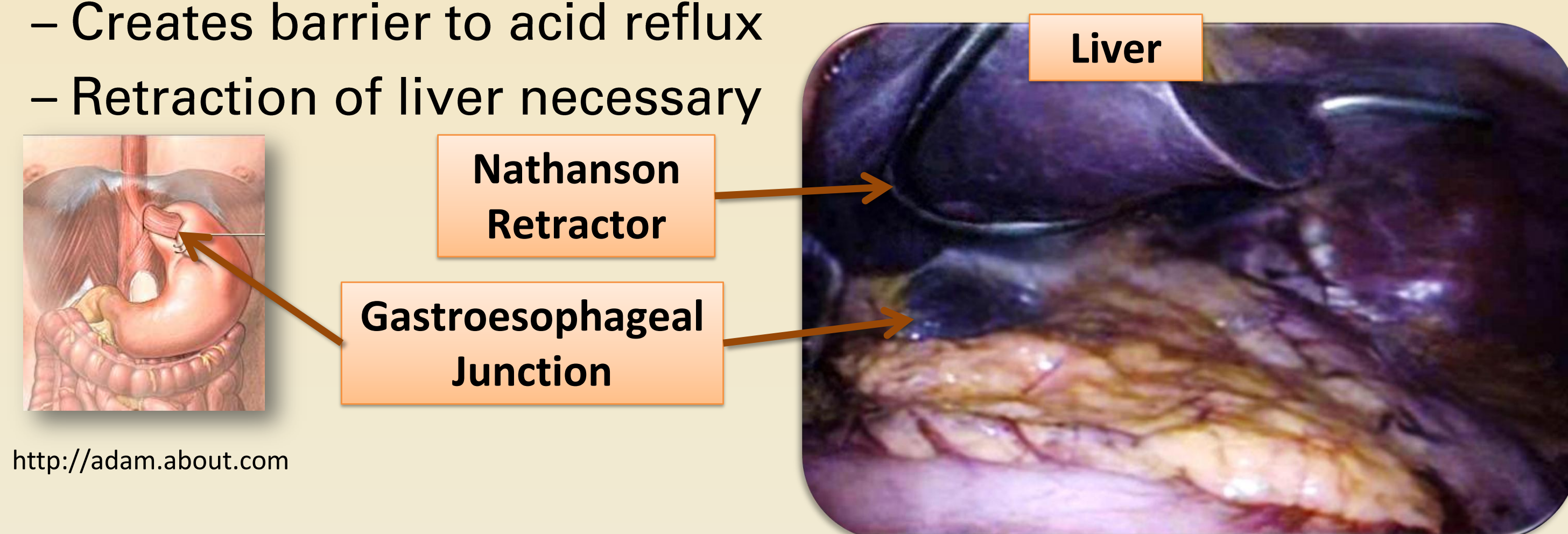
Motivation: Single Incision Laparoscopic Surgery (SILS)

- Decrease number of incisions
 - Cosmetic
 - Less risk of infection
 - Patient satisfaction



Procedure: Nissen Fundoplication

- Treats gastroesophageal reflux disease
 - Creates barrier to acid reflux
 - Retraction of liver necessary



Current Method: Nathanson Retractor

- Cannot be done as SILS: Requires an additional incision

Problem Statement:

- Use device for liver retraction during a SILS Nissen fundoplication
- Retract the left liver lobe of the liver
- Expose the gastroesophageal junction
- Deploy & remove through 12mm laparoscopic port

Design Criteria

- Expose entire gastroesophageal junction
- Under 5 minute deployment
- Distribute weight of liver
- Fit through 12 mm port
- Biocompatible



www.wikipedia.org/Dime



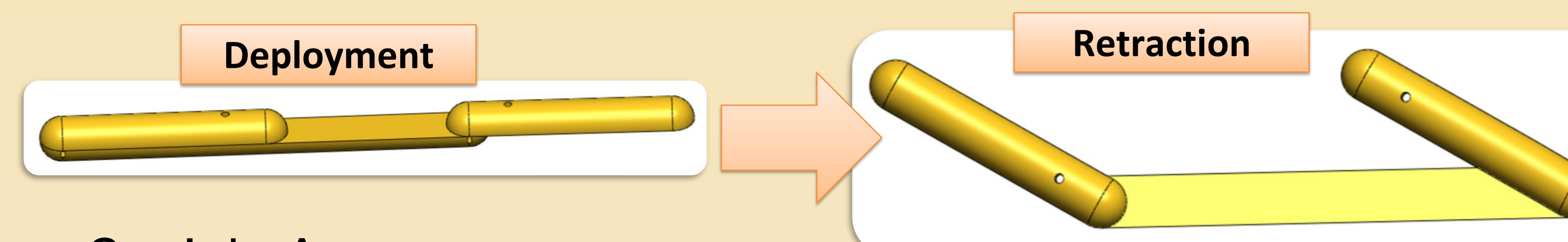
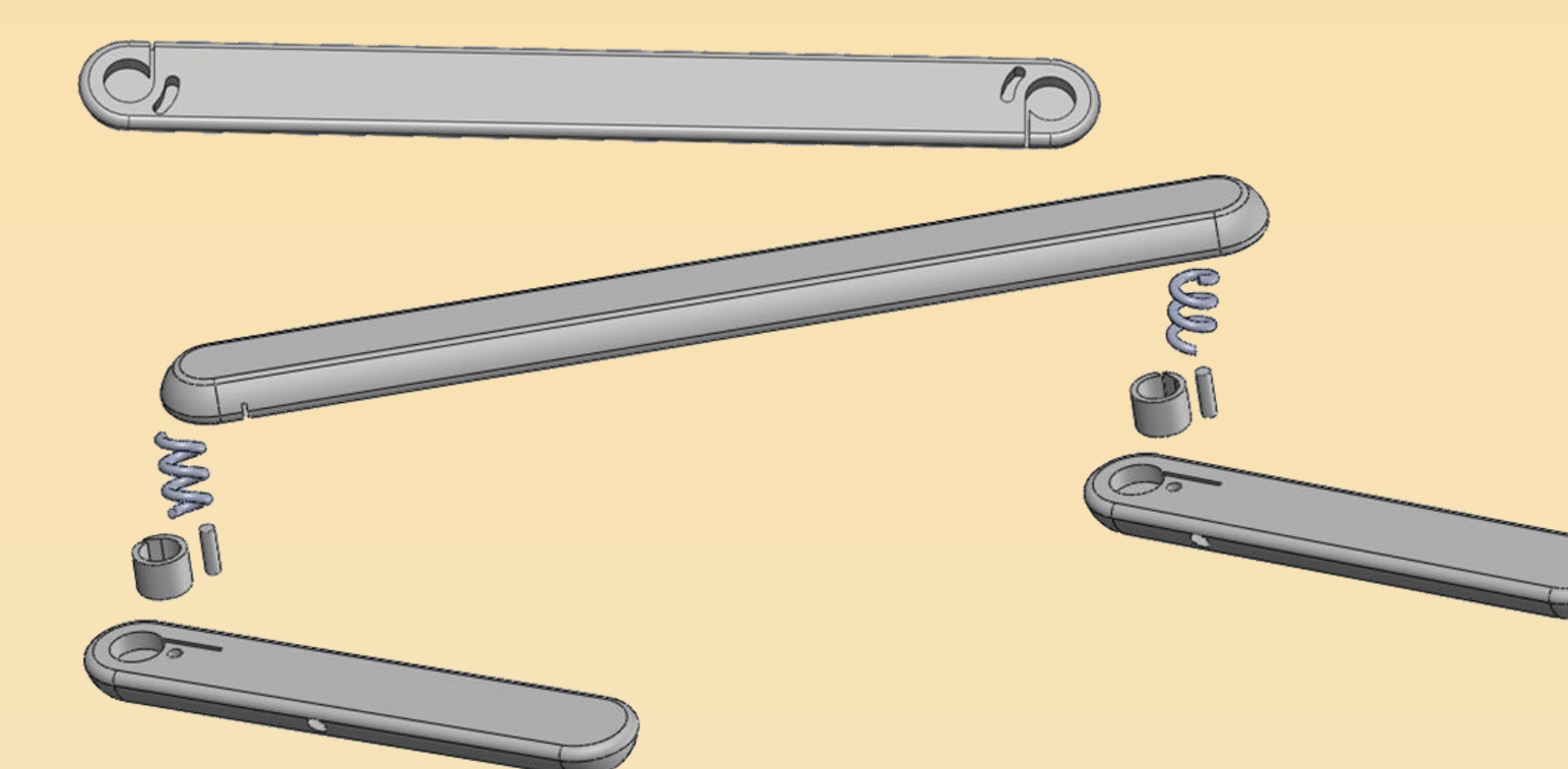
<http://www.covidien.com>

Retractor Design

Previous Work

- Set arm angles
- Staggered suture attachment
- Hollow cylinder axle
 - Torsional spring inside connecting arm to base
 - Transfers liver force to the cylinder
- Peg-slot stopping mechanism

Component View

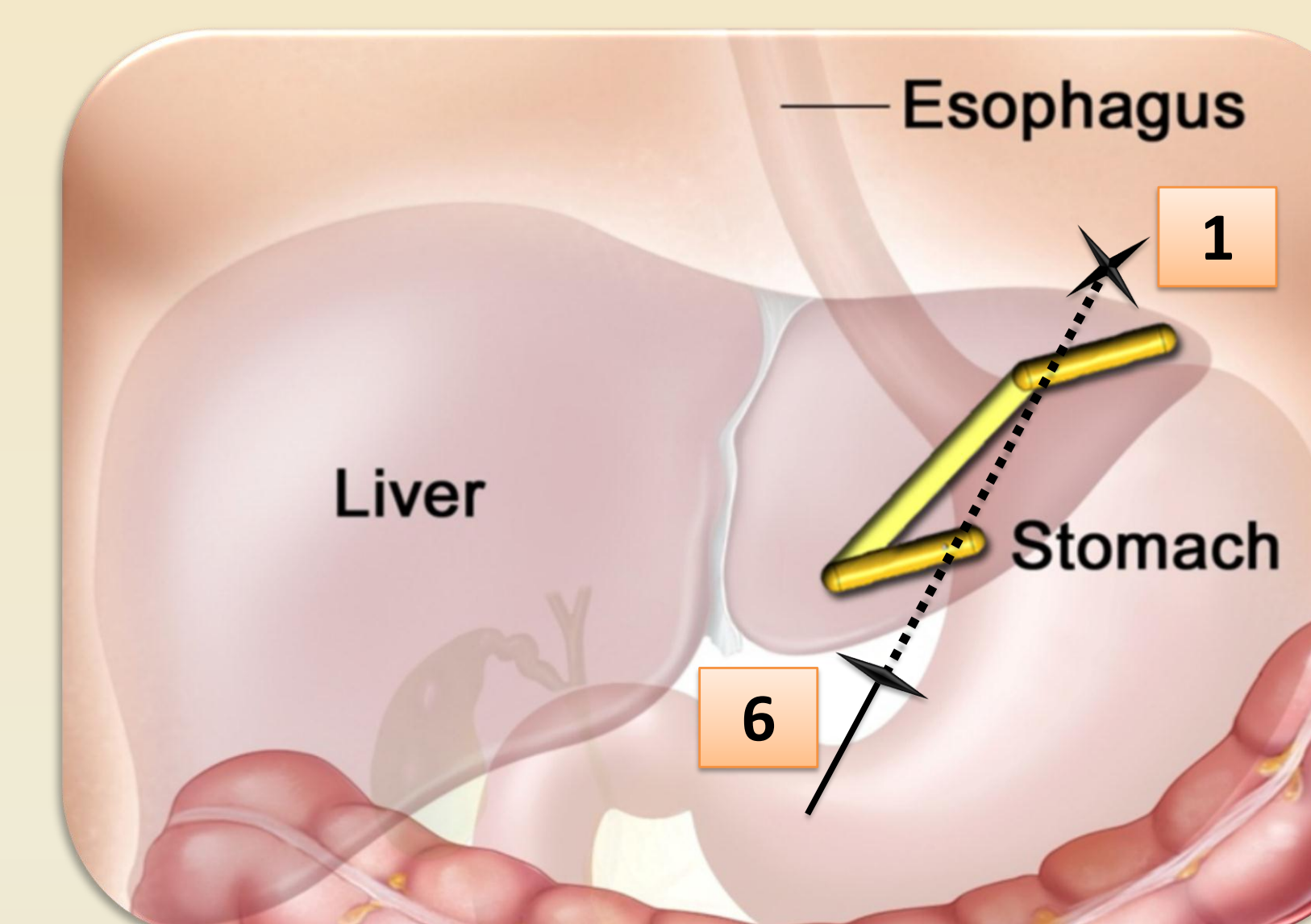


- Straight Arms
- Torsional springs in tension

- Tension release rotates arms
- Spring relaxed

Deployment Procedure

1. Attach suture to left crus
2. Thread suture through retractor
3. Insert retractor
4. Deploy retractor
5. Move retractor under liver
6. Pass suture out abdominal wall
7. Apply tension to retract liver



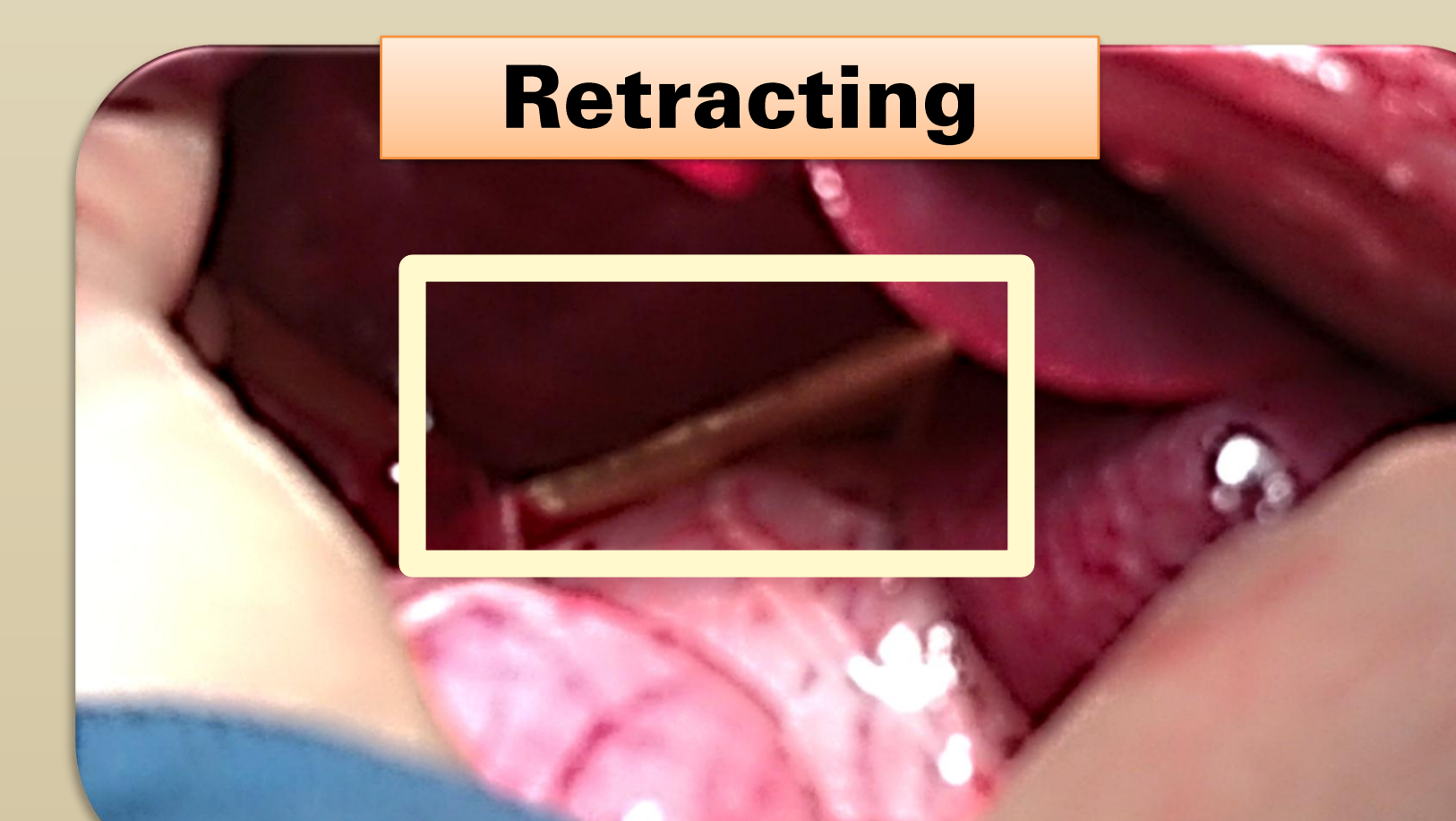
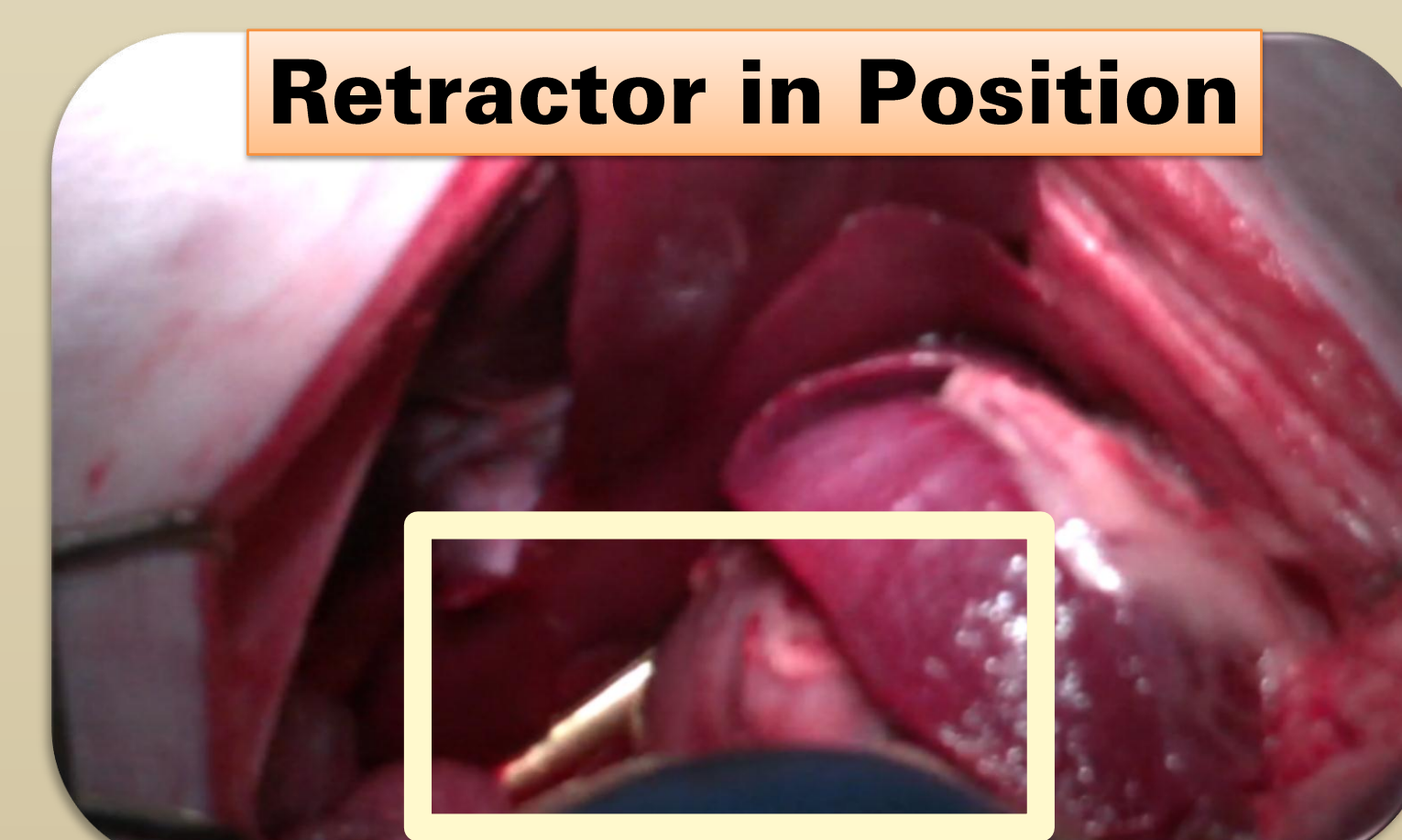
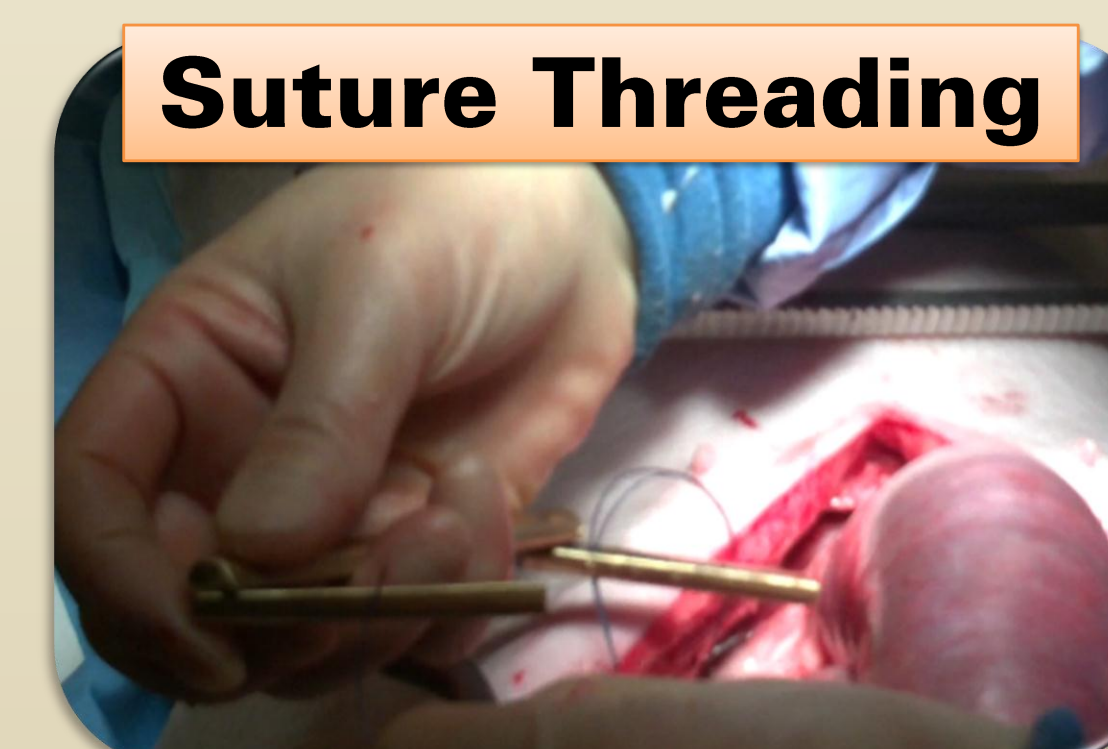
Testing

Testing, Phase I

- Client tested retraction in pig lab
- Assembled device fit through 12mm port

Outcomes

- Pig livers larger and floppier than human
- Retractor 'locked' before in position



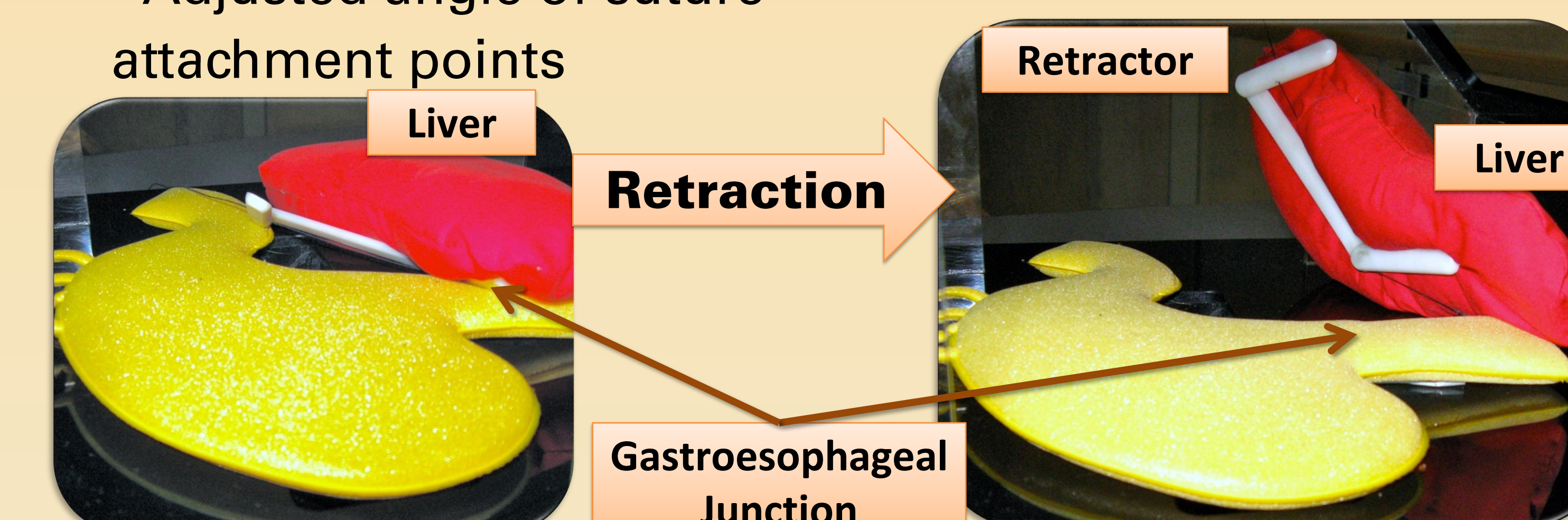
Testing, part II

Modifications

- Made biocompatible
- Hollow cylinder axle
 - Delrin rods
 - EPO-TEK 302-3M Epoxy
- Adjusted angle of suture attachment points

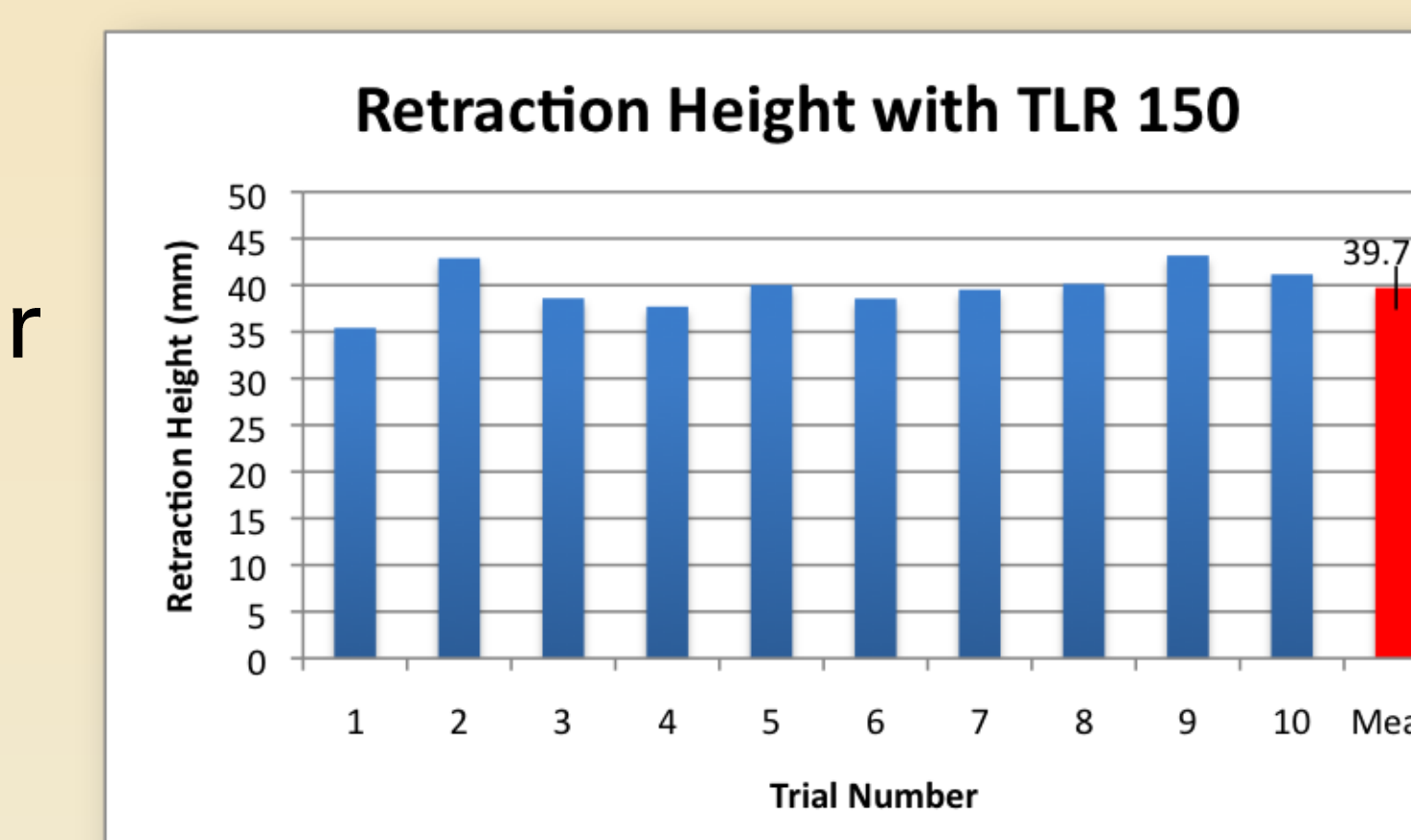
Method

- Constructed mock liver from specifications
- Used model stomach
- Sutures were attached



Results

- Force applied lifted liver an average of 39.7mm.



Future Work

- Develop process of mass production
 - Injection molding
- Apply device to additional procedures
 - LAP-BAND, transperitoneal nephrectomy, etc.
- Assess functionality with human liver
- Create multiple sizes

References

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