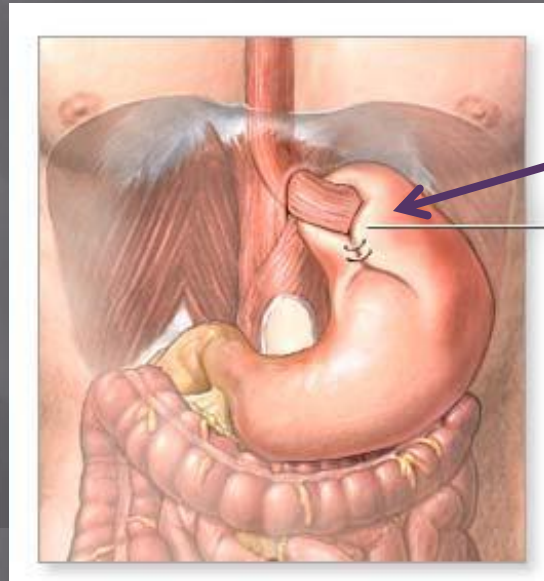


SILS LIVER RETRACTOR

Nick Ladwig, Kevin Hanson,
Kara Barnhart, Daniel Jonovic
Client: Dr. Jon Gould
Advisor: Professor Mitch Tyler

Nissen Fundoplication

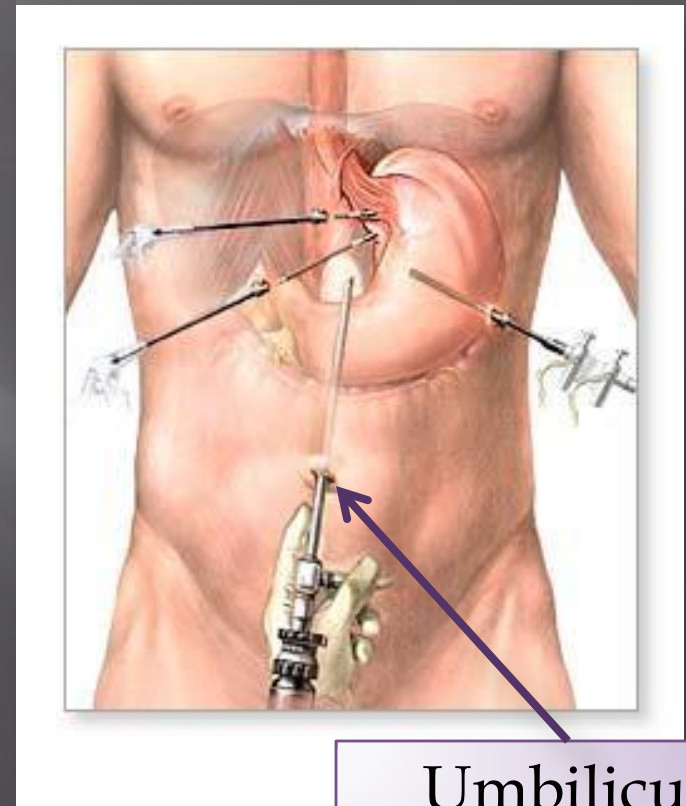
- ▣ Treatment for chronic heartburn by GERD
- ▣ Daily problem for 15 million Americans
- ▣ Upper stomach wrapped around esophagus
- ▣ Liver retracted to expose surgical site



Fundoplication

Current Trends

- ▣ Single incision laparoscopic
 - Need single port liver retractor
 - 32,000 surgeries/yr
- ▣ Other Applications
 - Adrenal gland, Heller's, Lap Band, Bariatric
 - 200,000 surgeries/yr



Umbilicus
(SILS Port)

Motivation

- ▣ Decrease # of incisions
 - Cosmetic
 - Less risk of infection
 - Patient satisfaction



Market

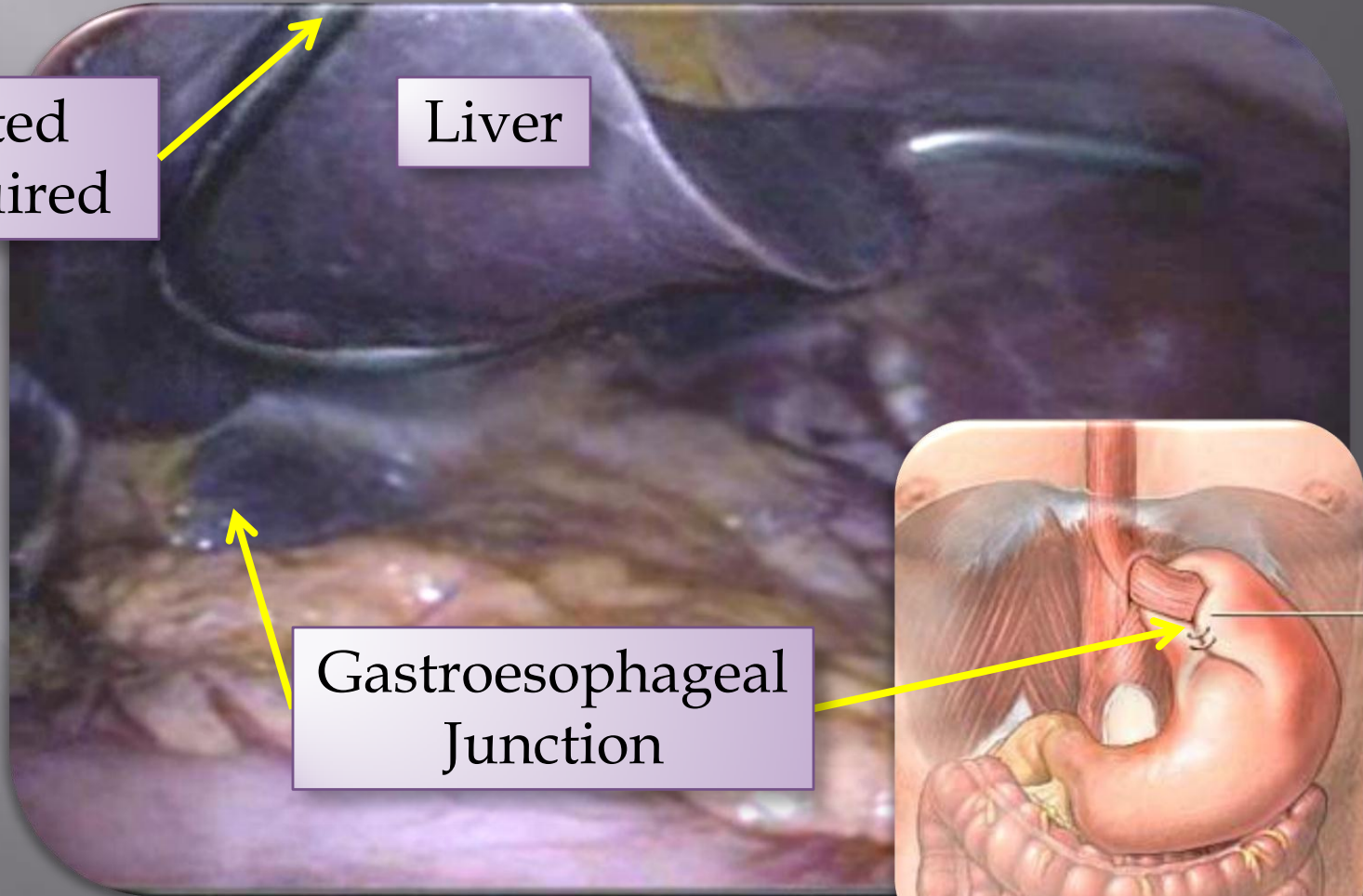
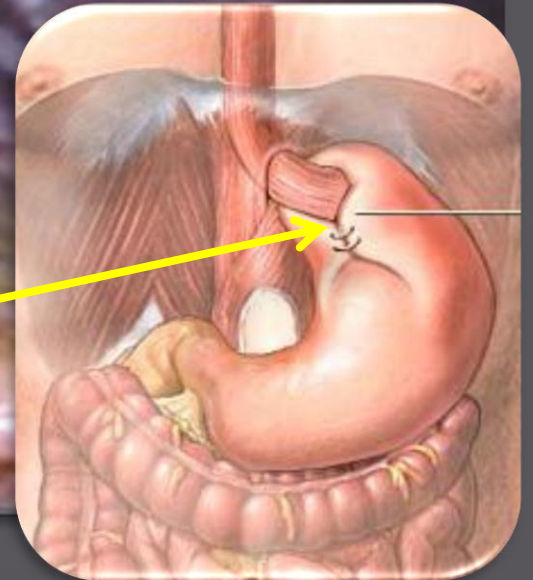
- ▣ 32,000 – 200,000 surgeries/yr
- ▣ Laparoscopy is popular
 - Comparable complication risk
 - ▣ NOTES = 3.76
 - ▣ Lap = 2.32
 - ▣ Open = 2.33
 - 97.4% choose NOTES over open if 3% complication chance
 - ▣ 1-2% currently

Nathanson Retractor

Dedicated
port required

Liver

Gastroesophageal
Junction



Problem Statement

- ▣ Use in single incision surgery
- ▣ Retract left liver lobe to abdominal wall
- ▣ Expose gastroesophageal junction
- ▣ Safely deployed and removed
- ▣ Fit through laparoscopic port



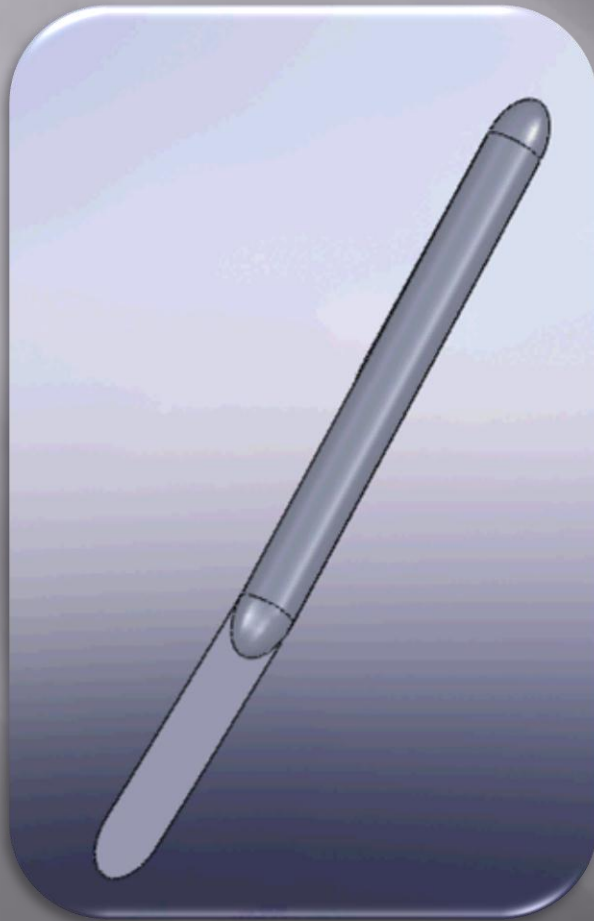
Design Specifications

- ▣ <5 minute deployment
- ▣ Within 1 cm of abdominal wall
- ▣ Distribute weight of left lobe (2.3N)
- ▣ Fit through 12 mm port
- ▣ Non-toxic
- ▣ Sterilizable

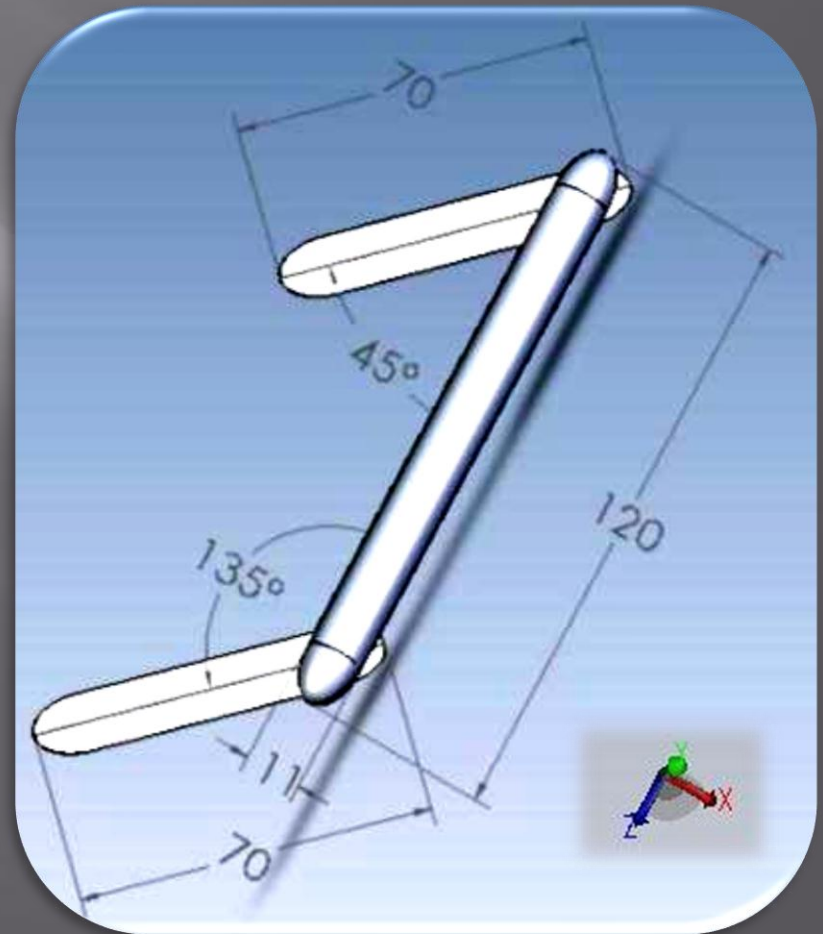


Retractor Design

Deployment

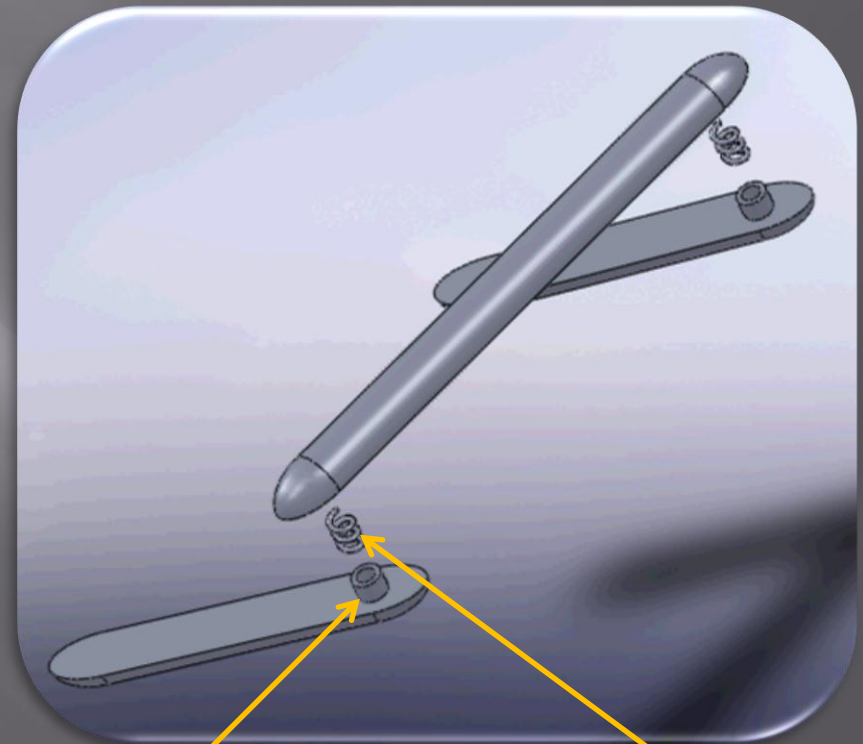


Retraction



Retractor Design: Spring Loaded

- ▣ Hollow cylinder axle
 - Torsional spring inside connects arm to base
- ▣ Deployment
 - Straight arms
 - Torsional spring in tension
- ▣ Retraction
 - Tension release rotates arms
 - Spring relaxed

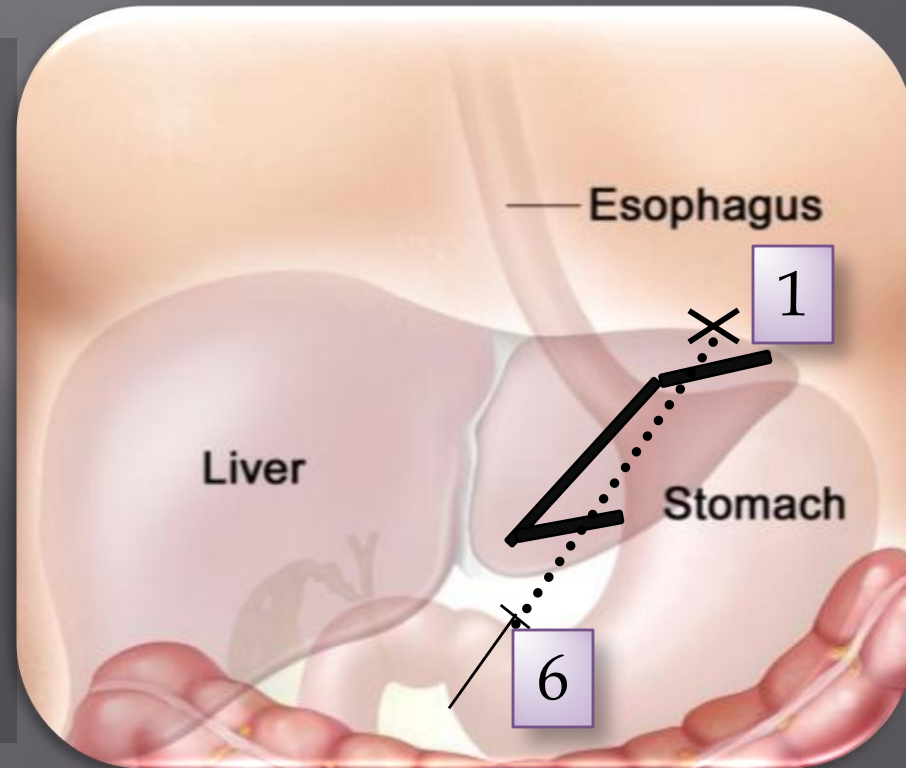


Hollow
Axle

Torsion
al
Spring

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



Material 1: Stainless Steel 316

ADVANTAGES

- ▣ High strength
- ▣ Super-corrosion resistance
- ▣ Extreme thermal stability
- ▣ Low cost
 - \$5/ft

DISADVANTAGES

- ▣ High density
- ▣ Low laparoscopic maneuverability
- ▣ Difficult to manufacture

Material 2: Delrin 150 (Polyoxymethylene)

ADVANTAGES

- ▣ Low density
- ▣ High strength
- ▣ Good chemical resistance
- ▣ Thermal stability to 180° F

DISADVANTAGES

- ▣ Slightly higher cost
 - \$20/ft
- ▣ Cannot machine ourselves

Material 3: PEEK (Polyether ether ketone)

ADVANTAGES

- ▣ Low density
- ▣ High strength
- ▣ Extreme chemical resistance and thermal stability
- ▣ Relatively low cost
 - \$12/ft
- ▣ USP Class VI Certified

DISADVANTAGES

- ▣ High density (8 g/cm³)
- ▣ Already in use for laparoscopic ports
- ▣ Cannot machine ourselves

Design Matrix

	Weight	Stainless Steel	PEEK	Delrin
Ease of Fabrication	25%	2	4	4
Strength/Durability	15%	5	4	3
Biocompatibility	25%	5	5	5
Cost	10%	5	4	2
Maneuverability	25%	2	5	5
	Total	3.5	4.5	4.15

Future Work

- ▣ Test entire procedure in pig
- ▣ Select spring
- ▣ Construct biocompatible prototype
- ▣ Submit invention disclosure report



Questions?

