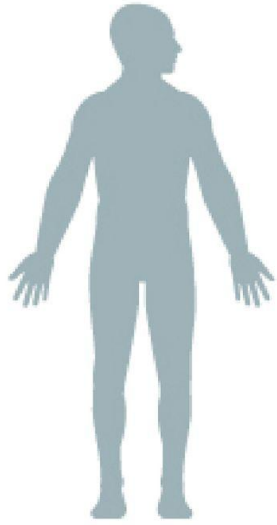
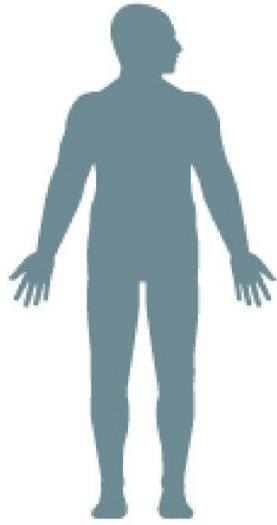


Master's thesis presentation

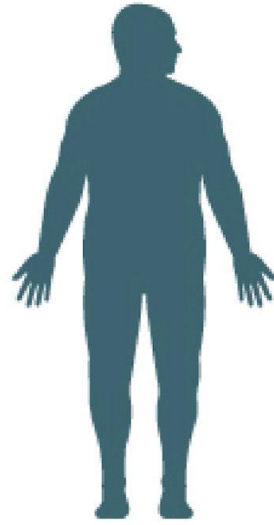
StapleStitcher



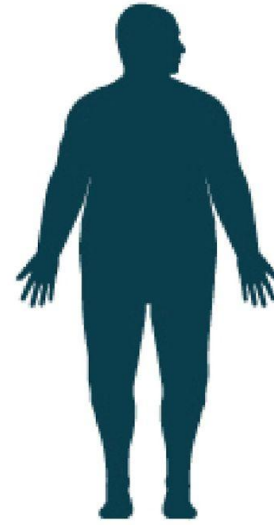
Normal Weight
BMI: 18.5-24.9



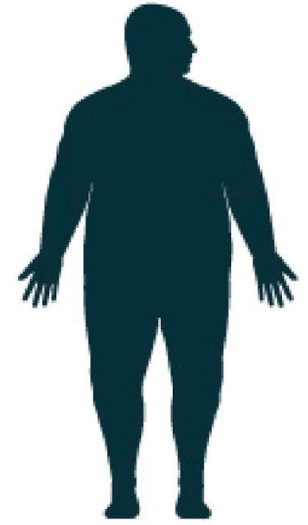
Overweight
BMI: 25-29



Obesity Level 1
BMI: 30-34.9



Obesity Level 2
BMI: 35-39.9



Obesity Level 3
BMI: >40

(Higuera-Hernández et al., 2018)

BACKGROUND

Excessive fat accumulation, leading to serious health risks

The background of the infographic features a semi-transparent blue silhouette of a human figure, specifically a woman, with internal organs like the lungs, heart, and intestines visible. The overall color scheme is a solid blue.

50%

of Dutch population was
overweight (CBS, 2022)

14%

severely overweight
(obese) (CBS, 2022)

4 mill

deaths, annually
(WHO, 2020)



4%

BACKGROUND

Only 4% achieves long-term weight loss with non-operative treatments
(Mitchell & Gupta, 2022)



BACKGROUND

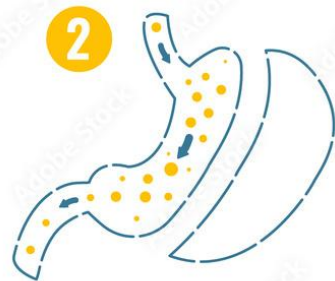
The term “Bariatric” originates from the Greek “baros” (weight) and “iatros” (healer)

Bariatric surgery

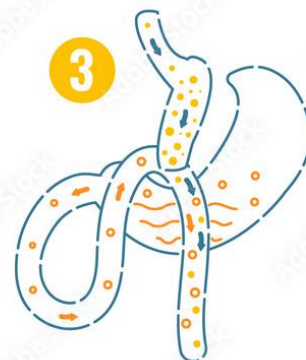
BACKGROUND



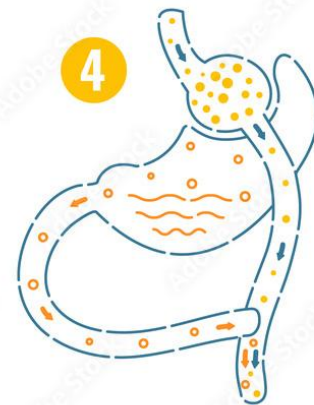
1 ADJUSTABLE GASTRIC BAND



2 GASTRIC SLEEVE

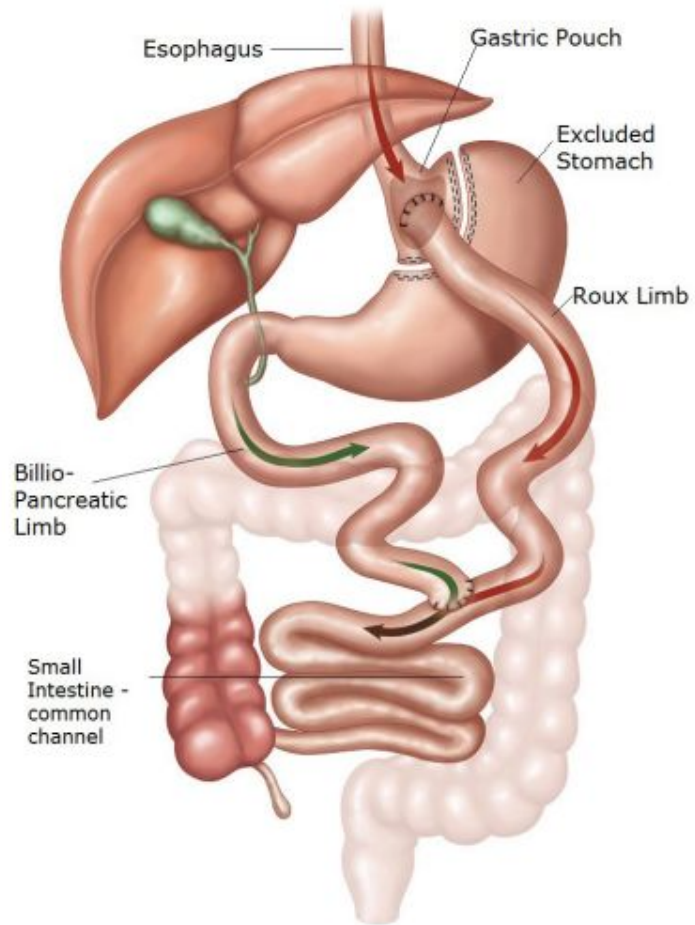


3 MINI-GASTRIC BYPASS

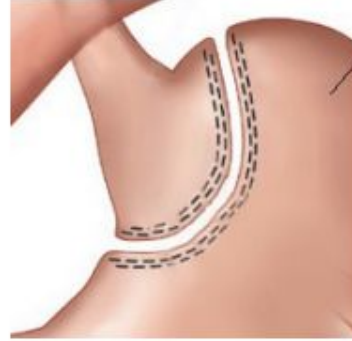


4 ROUX-EN-Y GASTRIC BYPASS

(Adobe stock, n.d.)



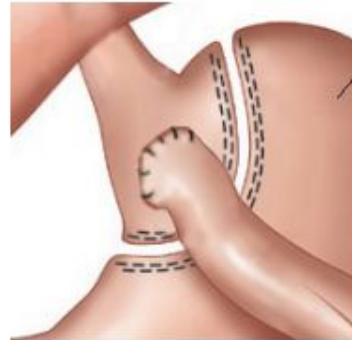
1. Creation of the gastric pouch



2. Dissection of small bowel



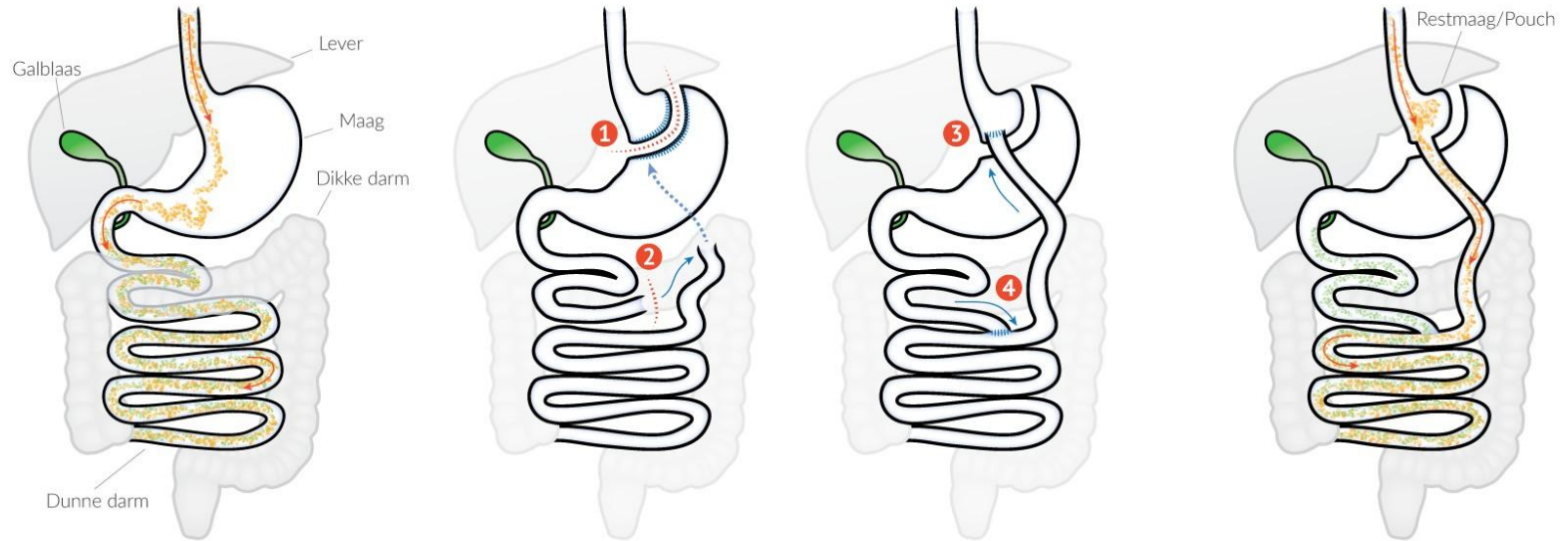
3. Creation of gastrojejunostomy



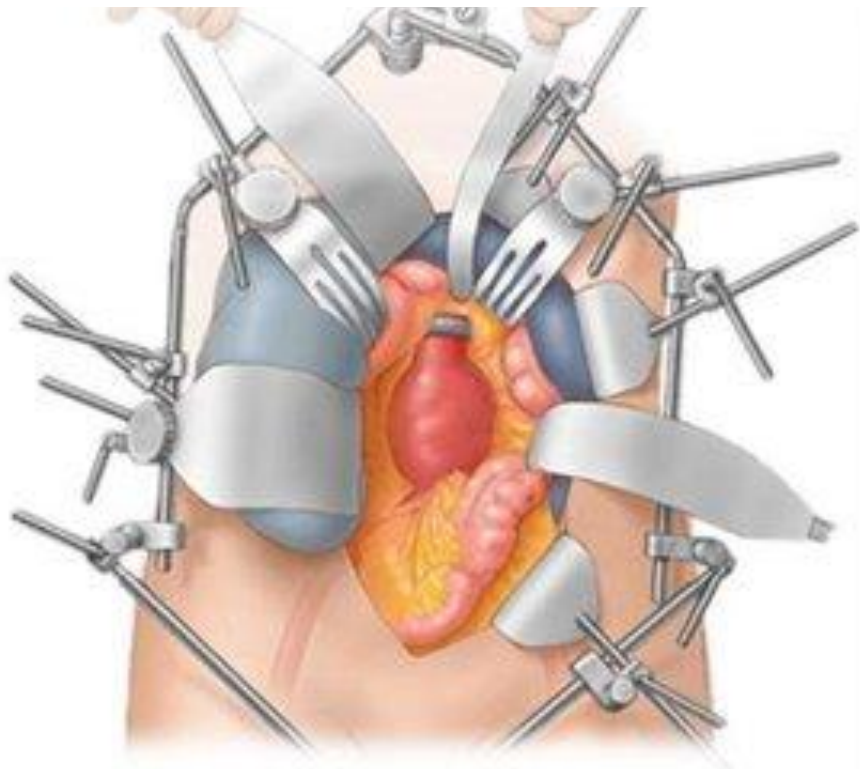
4. Creation of jejunojejunostomy



BACKGROUND



(Nederlandse obesitas kliniek, 2020)



(Zhao, 2015)

BACKGROUND

Open surgery (left) Minimally invasive surgery, laparoscopy (right)

BACKGROUND



(Aesculap, 2023)

BACKGROUND



(Shutterstock, n.d.)

BACKGROUND

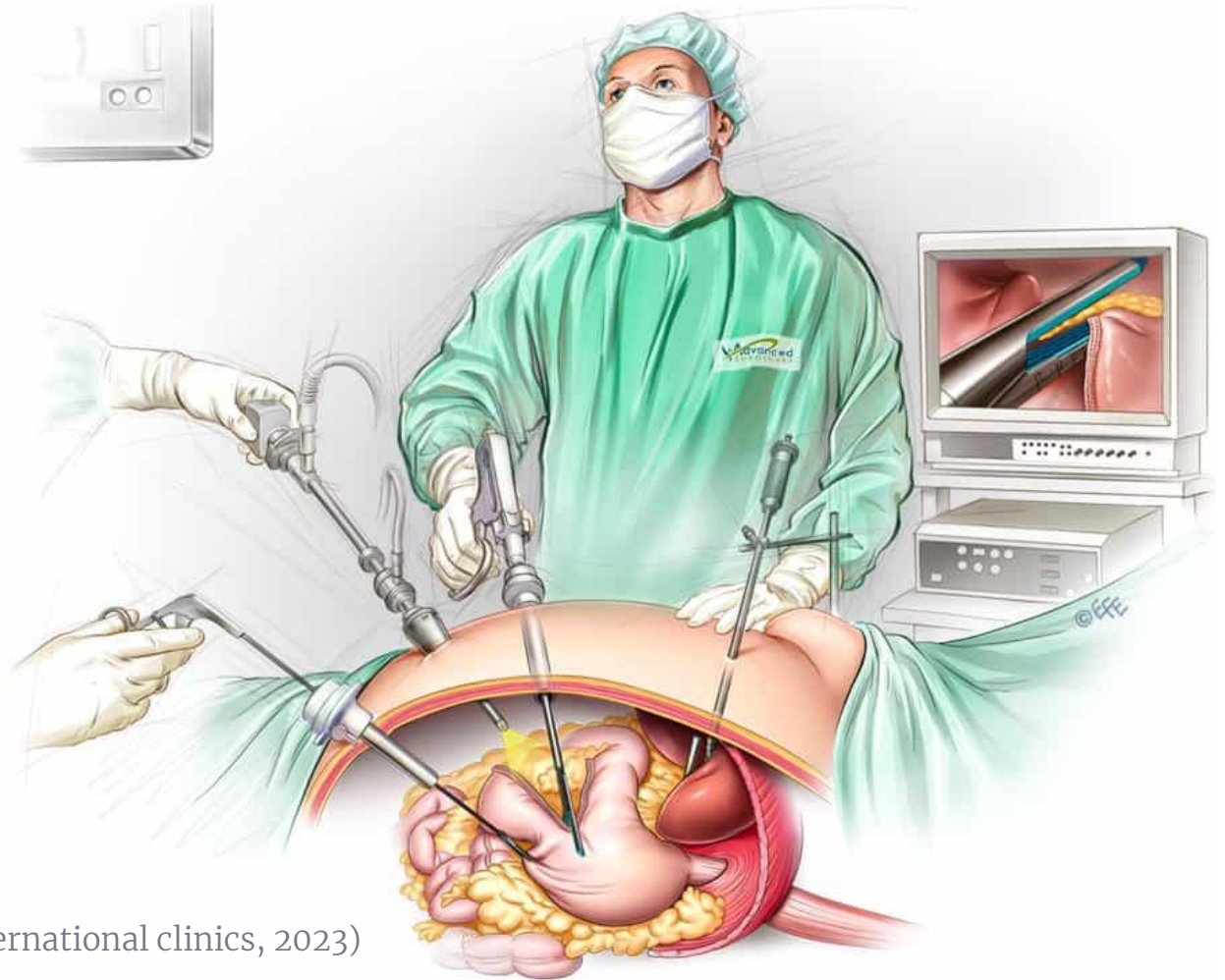


(Shutterstock, n.d.)

BACKGROUND

Abdomen filled with CO₂

Laparoscope projects
video on screen



(international clinics, 2023)

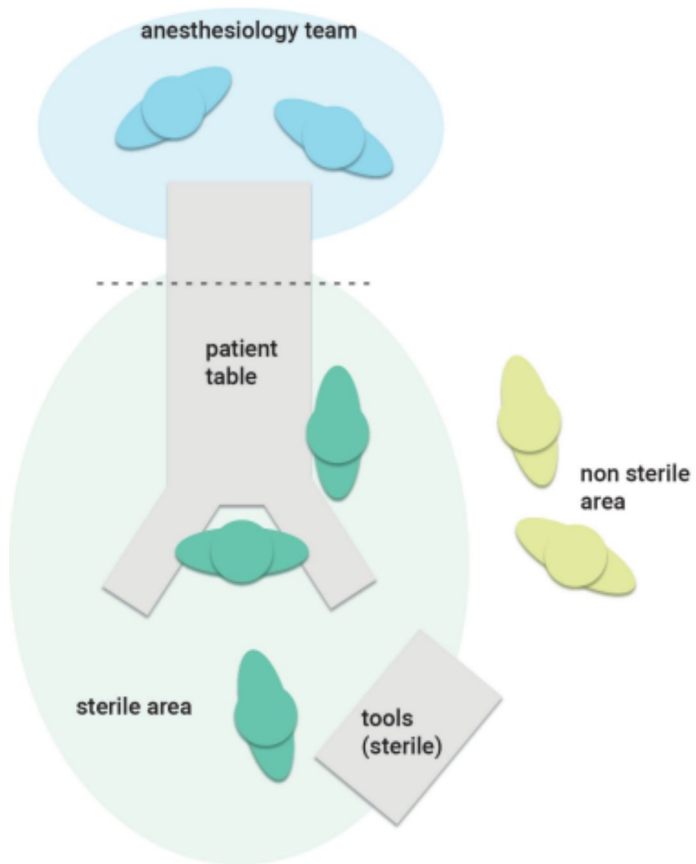
BACKGROUND



BACKGROUND

Hydraulic surgical table
Patient is inclined with
head downward and legs
upward, for better access
for the surgeons
(Shoves the organs away)





Sterile and non-sterile are in the OR



BACKGROUND

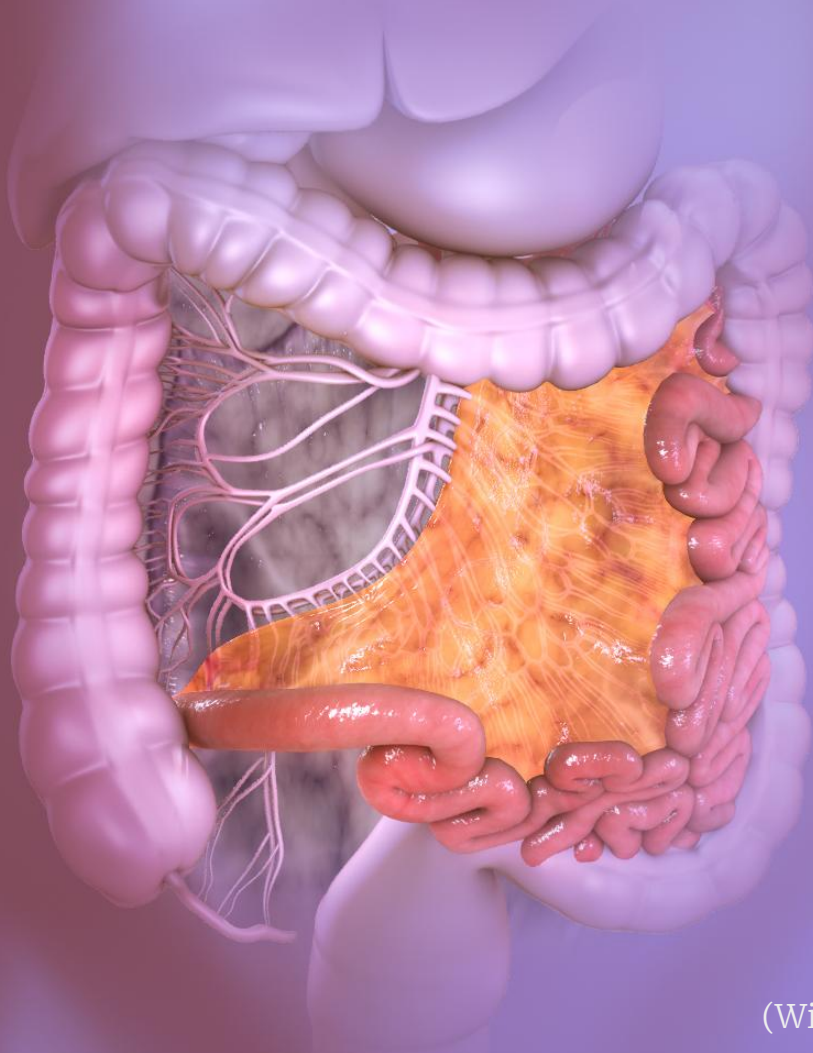
This is what robotic surgery looks like

Da vinci robot

BACKGROUND

Mesentery

attaches the intestines to the abdominal wall, and also helps storing the fat and allows the blood and lymph vessels, as well as the nerves, to supply the intestines.



(Wikimedia commons, 2018)

WARNING

Graphic content



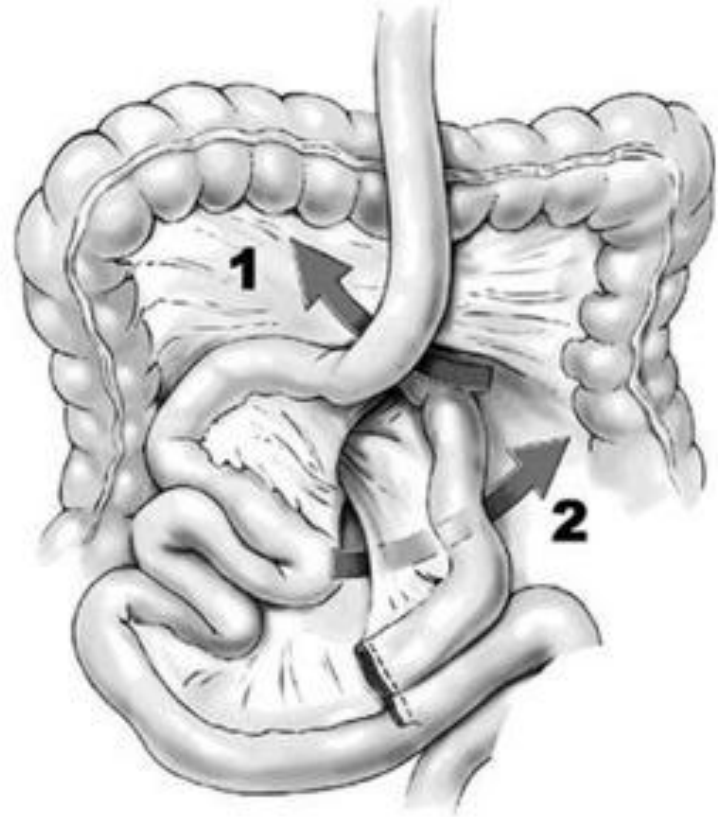
(Thieke, 2015)

BACKGROUND

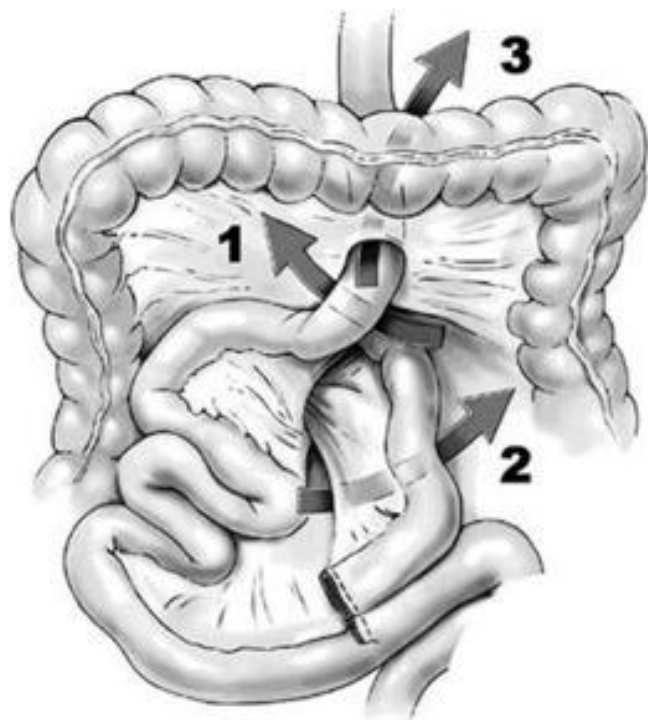
Open spaces called Mesenteric defects

- 1) Petersen's space
- 2) Mesojejunal space

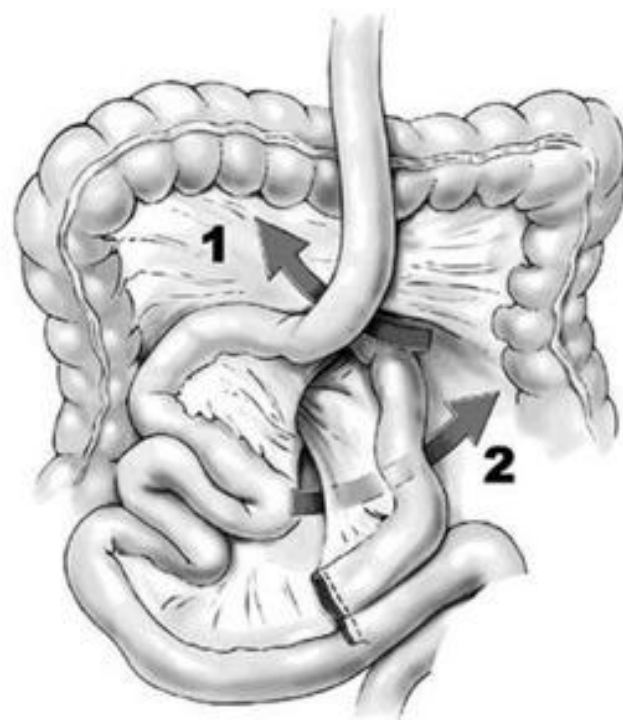
About 2 - 5 cm long (Xu & Zhou, 2023)



(Pokala et al., 2022)



RETROCOLIC



ANTECOLIC

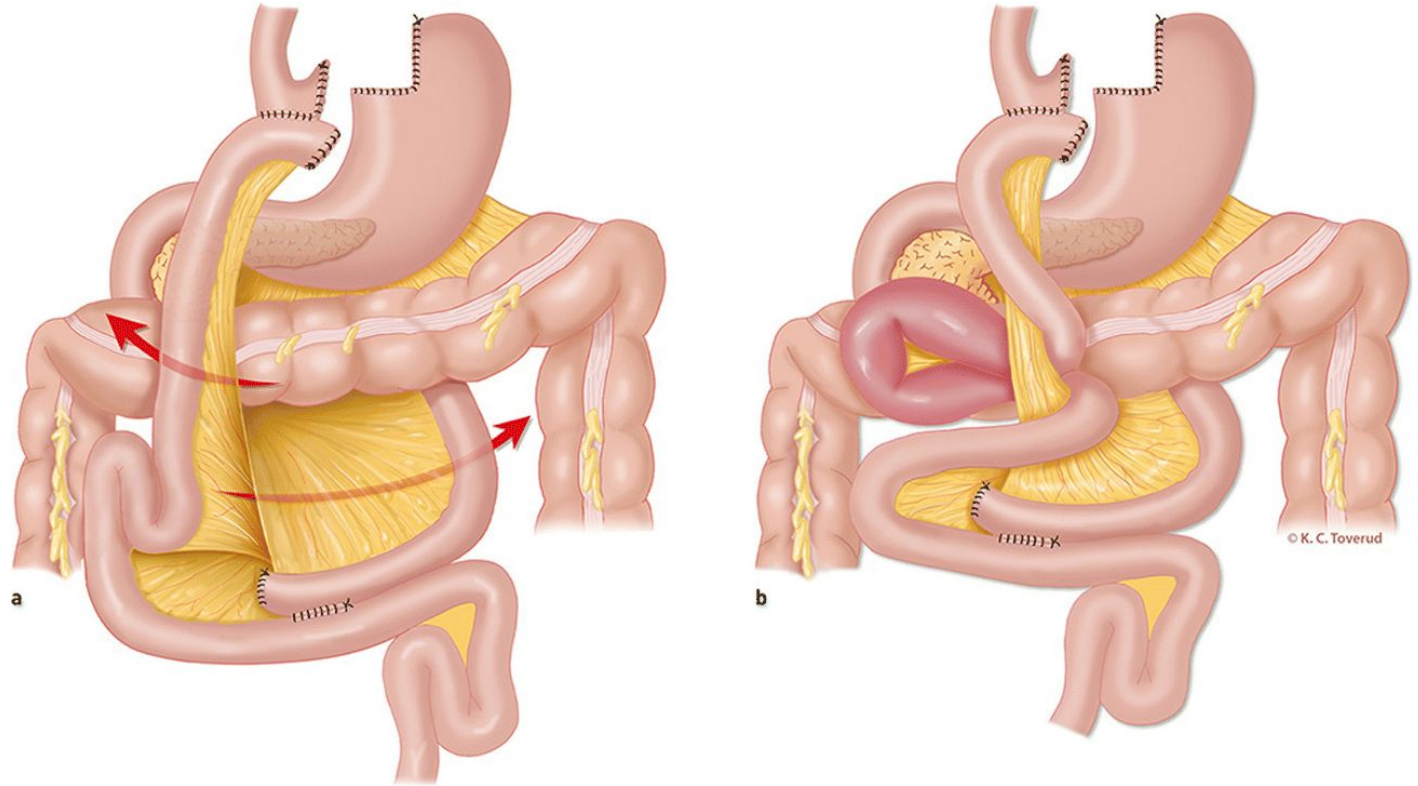
BACKGROUND

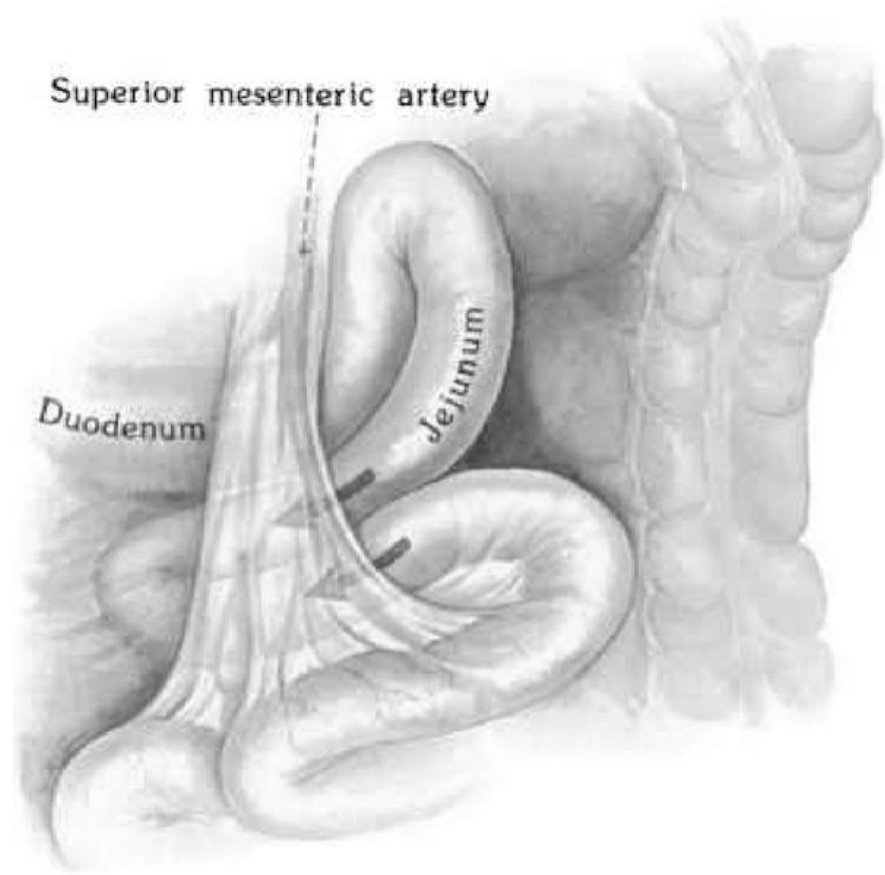
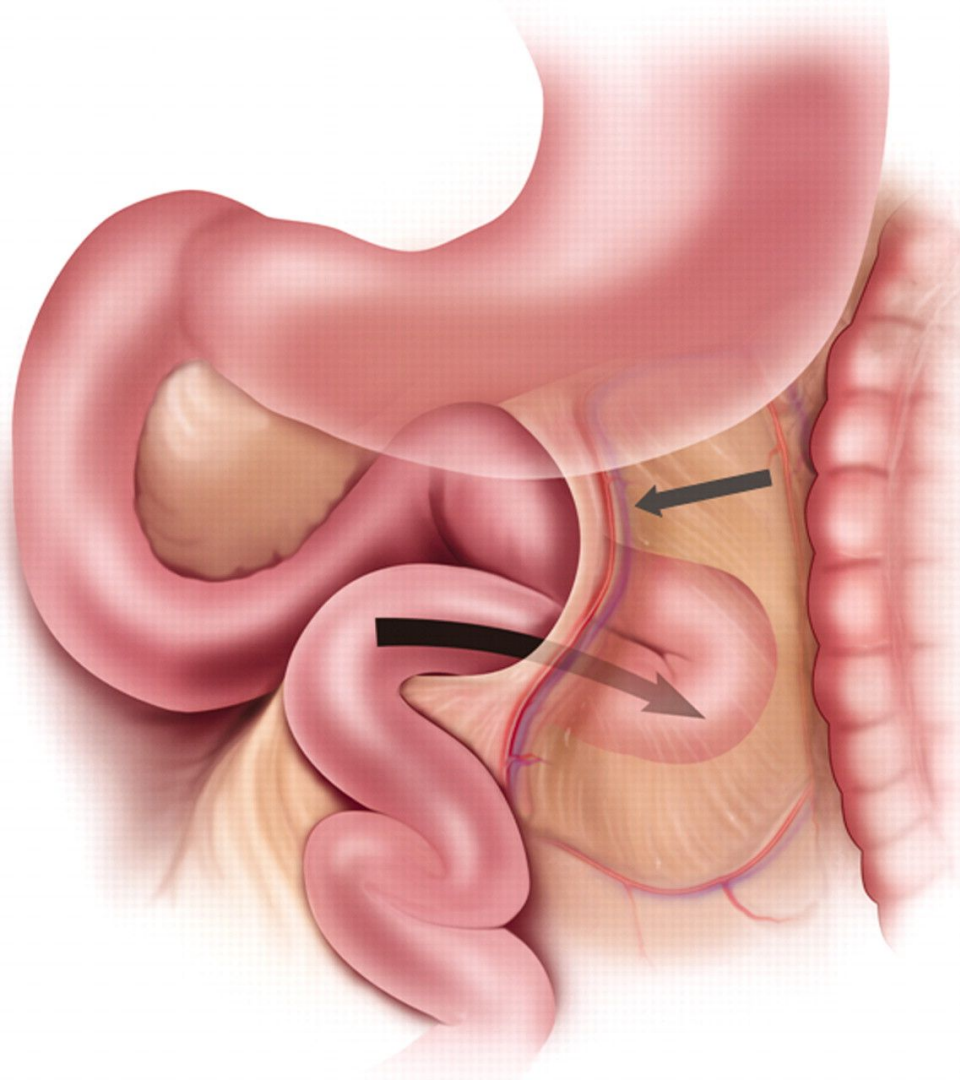
intestinal loops

bowel obstruction

internal herniation

Thus defects must
be closed





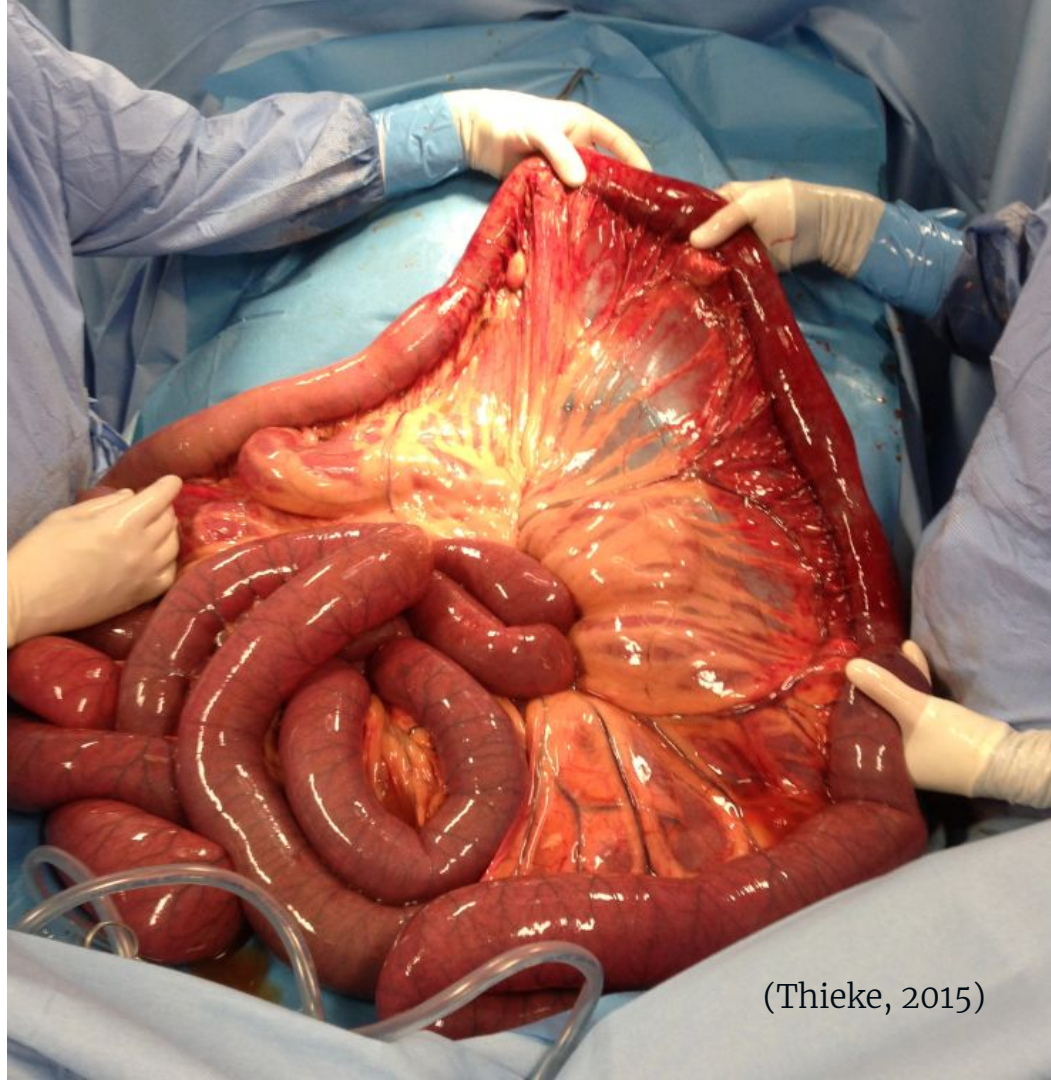
WARNING

Graphic content

BACKGROUND

Healthy intestines and mesentery
(left)

and a necrotic (dying) bowel
segment



(Thieke, 2015)

Two most used ways to close defects



Suturing

Manual suturing offers
great freedom



Stapling

Stapling offers
faster closure

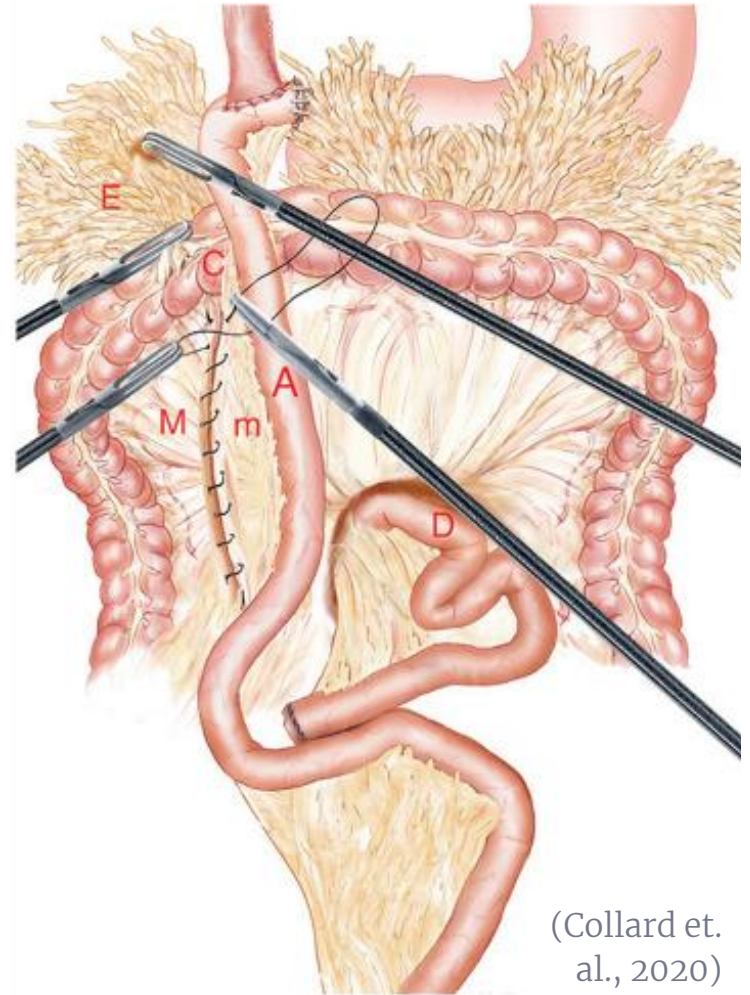
CLOSURE PROCEDURE

Assistant's grasper maintains transverse colon (C) to expose the bottom of the Petersen's defect.

Alimentary limb is pushed to patient's left to optimize exposure of the space.

Defect is closed with non-absorbable suture (as the tissue will not grow together by itself).

Taking care not to include omental fringes or the greater omentum (E) in the suture.



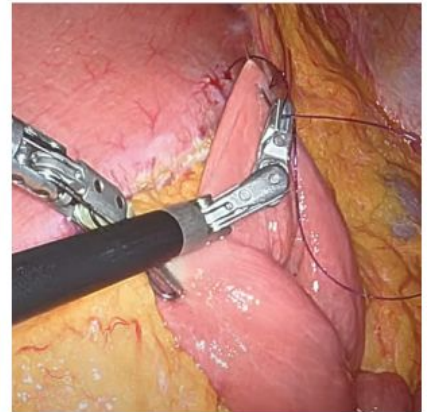
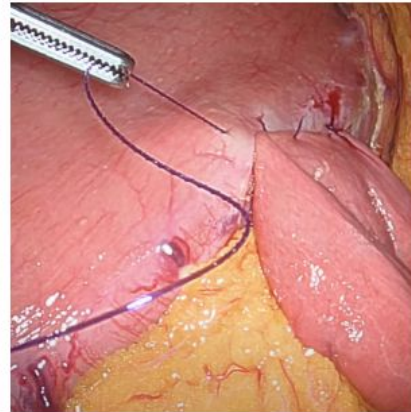
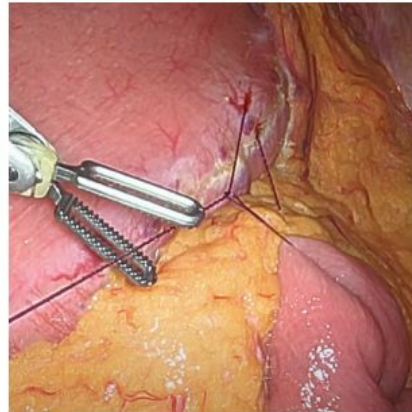
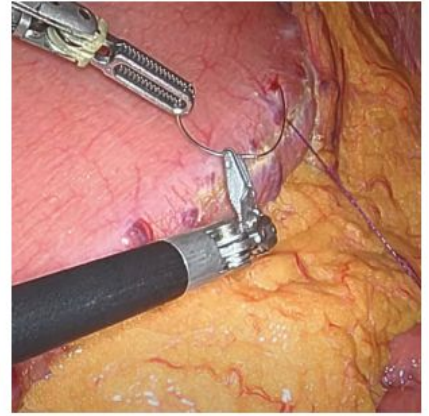
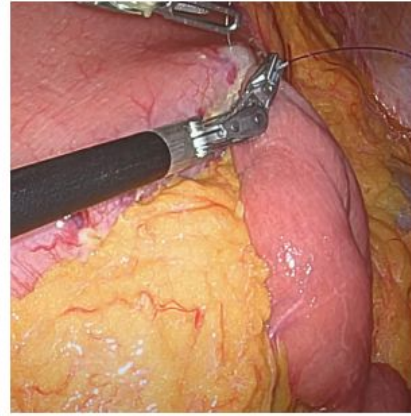
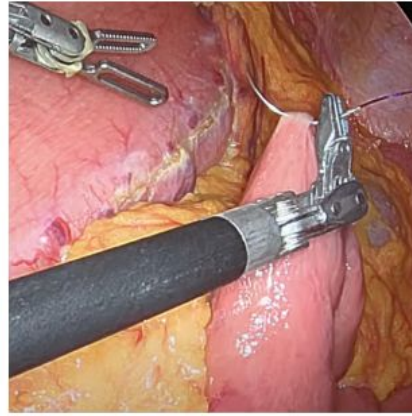
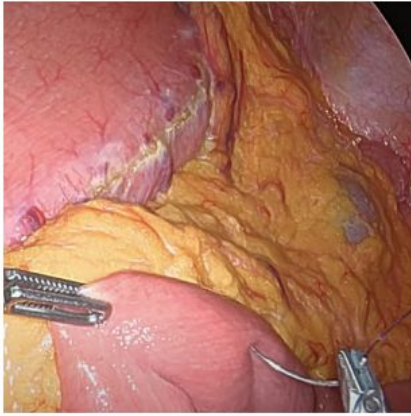
(Collard et al., 2020)

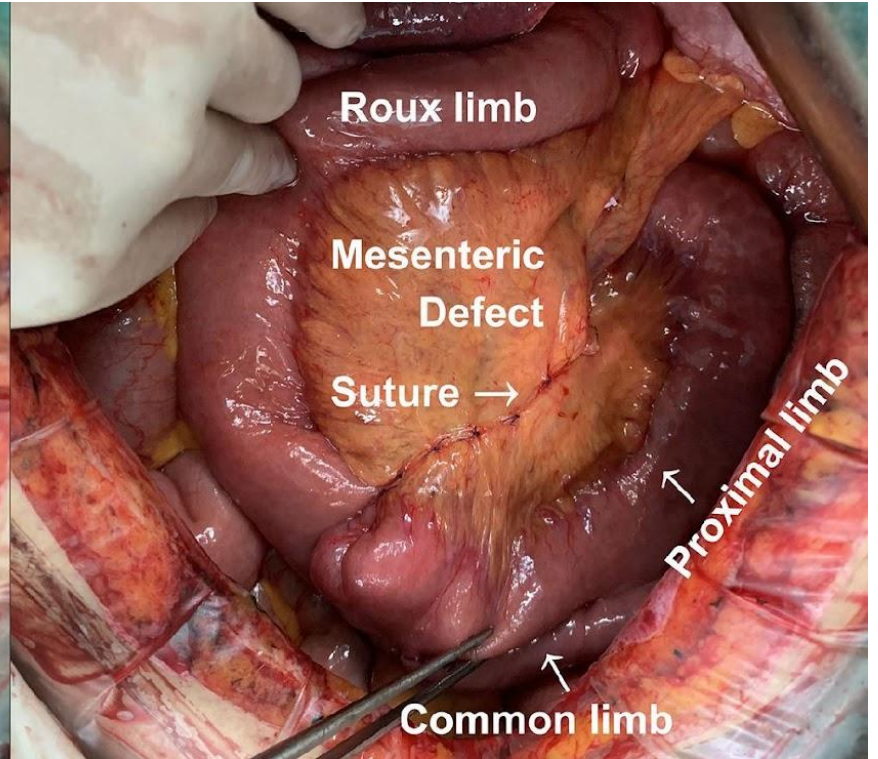
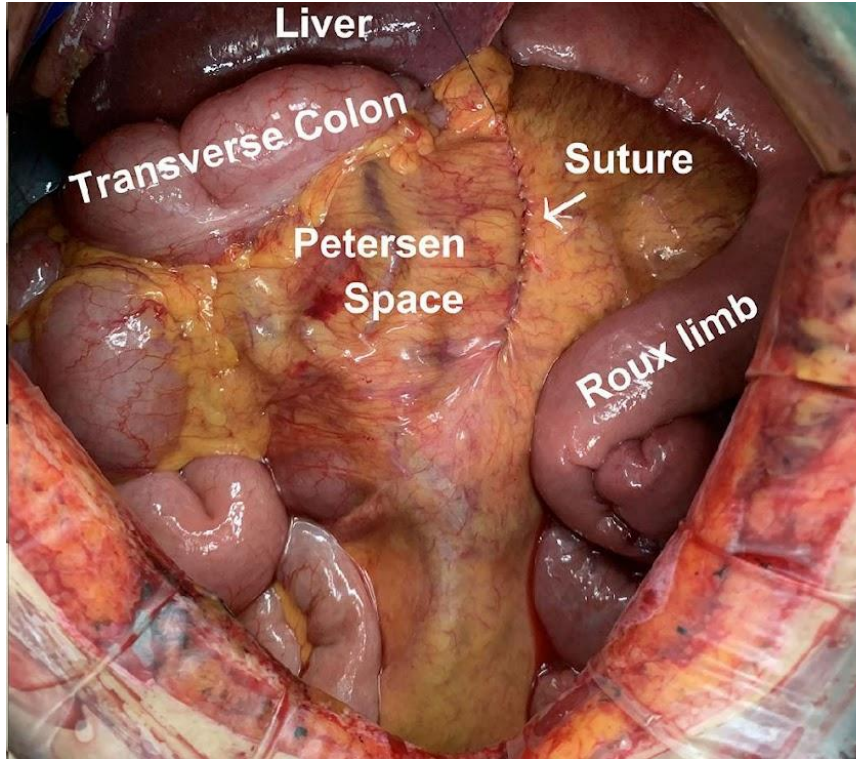
WARNING

Graphic content

CLOSURE PROCEDURE

(Wochner, 2022)





CLOSURE PROCEDURE

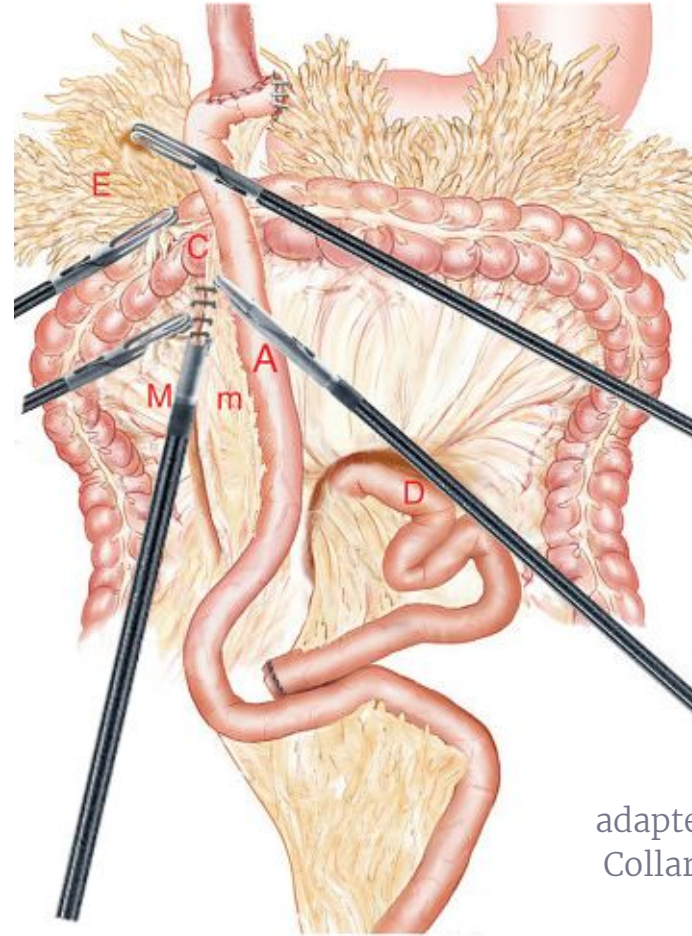
Assistant's grasper maintains transverse colon (C) to expose the bottom of the Petersen's defect

Alimentary limb is pushed to patient's left to optimize exposure of the space

Two graspers maintain each a side of the tissue and align it for stapling (and another one to provide counterpressure for stapler)

Defect is closed with non-absorbable staples

Take care not to include omental fringes or the greater omentum (E) in the stapling

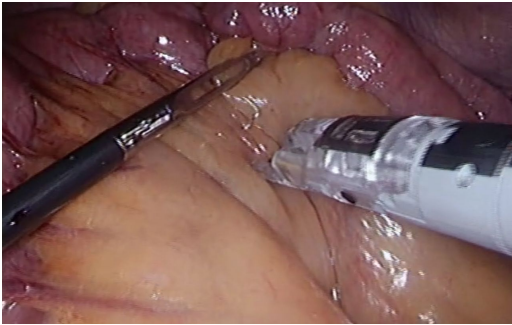
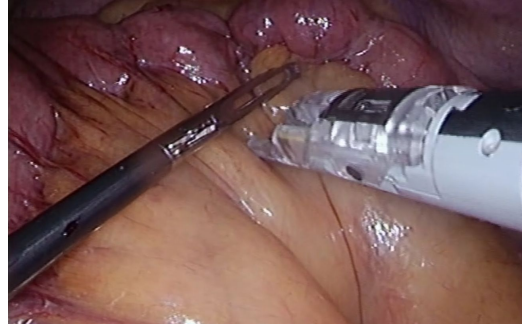
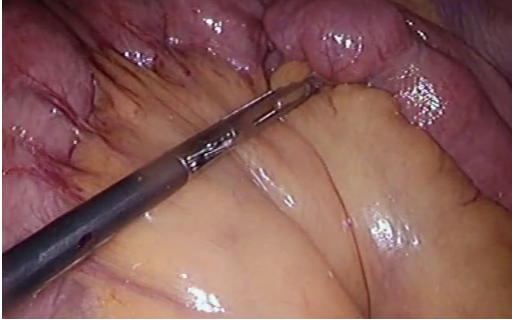


adapted from
Collard et. al.
(2020)

WARNING

Graphic content

CLOSURE PROCEDURE



(Acherman, 2023)

PROBLEM

When stapling:

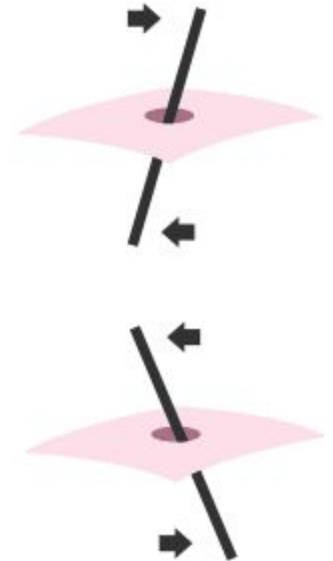
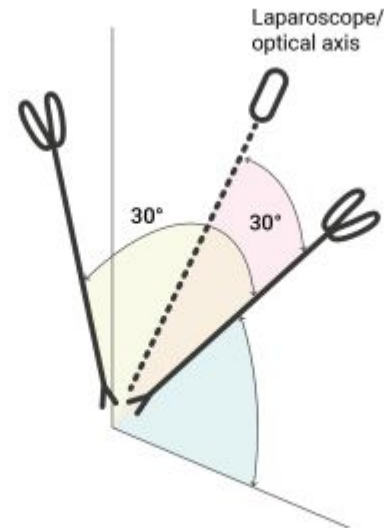
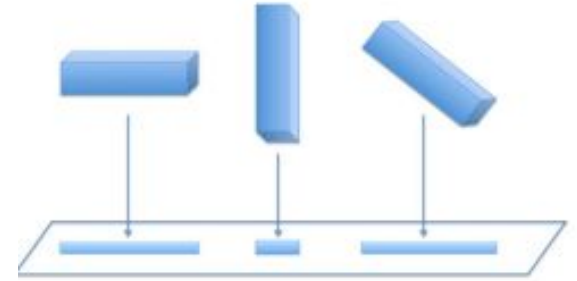
- 50% of staples fall out over time
- Catching both sides of the tissue is difficult
- Reloading is cumbersome,
must be done 4x



PROBLEM

Additional challenges:

- Cognitively demanding
- Ergonomic discomfort
- Hand-eye coordination
- Reduced depth perception and degraded visual image
- Fulcrum effect
- No direct control on laparoscope position and orientation
- Reduced tactile feedback
- Narrow workspace





PROBLEM



PROBLEM





PROBLEM

Tools used upside down, due to lack of space



Goal

Reduce time and cognitive effort required for MDs closure

Offer an alternative approach without the need for precise tissue alignment

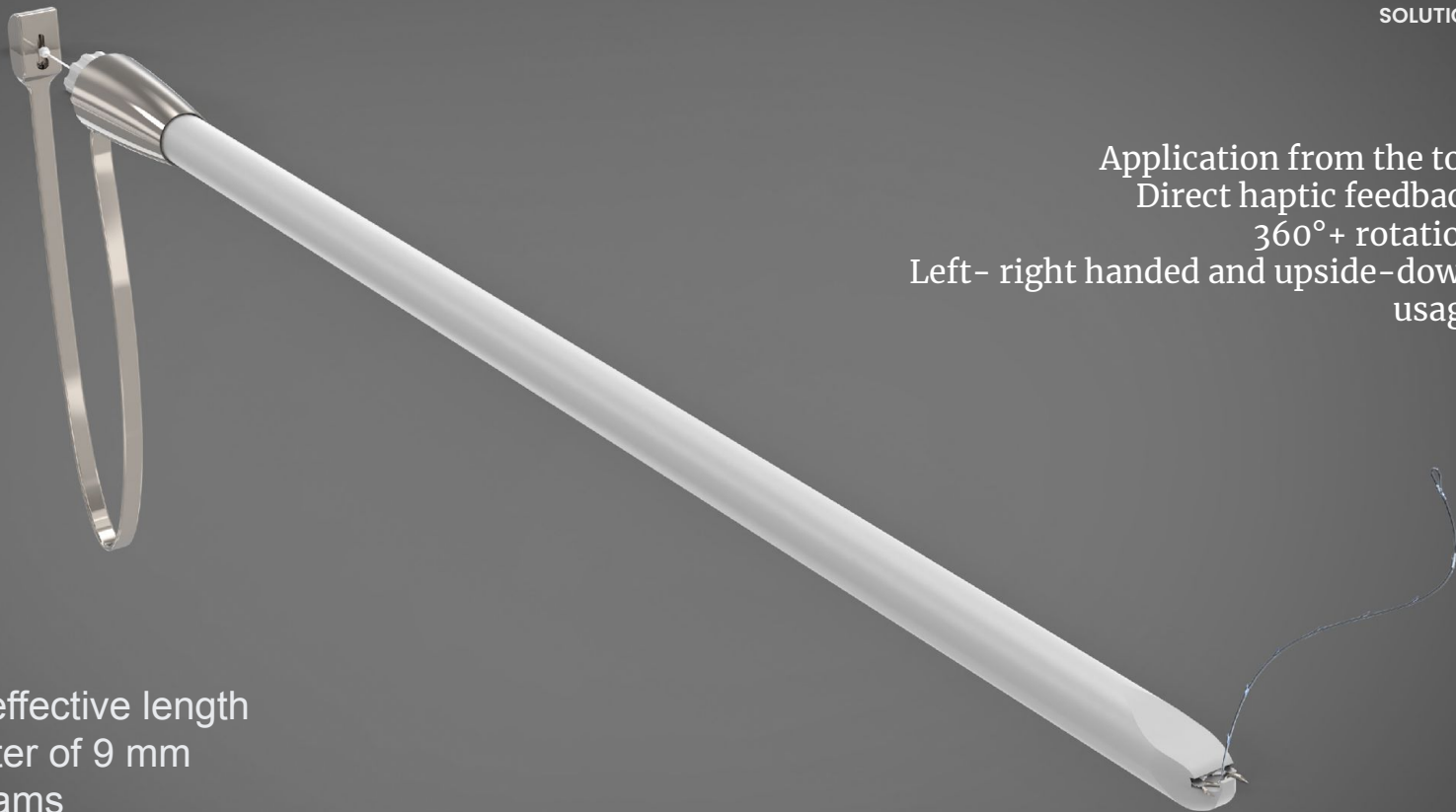
A blue stream of liquid falls from the top of the frame into a mechanical device. The device consists of a white rectangular block with a circular opening, a silver-colored ring, and a white curved component. The background is a dark gray gradient.

The solution

StapleStitcher

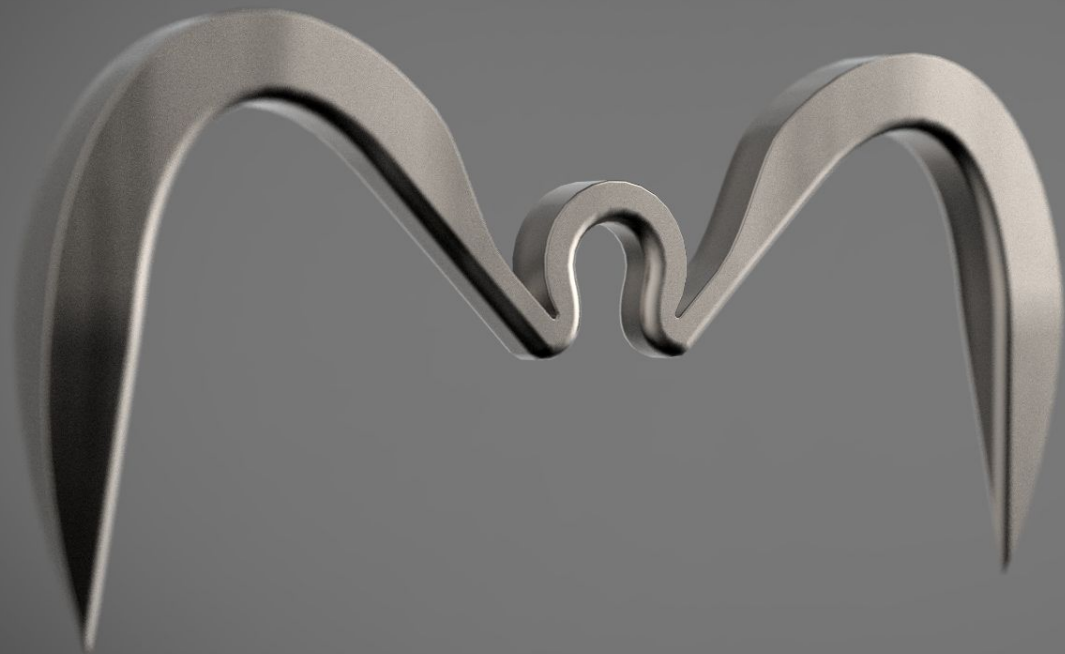
Application from the top
Direct haptic feedback
360°+ rotation
Left- right handed and upside-down
usage

35cm effective length
Diameter of 9 mm
200 grams



SOLUTION

Special staples





Atraumatic tapered tip

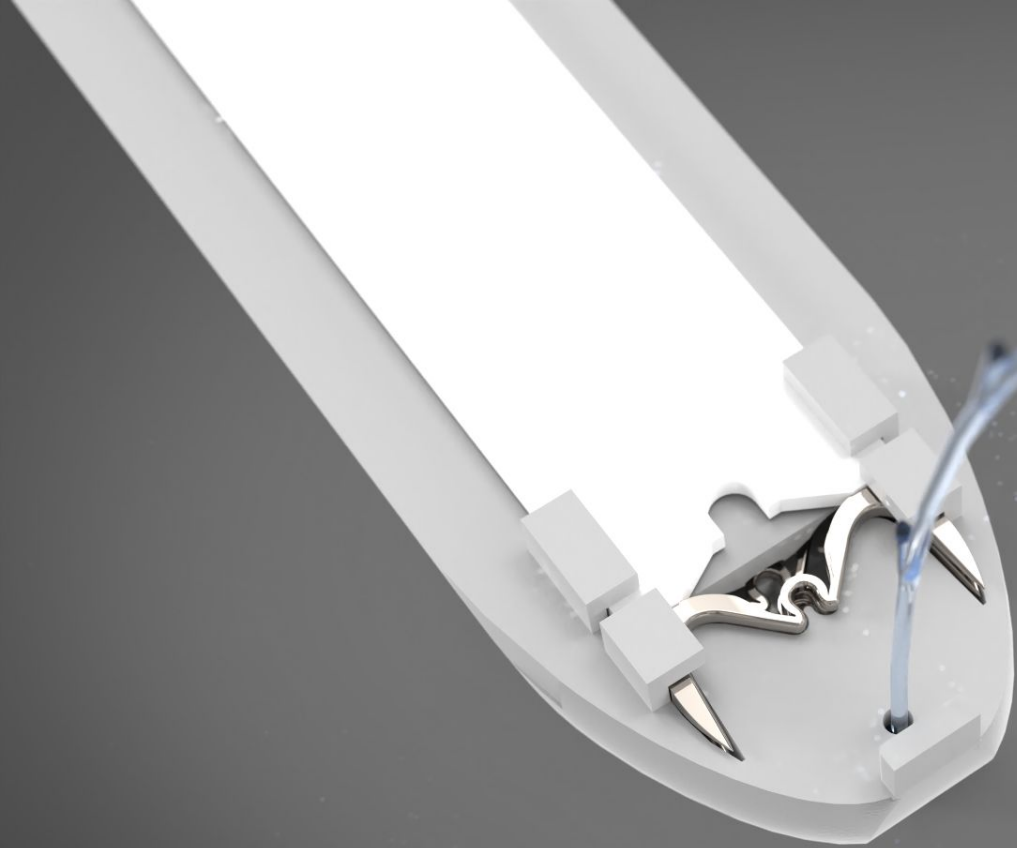
SOLUTION

Rounded off profile

Guides for placement onto suture

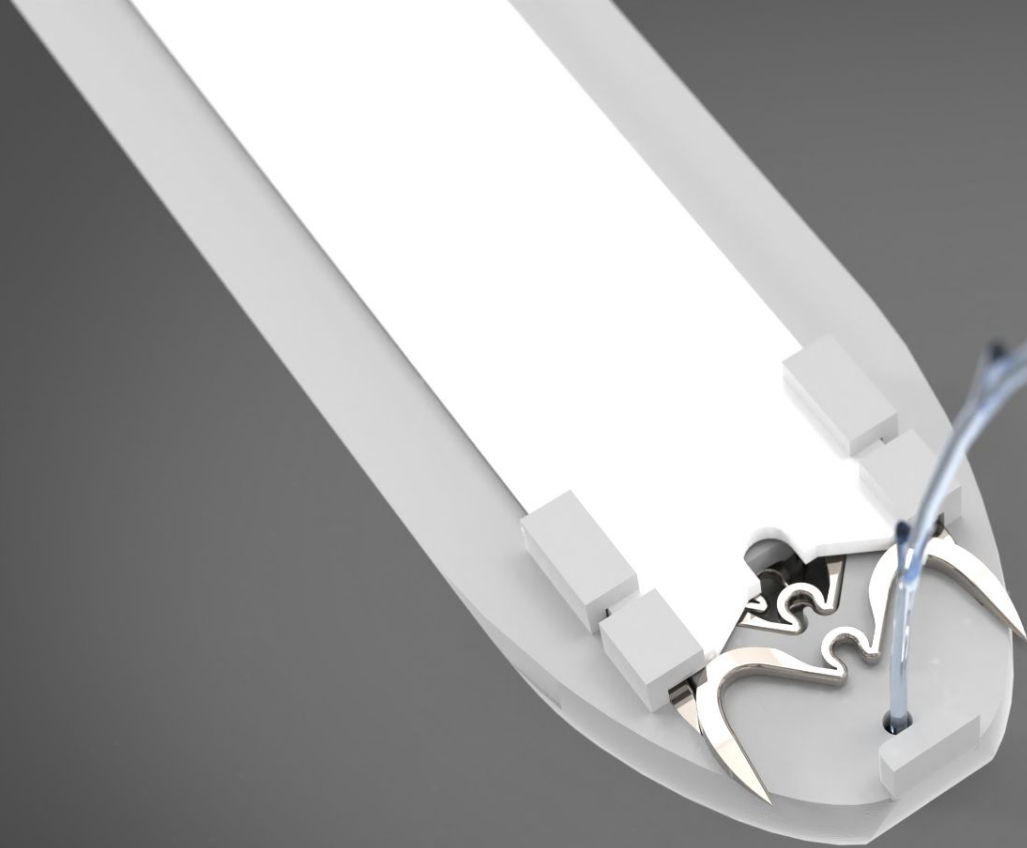
SOLUTION

Punch picks up a staple



SOLUTION

Punch picks up a staple



SOLUTION

Places staple onto
barbed suture



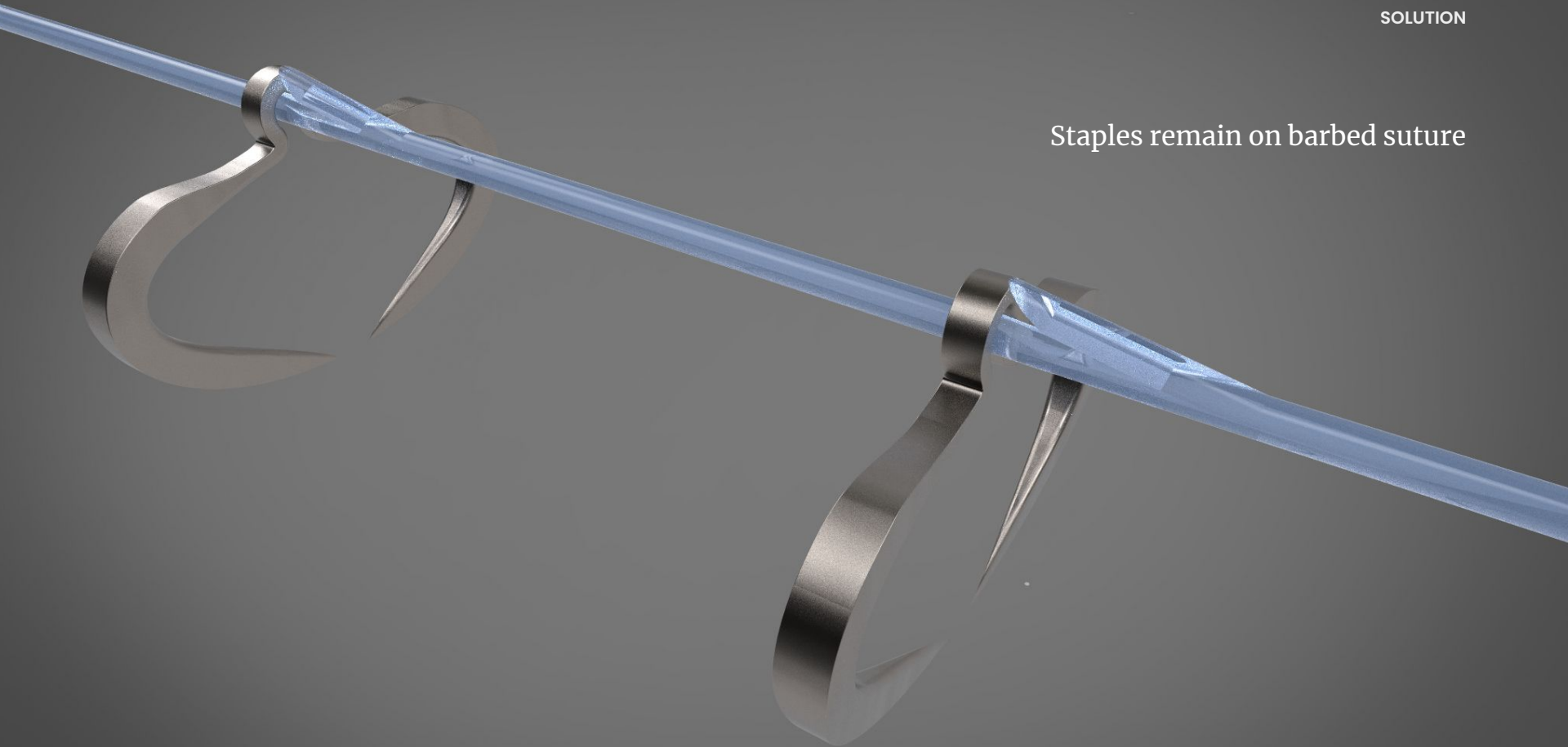
SOLUTION

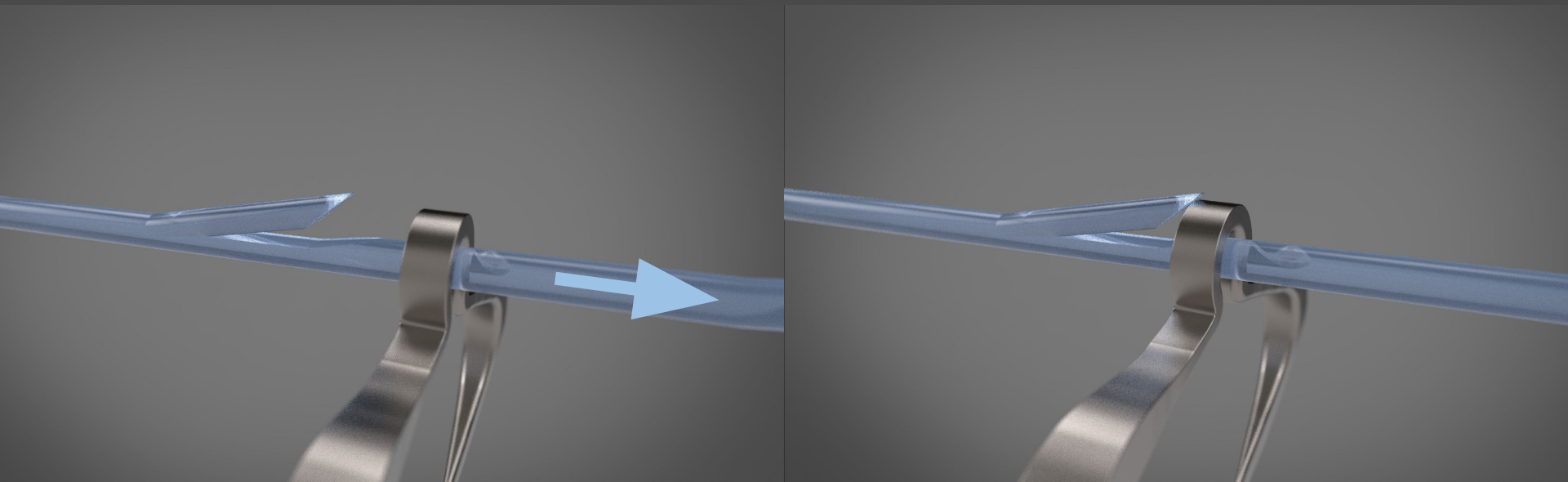
and pushes it into
the right shape



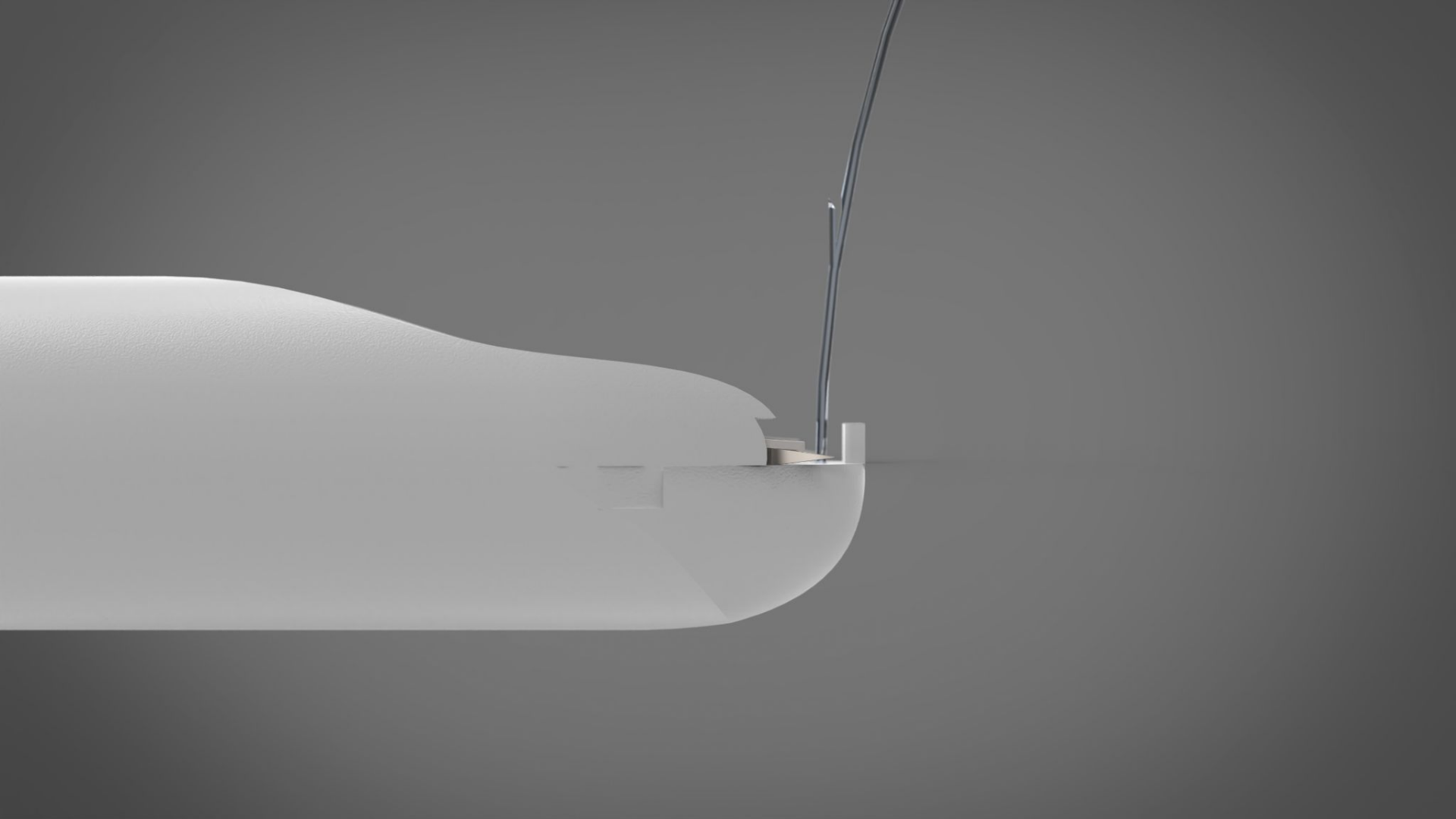
SOLUTION

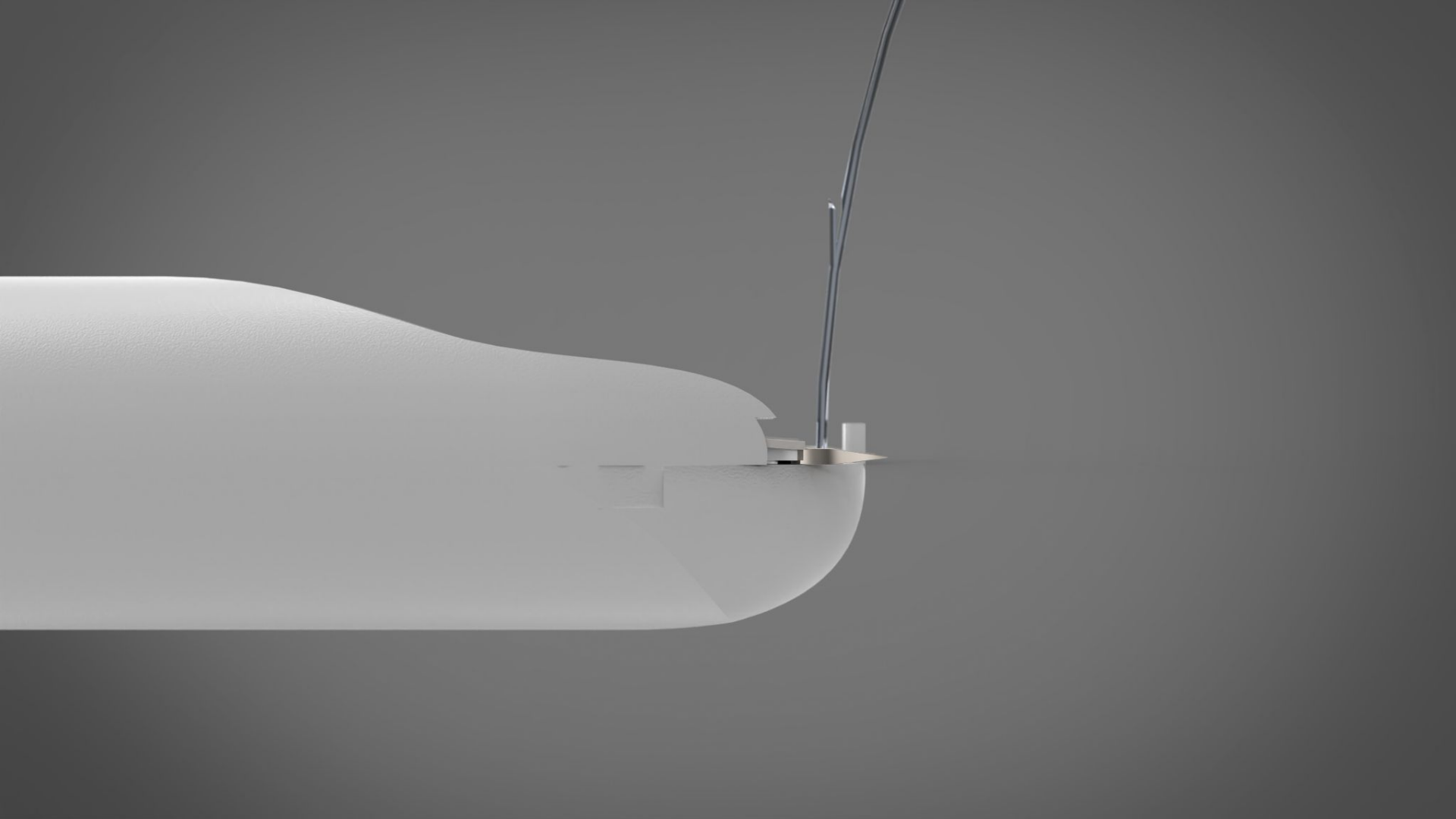
Staples remain on barbed suture





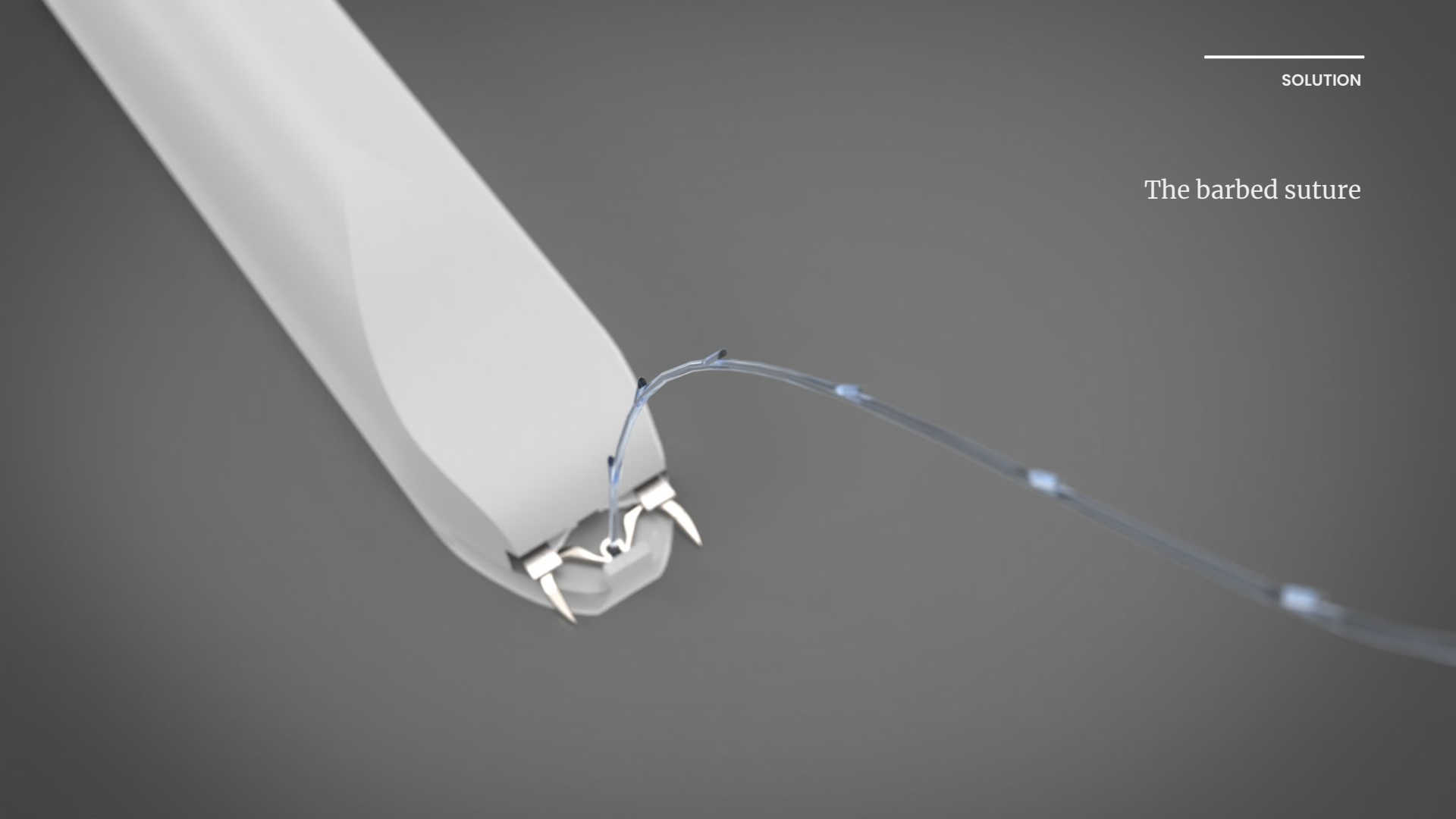
Barbed suture can slide through to tighten, and will not open after tightening





SOLUTION

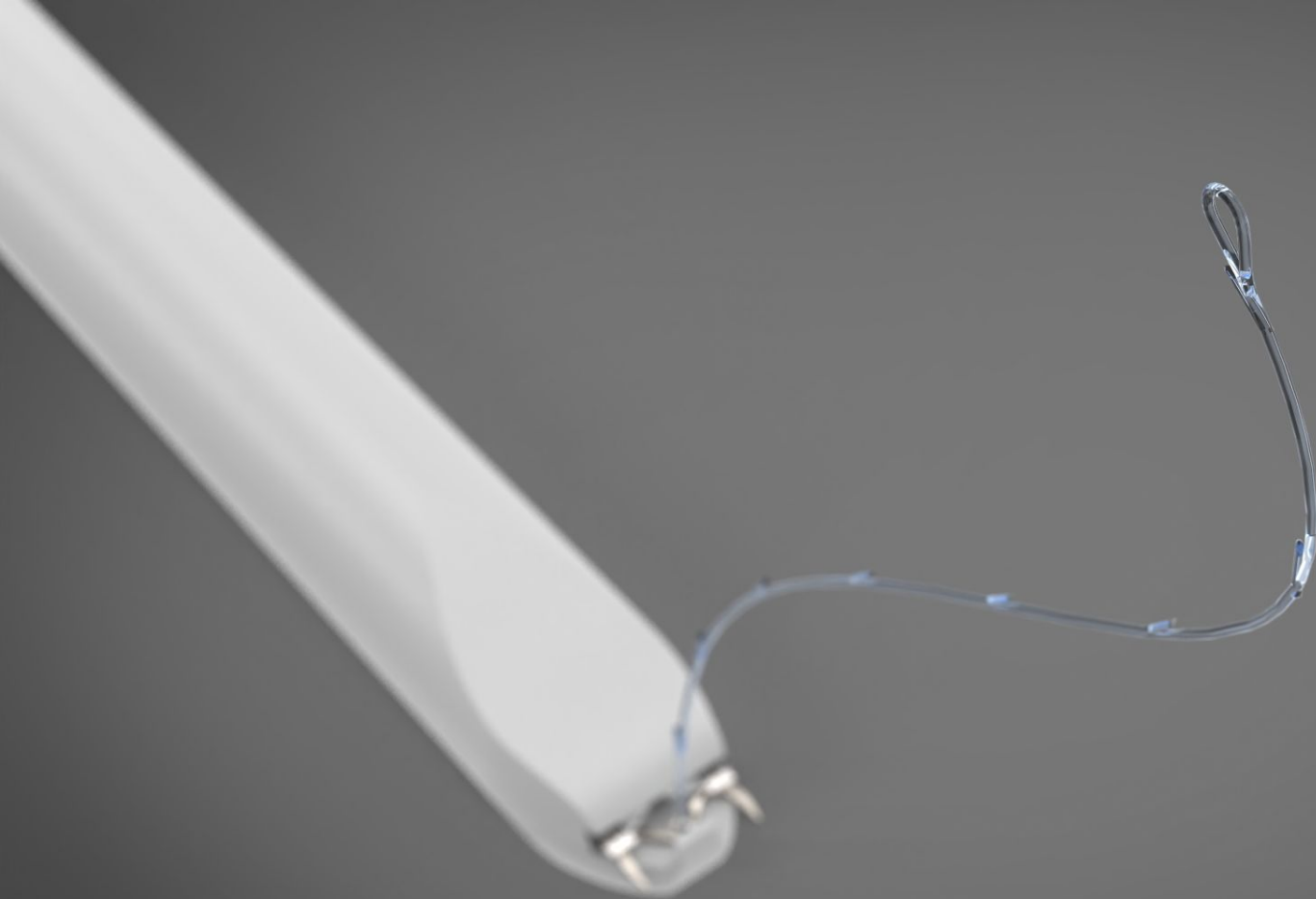
The barbed suture



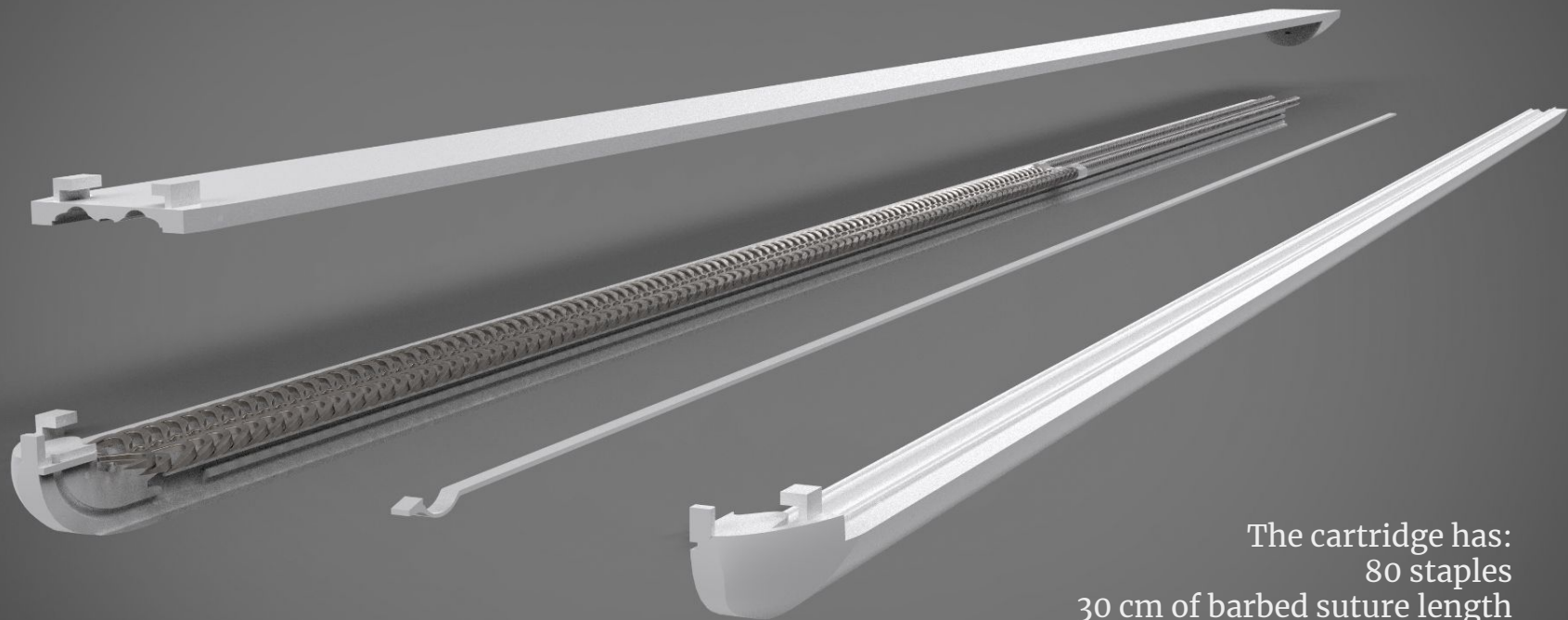
SOLUTION

The beginning of the
barbed suture to act as a
blockade

No need to make a knot



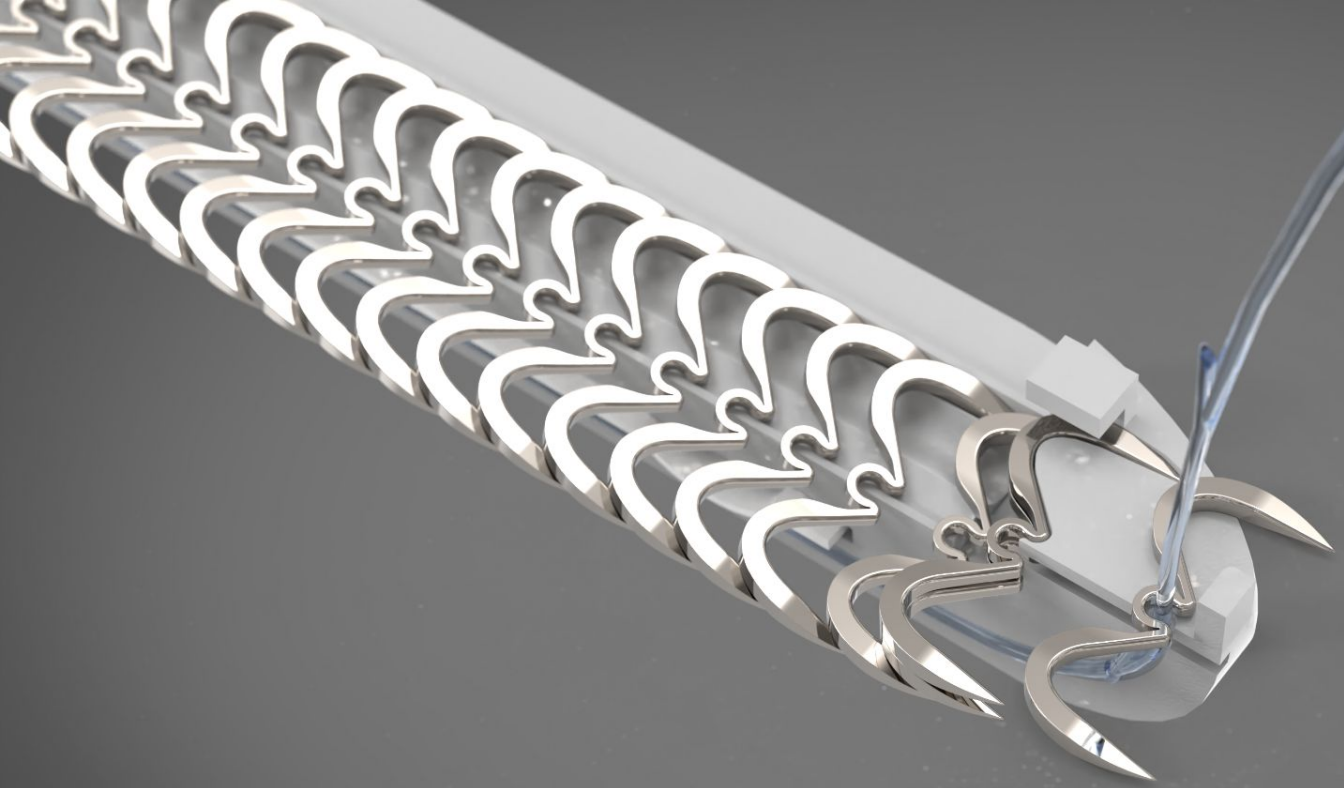
SOLUTION

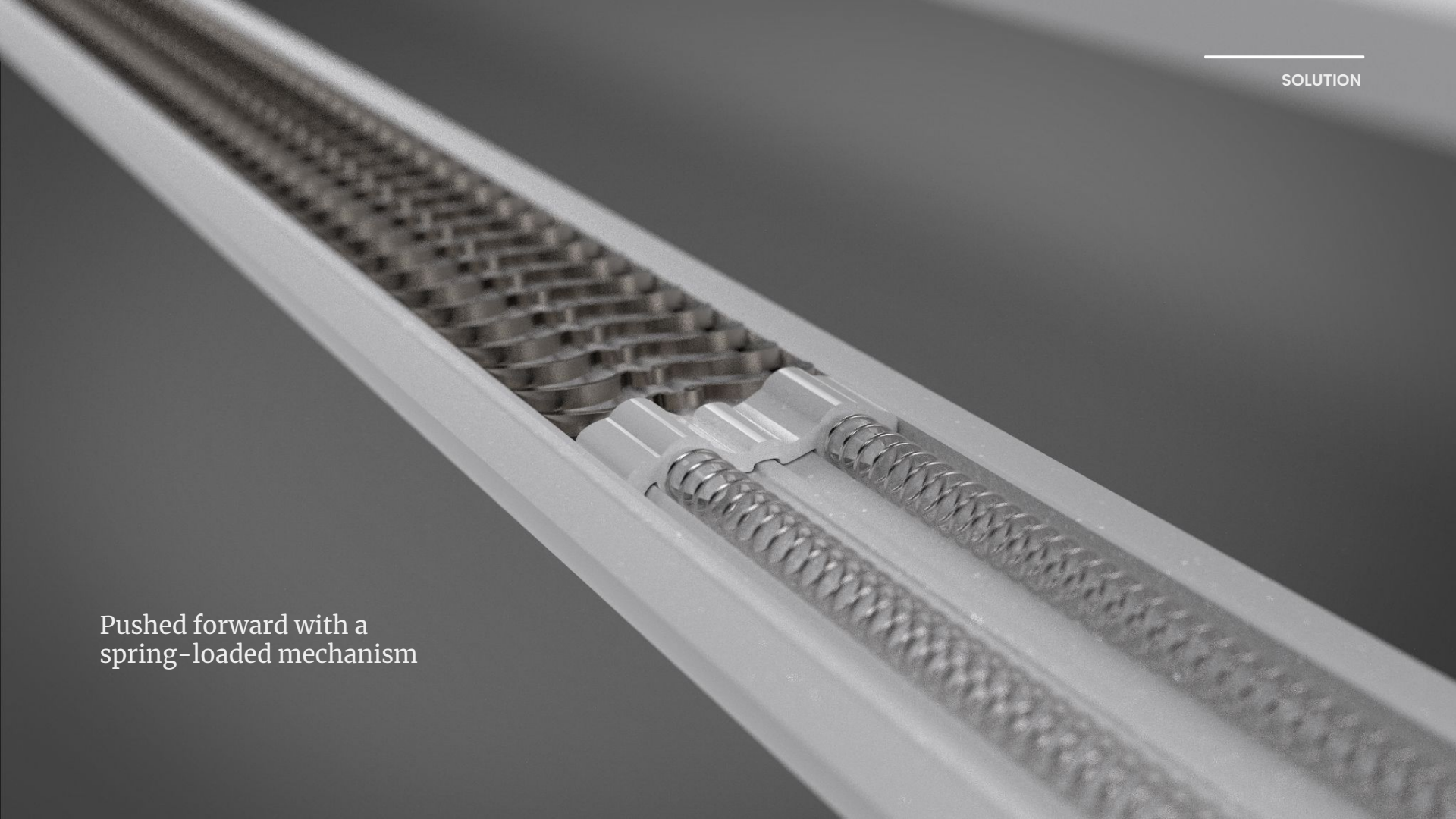


The cartridge has:
80 staples
30 cm of barbed suture length

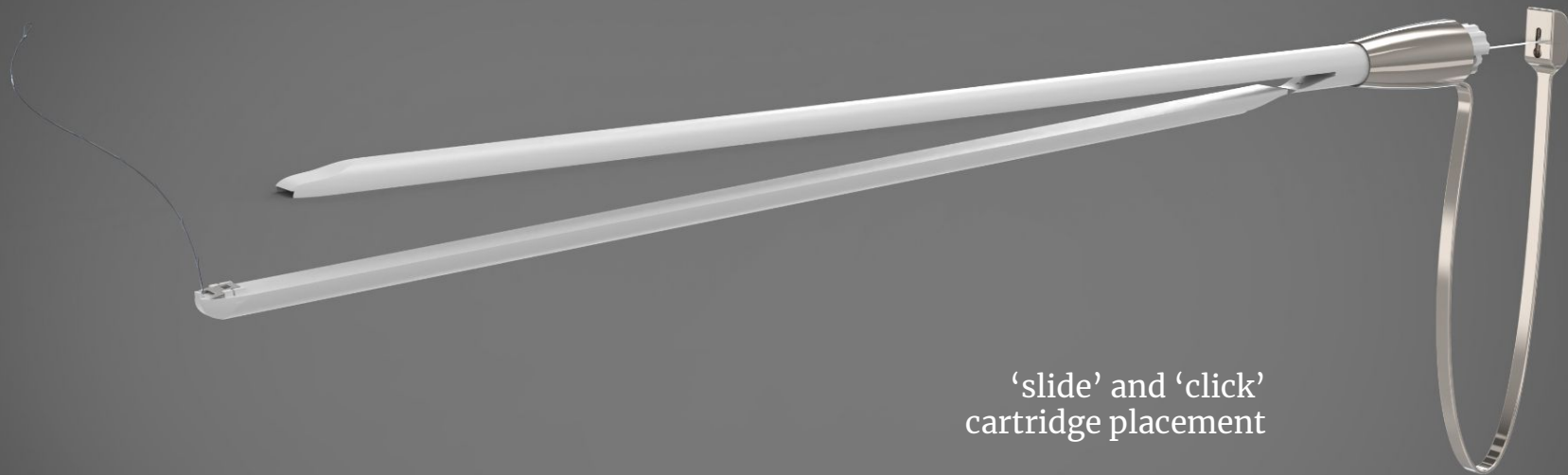
SOLUTION

Staples slide underneath
each other, creating a
'lift'



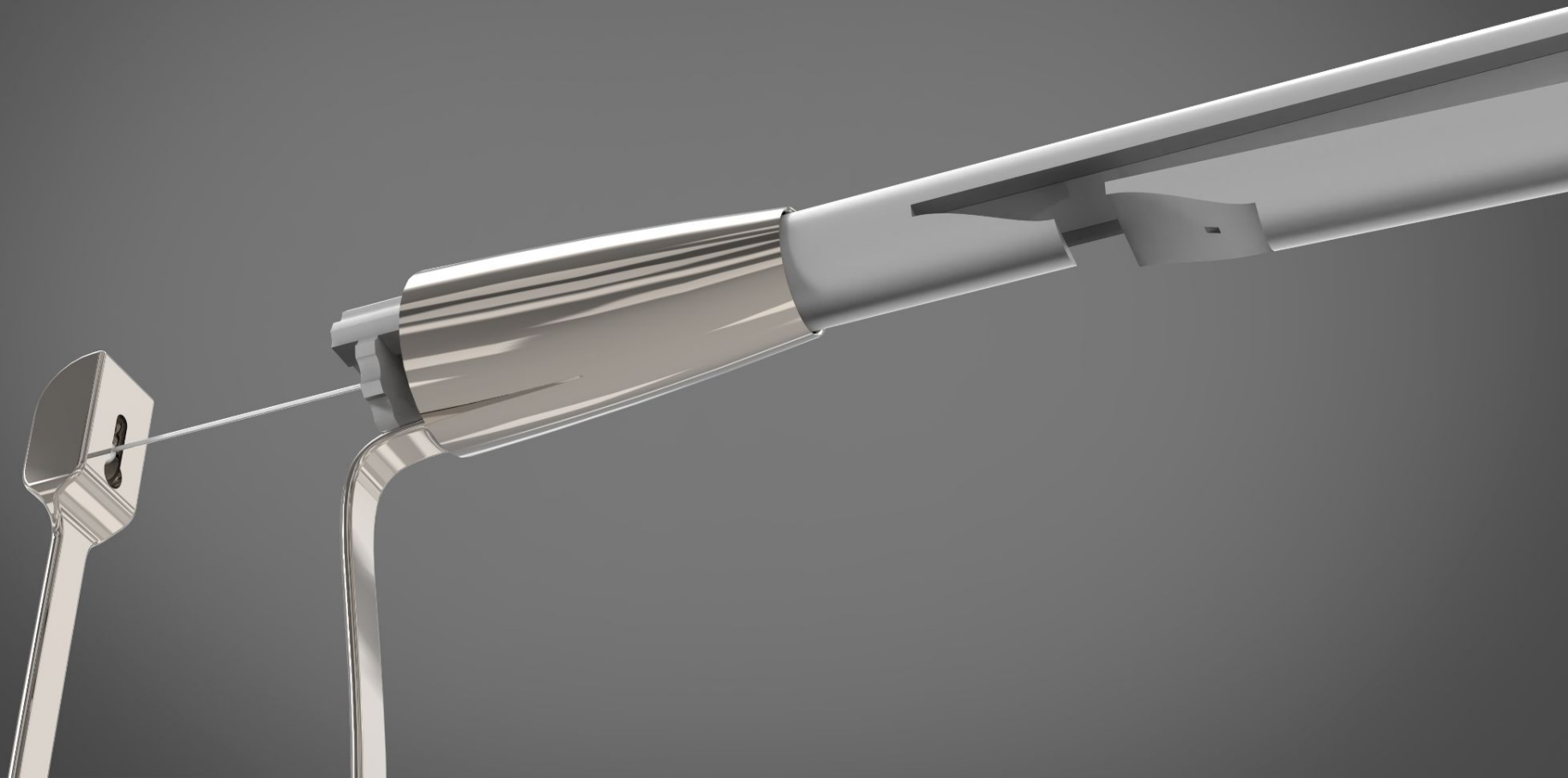
A close-up, black and white photograph of a mechanical assembly. The assembly consists of a long, narrow, light-colored housing. Inside the housing, there is a series of small, dark, rectangular components arranged in a row. These components are held in place by a spring-loaded mechanism. The mechanism includes a coiled spring and a sliding component that can move back and forth. The overall appearance is that of a precision-engineered part, possibly a filter or a sensor component.

Pushed forward with a
spring-loaded mechanism



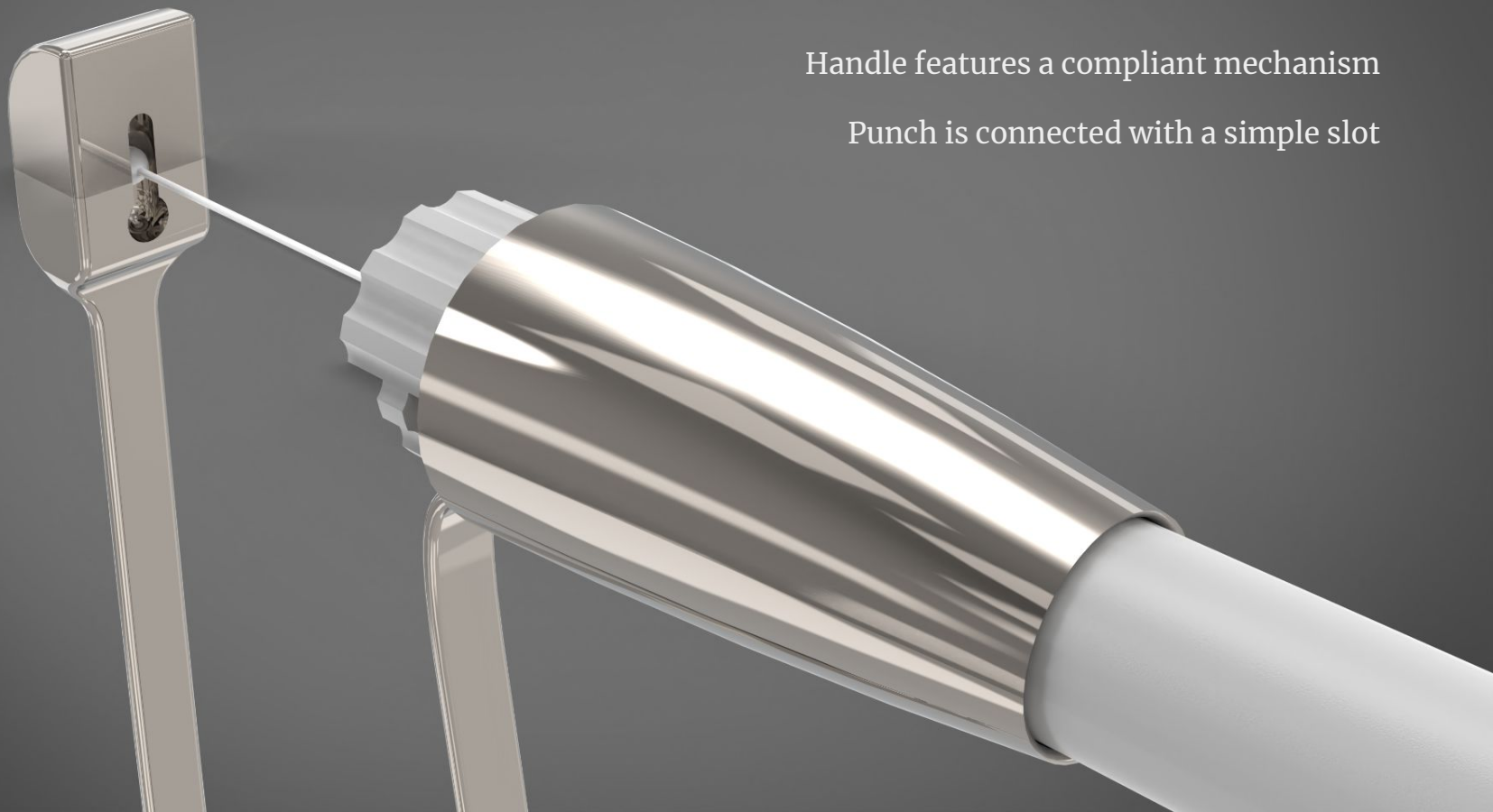
'slide' and 'click'
cartridge placement

SOLUTION

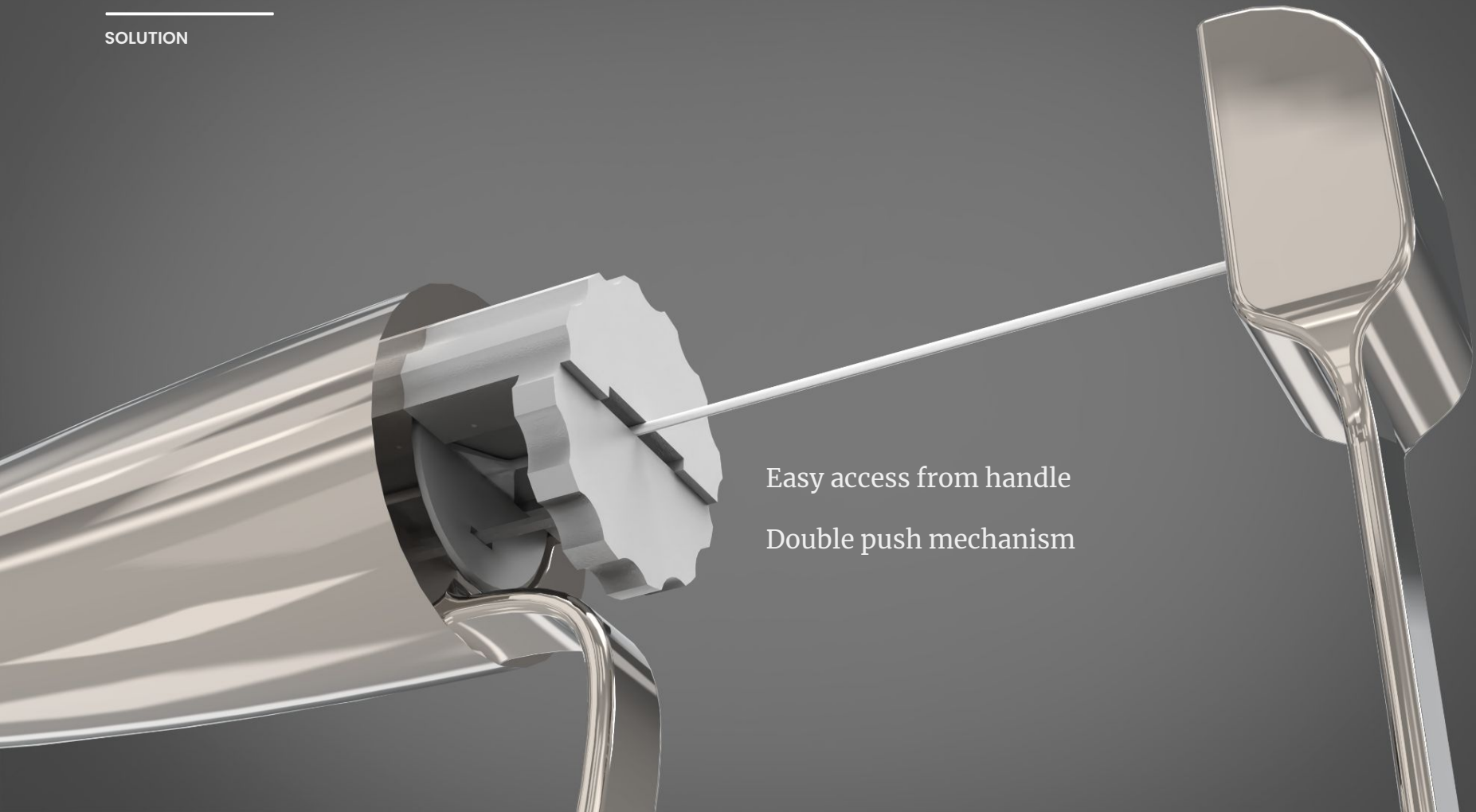


Handle features a compliant mechanism

Punch is connected with a simple slot



SOLUTION



Easy access from handle

Double push mechanism

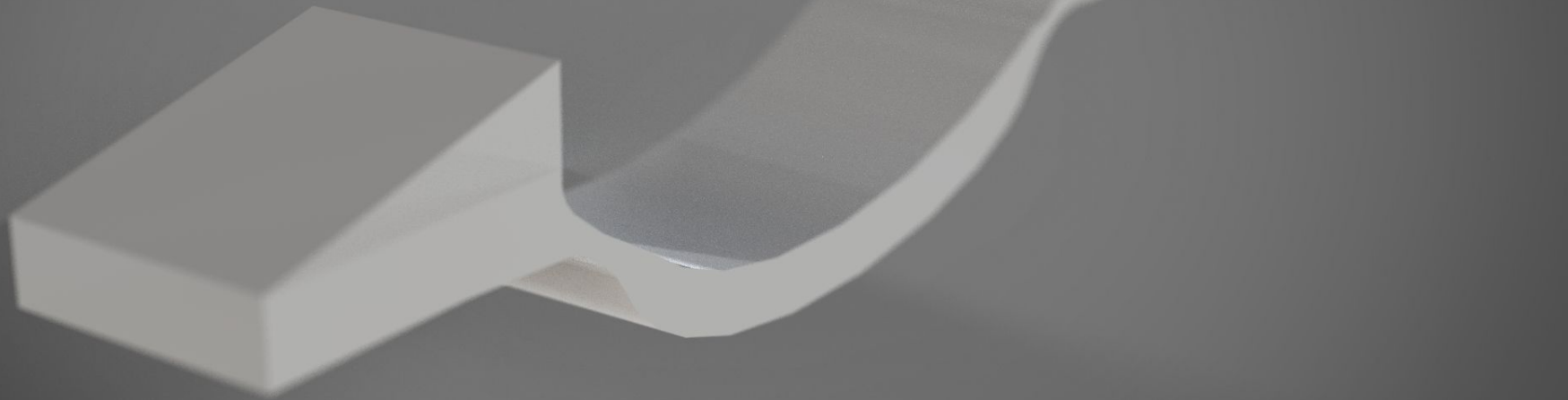
SOLUTION

On the inside

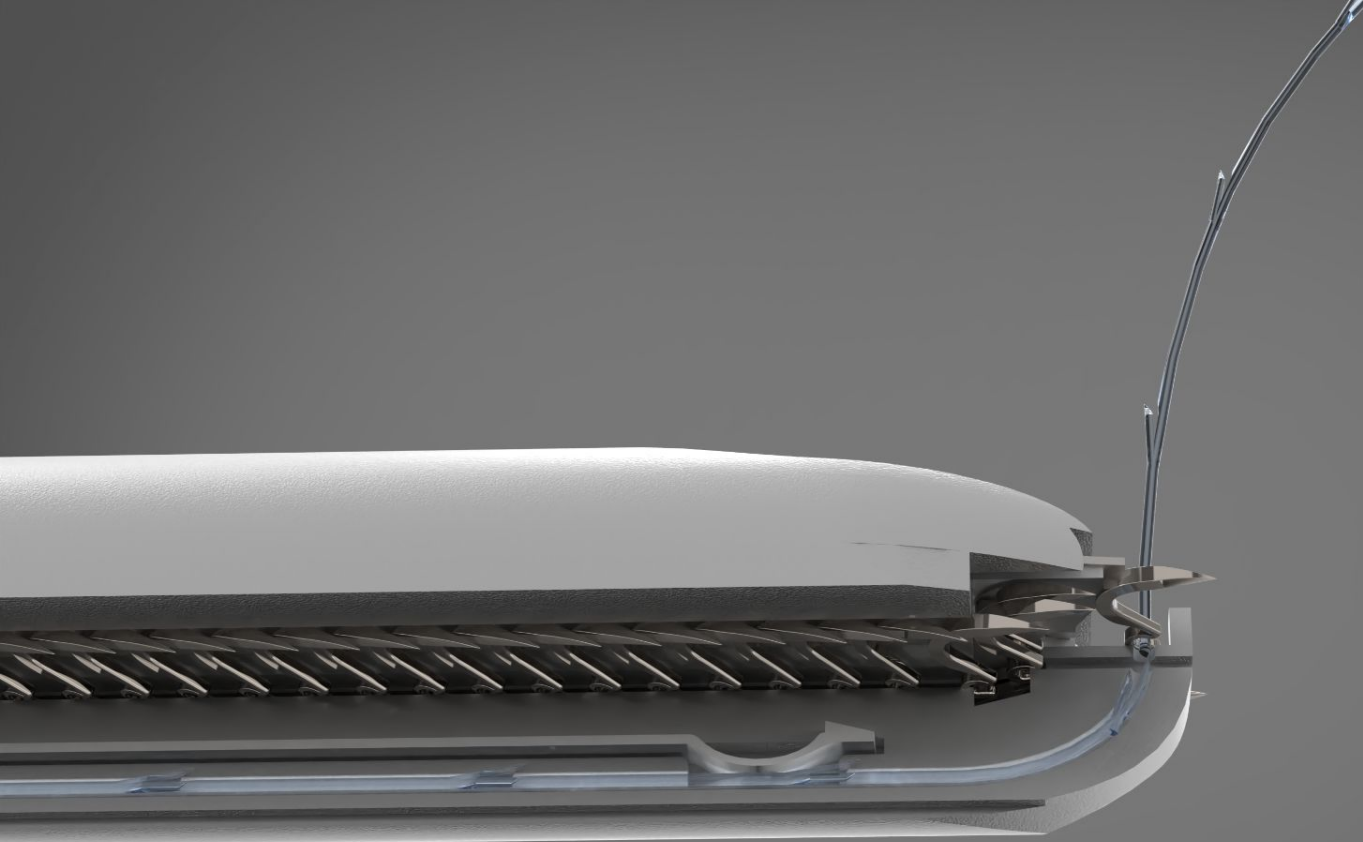
Zoomed in on the ratchet and teeth

SOLUTION

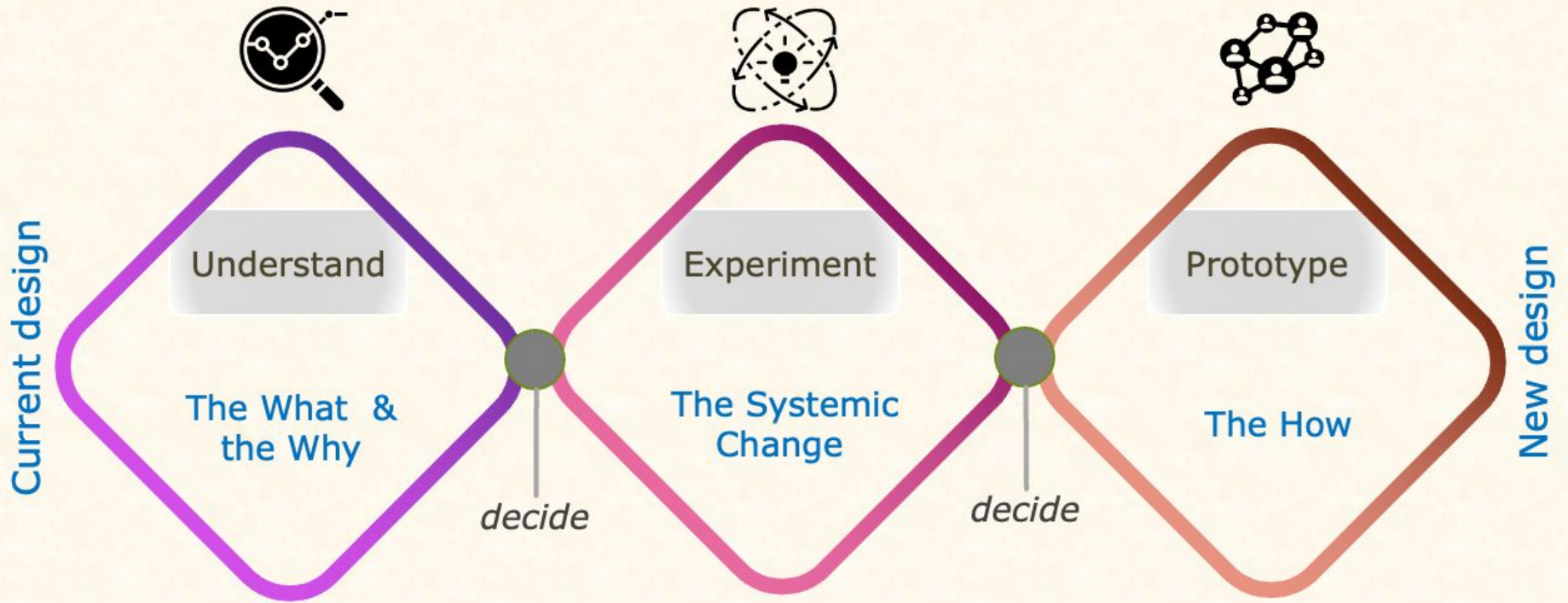
Compliant mechanism to lock
the suture, when tightening



SOLUTION



Compression of suture



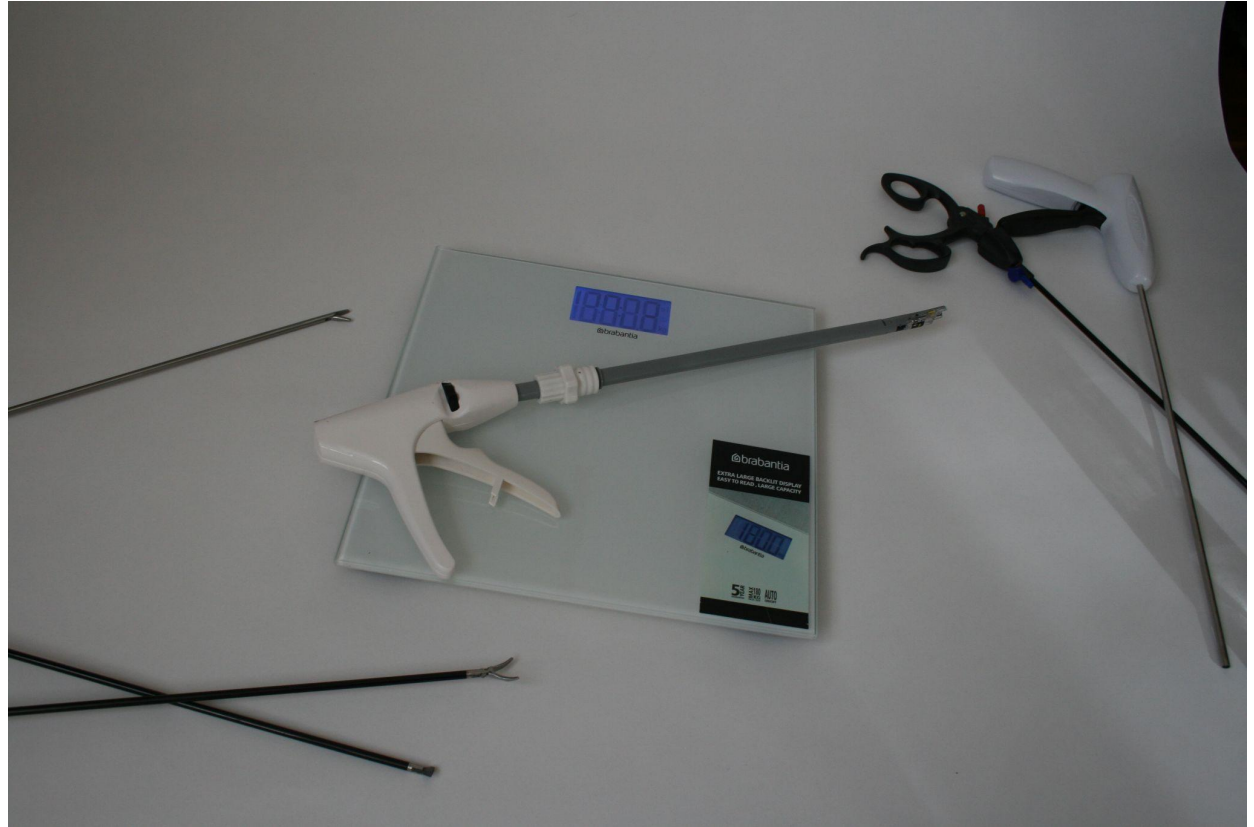
(Mortimer, 2022)

PROCESS

Open surgery (left) Minimally invasive surgery, laparoscopy (right)

PROCESS

Weighing existing
tools



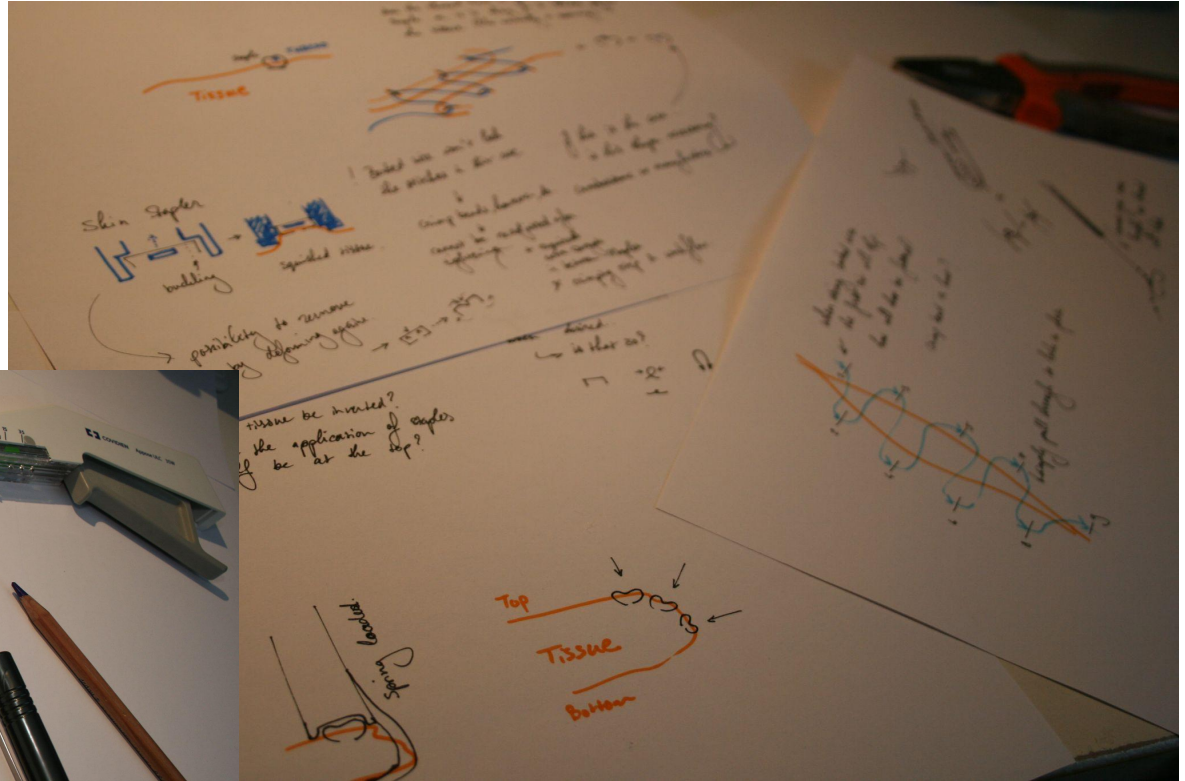
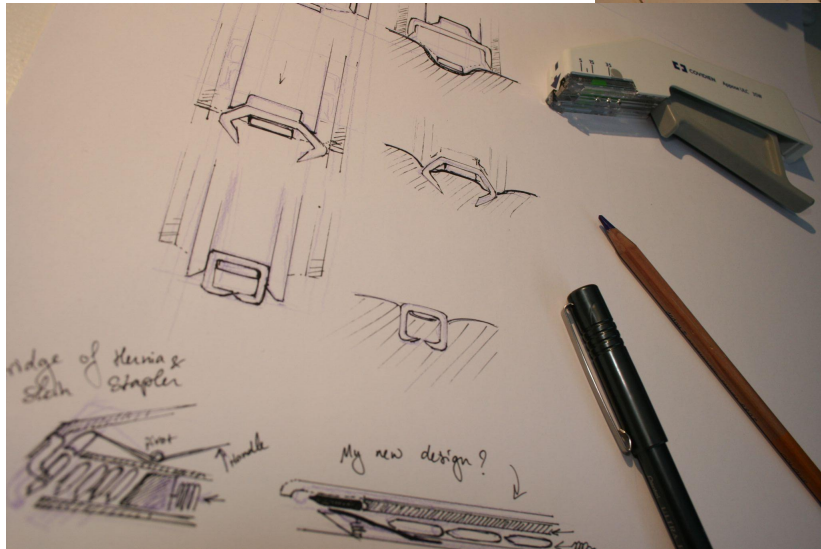
PROCESS

Tearing down
existing tools



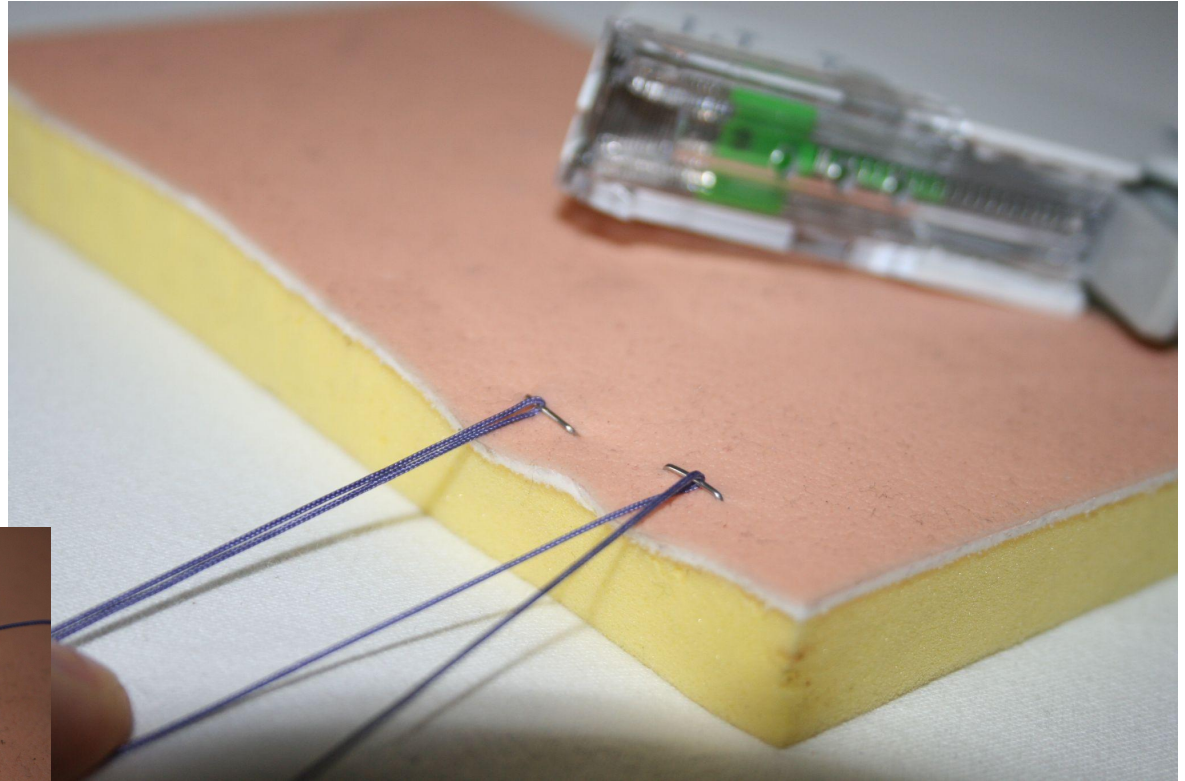
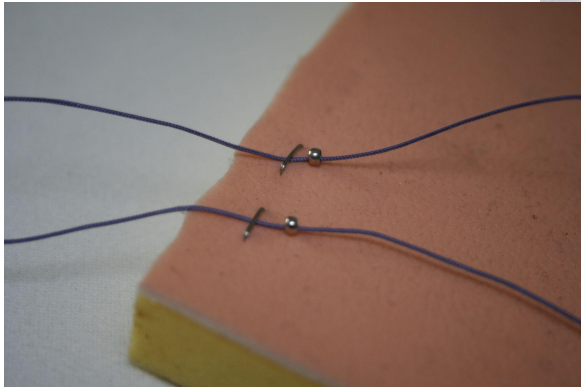
PROCESS

Generating ideas



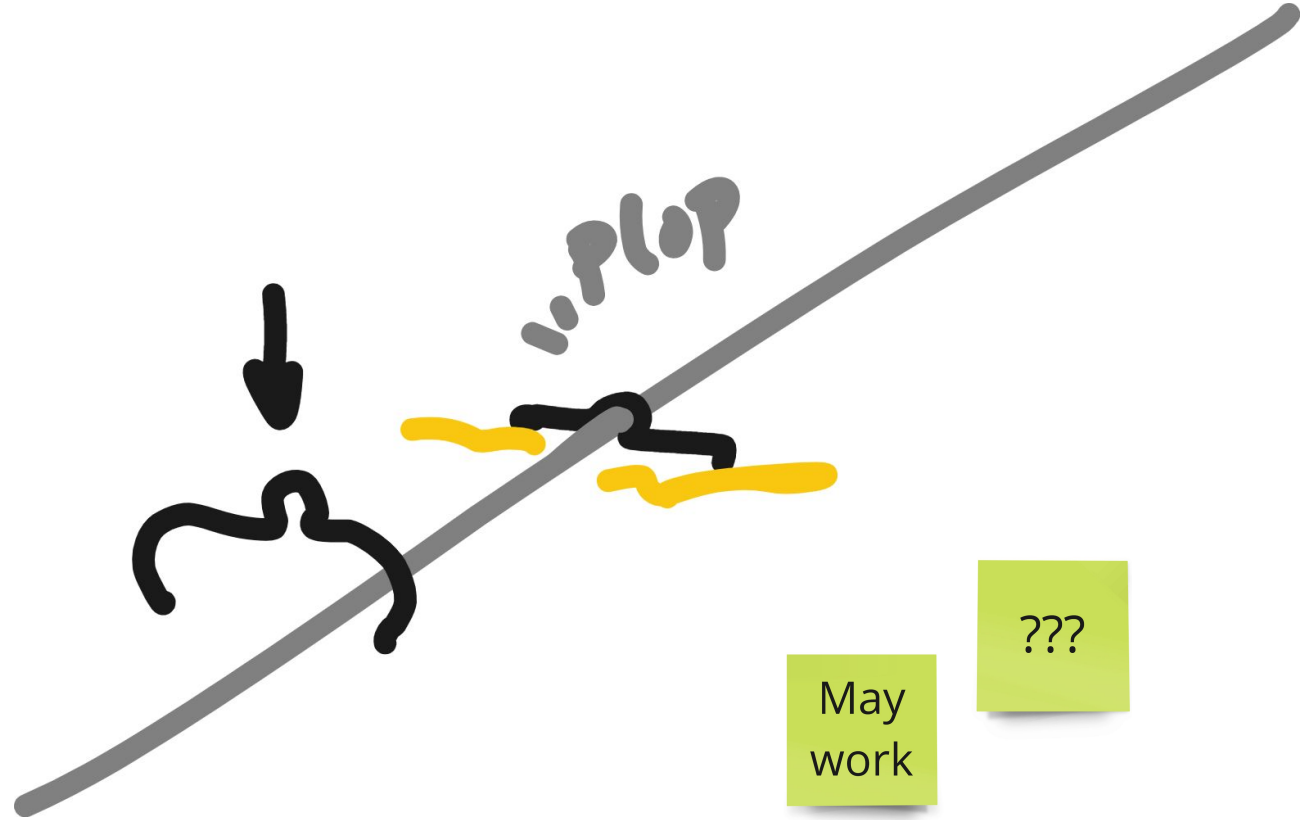
PROCESS

Selecting some ideas
through simple tests



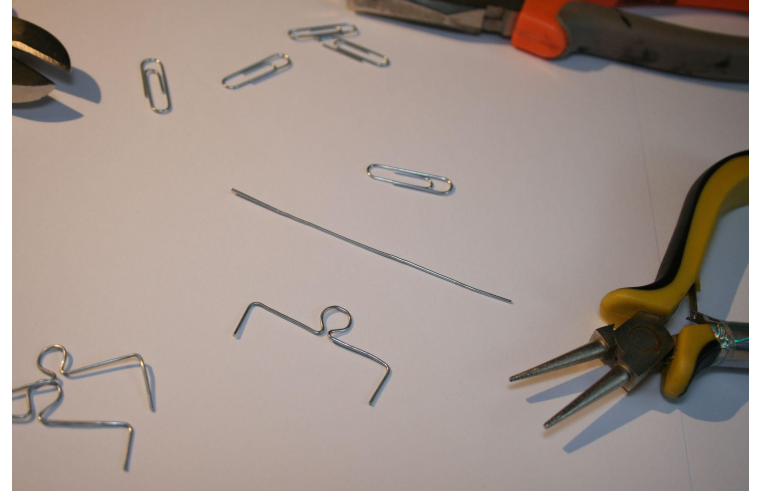
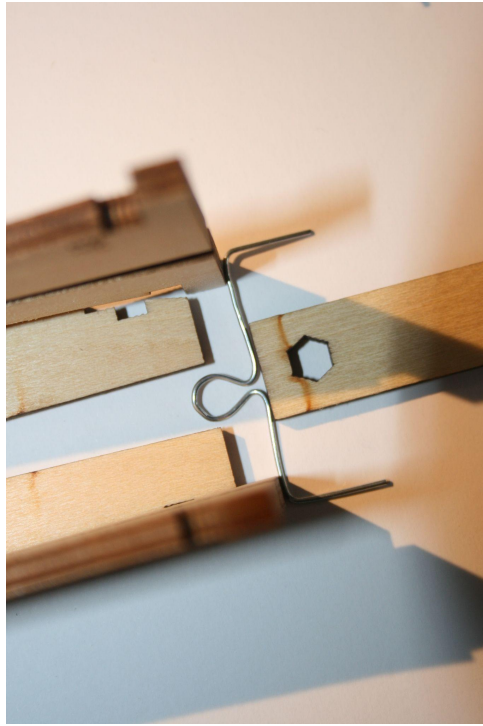
PROCESS

A new idea, based on
previous attempts

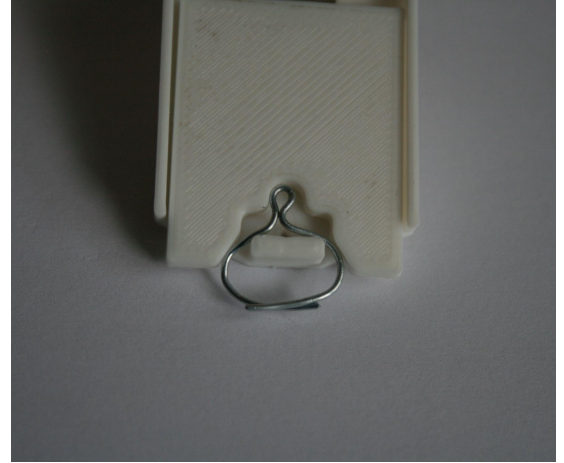
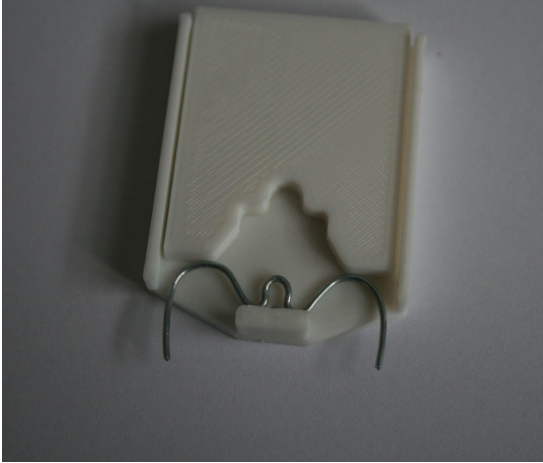


PROCESS

Low-fidelity testing

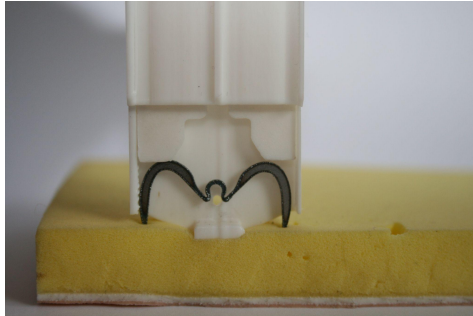
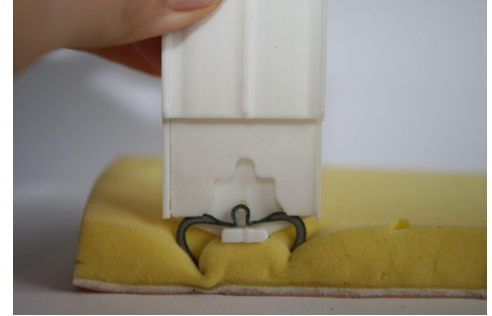
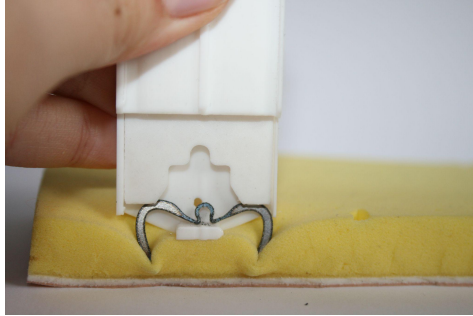
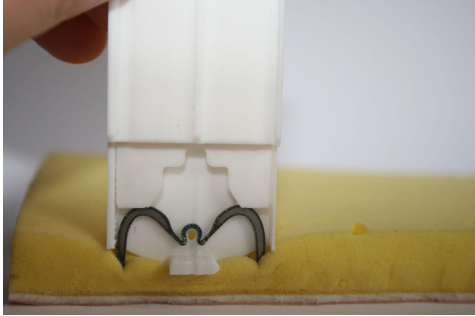


PROCESS



More low-fidelity testing

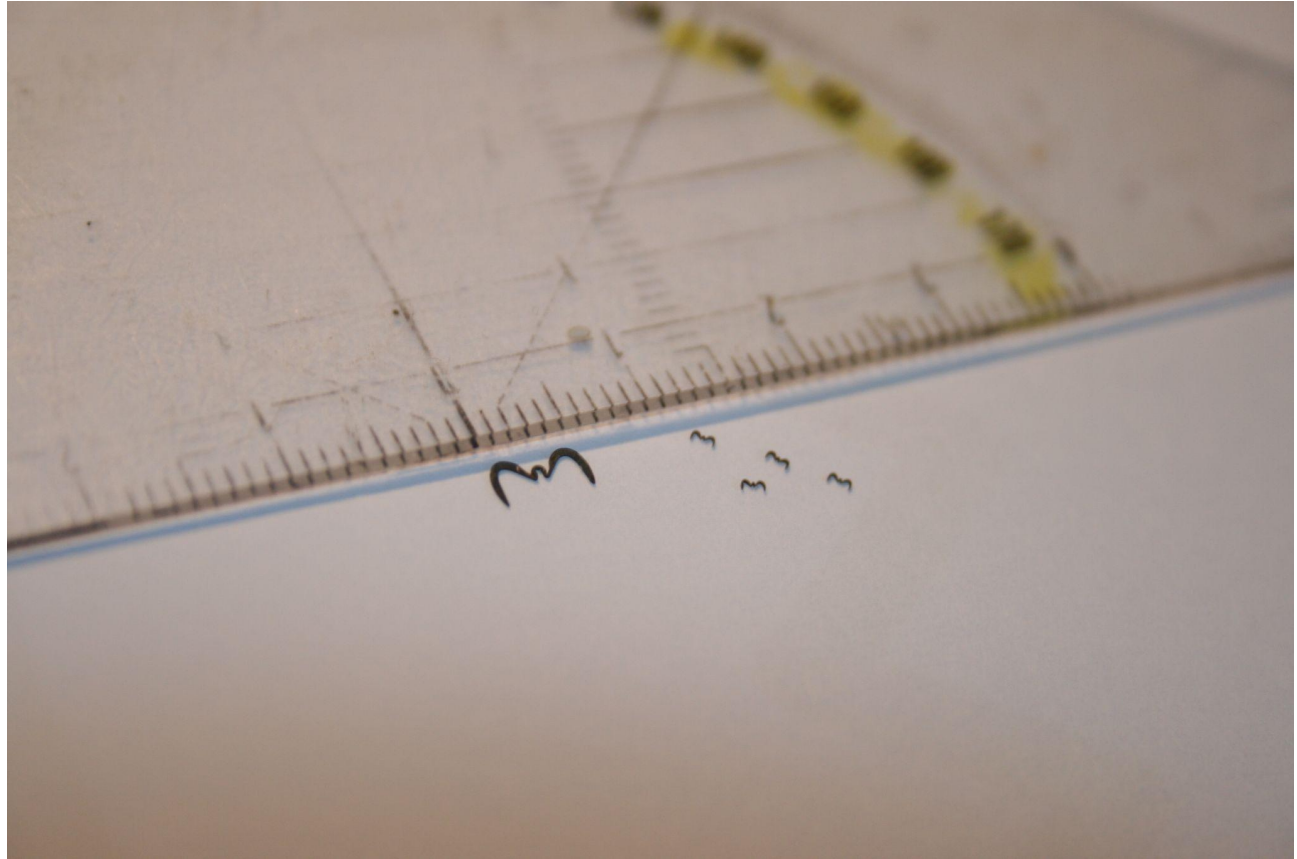
PROCESS



Gradually increasing
fidelity of the models

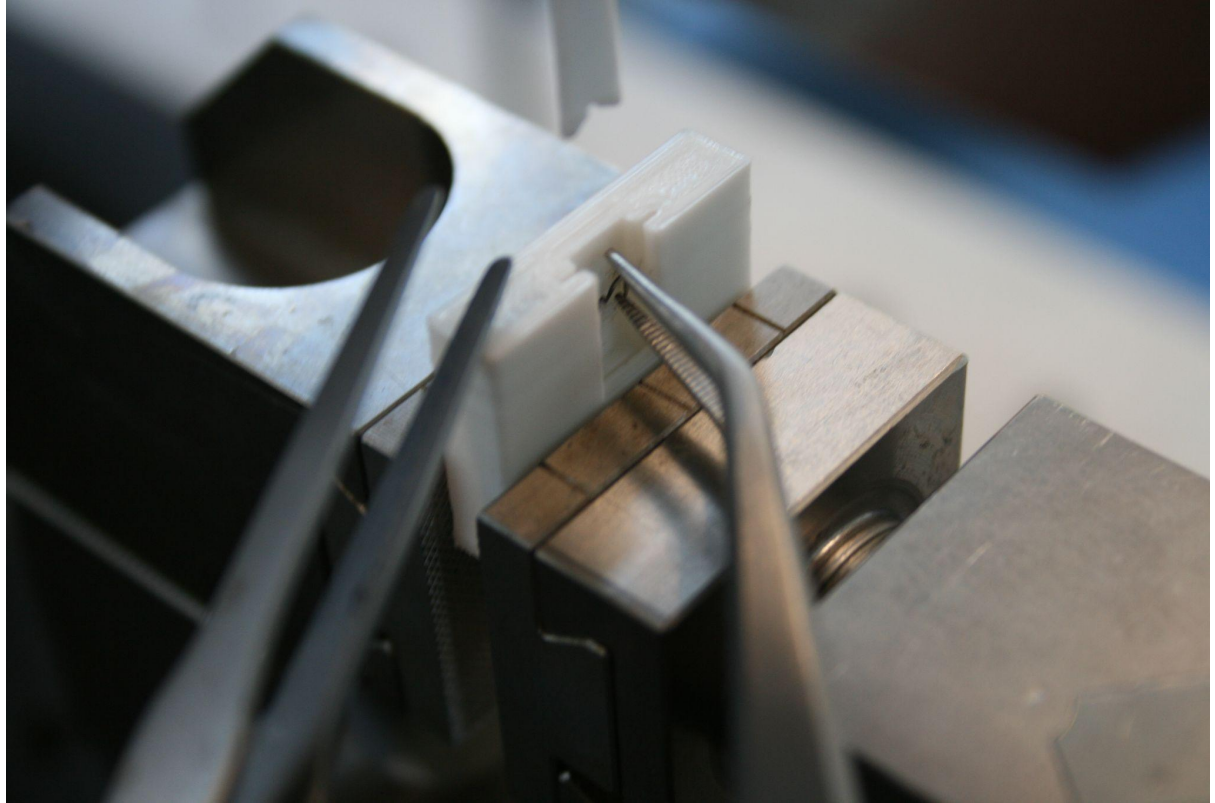
PROCESS

Making them too small
was also possible..

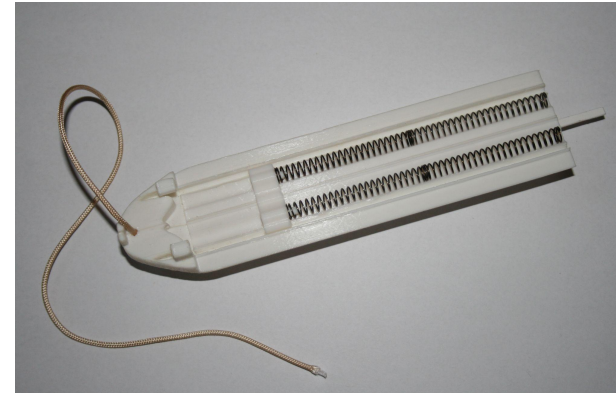
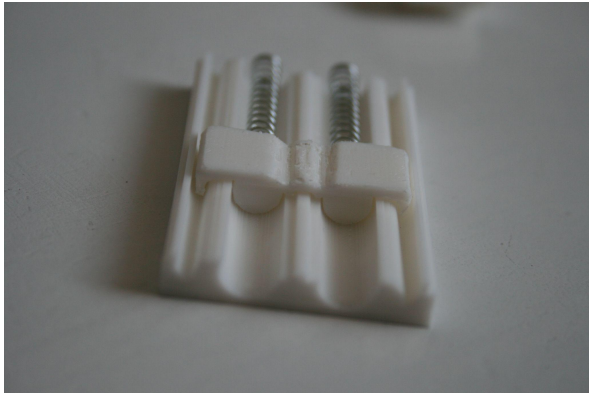
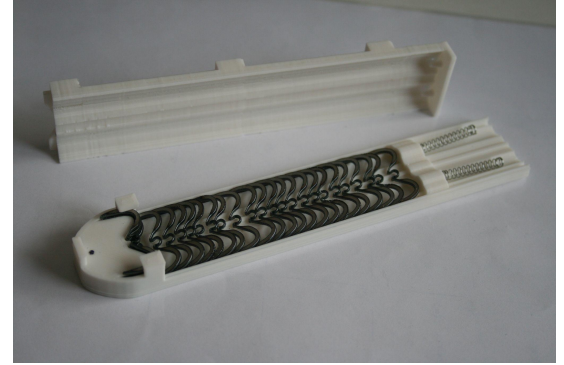
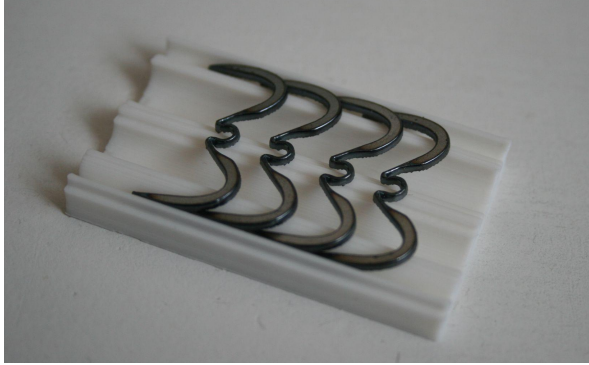


PROCESS

More testing



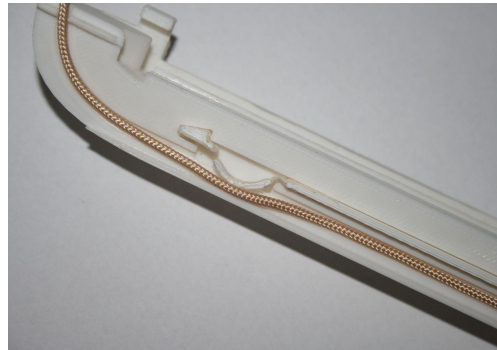
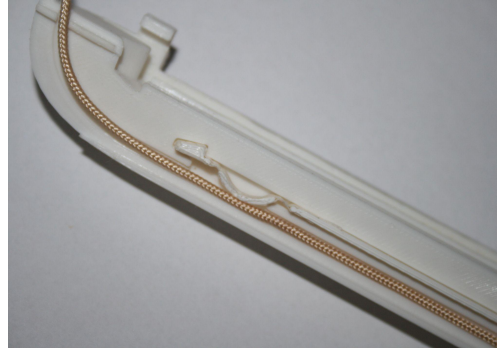
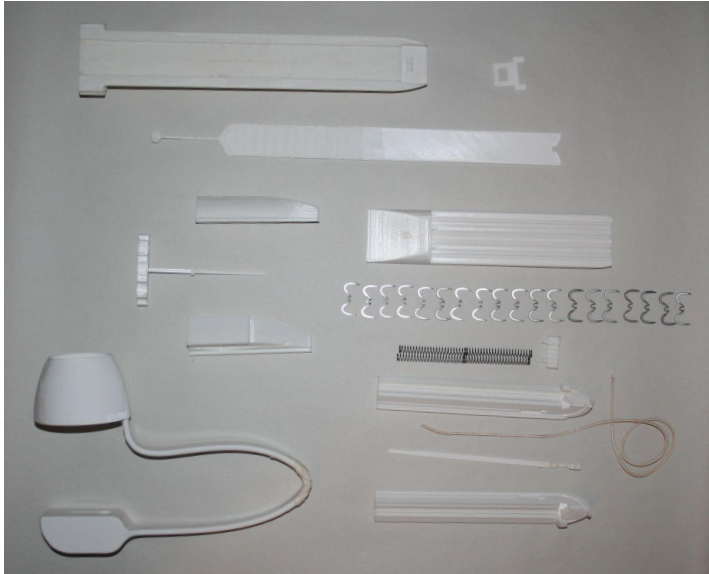
PROCESS



The same process applies to the cartridge

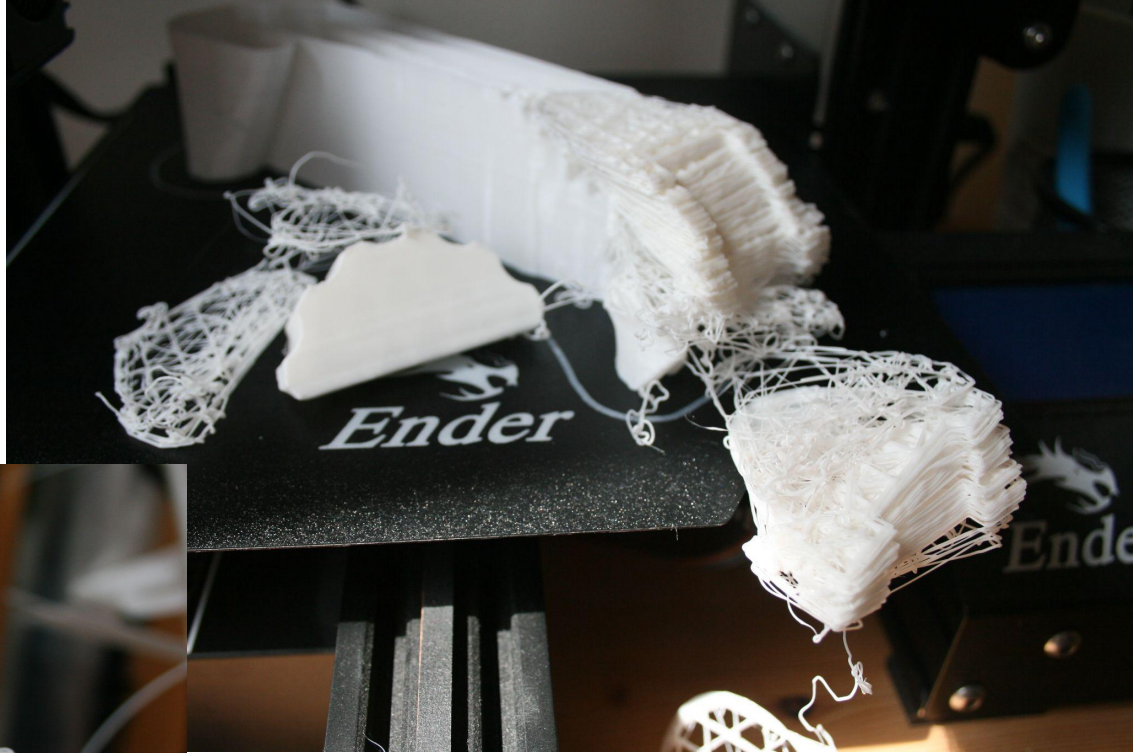
PROCESS

.. and to the rest of the product



PROCESS

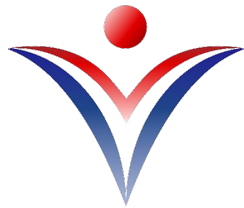
Not without problems of course



Questionnaire

The Dutch Society for Metabolic and Bariatric Surgery, and linkedin

10 participants



Dutch
Society for
Metabolic &
Bariatric
Surgery

Surgeons from:

- *Spaarne Gasthuis*
- *Nederlandse Obesitas Kliniek Den Haag en Gouda*
- *WeightWorks Amersfoort*
- *Maxima MC Veldhoven*
- *Catharina Ziekenhuis Eindhoven*
- *Obesitas center Weert*
- *Albert Schweitzer ziekenhuis Dordrecht, Zwijndrecht en Sliedrecht*
- *Horacio Oduber hospitaal Oranjestad*

EVALUATION

- Three main parts

- Defined the factors for successful MD closure
- Product proposal
 - Using multimedia approach: CAD models, textual concepts, animation.
- Then evaluate product according to those factors

Based on the available information, how would you rate the perceived effectiveness of the device?

Consider comparing it to manual suturing or regular staplers.

1 2 3 4 5

Very ineffective Very effective

Based on the available information, how would you rate the comfort of using the device?

Consider comparing it to manual suturing or regular staplers.

1 2 3 4 5

Very uncomfortable Very comfortable

What aspect of the device should be altered to improve your comfort?

Jouw antwoord _____

Do you foresee any complications or limitations with this device?

Please substantiate.

Jouw antwoord _____

The difficulties mentioned in literature and observed during observations were reaffirmed

“To invest enough time during the operation to visualize and close both defects.”

“When using staples, catching the tissue before staple formation. When suturing, it takes more time.”

“technique, technique, technique and patient factors.”

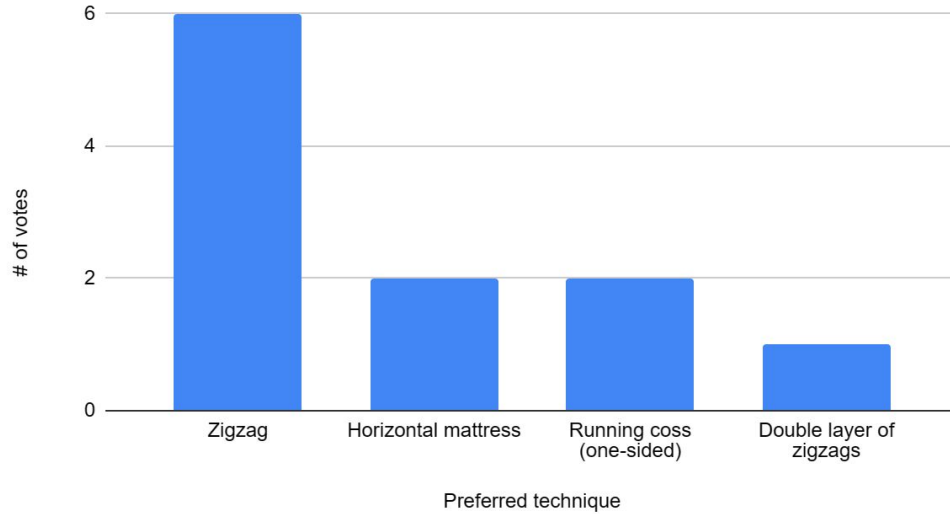
“Quick, persistent, stable closure. At least 50% will open up.”

“Hernia staplers are insufficient in grasping enough tissue and give inadequate closure.”

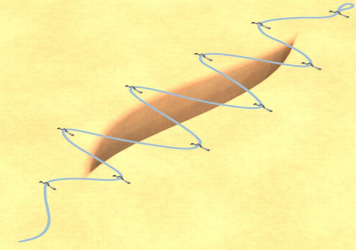
“You are short of a hand to get proper exposure, hence the EHS stapler is used which can work single-handedly, but it does not suffice either. So suturing is better, but that took a lot of time, cave bleeding.”

EVALUATION

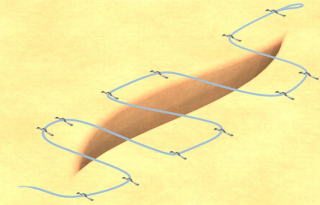
What technique surgeons would use



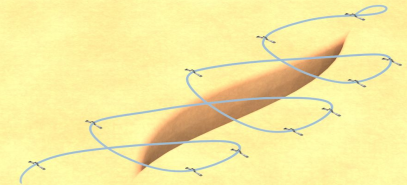
Zigzag



Horizontal mattress

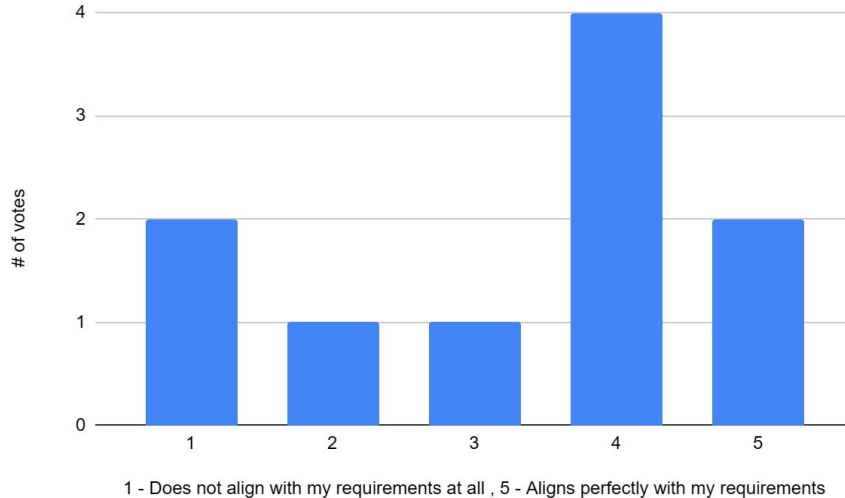


Running coss



Fulfillment of critical factors

Does it fulfill the requirements of successful MD closure?



Negative ratings:

"Most limitations are tissue-related."

"staples are too atraumatic".

"The mesenteric sides of the defect have to grow together. With this system, the two sides remain intact and therefore the tissue will have less tendency to grow together."

Positive ratings:

"It appears easier in use seeing that there's no need to align directly and that the suture can be tightened later".

EVALUATION

9 out of 10 found the StapleStitcher to be innovative.

Some reactions include:

"YES"

"Yes, but the success depends mainly on the success of the staples holding the tissue."

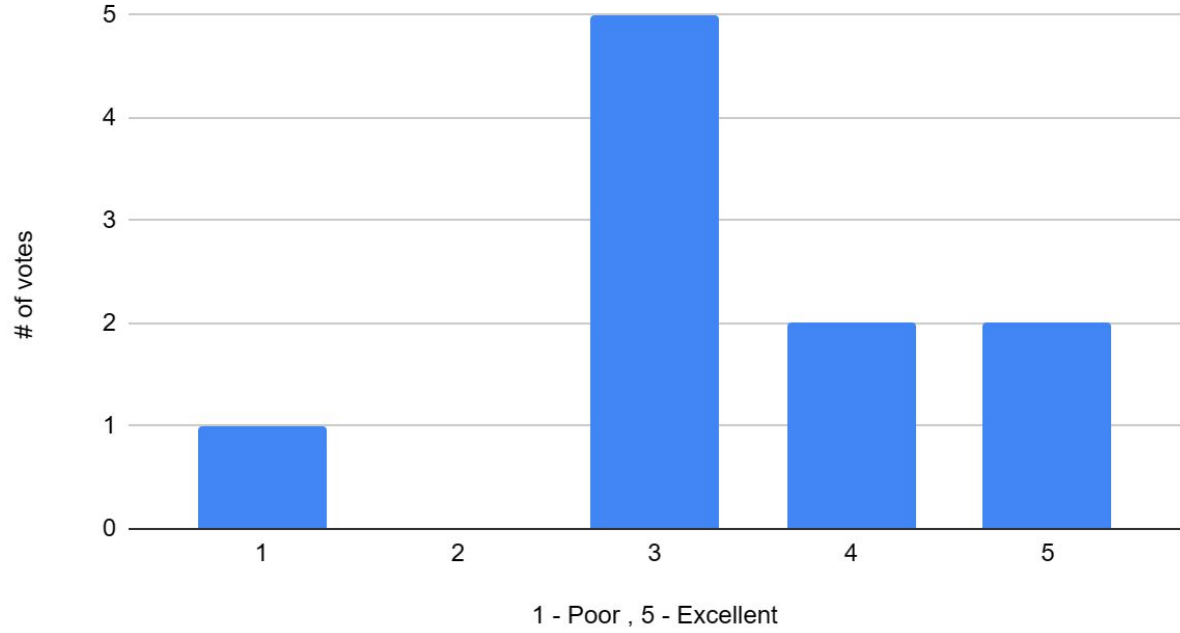
"Yes, but I still have a lot of questions about its long-term effects, cost, etc."

"Absolutely, unprecedented"

"Amazing!"

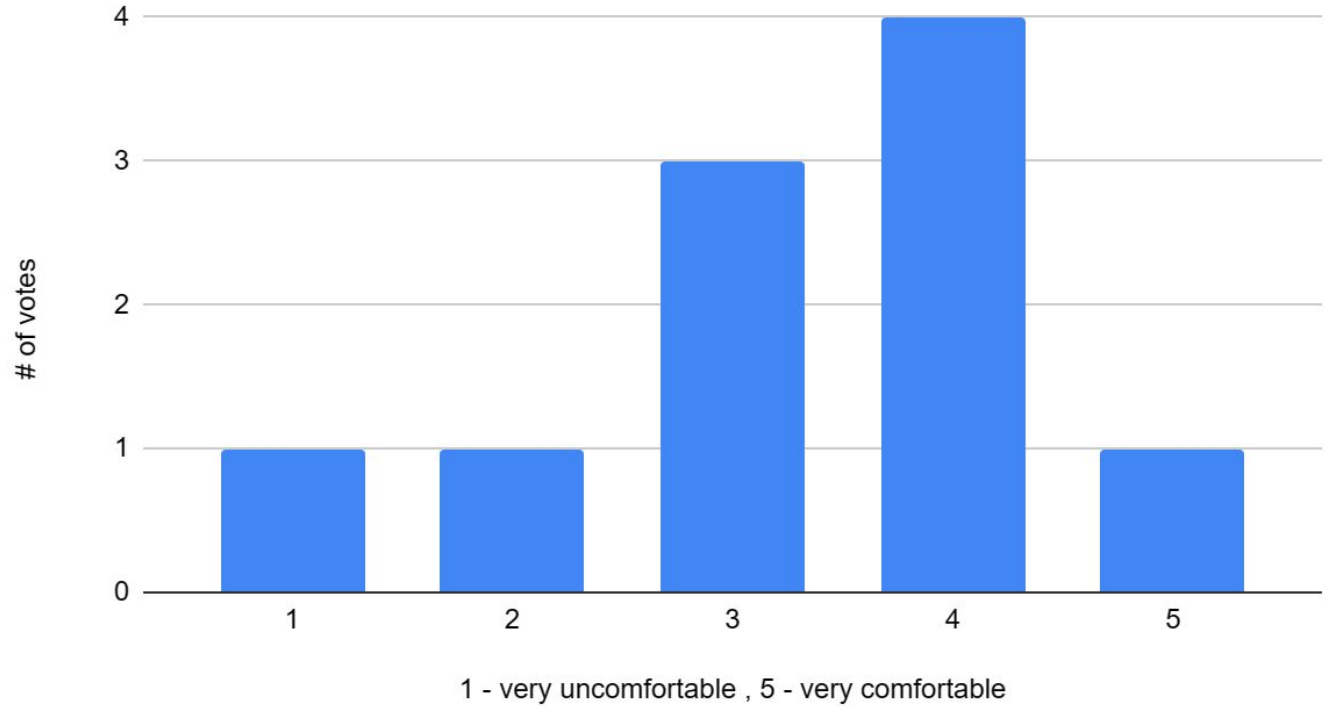
EVALUATION

Perceived quality of the device



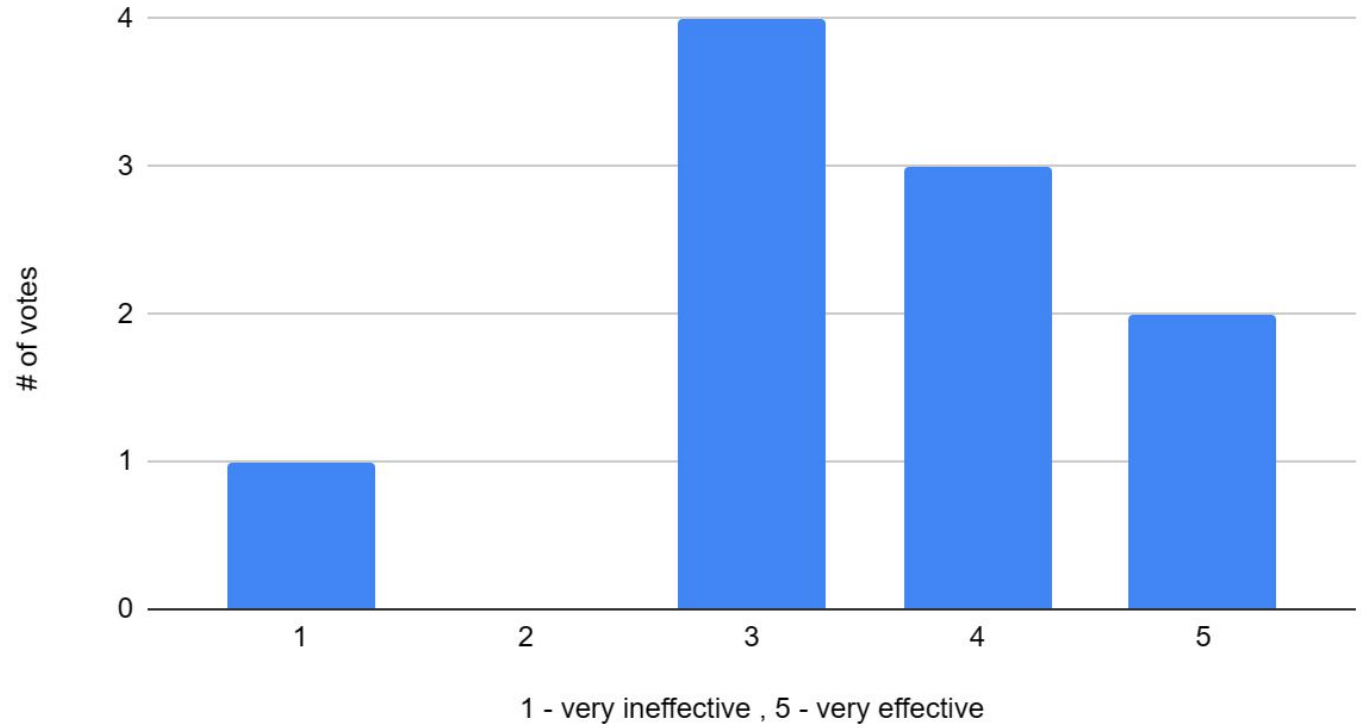
EVALUATION

Perceived comfort
of using the device



EVALUATION

Perceived effectiveness of the device



Perceived quality, comfort and effectiveness

"Can't evaluate it, as I would have to have it in my hands."

"It depends on handling the device."

"It remains to be seen how good the staples will grab the tissue."

"Depends on cost, effectiveness, time, and eco-friendliness."

"I have to see and feel it in real life first."

"Have to see it at work first"

"I don't know the device good enough to have an opinion about it"

"The handling is still unknown to me."

Improvements, additional features

“Automatic stabilizing / tightening the thread per staple.”

“Feedback system after placing a staple confirming that the staple is placed.”

“An indication for how much suture length is remaining.”

Additional fields of use

"Inguinal surgery"

Liesbreuk

"Intestinal anastomosis"

Anastomose van darmen

"Lap rectopexy"

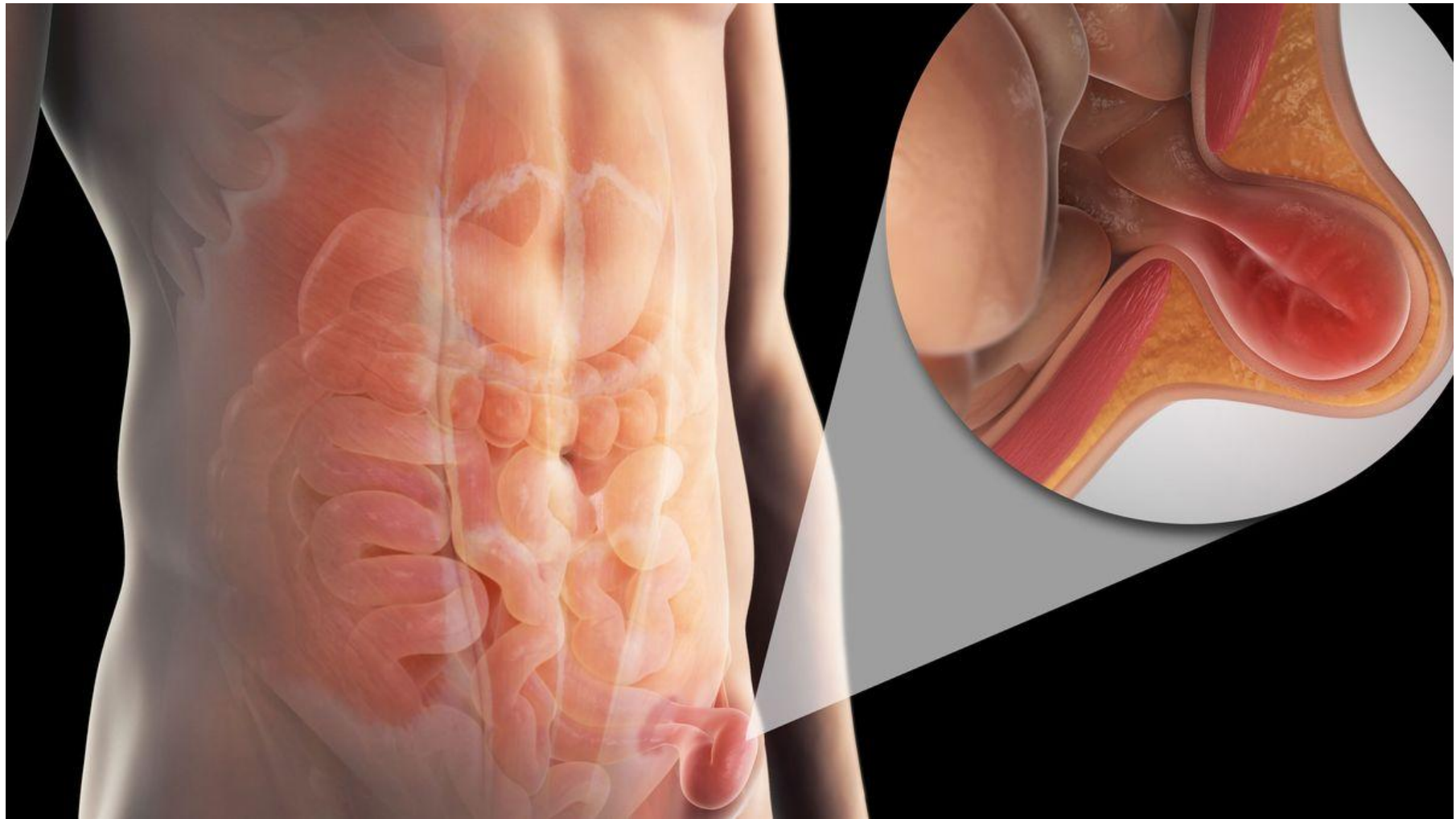
Rectopexie

"TAPP"

(which stands for transabdominal preperitoneal repair)

"Closing of ventral hernia defects as a part of IPOM"

(which stands for intraperitoneal onlay mesh technique)



Closing remarks

“Keep me posted!”

“I am curious to see the end result”

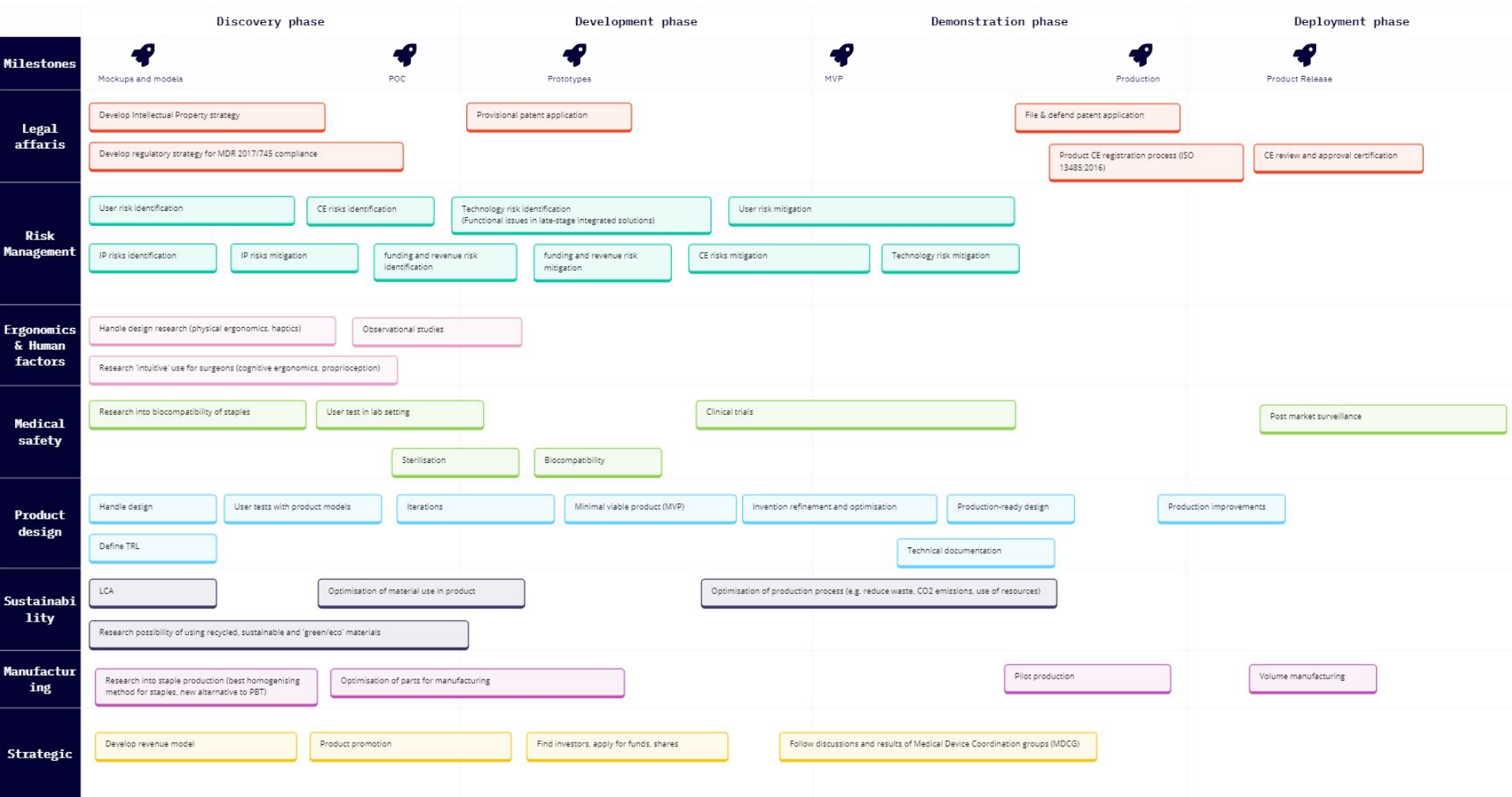
“Nice approach to a common problem in bariatrics. I would like to hold the instrument sometime. I am always ready for consultation.”

“proof is the eating of the pudding”.

RECOMMENDATIONS

- Handle design and ergonomics
- More iterative design
 - Improve components
 - Material usage
 - ISO tolerances
- Manufacturing
- Sustainability
 - LCA
- Risk management
- Medical safety research





CONCLUSION

- ❖ Underlying problems identified
- ❖ Addressed through systematic design process
- ❖ Innovative design proposal
- ❖ Overall positive evaluation

- ❖ Still early design stage
- ❖ More research needed

- ❖ Promising outlook





Thank you

For your attention

Any questions?

REFERENCES

Higuera-Hernández, M. F., Reyes-Cuapio, E., Gutiérrez-Mendoza, M., Rocha, N., Veras, A. B., Budde, H., Jesse, J., Zaldívar-Rae, J., Blanco-Centurion, C., Machado, S. A., & Murillo-Rodríguez, E. (2018). Fighting obesity: Non-pharmacological interventions. *Clinical Nutrition ESPEN*, 25, 50–55. <https://doi.org/10.1016/j.clnesp.2018.04.005>

CBS. (2022, September 9). Hoeveel volwassenen hebben overgewicht? - Nederland in cijfers 2022. Hoeveel Volwassenen Hebben Overgewicht? - Nederland in Cijfers 2022 | CBS. <https://longreads.cbs.nl/nederland-in-cijfers-2022/hoeveel-volwassenen-hebben-overgewicht/>

World Health Organization: WHO. (2020, February 21). Obesity. https://www.who.int/health-topics/obesity#tab=tab_1

Mitchell, B. G., & Gupta, N. (2022). Roux-en-Y Gastric Bypass [Internet]. In StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing (2023 Jan.). StatPearls Publishing LLC. <https://pubmed.ncbi.nlm.nih.gov/31985950/> PMID: 31985950 Bookshelf ID: NBK553157

Adobe stock. (n.d.). Stockvector Types of bariatric surgery weight loss procedures- gastric bypass, sleeve gastrectomy, adjustable gastric band. Stomach medical diagram infographics in line style. Vector illustration. Adobe Stock. https://stock.adobe.com/nl/images/types-of-bariatric-surgery-weight-loss-procedures-gastric-bypass-sleeve-gastrectomy-adjustable-gastric-band-stomach-medical-diagram-infographics-in-line-style-vector-illustration/362915307?as_campaign=ftmigration2&as_channel=dpcft&as_camplclass=brand&as_source=ft_web&as_camptype=acquisition&as_audience=users&as_content=closure_asset_detail-page

Wochner, N. (2022). Alternative closure method for laparoscopic gastrointestinal anastomosis. In TU Delft Repositories. <https://repository.tudelft.nl/islandora/object/uuid:1a5db094-4e54-4061-9b70-75b211de28a?collection=education>

Nederlandse Obesitas Kliniek. (2020, December 2). Een gastric bypass of maagverkleining helpt u afvallen | NOK. <https://www.obesitaskliniek.nl/behandeling/de-operatie/gastric-bypass/>

Zhao, B. (2015). A sensorless haptic interface for robotic minimally invasive surgery. ResearchGate. https://www.researchgate.net/publication/280889533_A_sensorless_haptic_interface_for_robotic_minimally_invasive_surgery

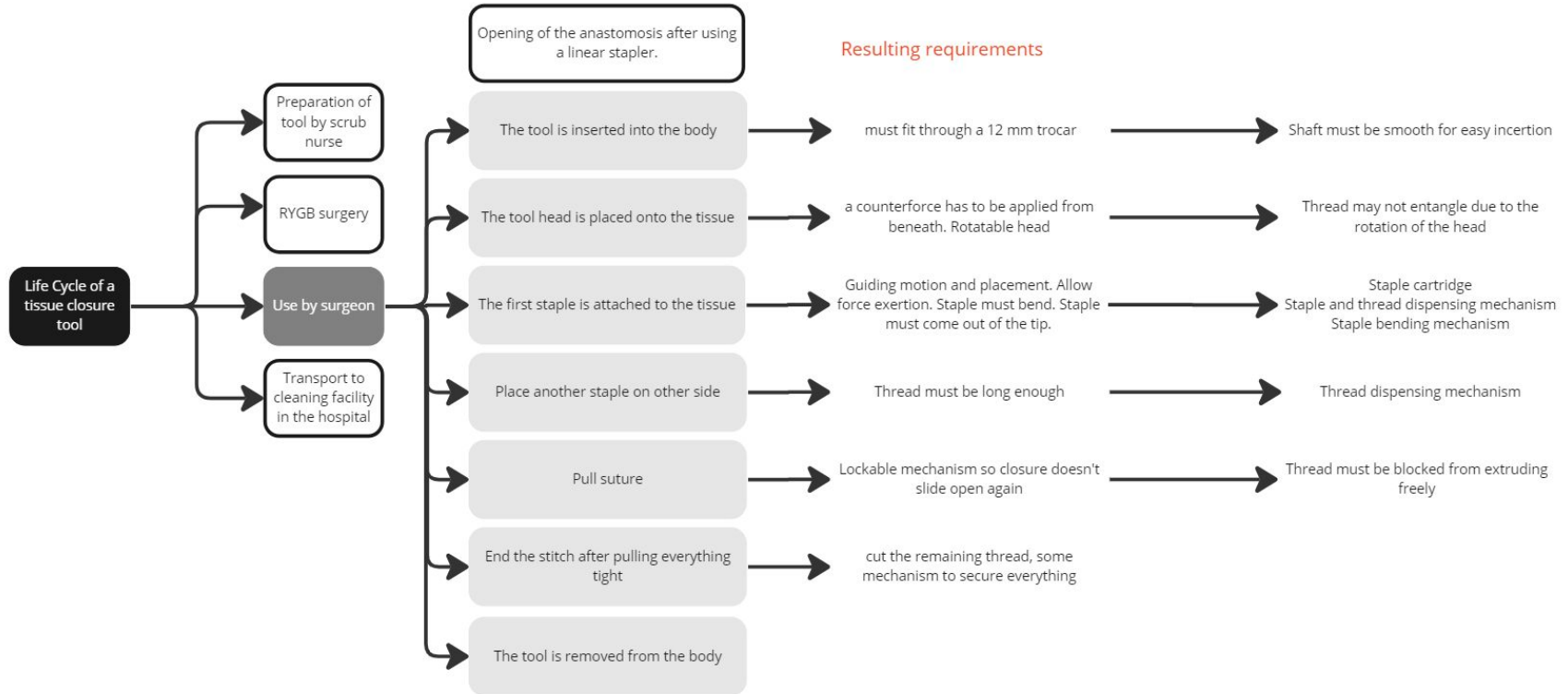
Pokala, B., Giannopoulos, S., & Stefanidis, D. (2022). Prevention and management of internal hernias after bariatric surgery: an expert review. *Mini-invasive Surgery*, 6(4), 23. <https://doi.org/10.20517/2574-1225.2021.136>

Collard, M., Torcivia, A., & Genser, L. (2020). Descriptive anatomy and closure modalities of inter-mesenteric spaces in laparoscopic Roux-en-Y gastric bypass. *Journal of Visceral Surgery*. <https://doi.org/10.1016/j.jviscsurg.2020.09.002>

Sun, Y., Zhang, D., Liu, Y., & Lueth, T. C. (2020). FEM-Based Mechanics Modeling of Bio-Inspired Compliant Mechanisms for Medical Applications. *IEEE Transactions on Medical Robotics and Bionics*, 2(3), 364–373. <https://doi.org/10.1109/tmrb.2020.3011291>

Function Analysis

Delft Design
Guide p. 61



Risk analysis

Severity scale

Rank	Definition	Example
1 Insignificant	No impact on patient safety. No impact on the surgeon. Minor nuisance of <10 minutes for the surgeon, of <10 minutes for the surgeon.	The surgeon briefly maintains an uncomfortable position, has to briefly exert force to place a staple, tissue flap out of the patient. Temporarily reduced product performance.
2 Minor	No impact on patient safety. No nuisance to the surgeon. Discomfort of and/or inconvenience up to 10 minutes for the surgeon.	Nausea, muscle stiffness after operating in an unusual position/posture. Degraded product performance.
3 Moderate	Slight impact on patient safety, no significant harm. Slight impact on the surgeon, no significant harm. Surgery delayed up to 30 minutes. Product failure.	Broken instrument outside the patient's body, instrument failure before use. Loss of product function.
4 Major	Temporary injury to patient, reversible. Broken fragment(s) in patient's body. Surgery delayed > 30 minutes and/or additional surgical interventions needed.	Foreign material inside the patient's body, broken component, revision surgery needed. Safety related product failure.
5 Catastrophic	Significant impact on patient safety, hazard could lead to long-term damage, serious physical injury or even death. Significant impact on the surgeon, hazard could lead to long term damage, serious physical injury or even death.	Organ failure, coma, death. Catastrophic safety related product failure.

These are indicated with a letter S + rank

Occurrence scale

Subjective estimate of occurrence

Rank	Definition	Occurrence probability <small>Logarithmic scale</small>
1 Very unlikely	Extremely rare event. The occurrence of the event is not reproducible. Never occurs during the product lifetime.	$P < 0.01\%$
2 Improbable	Event rarely occurs. There is indirect evidence of the event, could occur due to unusual situations.	$0.01\% > P < 0.1\%$
3 Moderate	Occasional event. There is direct evidence of the event. Occasional occurrence during the product lifetime.	$0.1\% > P > 1\%$
4 Probable	Likely event. There is strong direct evidence of the event. Event could occur regularly during the product lifetime.	$1\% > P > 10\%$
5 Very probable	Near certain occurrence. There is irrefutable direct evidence of the event. The event could repeatedly occur in a single product's lifetime.	$P > 10\%$

These are indicated with a letter O + rank

Risk priority rating

		Occurrence				
		1	2	3	4	5
Severity	1	1	2	3	4	5
	2	2	4	6	8	10
	3	3	6	9	12	15
	4	4	8	12	16	20
	5	5	10	15	20	25

These are indicated with a background colour

Stakeholders



Surgeon



Patient



Scrub nurse



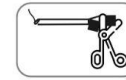
Anesthesiology team



Other hospital personnel



Manufacturer



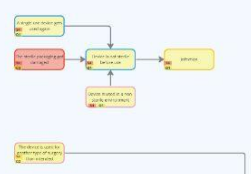
Device

These are indicated with a coloured border

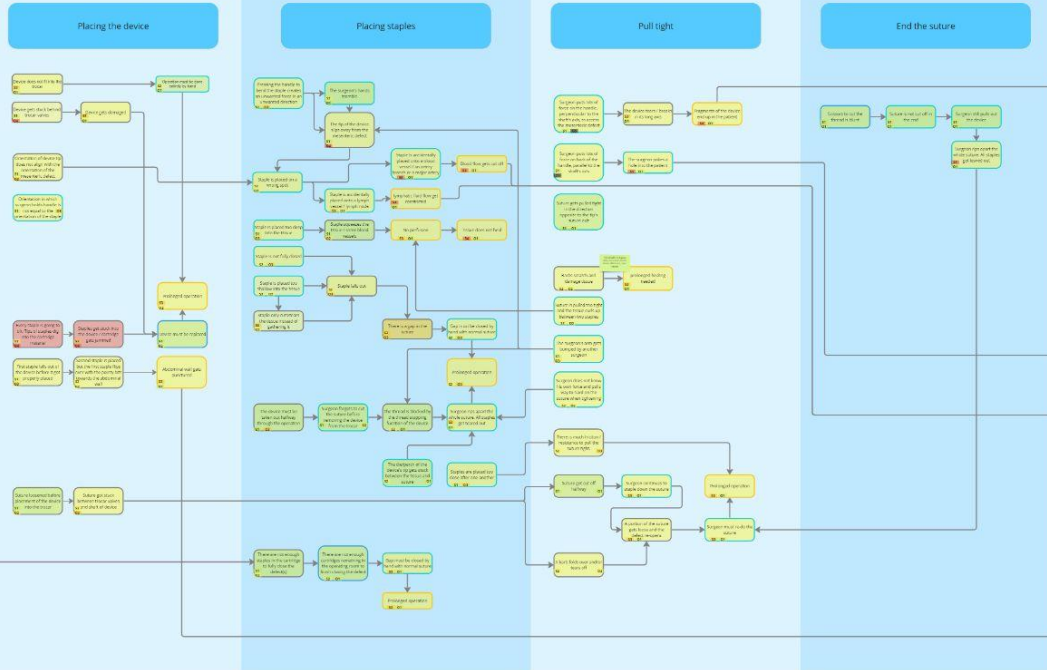
Risk analysis

Before surgery

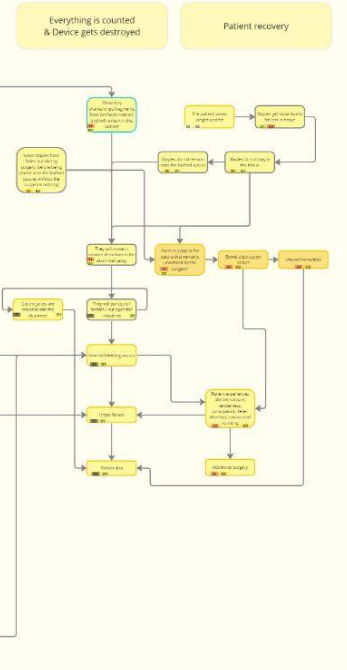
Preparation



During surgery



After surgery



Staple requirements

(a)

PHYSICAL PROPERTIES

- Should have sufficient mechanical and tensile strength to penetrate the tissue.
 - high strength to diameter ratio.
 - It should has a consistent diameter throughout the body
- Pliable, and it should be resistant to shrinkage.
- Easy removal procedure or can be biodegradable
- Easy to sterilize without alterations to its properties
 - Predictability of performance
 - Economical to use

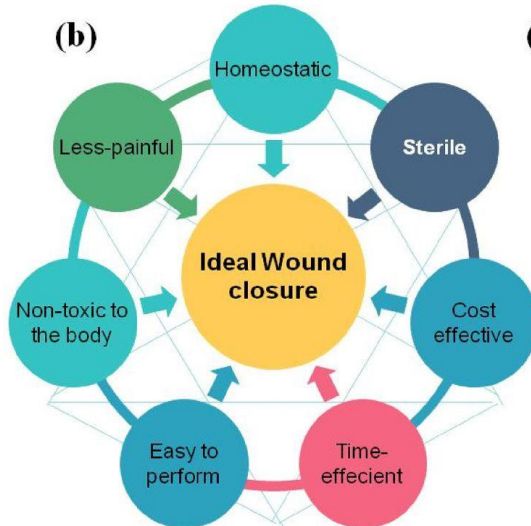
CHEMICAL PROPERTIES

- Non-electrolytic, non-ferromagnetic, non-capillary
- Should not leach any chemicals under physiological condition
- Does not interfere normal biochemical process of human body
- Should not show any cross-reactivity in physiological environment
- Stable in body pH as well as wound pH

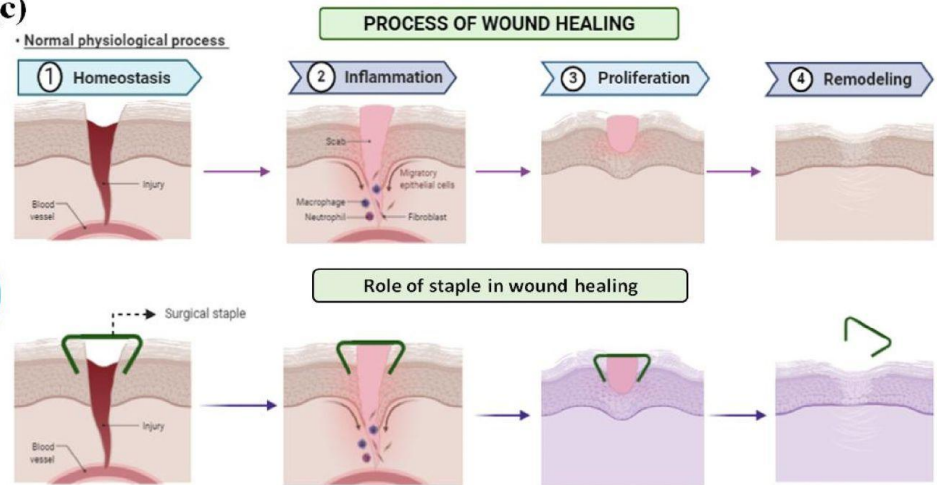
BIOLOGICAL RESPONSES

- would not provide a medium for bacterial growth.
- Should not elicit any hypersensitivity and allergic reaction
 - Non-carcinogenic
 - Has optimal tissue acceptancy
- Absorbed with minimal tissue reaction
- Should not undergoes *in-vivo* corrosion
- Should not generate any toxic chemicals *in-vivo*.
- Does not shows any secondary surgical site infection





















(b)








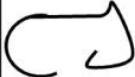


(c)



Staple requirements

<p>Illustration 1</p>  <p>Acceptable Condition: Ideal "B-shape" (Both points even with crown)</p>	<p>Illustration 2</p>  <p>Acceptable Condition: Ideal "B-shape" (Both points below crown)</p>	<p>Illustration 3</p>  <p>Acceptable Condition: Ideal "B-shape" (Both points below crown)</p>	<p>Illustration 4</p>  <p>Acceptable Condition: Ideal "B-shape" (Both points below crown)</p>
<p>Illustration 5</p>  <p>Acceptable Condition: Unbalanced "B-shape" (Different size loops)</p>	<p>Illustration 6</p>  <p>Acceptable Condition: Unbalanced "B-shape" (Different size loops and right point above crown)</p>	<p>Illustration 7</p>  <p>Acceptable Condition: Unbalanced "B-shape" (Different size loops)</p>	<p>Illustration 8</p>  <p>Acceptable Condition: Unbalanced "B-shape" (Different size loops)</p>
<p>Illustration 9</p>  <p>Acceptable Condition: Unbalanced "B-shape" (Left leg approaching parallel to crown)</p>	<p>Illustration 10</p>  <p>Acceptable Condition: Distorted "B-shape" (Both legs pointing towards crown)</p>	<p>Illustration 11</p>  <p>Acceptable Condition: Bowed crown (Loops formed crown bowed)</p>	<p>Illustration 12</p>  <p>Acceptable Condition: Distorted crown (Loops formed crown bent or distorted)</p>
<p>Illustration 1</p>  <p>Unacceptable Condition: Right leg is non-conforming (Pointing away from crown)</p>	<p>Illustration 2</p>  <p>Unacceptable Condition: Both legs are non-conforming (Pointing away from crown)</p>	<p>Illustration 3</p>  <p>Unacceptable Condition: Left leg is non-conforming (Pointing away from crown)</p>	<p>Illustration 4</p>  <p>Unacceptable Condition: Left leg is non-conforming (Pointing away from crown)</p>
<p>Illustration 5</p>  <p>Unacceptable Condition: Both legs are non-conforming (Legs partially formed - crown folded)</p>	<p>Illustration 6</p>  <p>Unacceptable Condition: Both legs are non-conforming (Misdirected forming)</p>	<p>Illustration 7</p>  <p>Unacceptable Condition: Left leg is non-conforming (Pointing away from crown)</p>	<p>Illustration 8</p>  <p>Unacceptable Condition: Right leg is non-conforming (Pointing away from crown)</p>

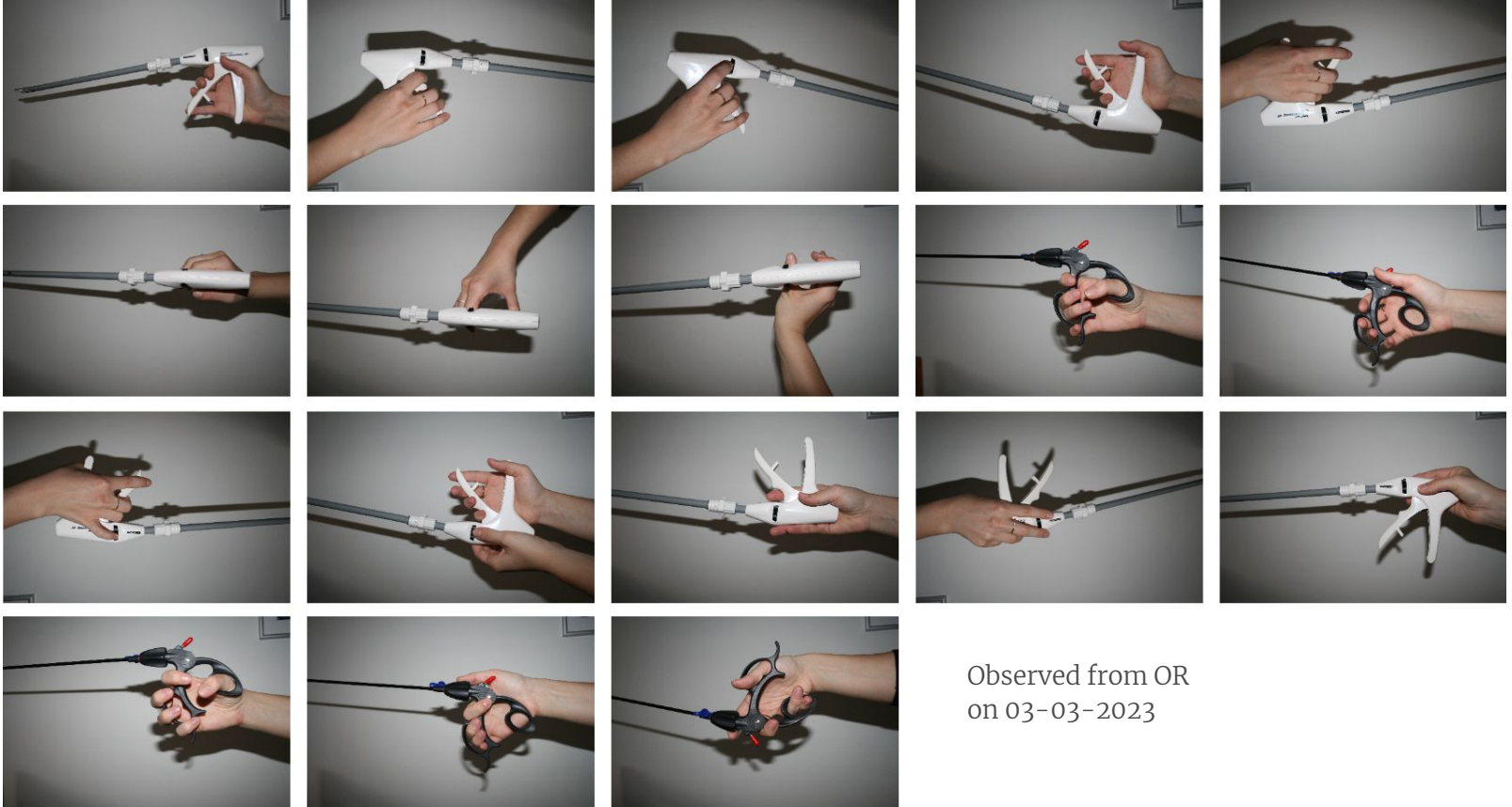
Clinically Accepted Designs	Clinically Un-accepted Designs
 <ul style="list-style-type: none"> Uniform B-shaped Same size leg 	 <ul style="list-style-type: none"> Un-uniform shaped Un-uniform deformed leg
 <ul style="list-style-type: none"> Un-uniform B-shaped Same size leg but incomplete 	 <ul style="list-style-type: none"> Uniform shaped Uniform deformed leg, outside head
 <ul style="list-style-type: none"> Uniform B-shaped Same size leg but completely closed 	 <ul style="list-style-type: none"> Uniform shaped Uniform deformed leg, extended side parts
 <ul style="list-style-type: none"> Un-uniform B-shaped Un-uniform deformed leg 	 <ul style="list-style-type: none"> Un-uniform shaped Right leg deformation

Disposed instruments

- Mostly single-use and disposable
 - Cheap materialisation and production
 - Some instruments leaked blood at handle
 - Get incinerated



Hand positions



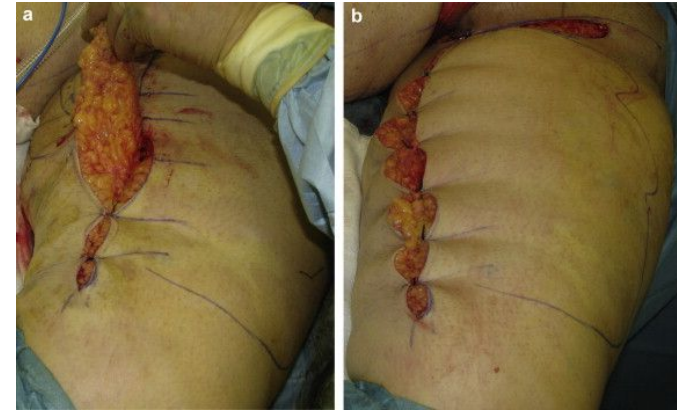
Observed from OR
on 03-03-2023

Suture Staple strength

Intraoperative photograph showing skin staples placed outside the skin markings at the level of the hash marks on the right thigh (medial view) in a female patient. b. The same patient shown with the staples brought together as a bootlace using silk sutures (medial view).



Intraoperative photograph of the same patient shown in Figure 1 demonstrating the operative technique on the left thigh. As the dissection is continued proximally paired staples immediately below the level of resection are reapproximated using silk sutures (anteromedial view). b. The same patient shown with the bootlace closure applied to the whole thigh prior to final closure (anteromedial view).



We have found that the bootlace thighplasty technique using a staple and suture system ensures that the correct amount of skin is excised with even tissue tension, and is therefore superior to skin pinch or simple tailor tacking with staples.⁴ Our refinement of planning and closure in thighplasty ensures simple, safer resection of tissues, reduced intraoperative oedema, and facilitated closure. This technique is easily reproducible, produces a more predictable result, with potentially fewer scars, and optimised soft tissue contouring. This diminishes the risk of excessive tension resulting in skin necrosis and dehiscence and may reduce the requirement for revision surgery. The new technique does not add surgical time to thighplasty as it is more precise, reducing the need for adjustments, and staples are not replaced during closure.

#0A6EBD

#5A96E3

#A1C2F1

Poppins and Merriweather