

NOTES

inventing the future of surgery

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IRCAD
University of Strasbourg
France*

Disruptive innovation

An innovation that creates a new market by applying a different set of value which ultimately and ... unexpectedly overtakes an existing market



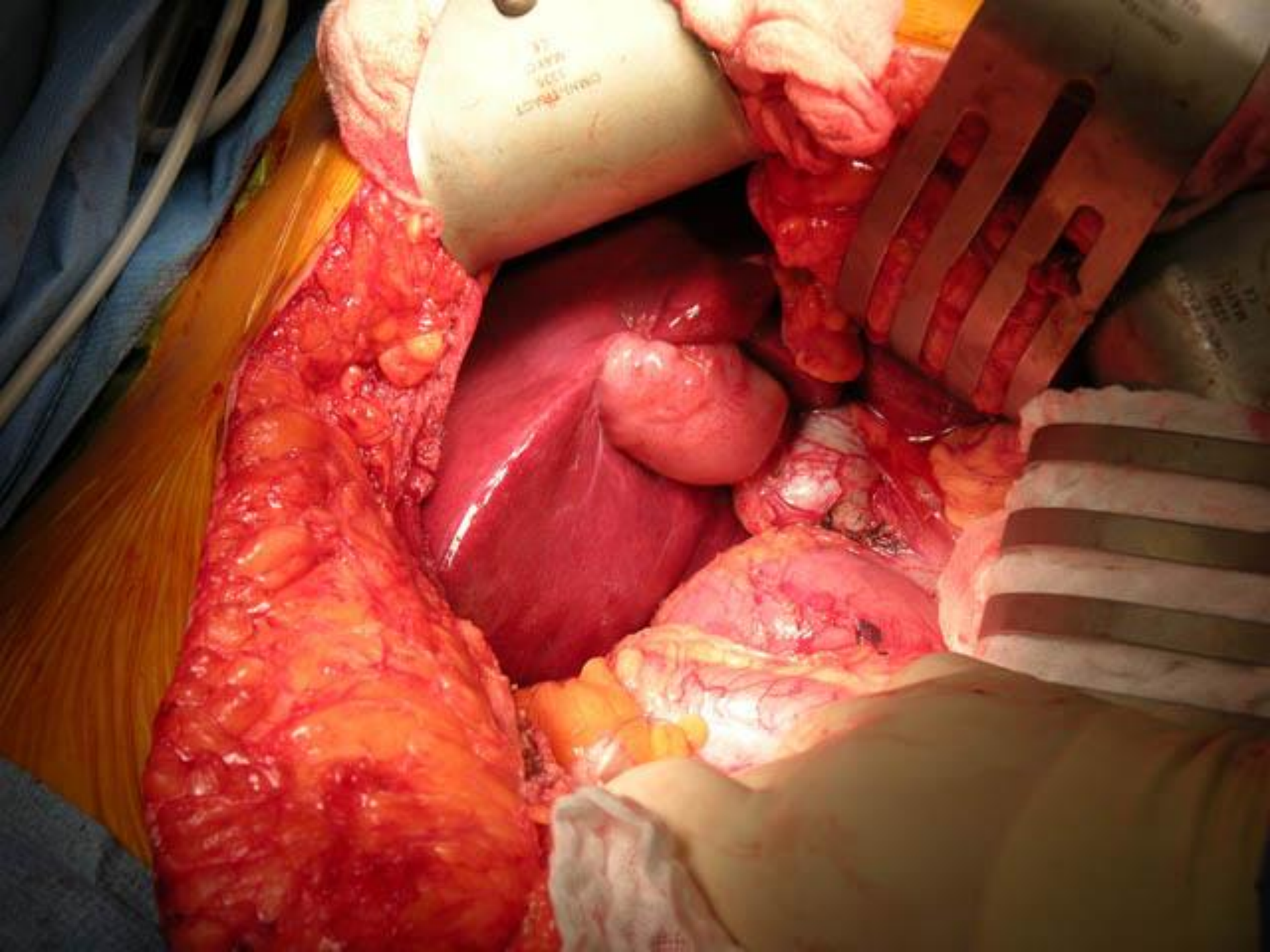
“The abolishment of pain in surgery is a chimera.
It is absurd to go on seeking it...

Knife and pain are two words in surgery that must
forever be associated in the consciousness of the patient”

Dr. Alfred Velpeau, French surgeon, 1839.

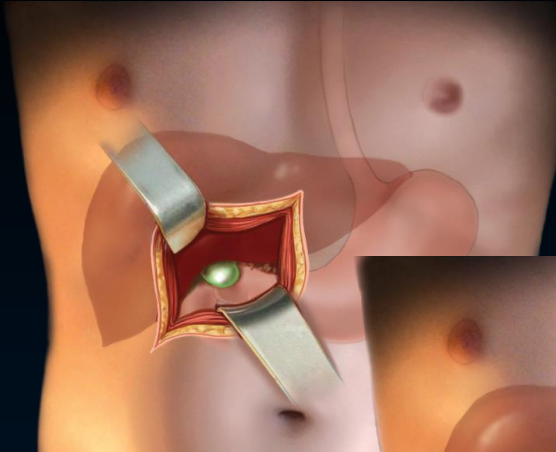
“ We can surely never hope to see the craft of surgery
made much more perfect than it is today.
We are at the end of a chapter ”

1930, Berkeley G.A. Moynihan

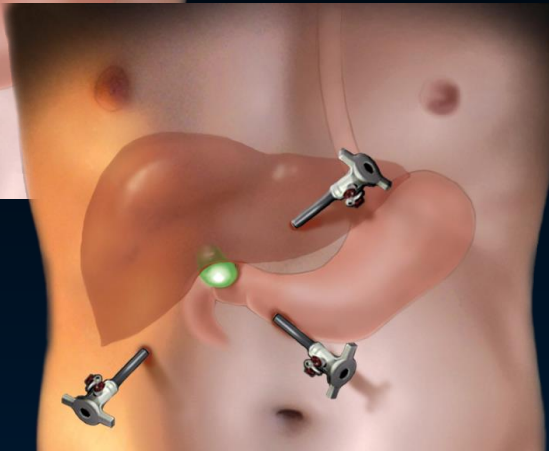


Minimal Access Surgery

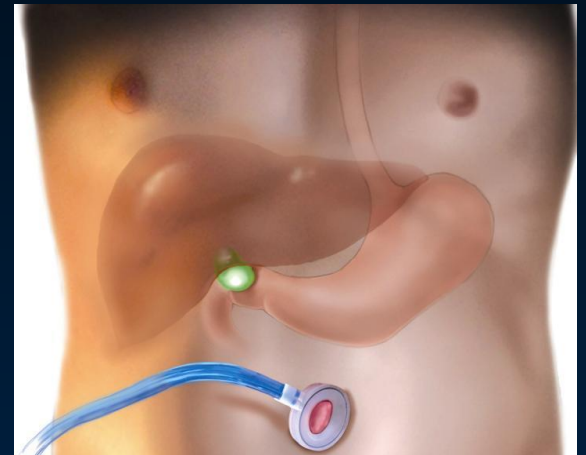
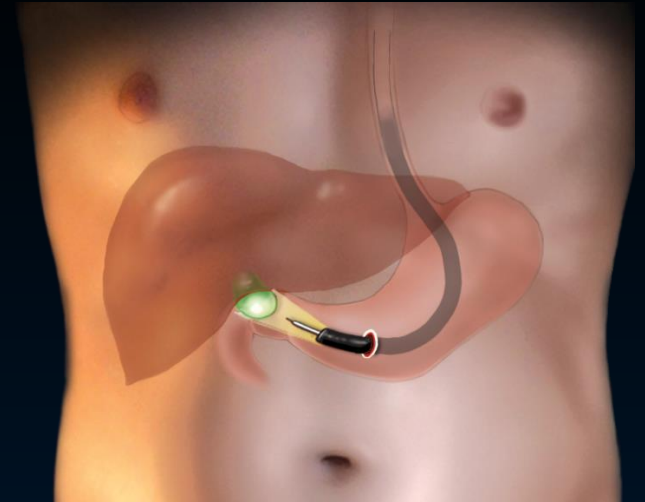
1886



1987



2010



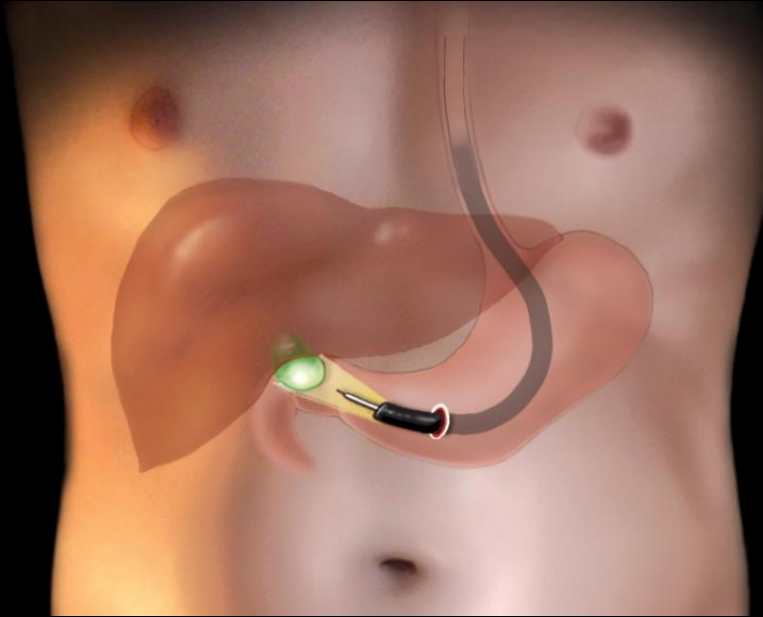
What is N.O.T.E.S.™ ?

Natural Orifice Transluminal Endoscopic Surgery

White Paper 2005
ASGE & SAGES

*...The natural orifices may provide the entry point for surgical interventions in the peritoneal cavity, **thereby avoiding abdominal wall incisions...***

NOTES : NO SCAR surgery



- No abdominal wall incision
 - scars
 - wound infection
 - incisional hernias
- Less physiologic stress ?
- Faster recovery ?

Optimal site for peritoneal access

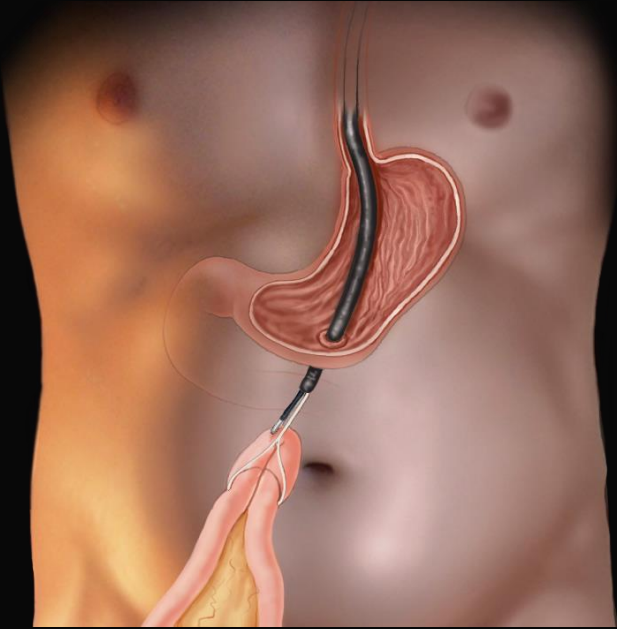
Organ retraction

Triangulation

Tissue approximation

Control of intra-operative complications

N.O.T.E.S: Challenges



1. Access & closure
2. Exposure-retraction
3. Instrumentation
4. Training

Access to the peritoneal cavity

Single or Combined

Transvaginal

Transcolonic

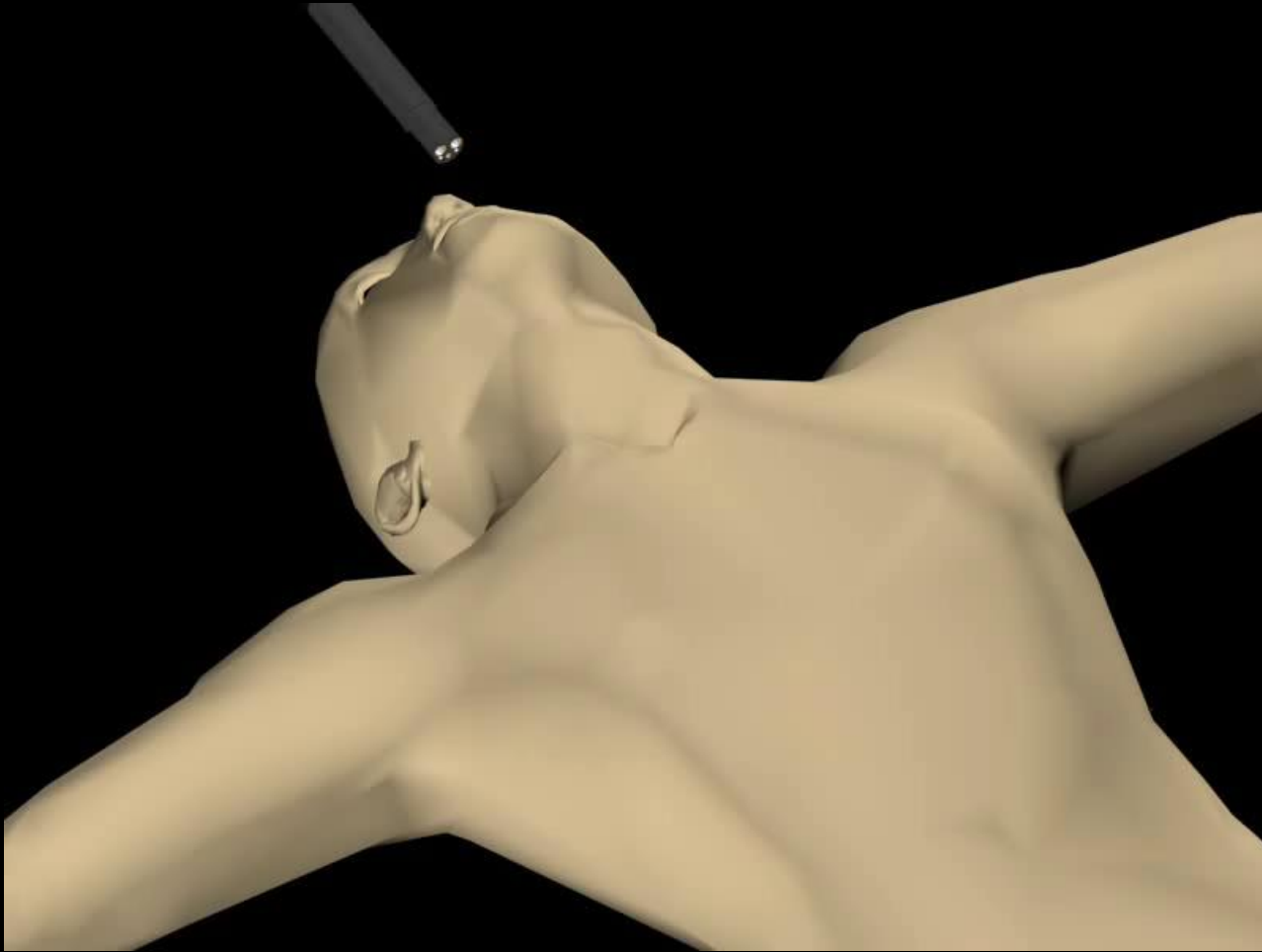
Transgastric

Transvesical

Techniques of access

Closure: ZERO tolerance

Transgastric Access



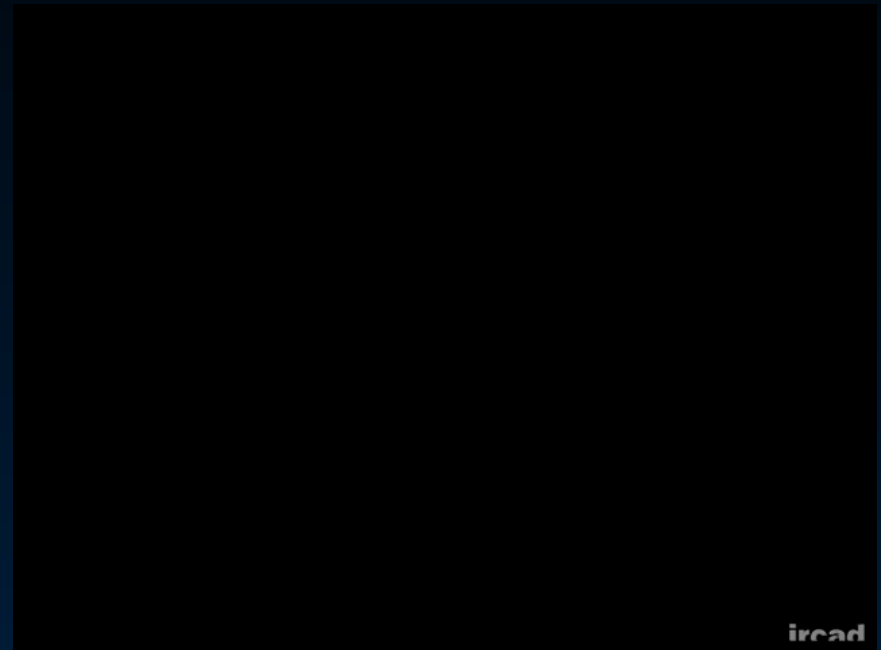
Transgastric Access

1. Techniques of Gastrotomy

Free Cut

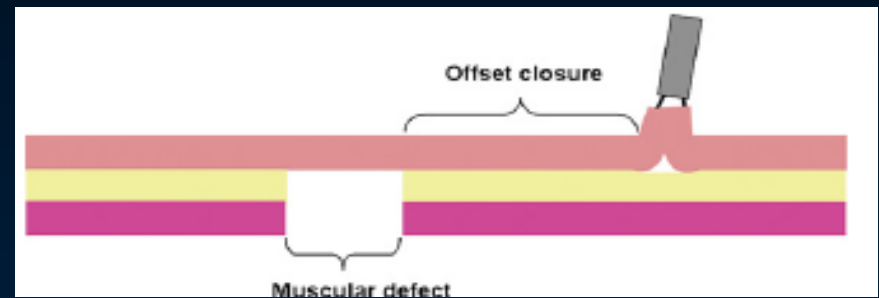
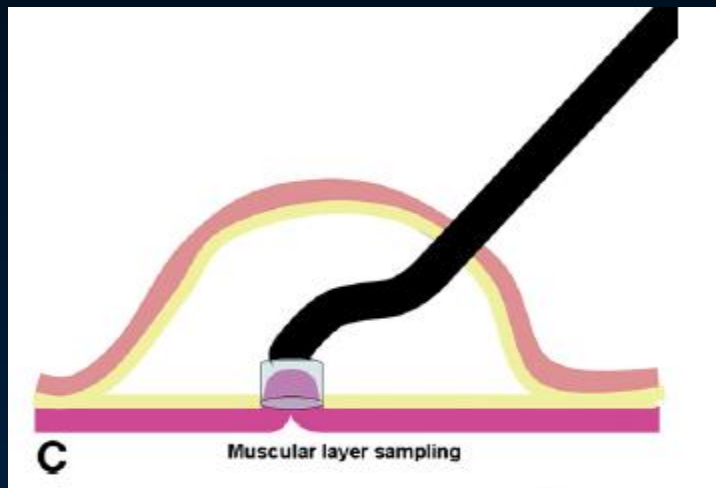
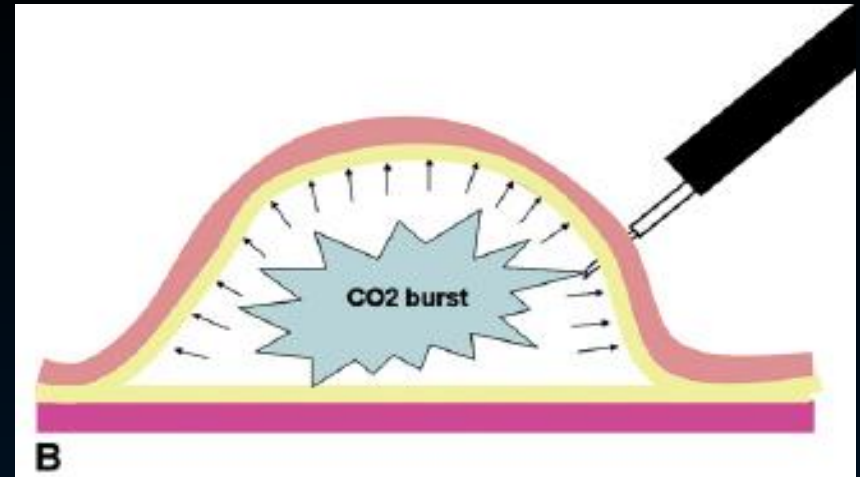
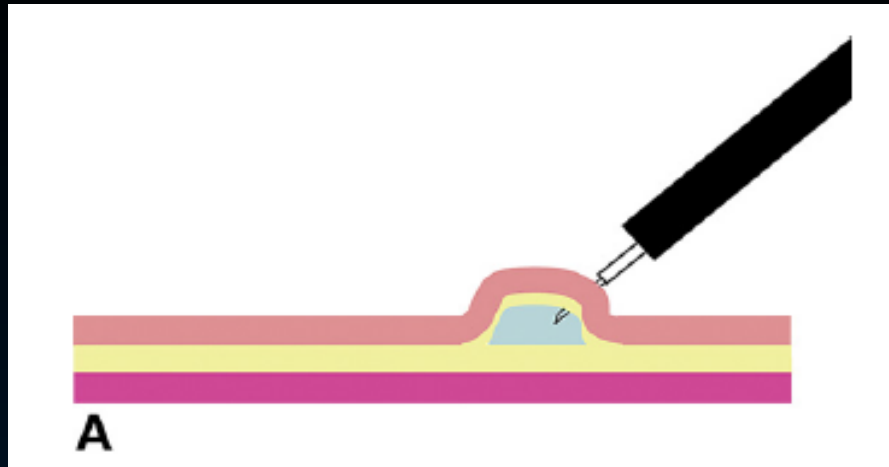


PEG + Balloon Dilatation



Transgastric Access

1. Techniques of Gastrotomy



Sumiyama et al. *Gastrointest Endosc* 2007

Techniques of Closure

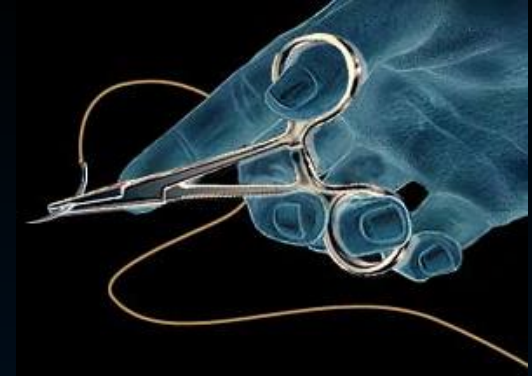
Technology	Author	Year
Endoclips	Kalloo	2004
	Raju	2006
	Pai	2006
Suturing	Hu	2005
NDO plic.	McGee	2007
Occluder	Perretta	2007
T- Fasteners	Sumiyama	2007
Plugs	Clos	2007
G-Prox	Swanstrom	2007
Gastrotomy Tube	McGee	2008
Stapler	Meireles	2008

Closure techniques

Ideal closure...

Effective and safe:

- Under vision
- Select bite + select suture
- Good tissue approximation
- Intracorporeal reload
- Easy to use
- Cost effective



Transgastric Access

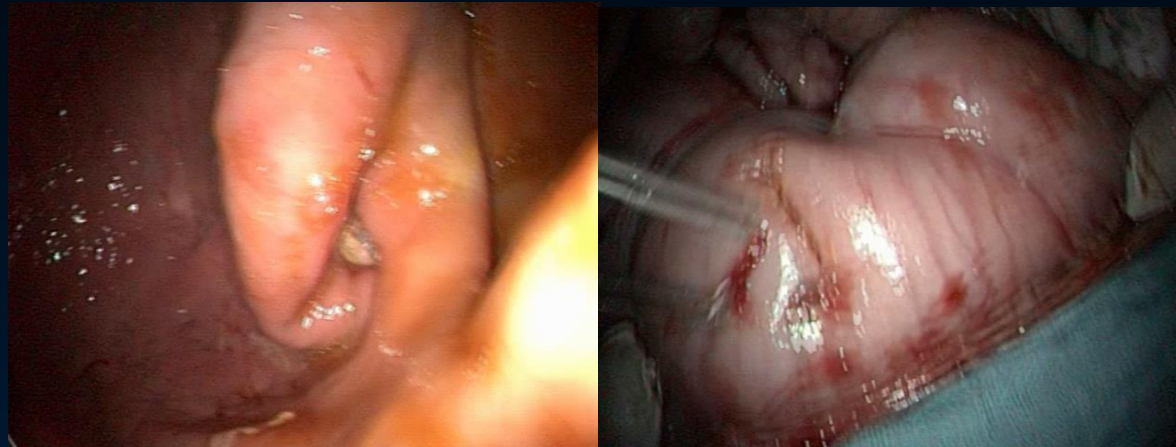
2. Techniques Gastrotomy Closure

1. Endoclips (Olympus, Boston...)

1 endoscope



2 endoscopes



Transgastric Access

2. Techniques Gastrotomy Closure

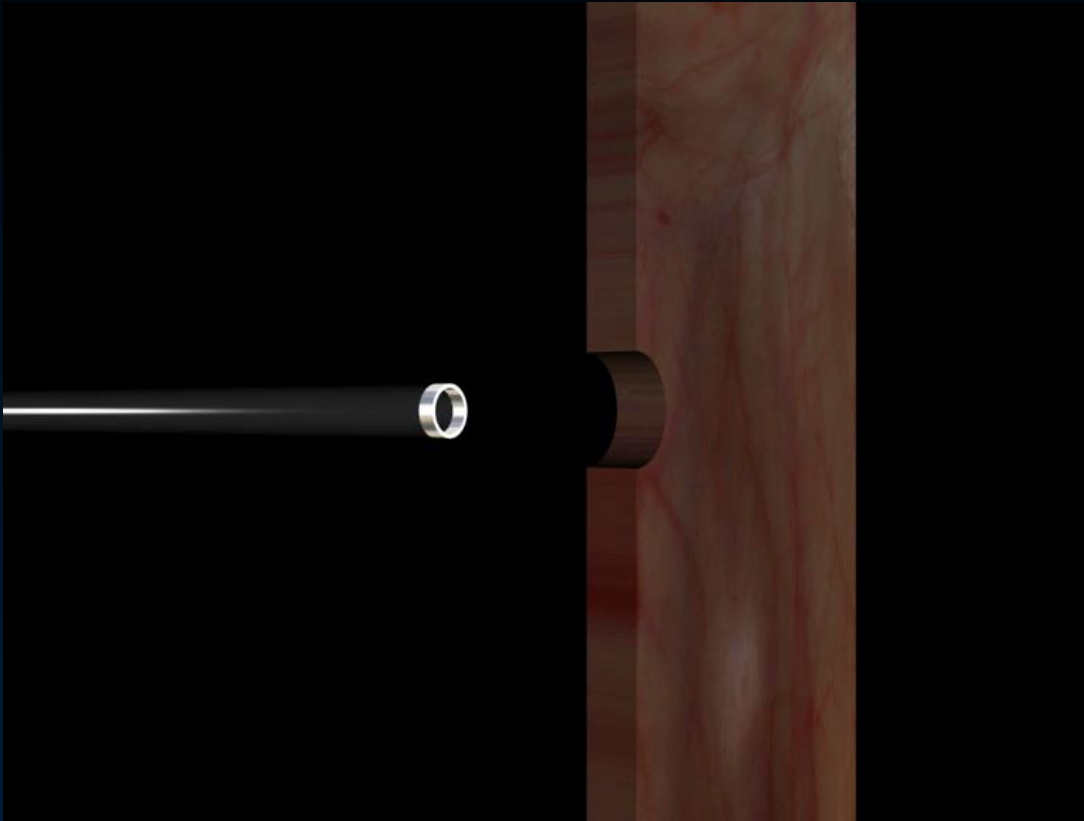
OTSC clip



Transgastric Access

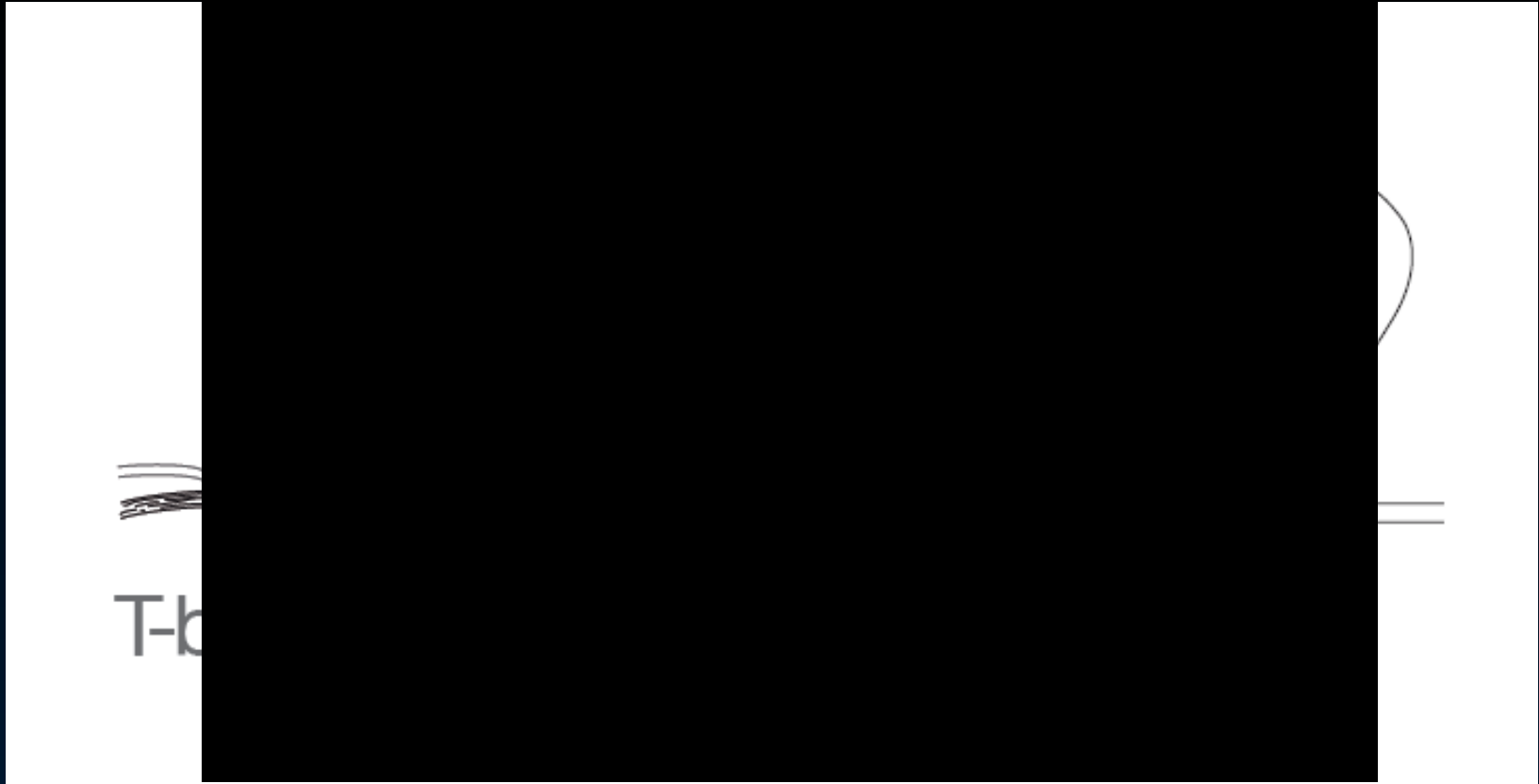
2. Techniques Gastrotomy Closure

Occluder



Closure techniques

2. Techniques Gastrostomy Closure

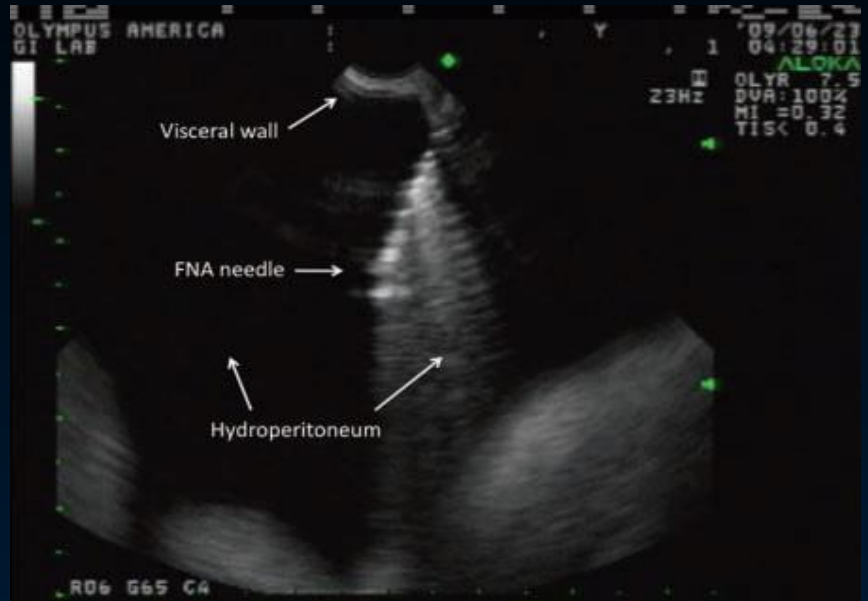


Sumiyama et al Gastrointest Endosc 2007.

Trans-gastric access

Access Techniques : T-bars

Technique AVEUGLE : ultrason endoscopique



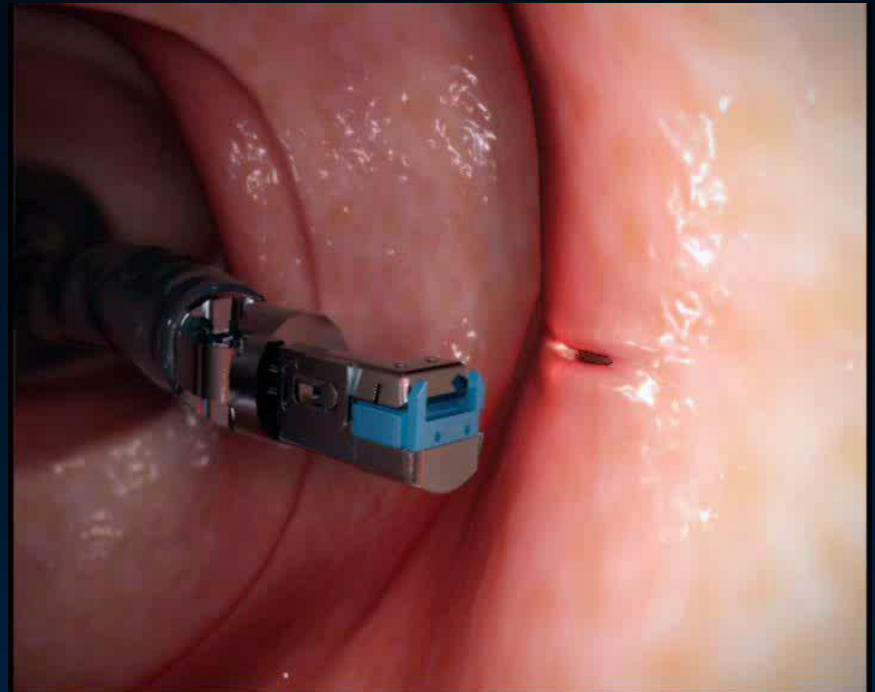
Elmunzer et al. Surgical Innovation 2010

Closure techniques

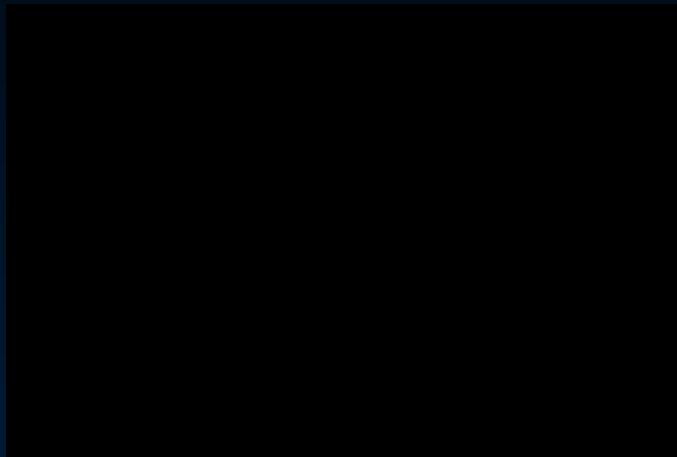


G-Prox™ USGI

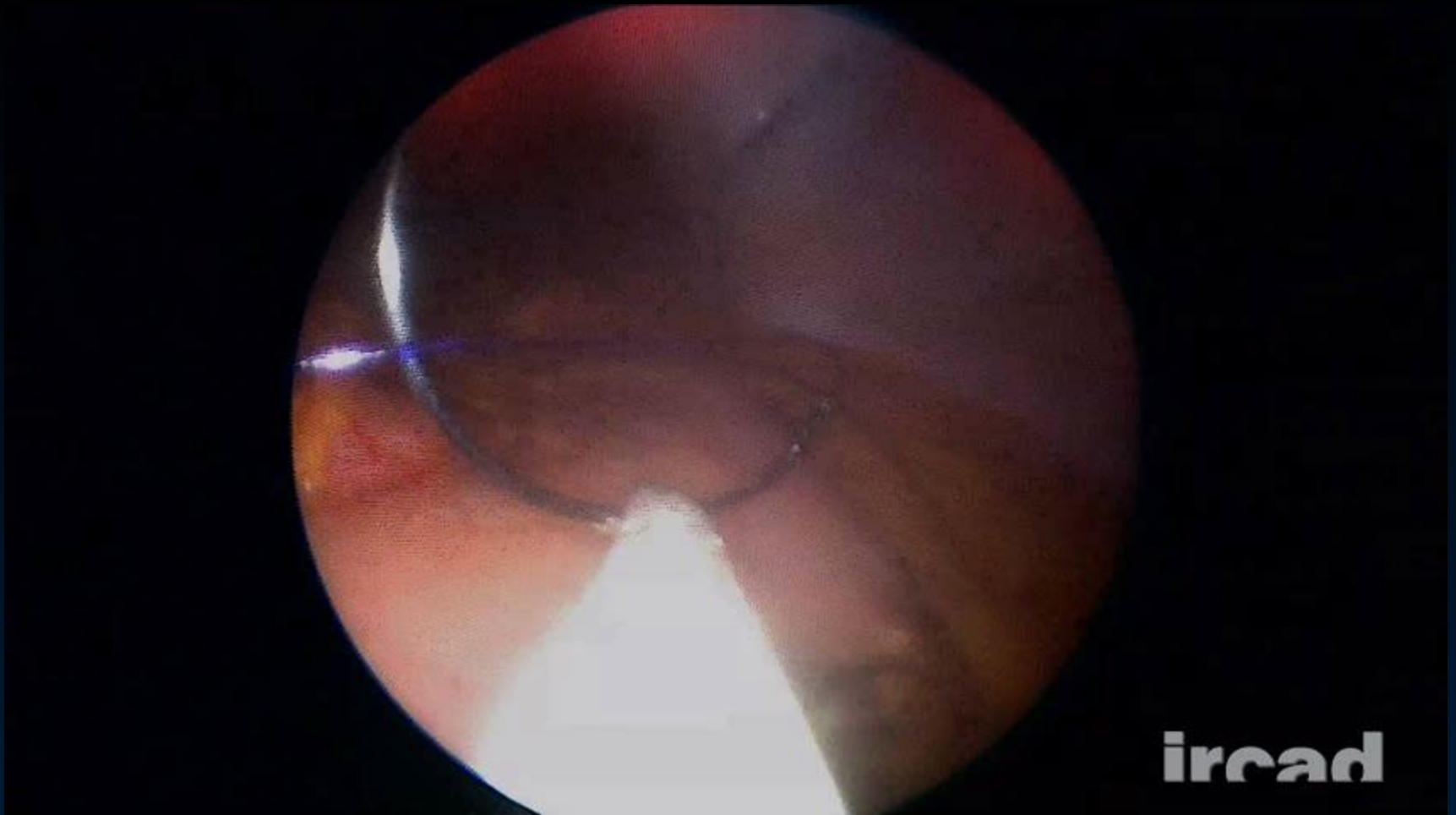
Power Medical Intervention



Overstitch



Closure techniques

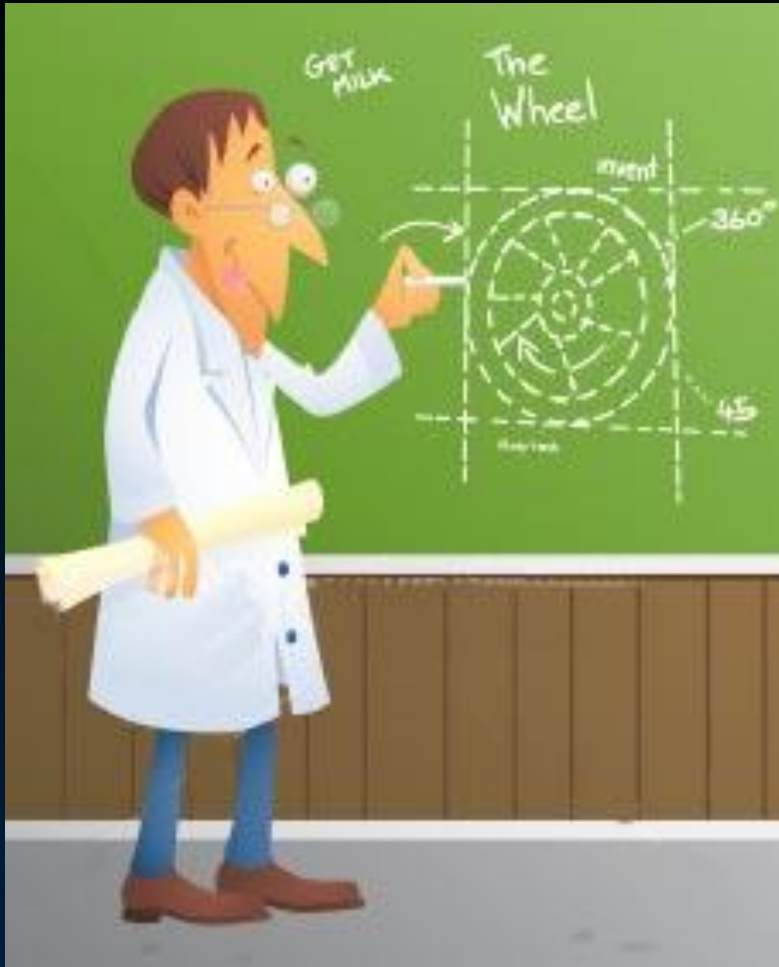




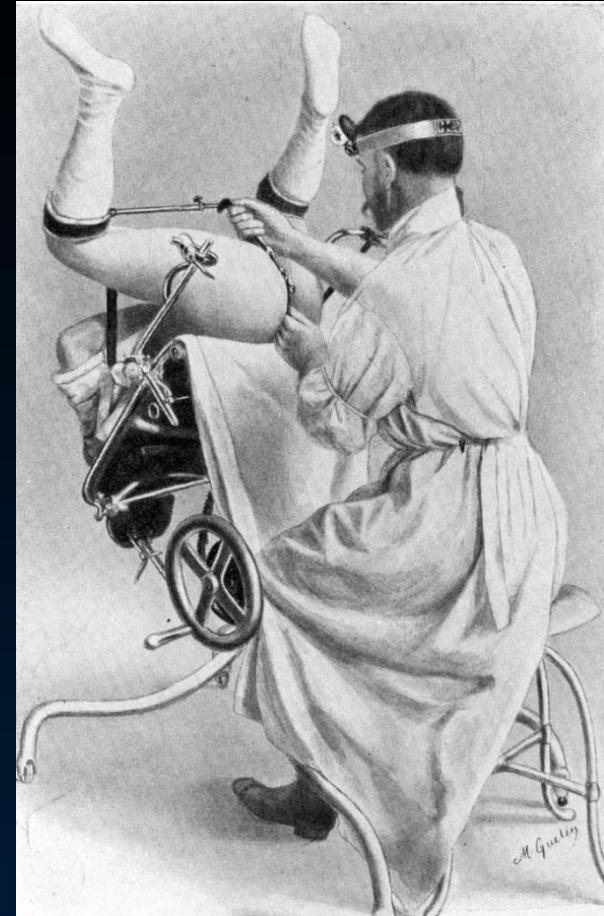
410 experimental procedures



Transvaginal Surgery



ТРАНСВАГИНАЛЬНЫЙ ДОСТУП



Д.О. Отт
«Оперативная гинекология» (1914)

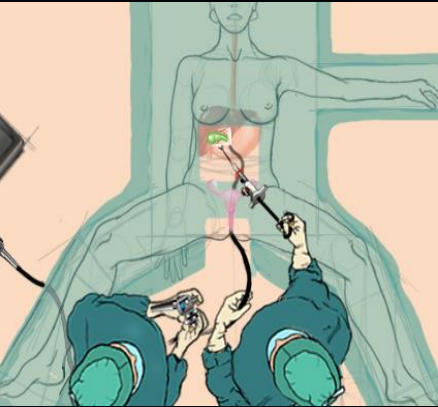
Vaginal surgery.....no news

- ✓ Genital prolapse
- ✓ Stress incontinence
- ✓ Vaginal hysterectomy
- ✓ Abnormal anatomy (vaginal septum, ...)
- ✓ Endoscopy (culdoscopy, hysteroscopy, fertiloscopy)
- ✓ First vaginal appendectomy (1949) !!!
- ✓ D & C
- ✓ Delivery
 - Episiotomy

NOTES transvaginal Cholecystectomy

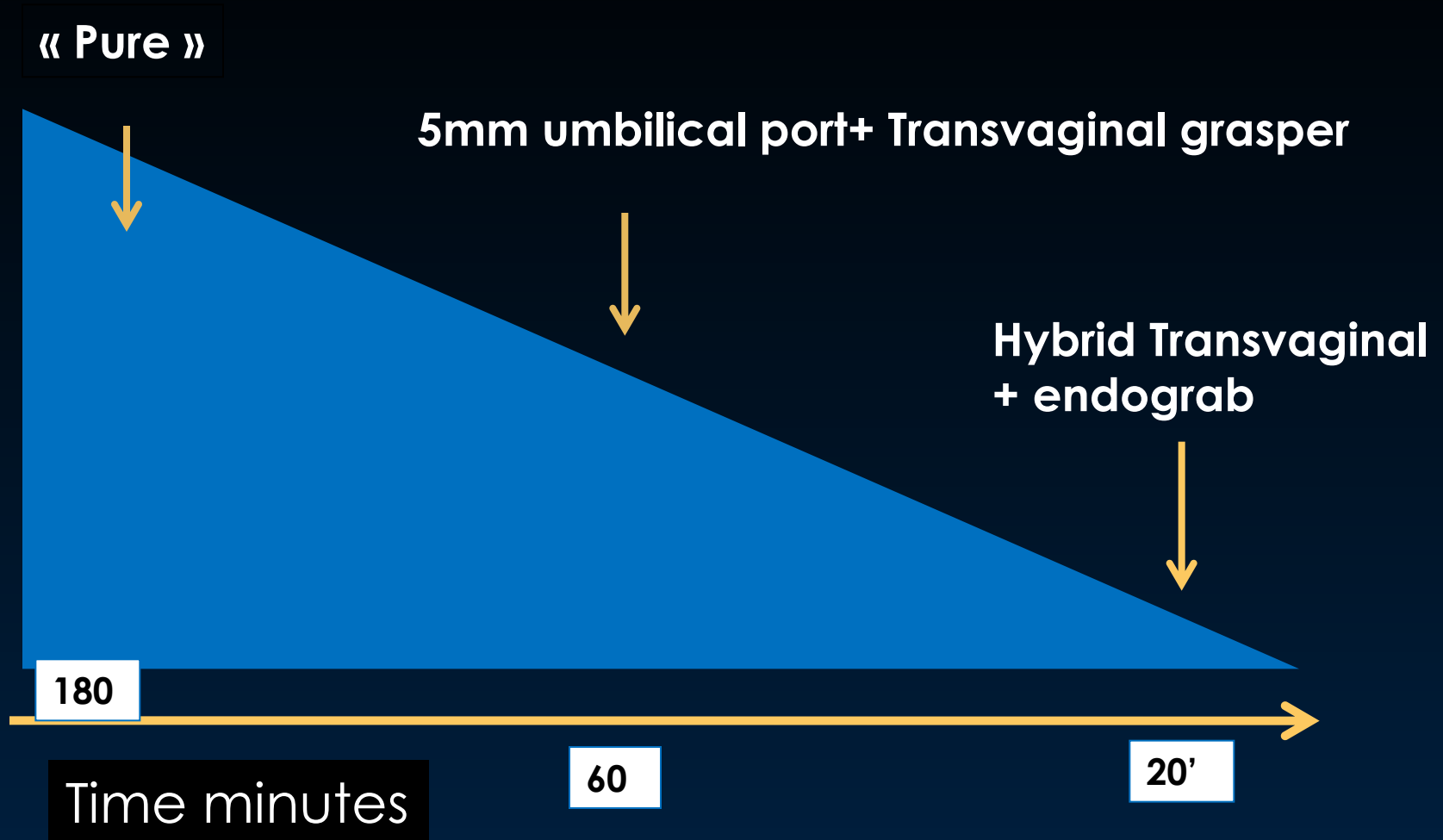


NOTES hybrid transvaginal technique

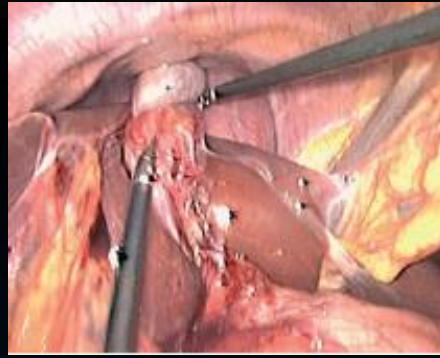
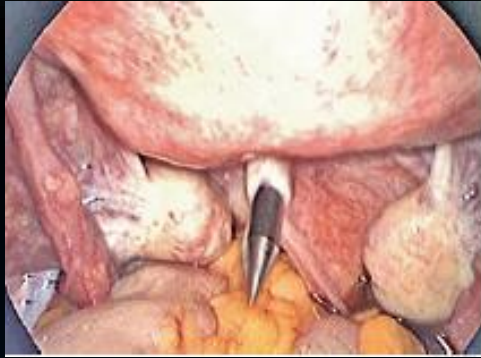


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Evolution of the technique

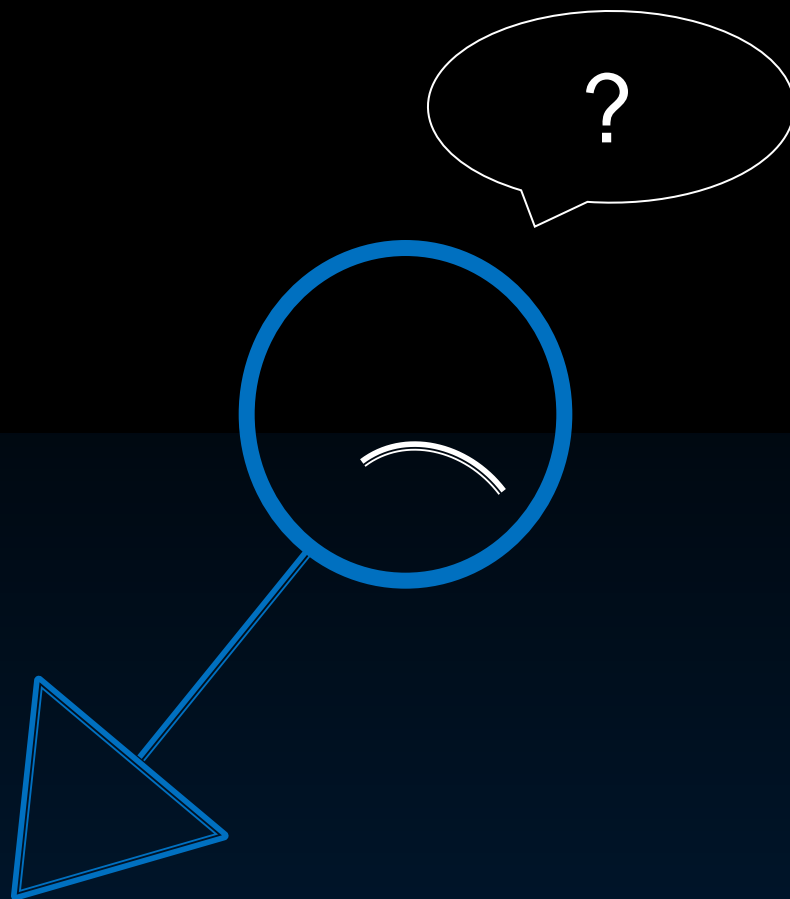
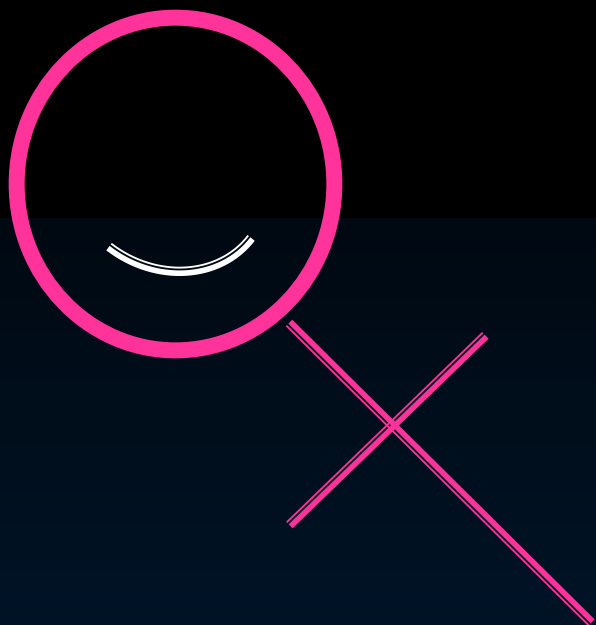


Transvaginal cholecystectomy - laparoscopy

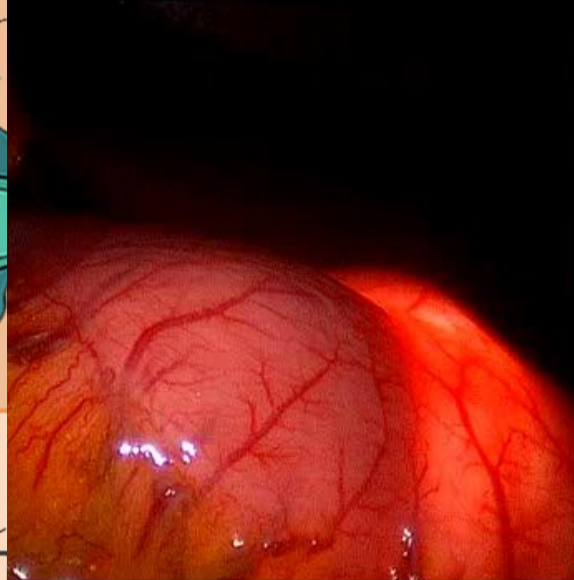
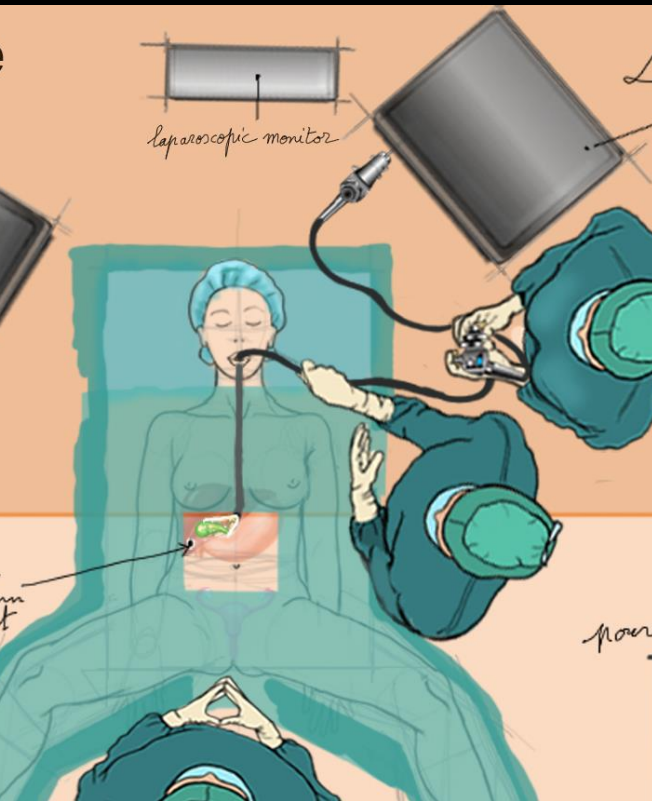


C. Zornig, et al. Endoscopy 2009

German NOTES Registry: more than 1000 patients registered with transvaginal laparoscopic procedures



Transgastric cholecystectomy



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NOTES : Challenges

Transgastric access



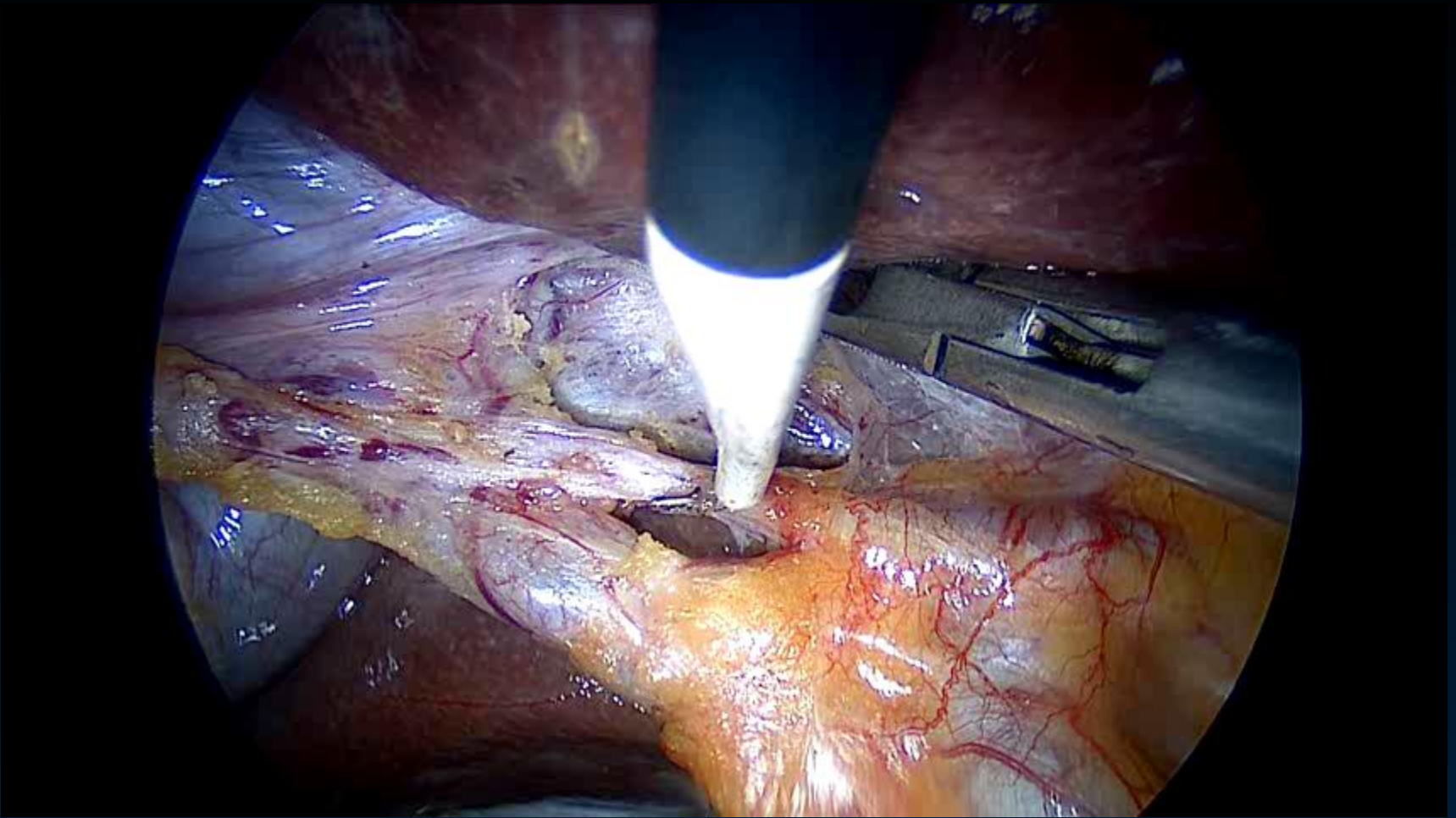
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Ergonomics

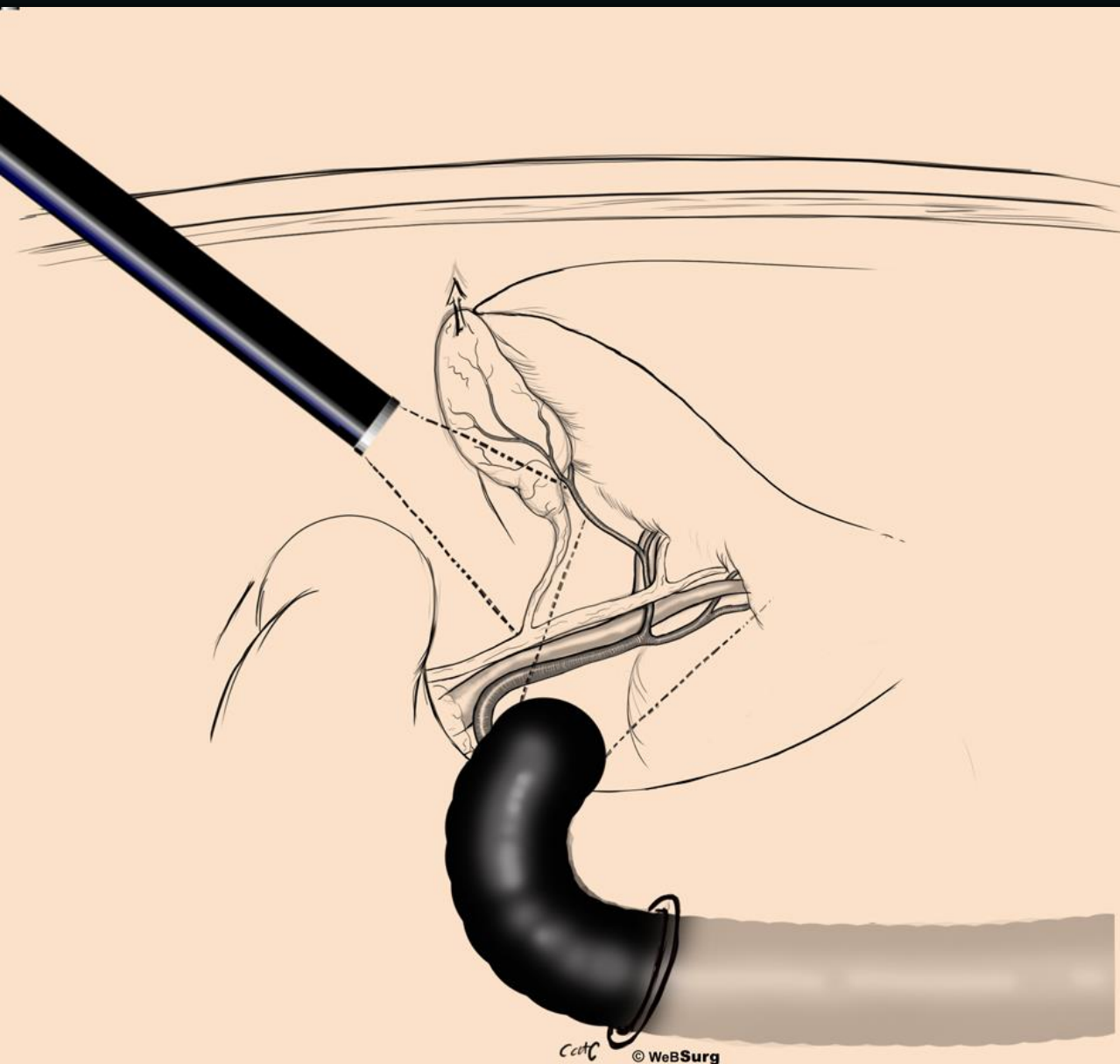


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Laparoscopic cholecystectomy



Transgastric Hybrid Cholecystectomy



NOTES: Challenges

Optimal site for peritoneal access

Organ retraction

Triangulation

Tissue approximation

Problems

- Poor tools

- **scopes**

- Too flexible
 - Not fixed
 - small channels
 - parallel – close proximity : **!!! Triangulation !!!**

- **Instruments**

- Small
 - Poor grasp strength
 - No control at tip

- User interface

- Not ergonomic
 - Requires multiple assistants



2005

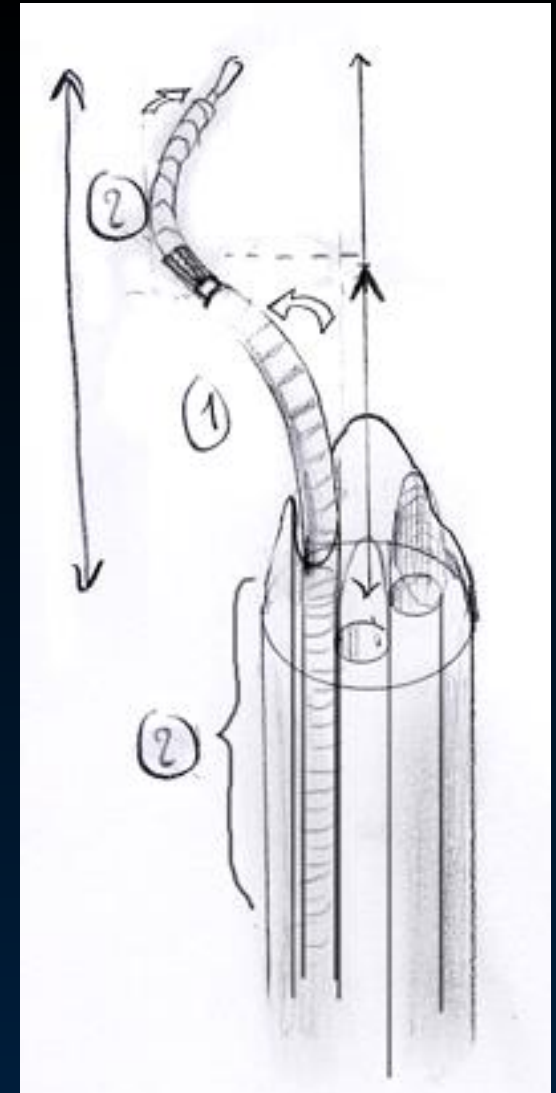
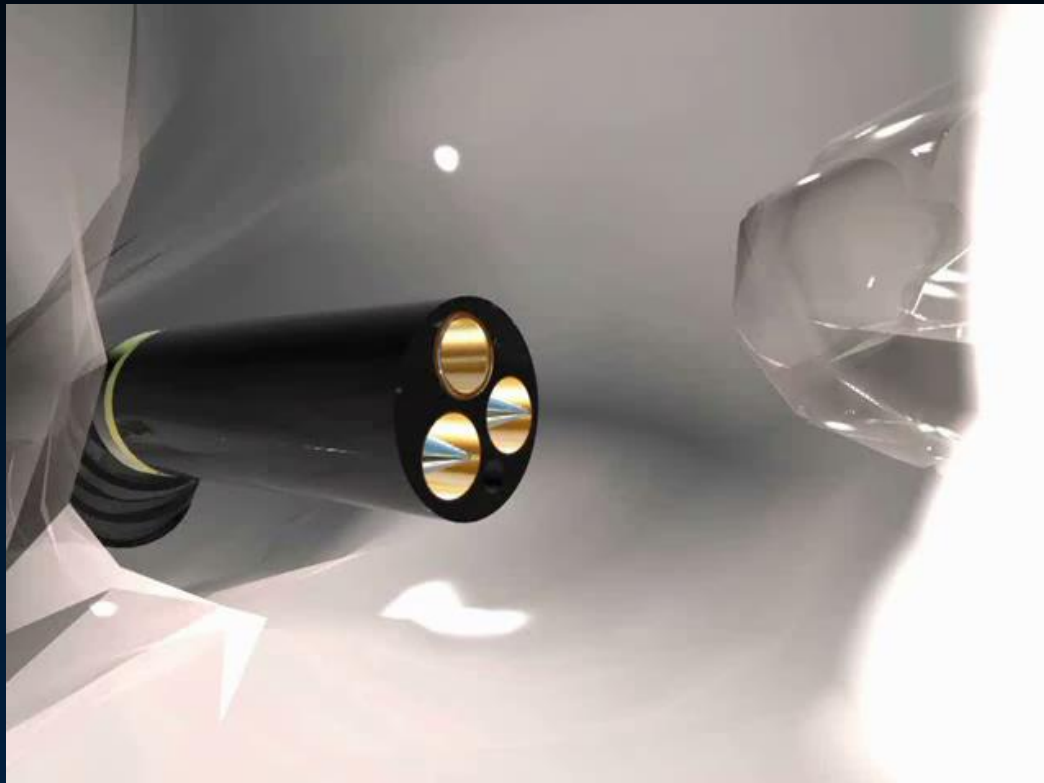
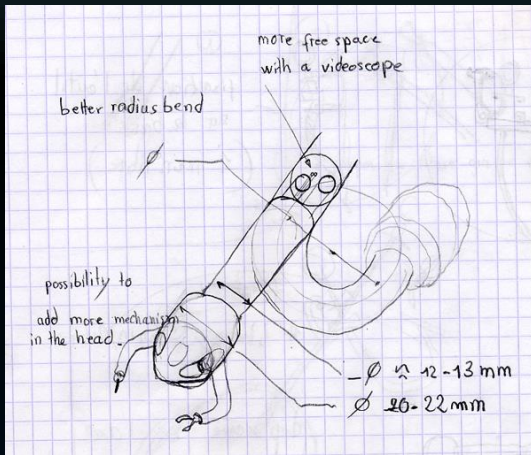


2005



User FRIENDLY interface ?

2006

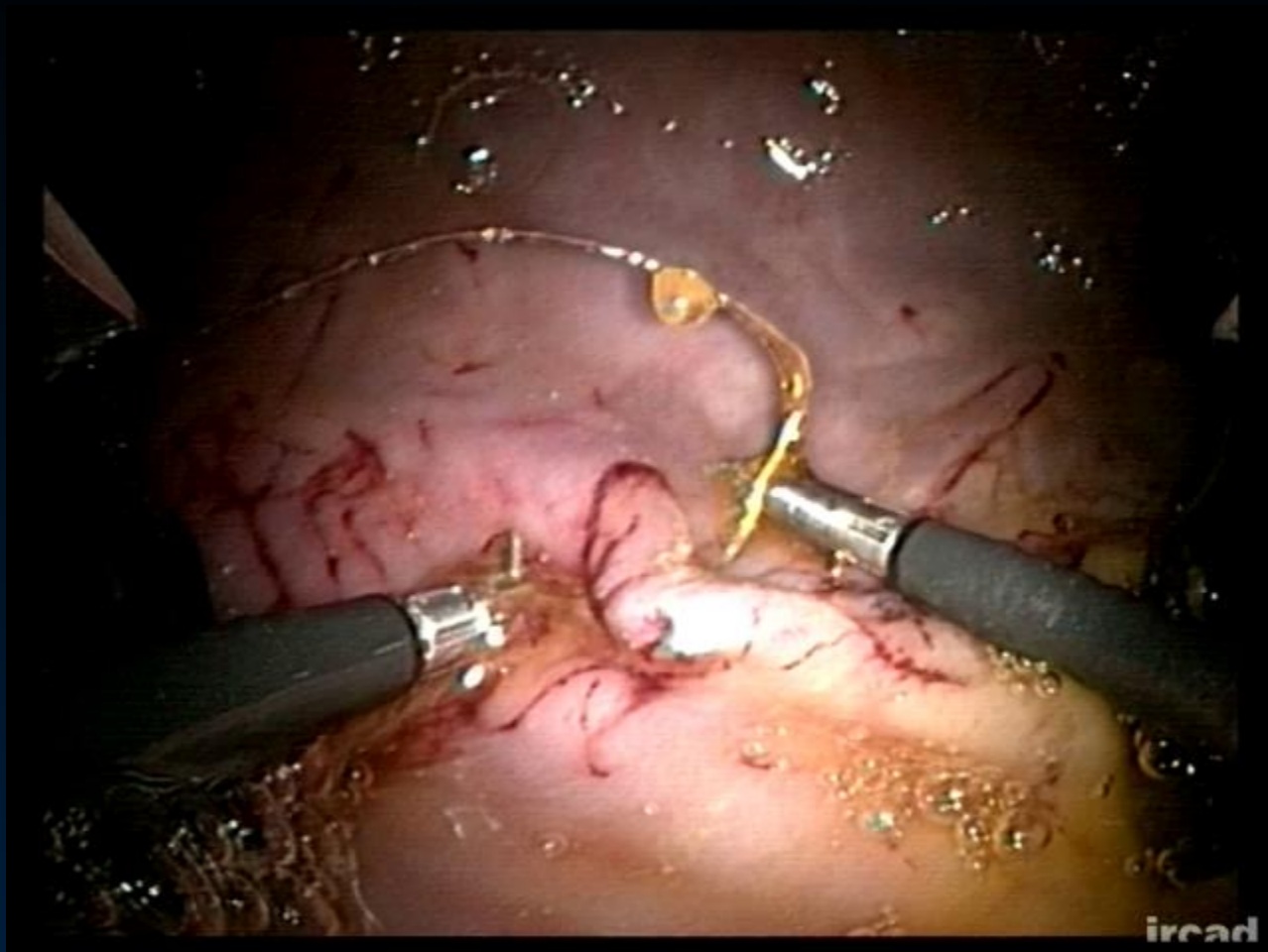


Anubiscope

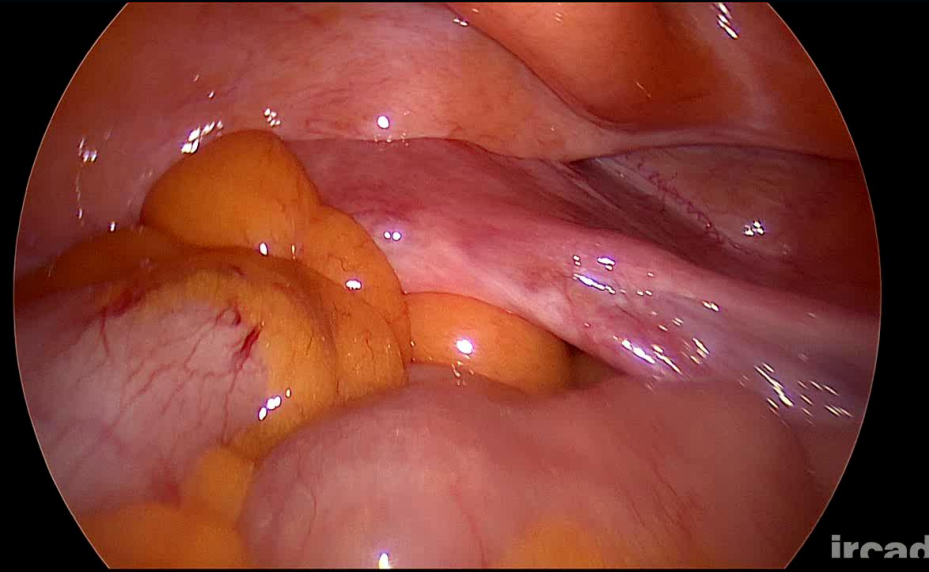
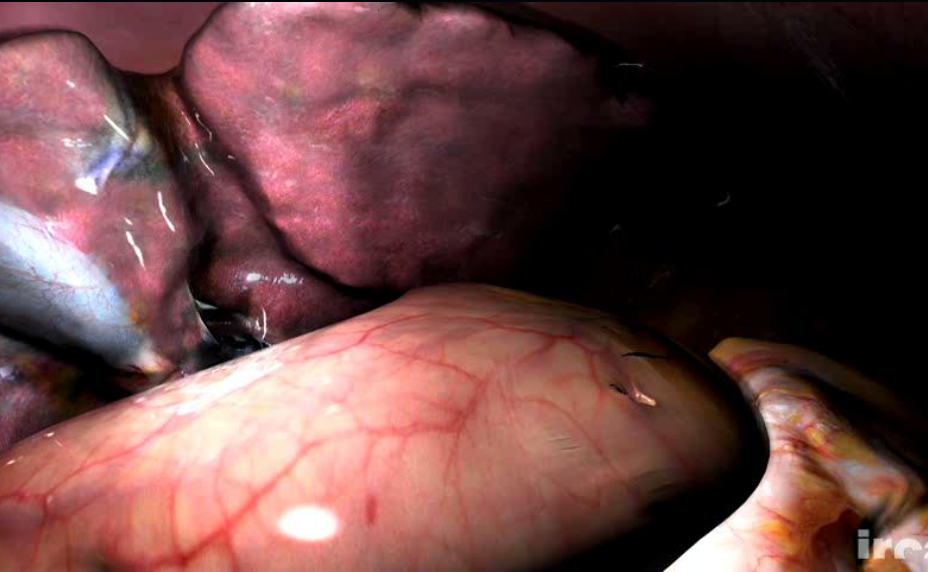


The surgical paradigm

Transgastric Access: anubiscope sutures



First Anubis TV cholecystectomy

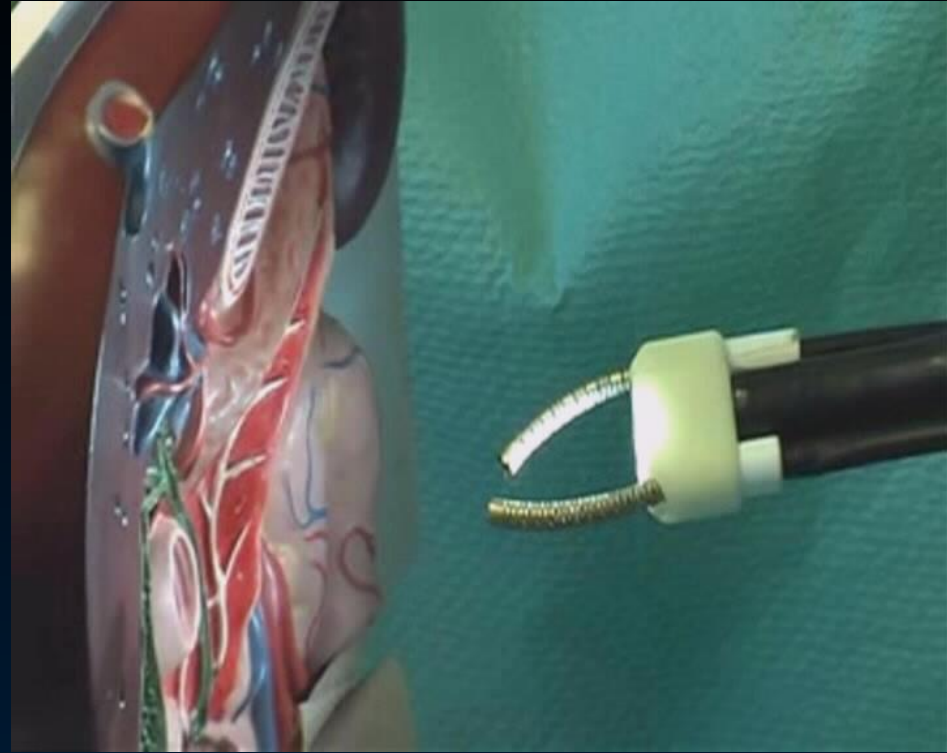


Flexible Robotic Platform – Telemanipulation of the Endoscope

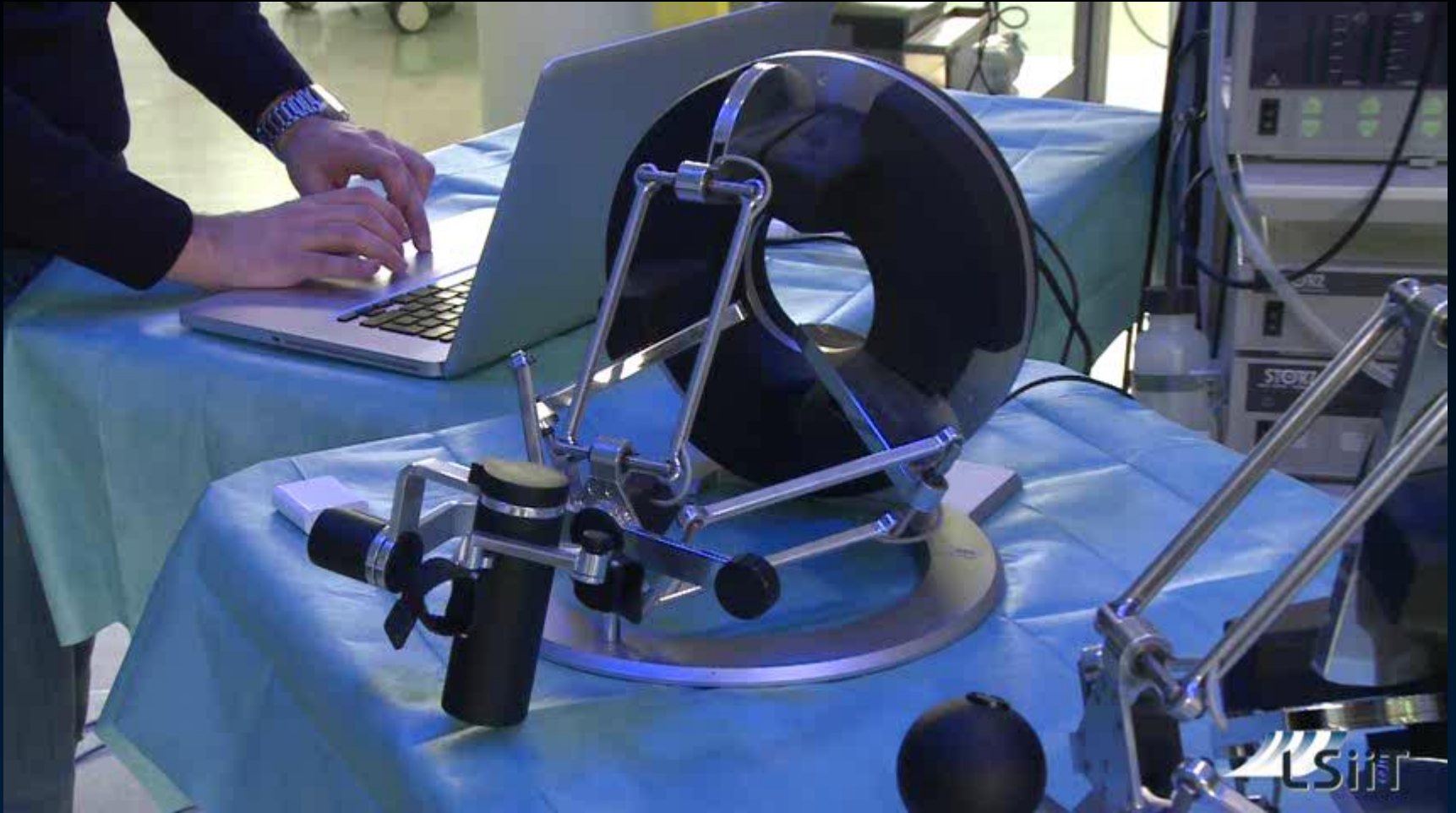
Single user Master Slaves NOTES Robot



Flexible Robotic Platform – Telemanipulation of the Endoscope



Simulation



NO-SCAR
To
SCAR-LESS

SINGLE PORT: SCARLESS surgery

Rationale

- NOTES has technical and conceptual limitations
- Umbilicus is a natural scar of a natural orifice....
- Single incision: better **cosmetic** results
- **Pain** after laparoscopic surgery is related
to the number of trocars
- Less trocars, less **complications**



Single access laparoscopy

Single port	Single incision
<p>All instruments via one port</p> <ul style="list-style-type: none">➤ Trocars: rigid or flexible➤ Sleeves➤ All in one systems	<p>All instruments via a single skin incision- multiple fascia entry points</p> <p>Standard trocars</p>

NOTES-SINGLE PORT: Challenges

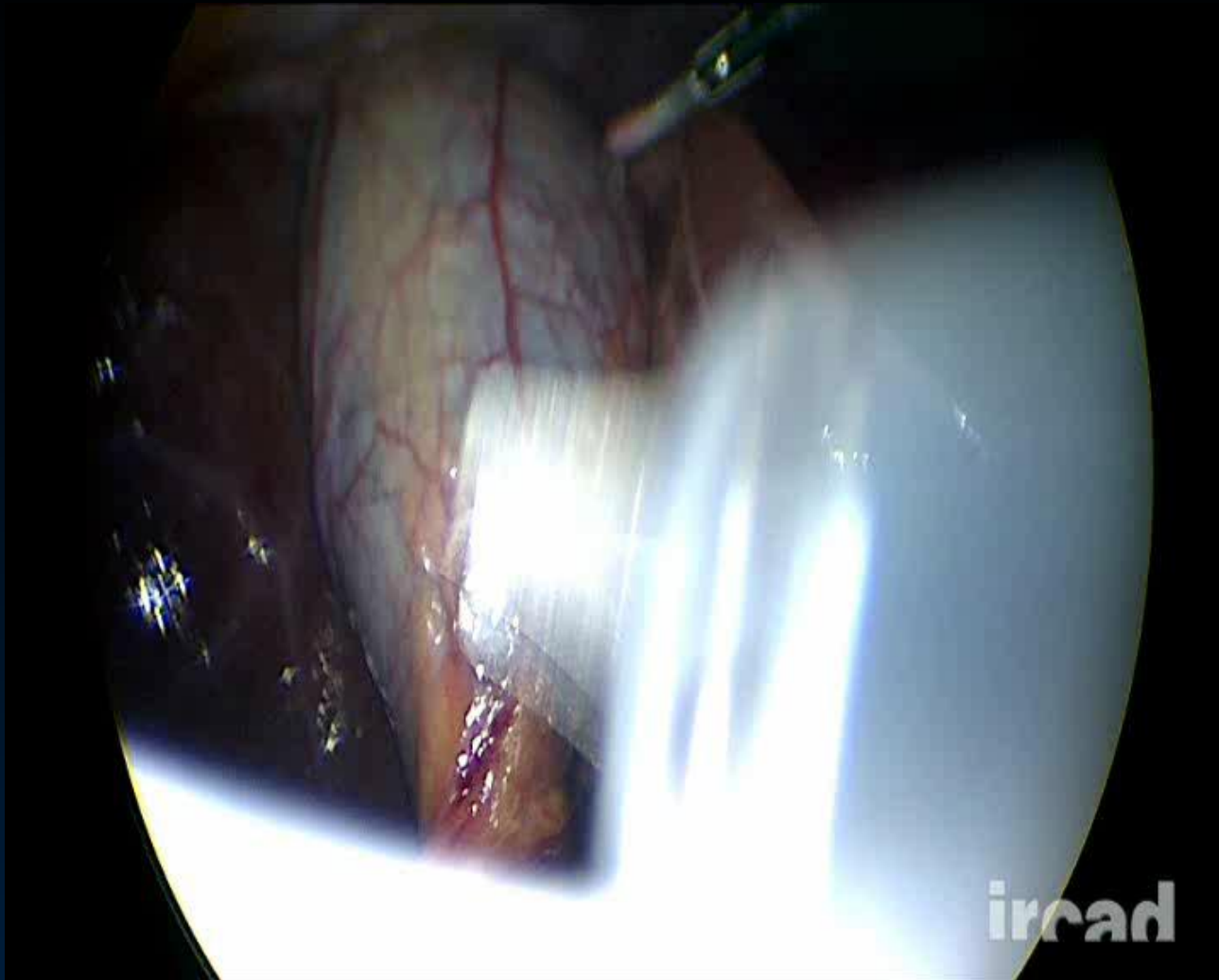
Optimal site for peritoneal access

Organ retraction

Triangulation

Tissue approximation

SINGLE PORT: Challenges

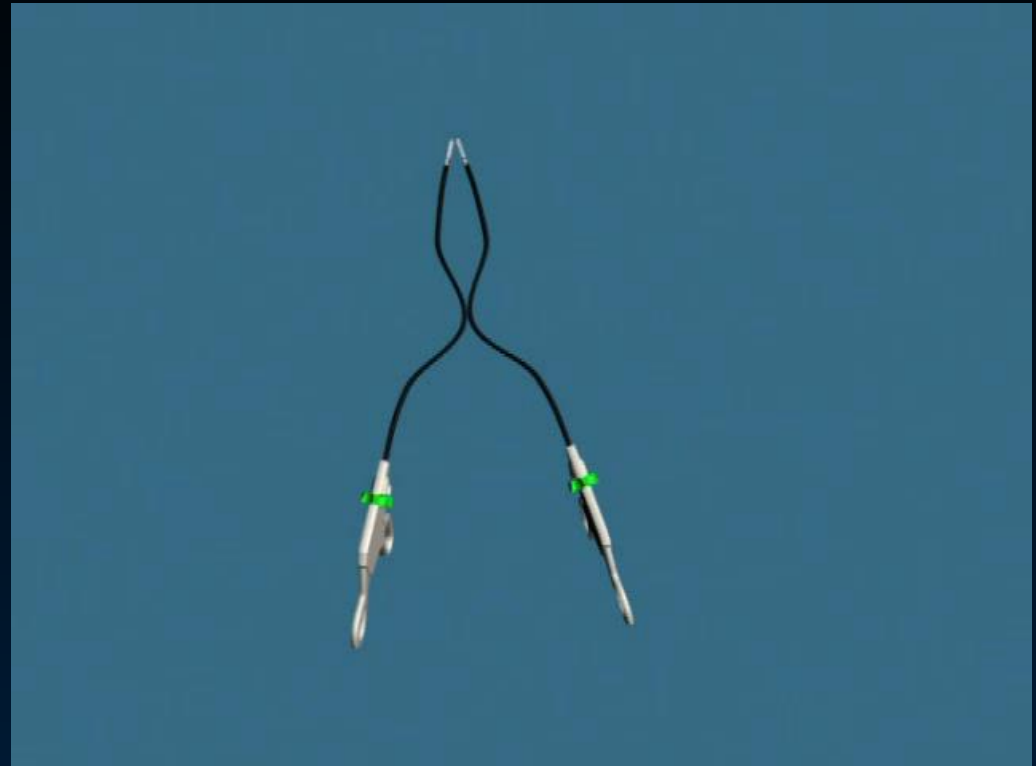
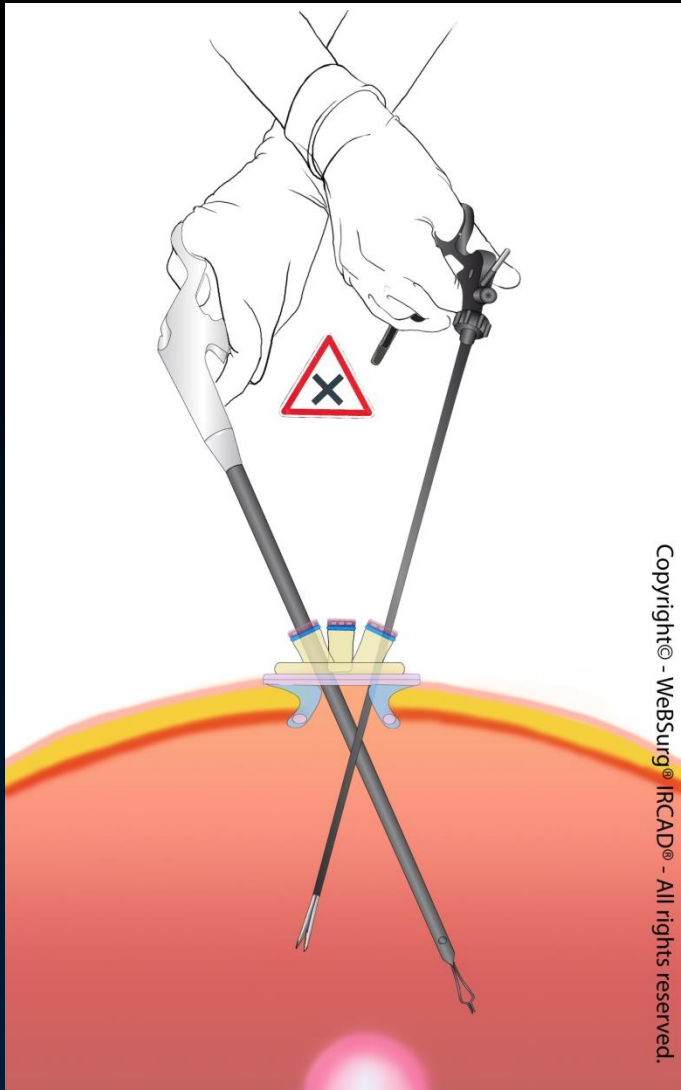


SINGLE PORT: Challenges

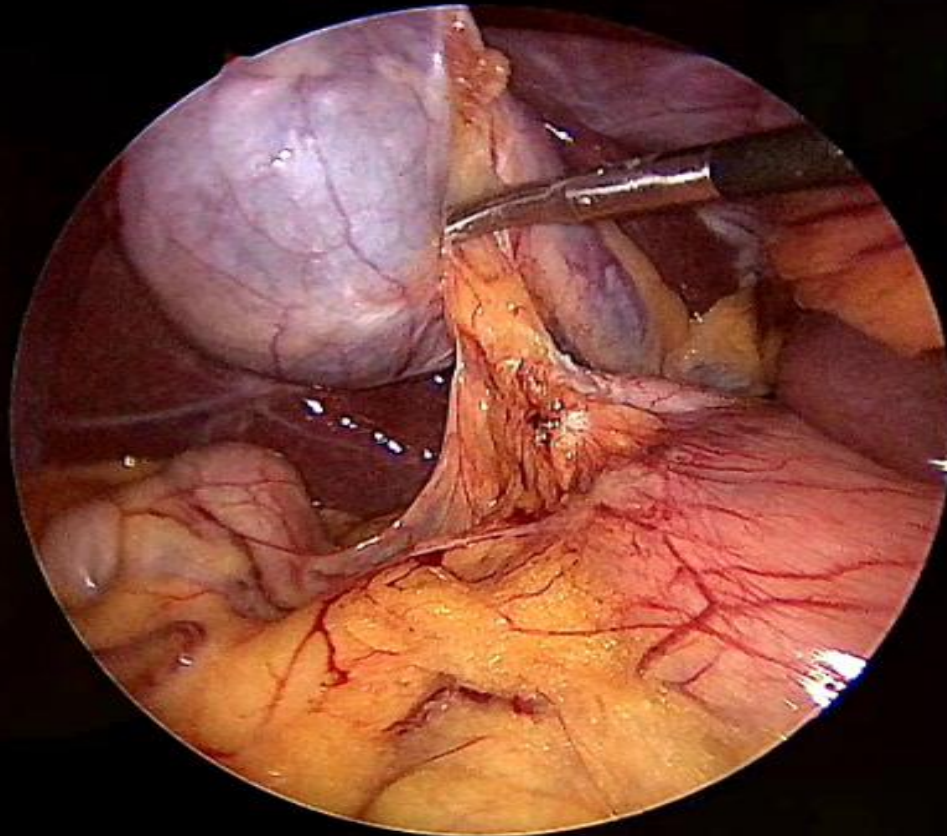


SINGLE PORT: Challenges

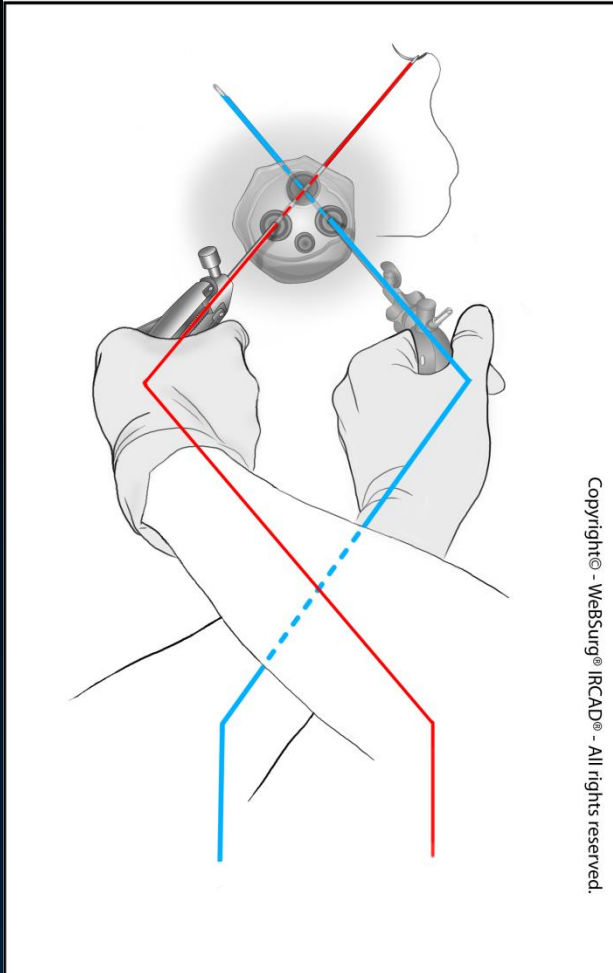
INSTRUMENTS



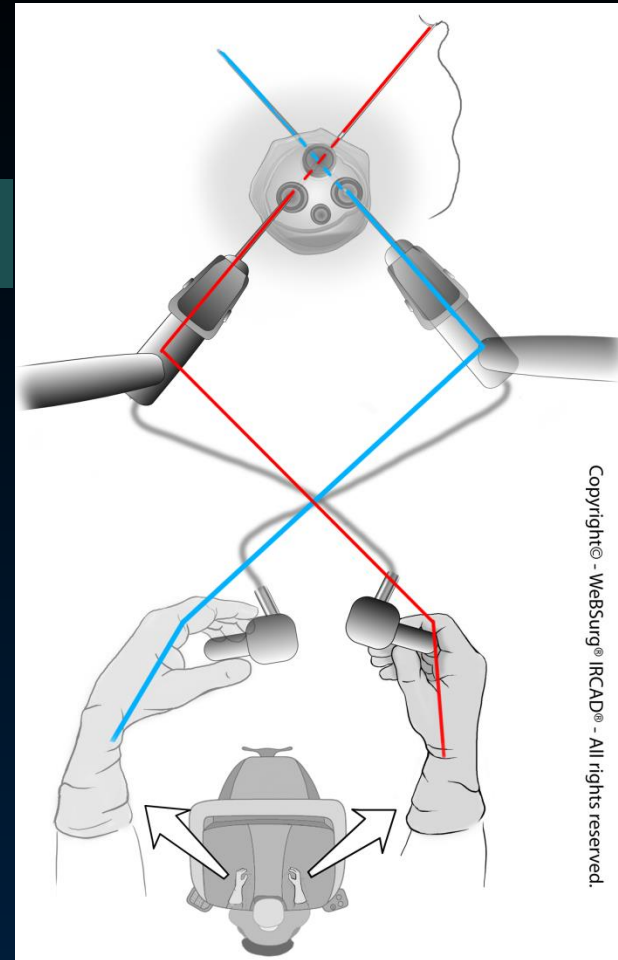
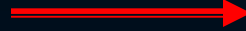
SINGLE PORT: Challenges



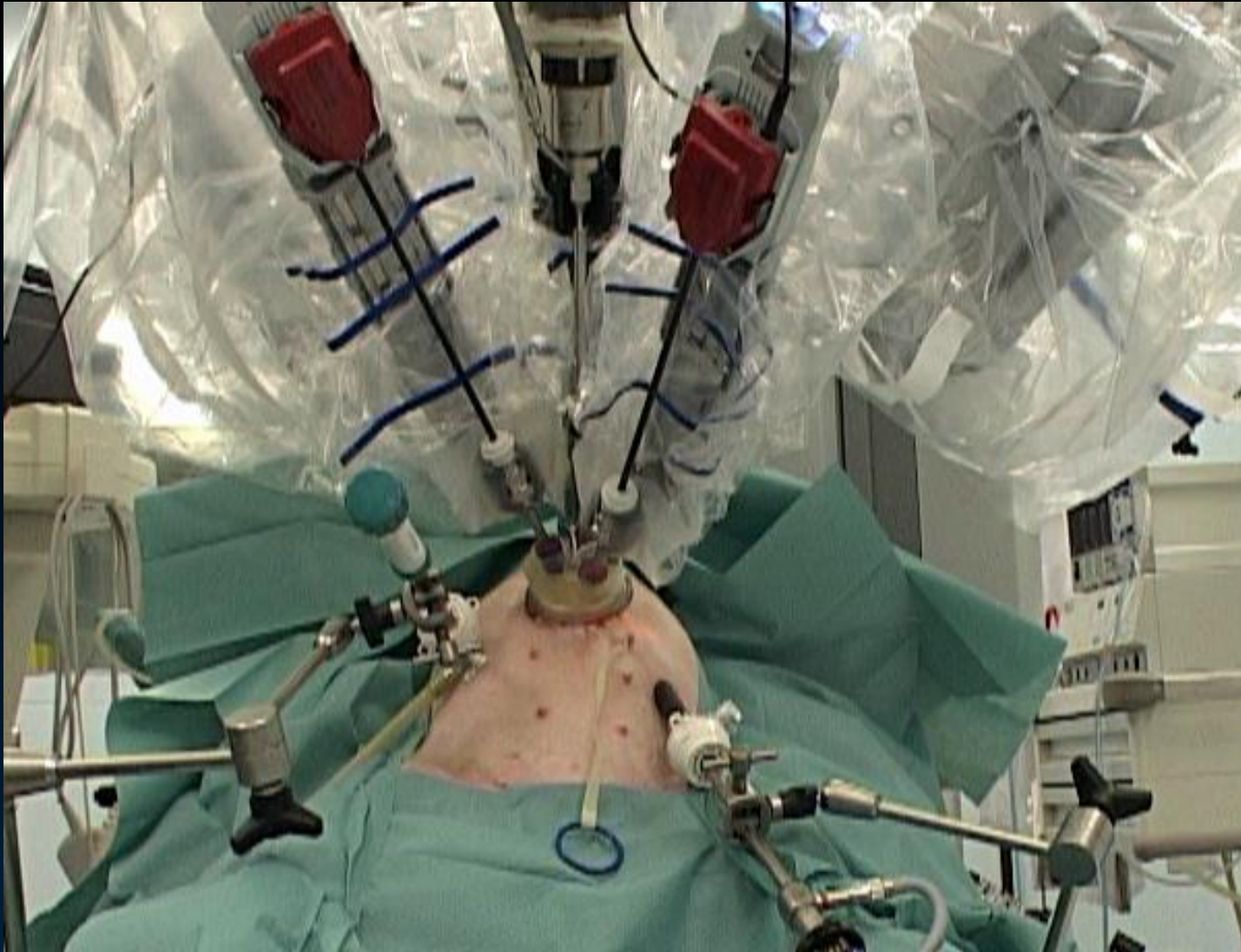
SINGLE PORT: Challenges



ROBOTIC

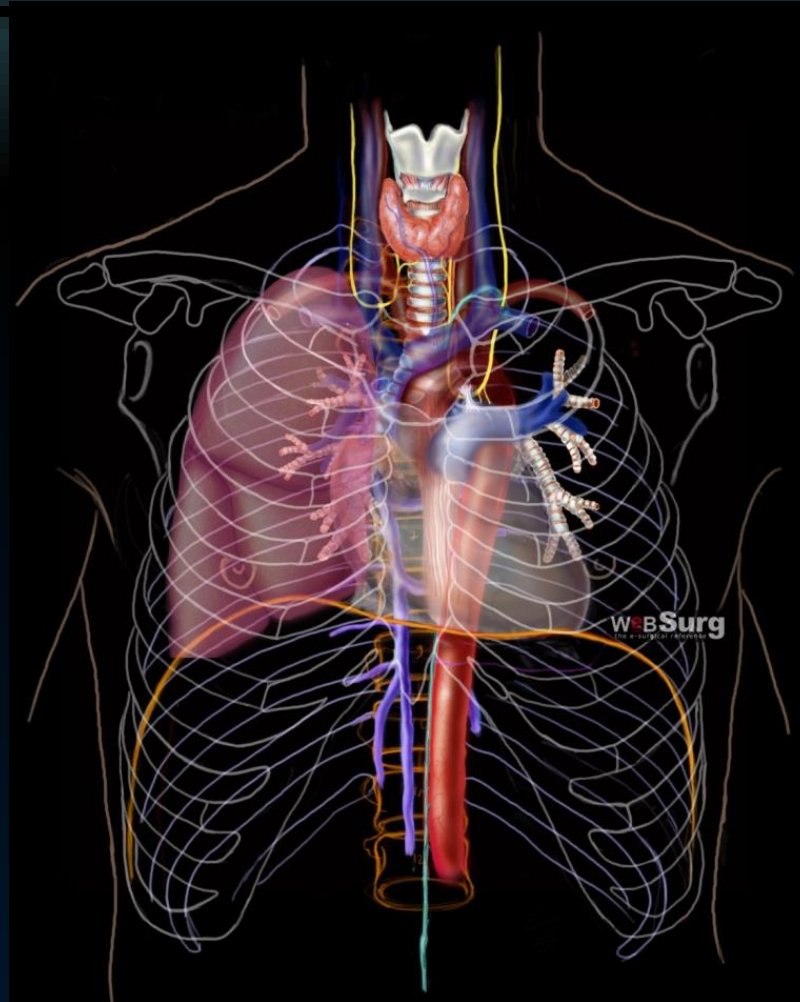


SINGLE PORT: Challenges



Fear

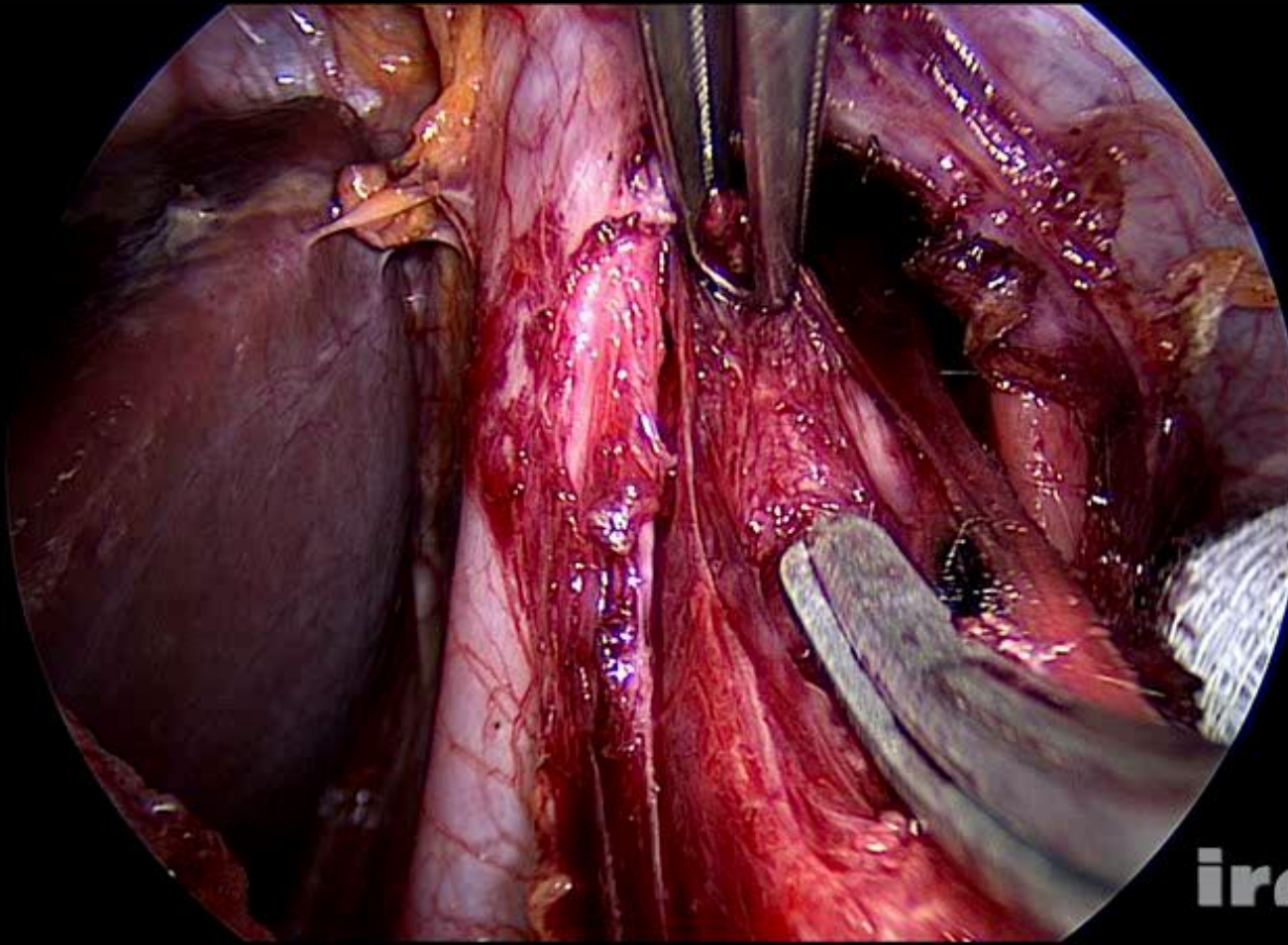
LESS



« God put the esophagus into the chest
to hide it from surgeons.. »

Lee Swanstrom

Heller myotomy



irc

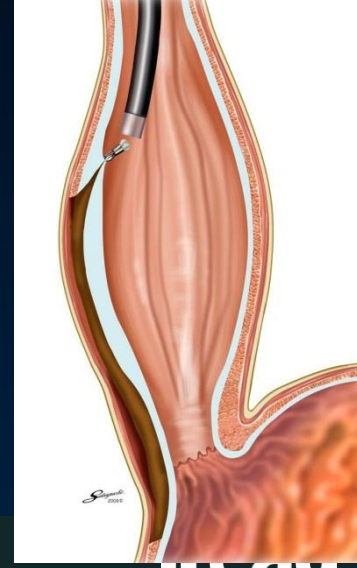
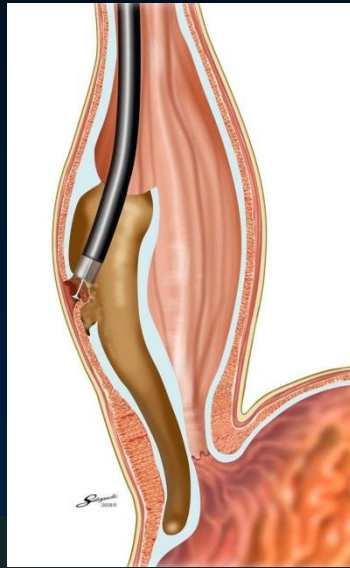
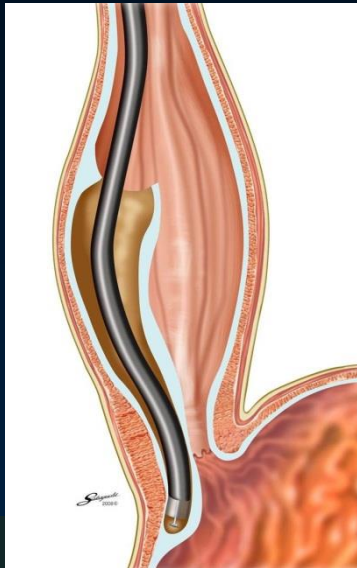
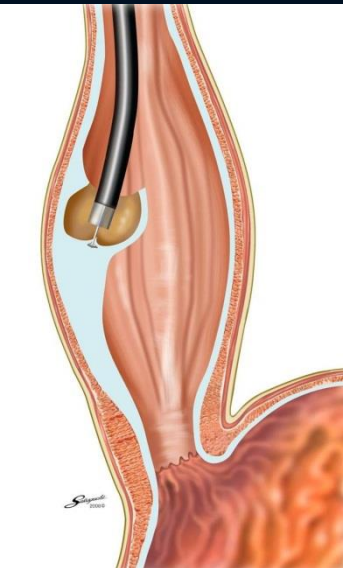
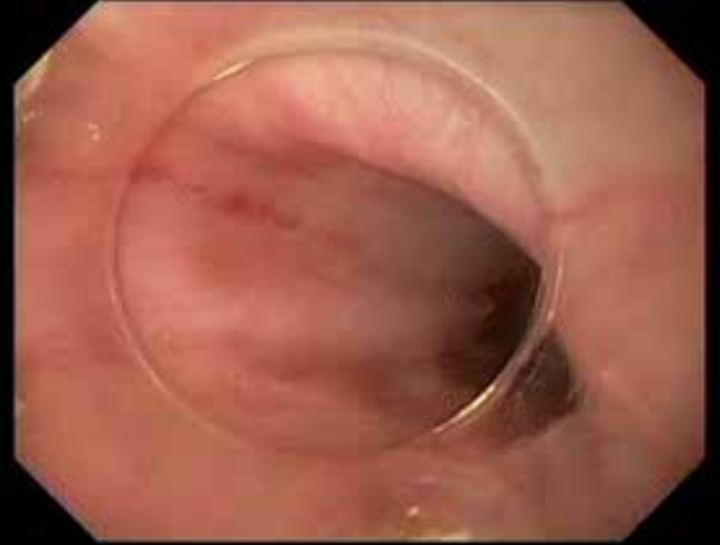
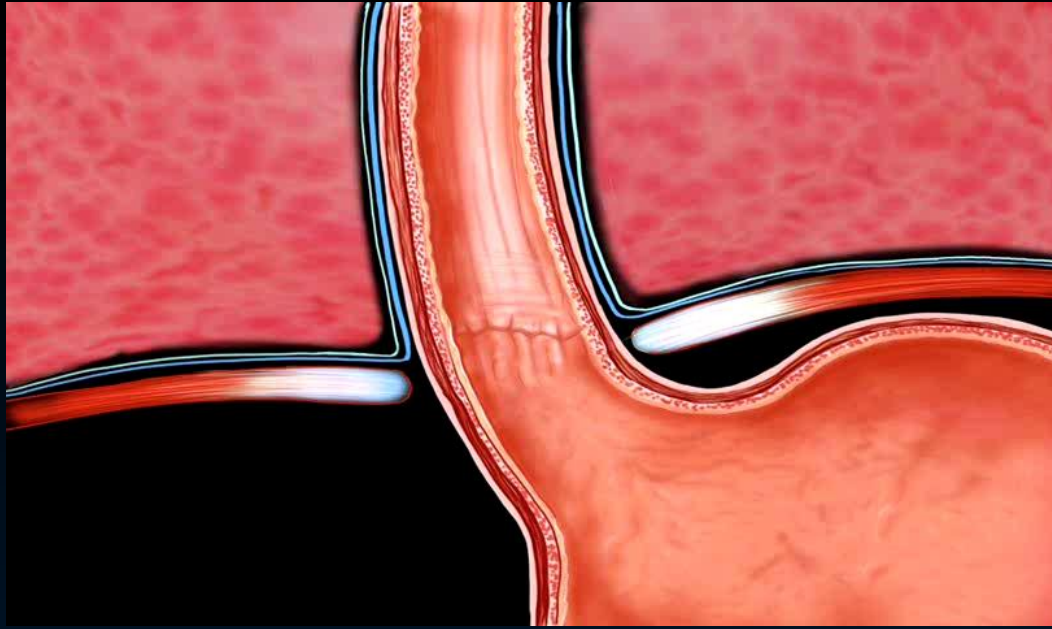
H. Inoue

Per Oral Endoscopic Myotomy

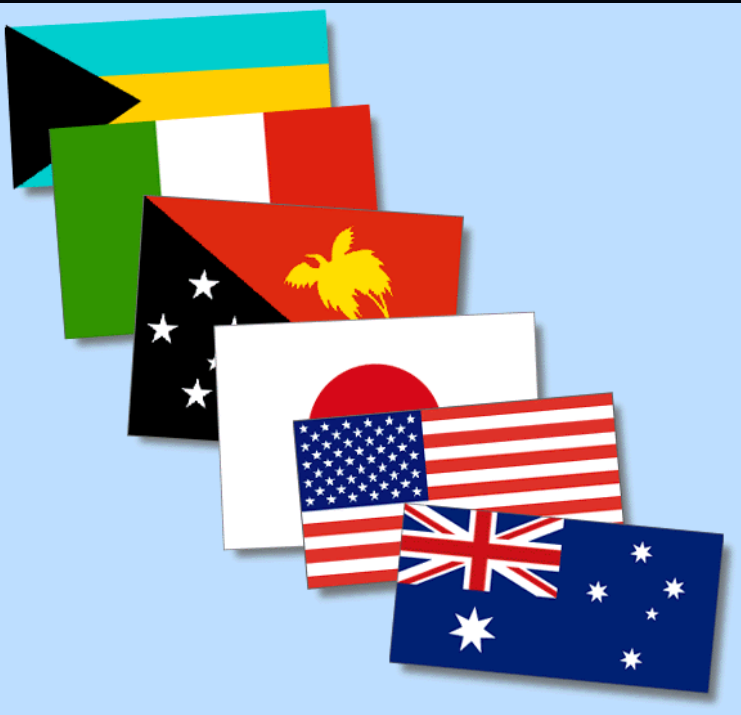


- DDW 2008
- 4 cases
- ESD technique

POEM



P.O.E.M



➤ 1500
cases

Conclusions

Evolution de la Chirurgie et de l'Endoscopie

INVASIVENESS

surgery

Laparoscopic surgery

NOTES ?

1900

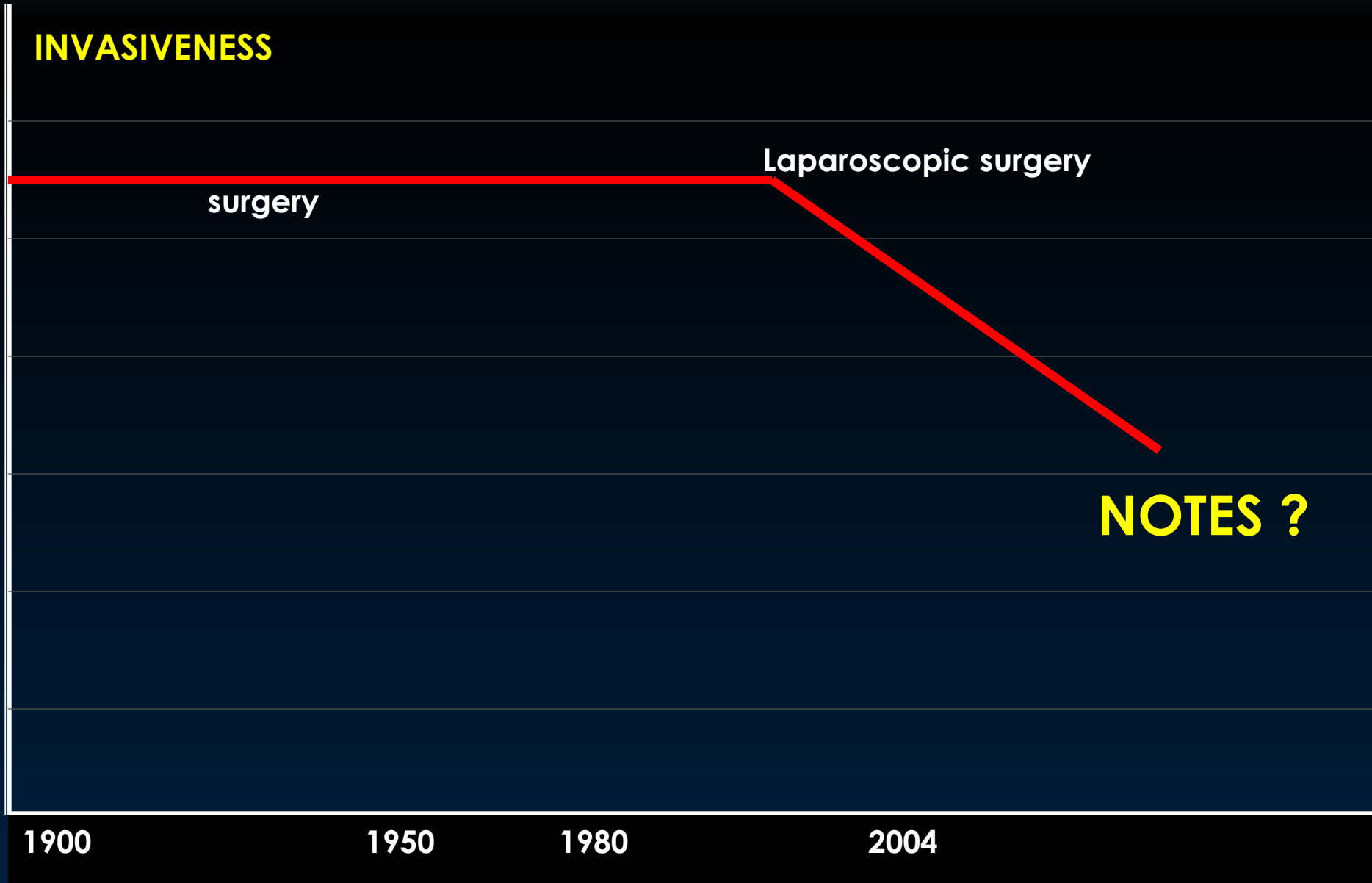
1950

1980

2004

TIMELINE

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Evolution de la Chirurgie et de l'Endoscopie

INVASIVENESS

surgery

Laparoscopic surgery

endoscopy

Therapeutic endoscopy

NOTES ?

1900

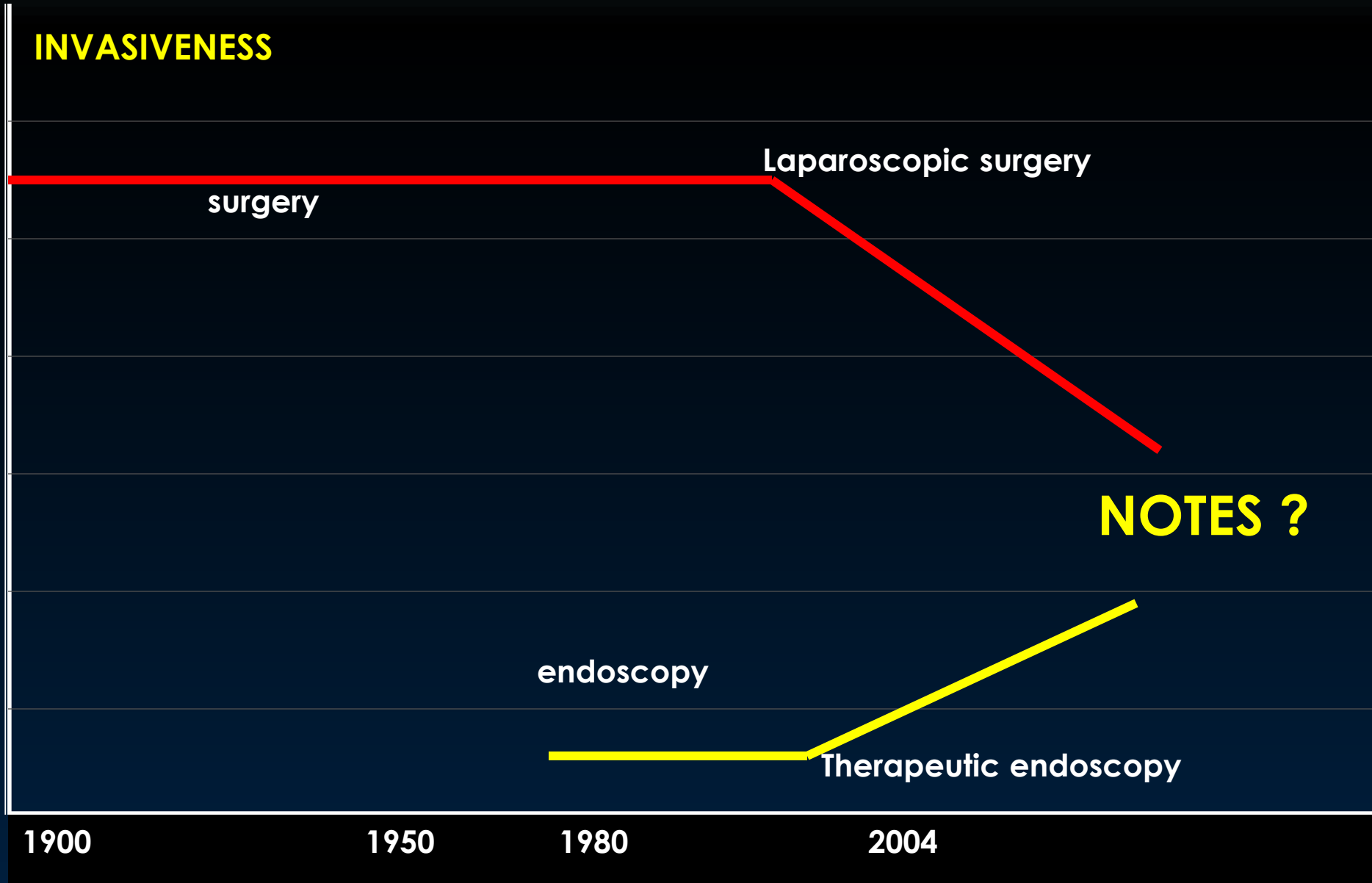
1950

1980

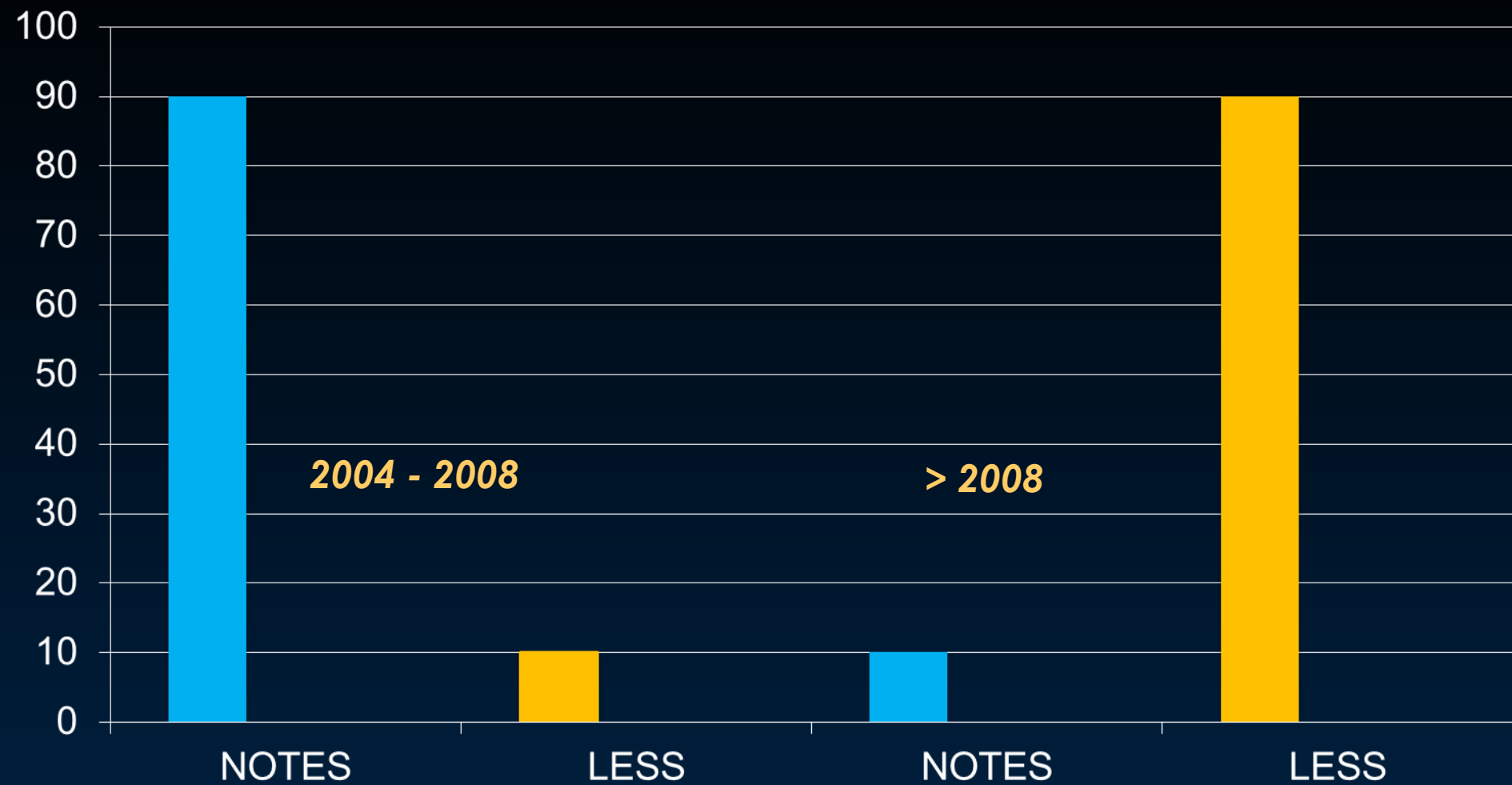
2004

TIMELINE

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The “HYPE FACTOR”



NOTES Current Human Applications

Conclusions

1. Totally NOTES cholecystectomy - appendectomy are feasible
2. Major limitation
instrumentation – clips (patient safety) – retraction
potential for R&D
3. Current techniques : Hybrid NOTES (trocar)
4. No clinical conclusions at this point
5. Other applications under evaluation:
POEM has shown good results with low morbidity

NOTES ENDOLUMENAL

- ✓ ESD
- ✓ POEM
- ✓ GERD
- ✓ ENDOBARIATRICS
 - Bariatric revision
 - Primary procedure

Surgeries Replaced By Endoscopic Procedures

- ✓ GERD
- ✓ Biliary tract disease
- ✓ Panc. Pseudocysts
- ✓ PUD
- ✓ Varices
- ✓ Hemorrhoids
- ✓ Achalasia
- ✓ Barrett's esophagus
- ✓ Intestinal neoplasms
 - Esophagus
 - Stomach
 - Rectum
- ✓ Fistula
- ✓ Strictures
- ✓ Enteral access
- ✓ Incontinence

Surgeries Replaced By Endoscopic Procedures

✓ cancer

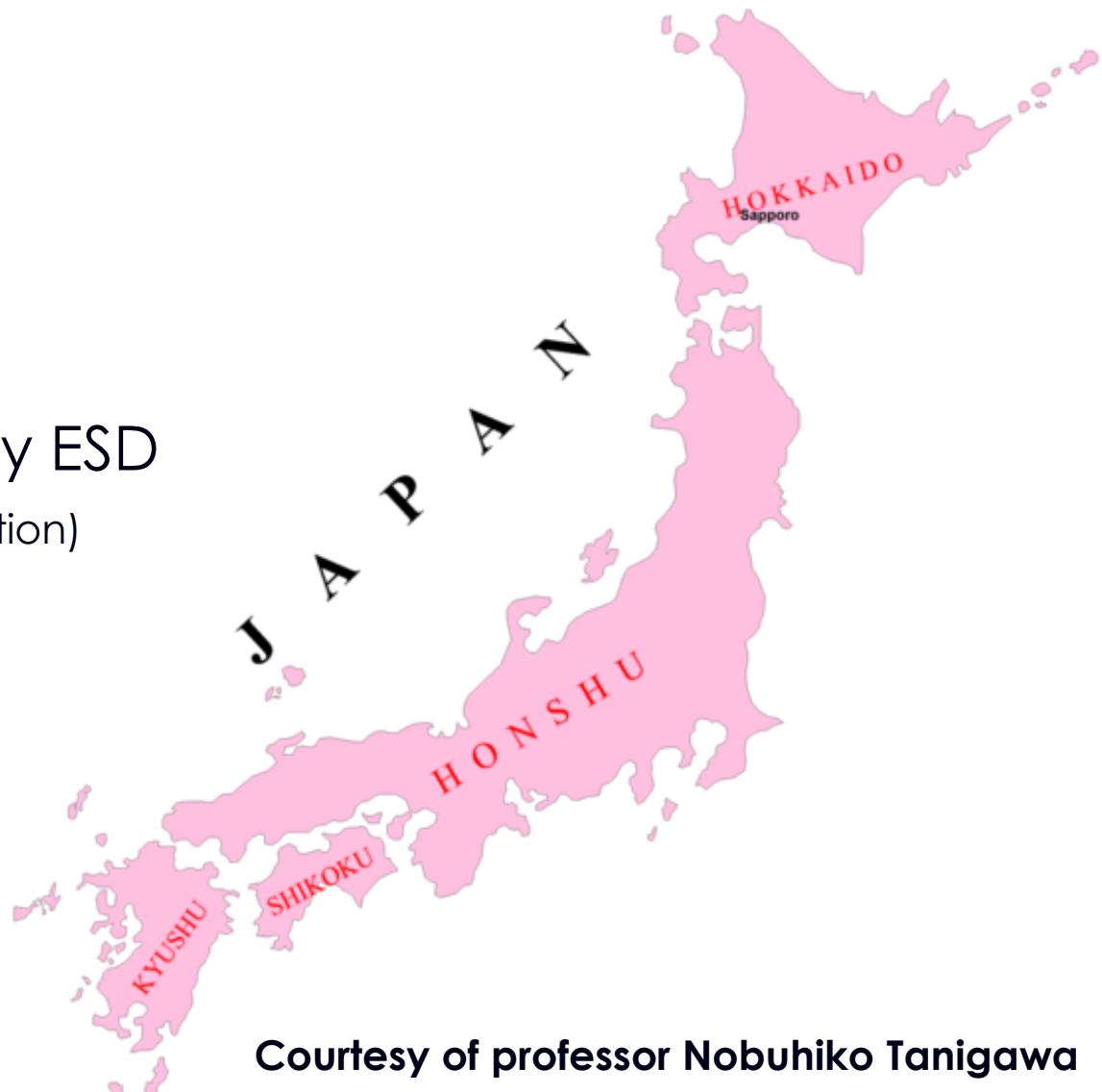
- oesophagus
- stomach
- Rectum

% of cancer treated by ESD
(endoscopic submucosal dissection)

2017-80%...?.

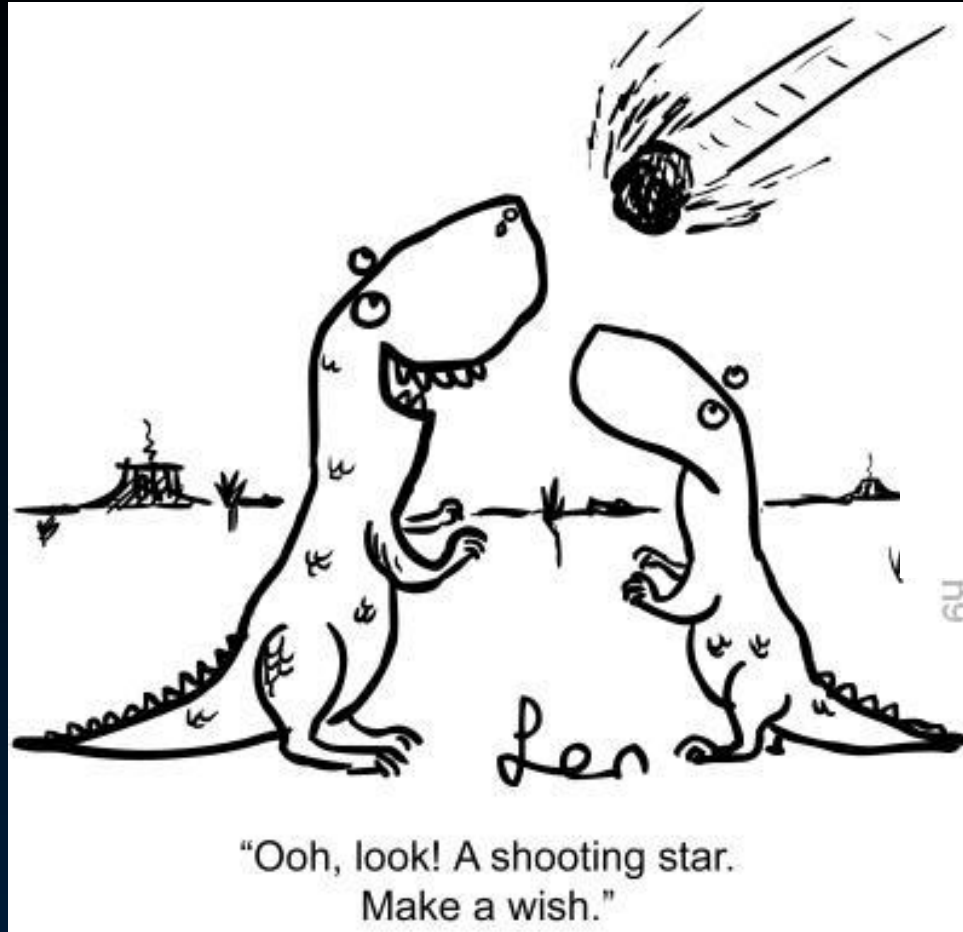
2012- 50%

2009- 40%



Courtesy of professor Nobuhiko Tanigawa

Learn and teach flexible endoscopy



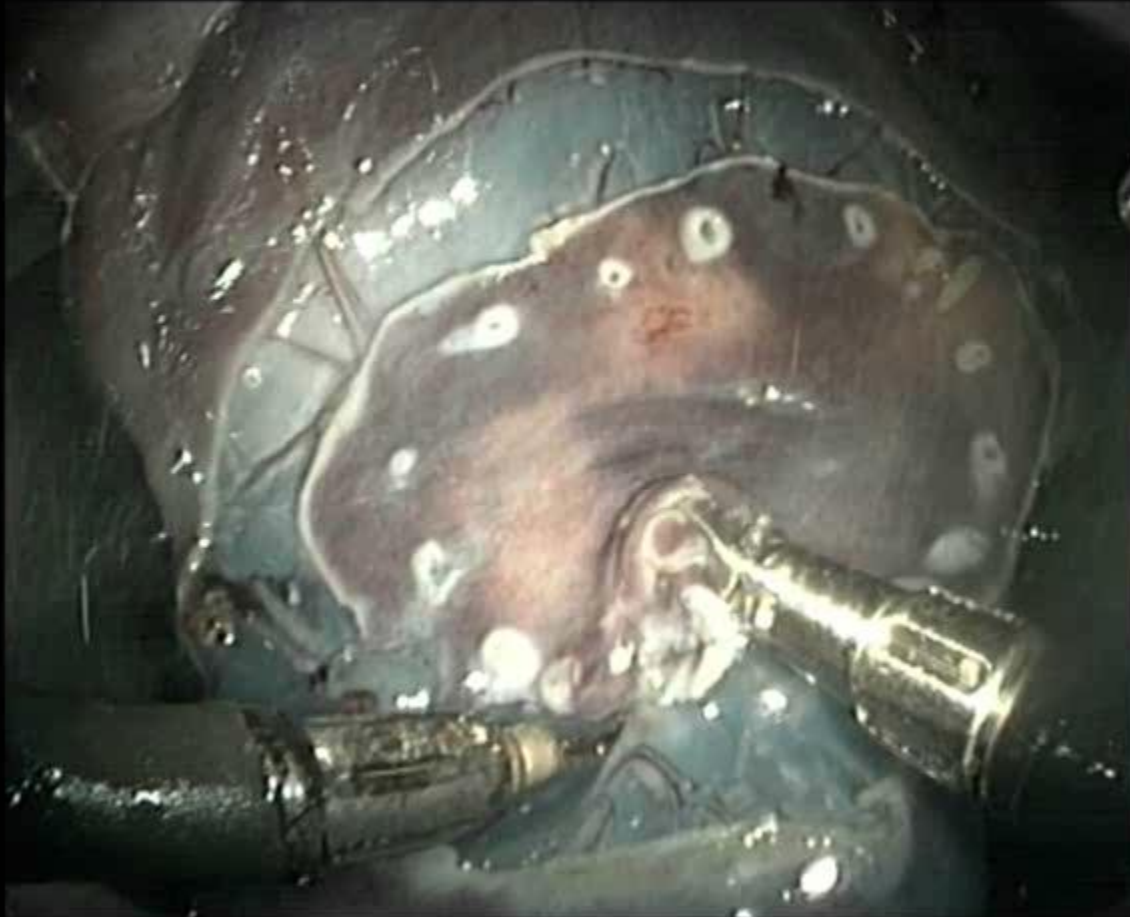
The background is a dark field filled with numerous thin, light-colored, thread-like structures that resemble biological filaments or spores. Some of these structures have small, rounded, light-colored heads. Overlaid on this background are two large, semi-transparent circles. The circle on the left is pink and contains the text 'GI'. The circle on the right is gold and contains the text 'Surgery'. The two circles overlap in the center of the image.

GI

Surgery

ESD with a surgical paradigm

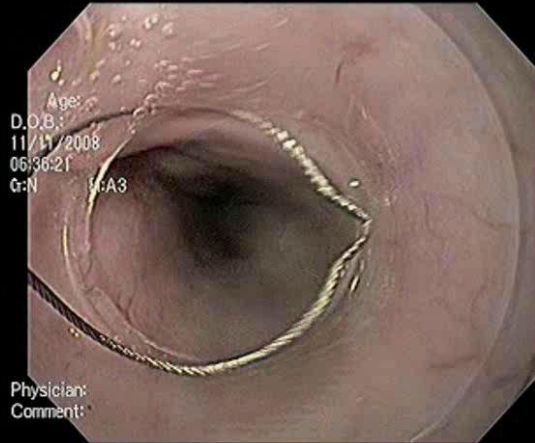
The Anubiscope



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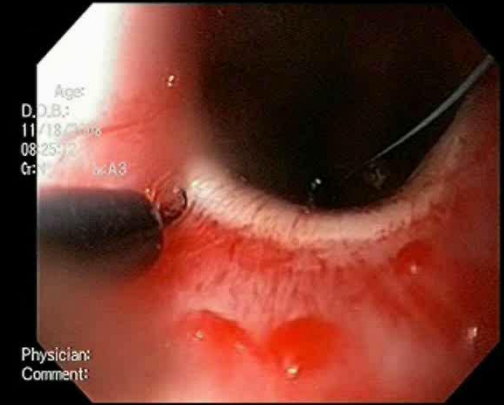
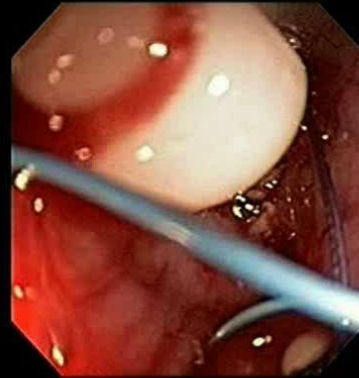
Transoral Endoscopic Inner Layer Esophagectomy

Courtesy B.A. Jobe

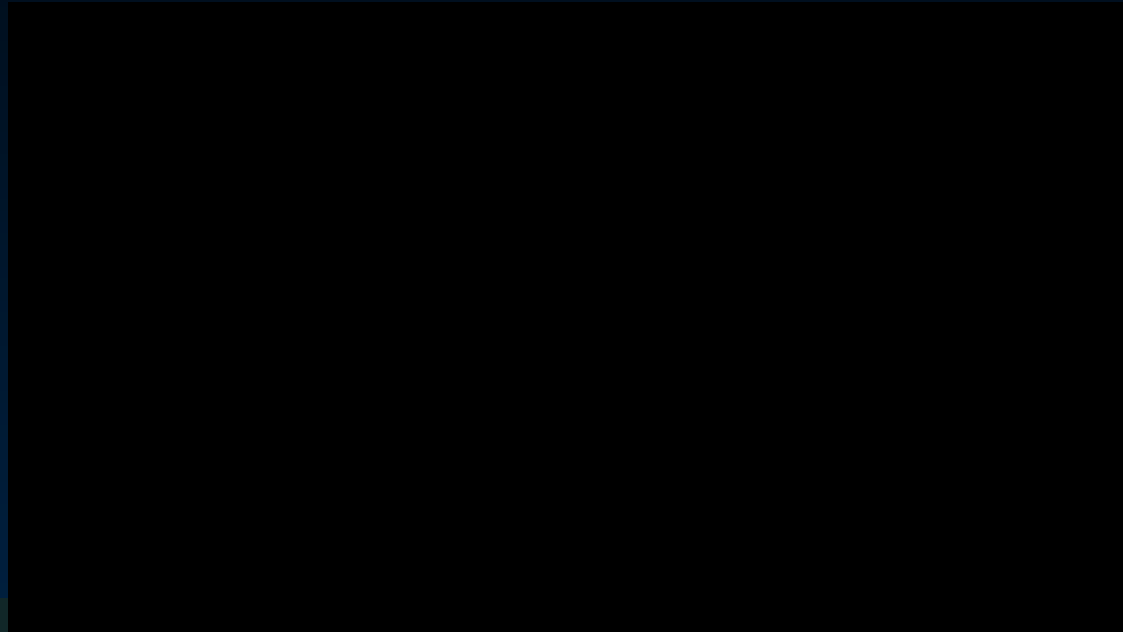


Age:
D.O.B.:
11/04/2008
12:22:43
Gr:N ICA3

Physician:
Comment:



MRI sentinel node mapping – Ann NY Acad Sci 2011



IHU Strasbourg programme de recherche

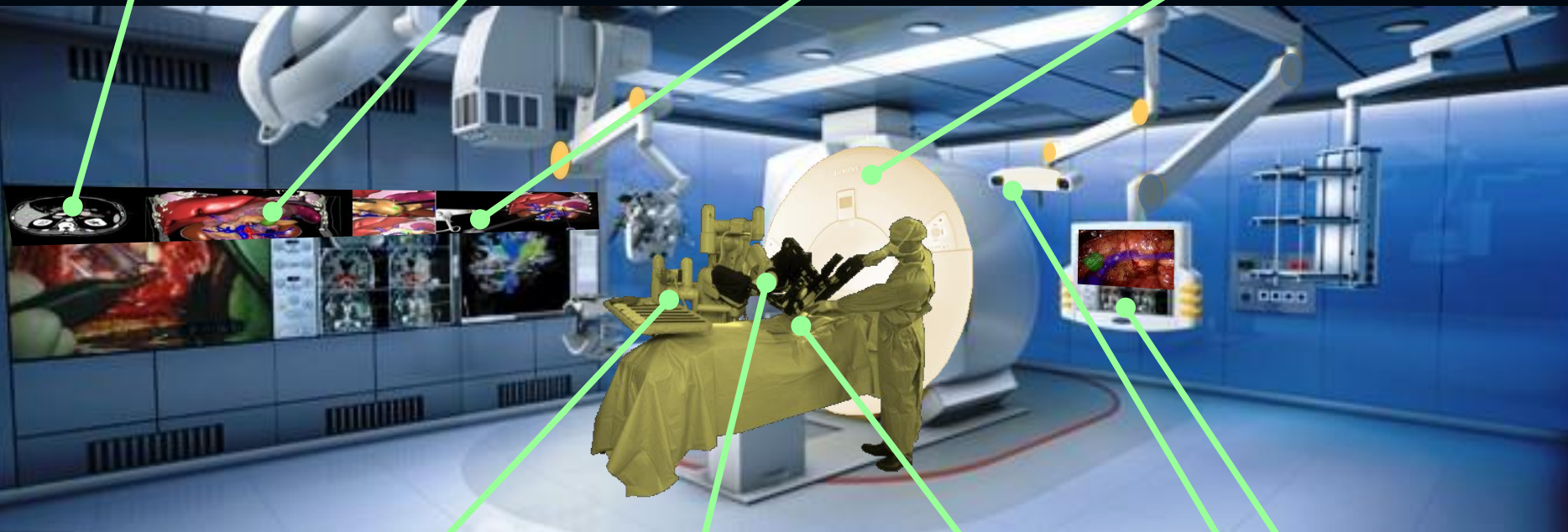
Databank : Digital & Biological Material

**Pre-operative
Medical Imaging**

**Digital Patient
Modelling**

**Surgical Planning
& Simulation**

**Intra-operative
Medical Imaging**



**Education
& Network**

**Biological
Targetting**

**Robotics &
Automation**

**New Surgical
Devices**

**Tracking &
Augmented reality**

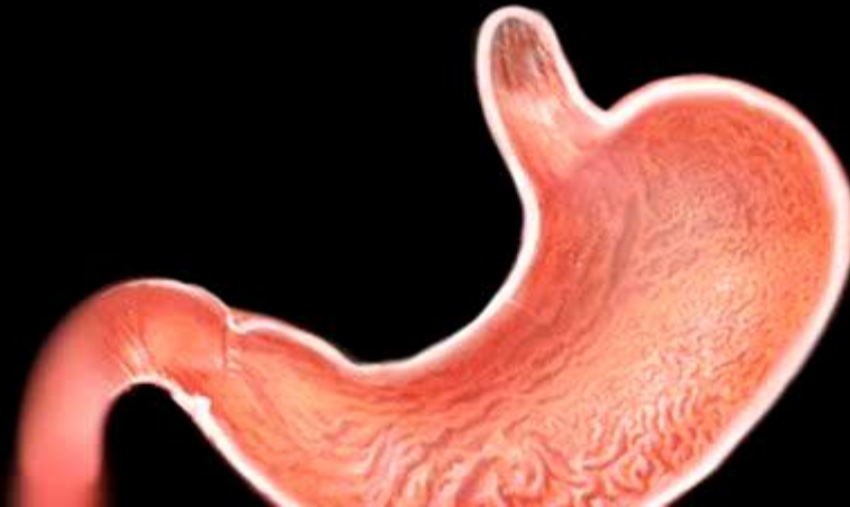
A grayscale microscopic image showing several cells with distinct nuclei and cell membranes. The cells are arranged in a cluster, with some showing more detail than others. The background is a textured, slightly grainy gray.

Future

=

preserve & restore

Esophageal atresia

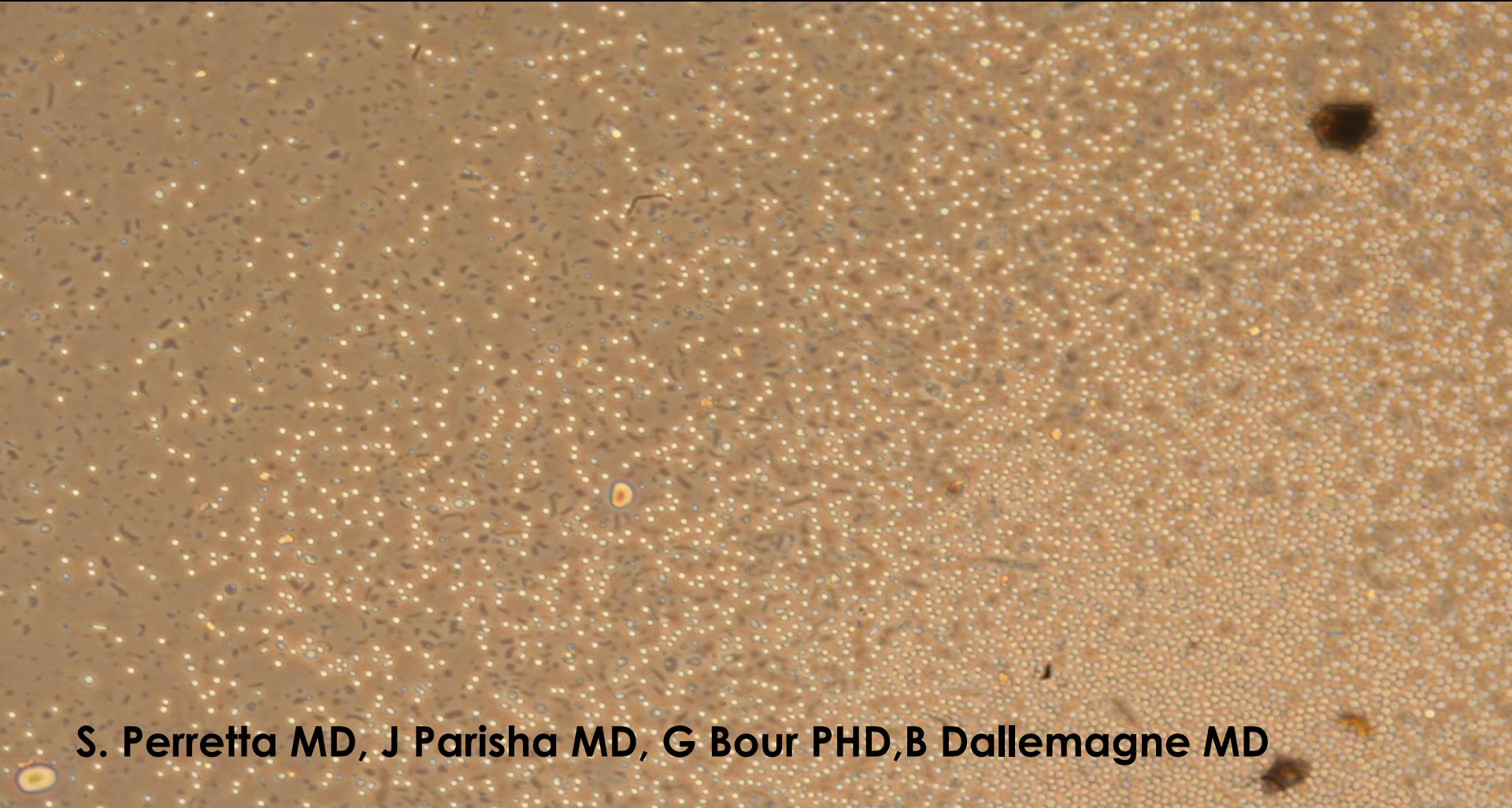


Endoscopic esophageal lengthening and
anastomotic techniques Surg Endosc 2011

Bilateral submucosal endoscopic lengthening myotomies

ircad

Endoscopic intasphincteric injection of muscle- derived cells



S. Perretta MD, J Parisha MD, G Bour PHD, B Dallemagne MD

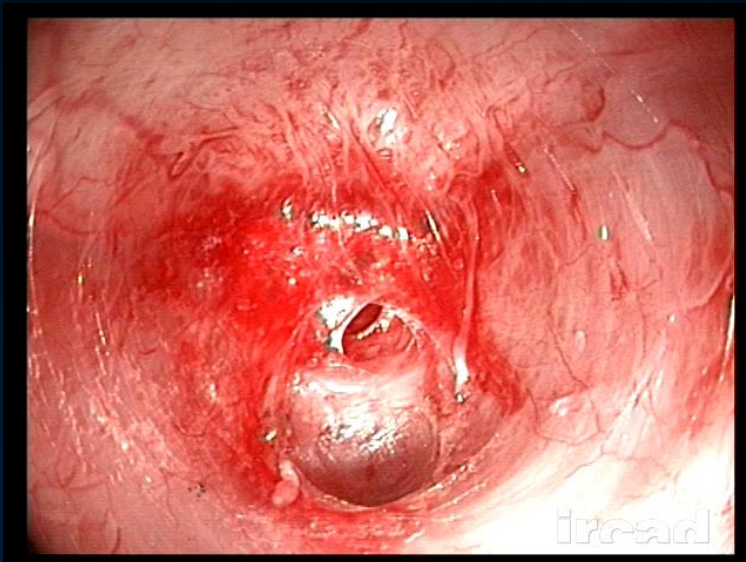
Endoscopic smooth cell sampling



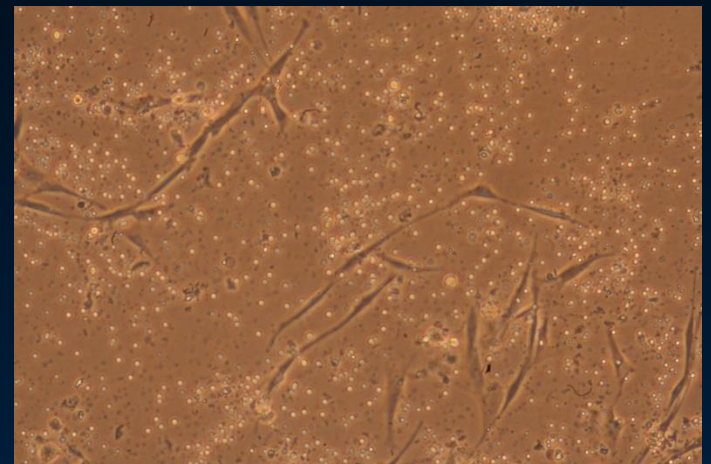
Stomach



1 week



Esophagus

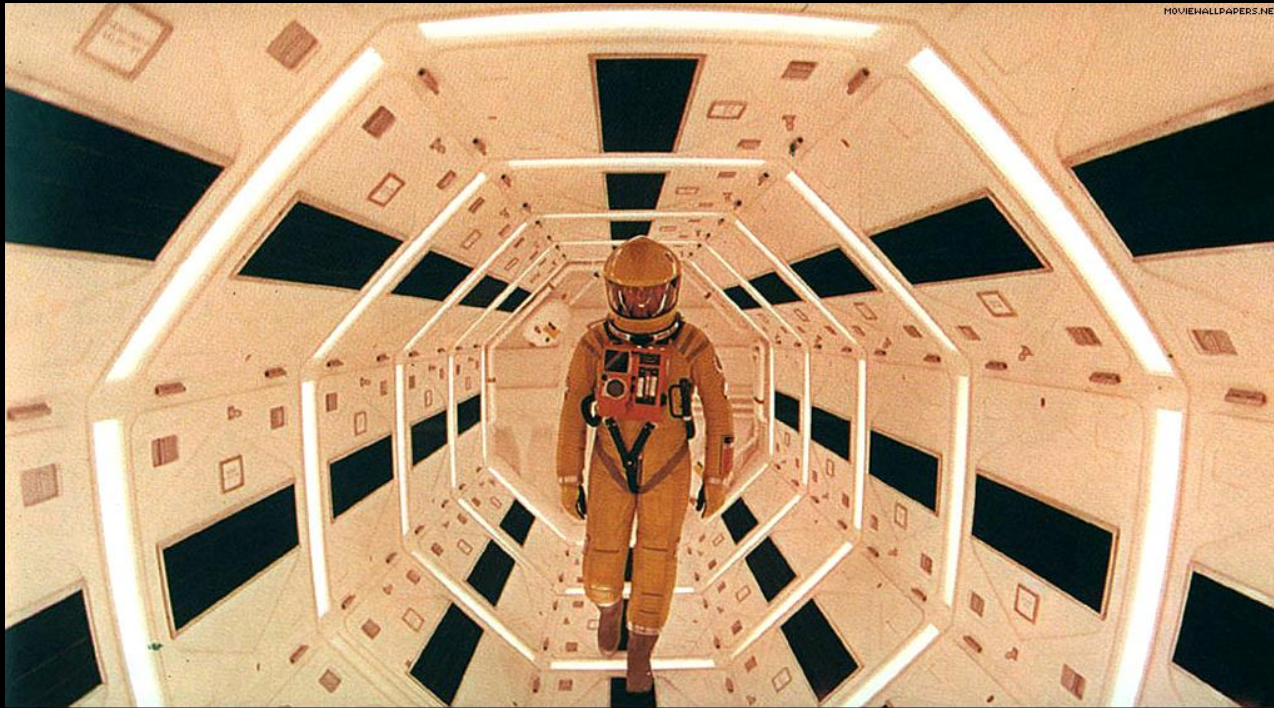


2 weeks

Surgery, gaining much from the general advance of knowledge, will be rendered both knifeLESS and bloodLESS.—

John Hunter, Surgeon, London, England, 1762

« The knife man »
by Wendy Moore



*Research for the sake of science is good,
research for the sake of humanity is divine*

B. E. S. T

www.ircad.fr/students

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