

Sharing Robotic Surgical Expertise

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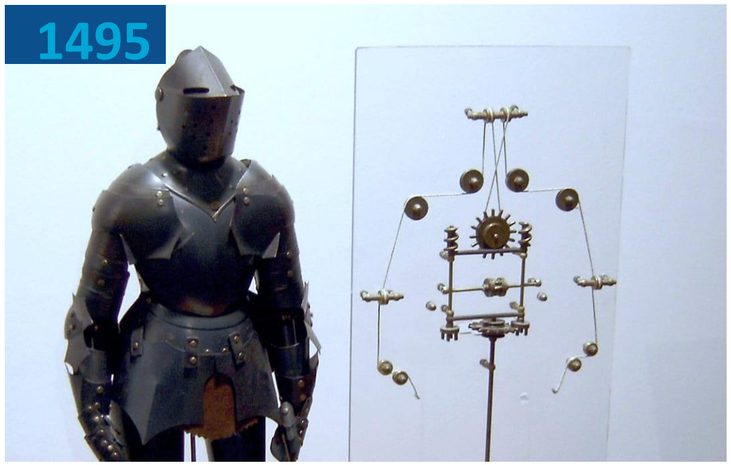
I have NO financial disclosure or conflicts of interest with the presented material in this presentation.

Contents

1. History of ***Robot***
2. Evolution of ***Surgical techniques*** in Gynecology
3. Robotic radical trachelectomy
4. Robot assisted surgical staging in endometrial cancer
5. Technical tips to prevent surgical complications
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From Mechanical Knight to the *Word "Robot"*

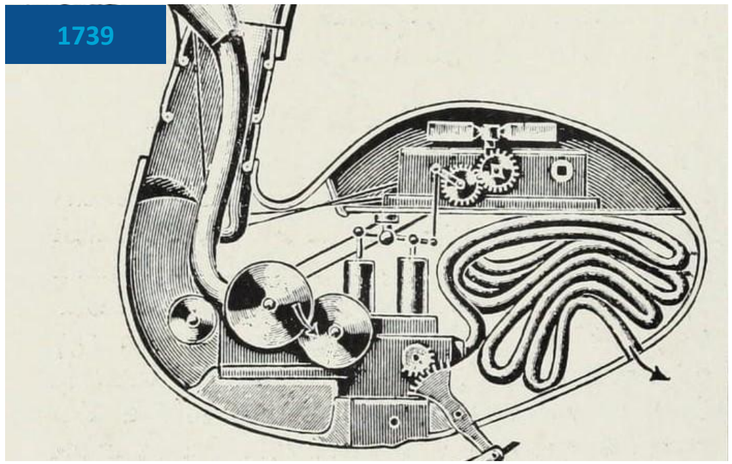
1495



RENAISSANCE · ITALY

Leonardo's Mechanical Knight

1739



ENLIGHTENMENT · FRANCE

Vaucanson's Digesting Duck

Jacques de Vaucanson's copper duck could flap its wings, drink water, and — water, and — famously — appear to digest food. A **marvel of clockwork clockwork biology** that astonished 18th-century Europe.

1920



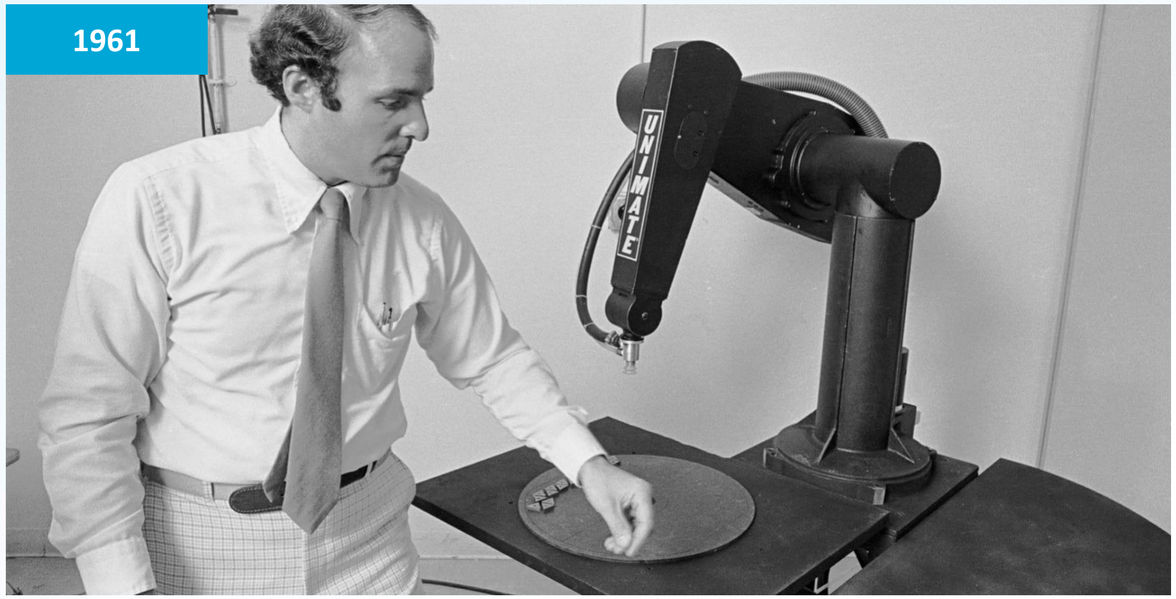
MODERN ERA · CZECHOSLOVAKIA

R.U.R. — *the word "robot"*

Karel Čapek's play *Rossum's Rossum's Universal Robots Robots* gave the world the the word **"robot"** — from the the Czech *robota*, meaning forced labor.

From *Factory Arms* to Walking Humanoids

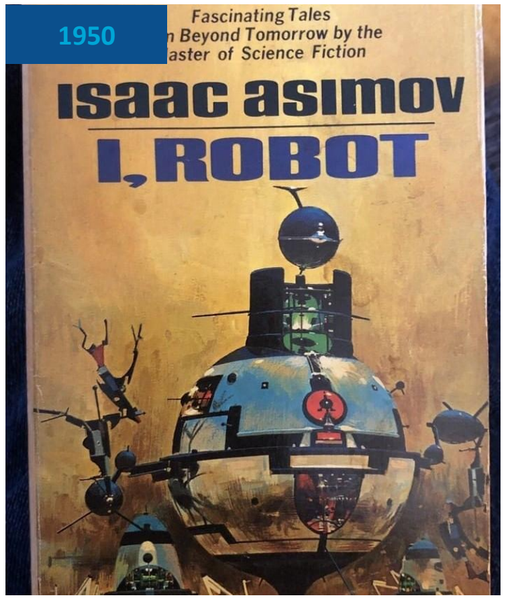
1950 → 2000



THE FIRST INDUSTRIAL ROBOT · USA

Unimate — Robots Enter the Factory

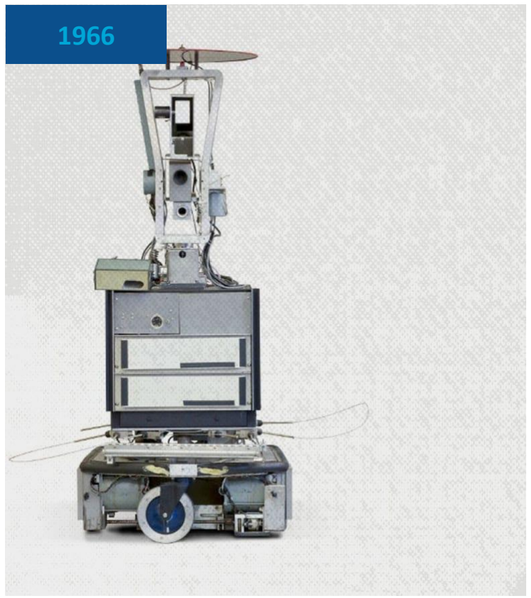
Invented by **George Devol** and commercialized by **Joseph Engelberger**, Unimate joined General Motors' assembly line Motors' assembly line in New Jersey — lifting hot die-cast metal parts. It launched the **global industrial robotics robotics industry**.



FICTION SHAPES REALITY

Asimov's *I, Robot*

Isaac Asimov's **Three Laws of Robotics** defined how how humans would imagine — and later engineer — engineer — intelligent machines.



STANFORD · SRI

Shakey — First AI Robot

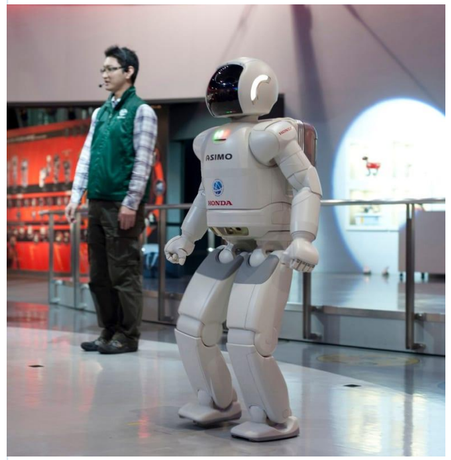
The world's first **mobile robot with reasoning**. Shakey could plan actions, navigate rooms, and manipulate objects using AI.

The Robots *Come Alive*

2000 → Today

From humanoid gaits to citizenship — and now, foundation-model brains.

2000



HONDA · JAPAN

ASIMO

The first bipedal humanoid to **walk, run, and climb stairs** naturally — an icon of 2000s robotics.

2016

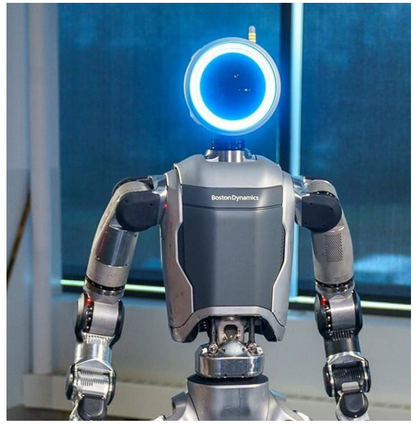


HANSON ROBOTICS · HK

Sophia

The world's first robot to to be granted **citizenship citizenship** — by Saudi Arabia in 2017.

2013

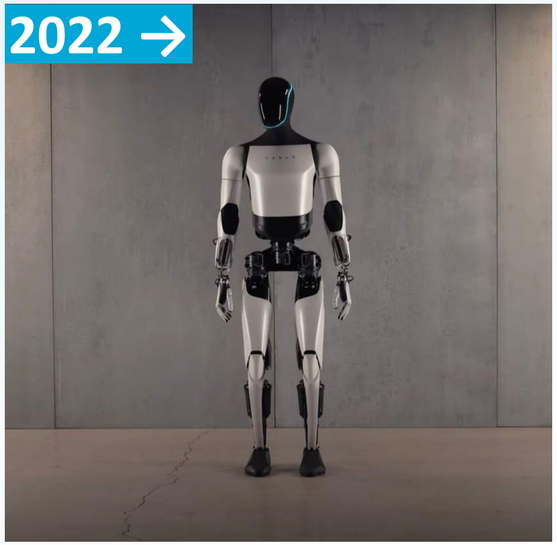


BOSTON DYNAMICS · USA

Atlas

The most agile humanoid ever built — **parkour, backflips, dynamic recovery**. Now paired with Google DeepMind AI.

2022 →



TESLA · USA

Optimus

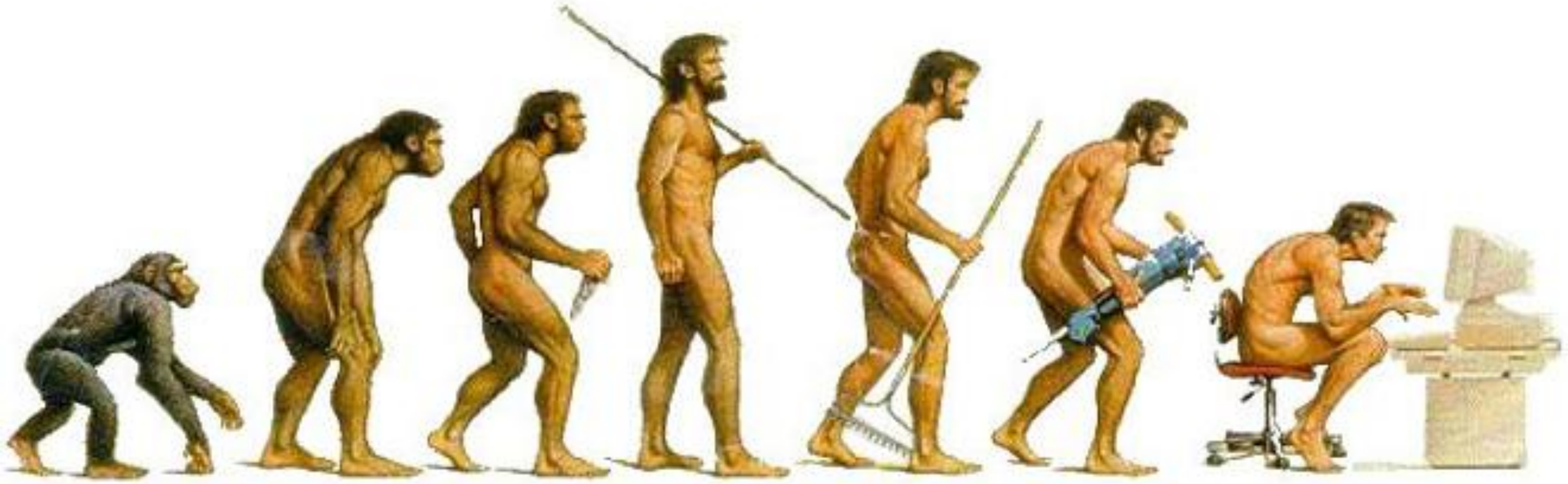
General-purpose humanoid designed for **mass production.** The dawn of robots as everyday *consumer products*.

How things have Changed

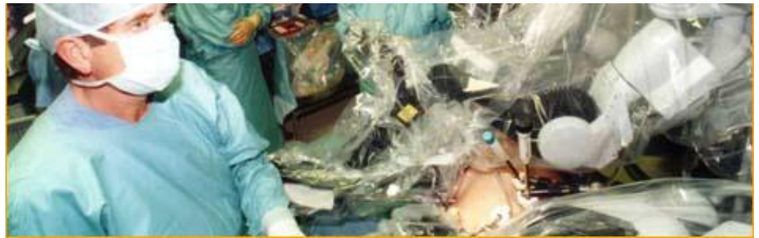
; Evolution of gynecologic Surgery



- Barber pole: 17-18th Century

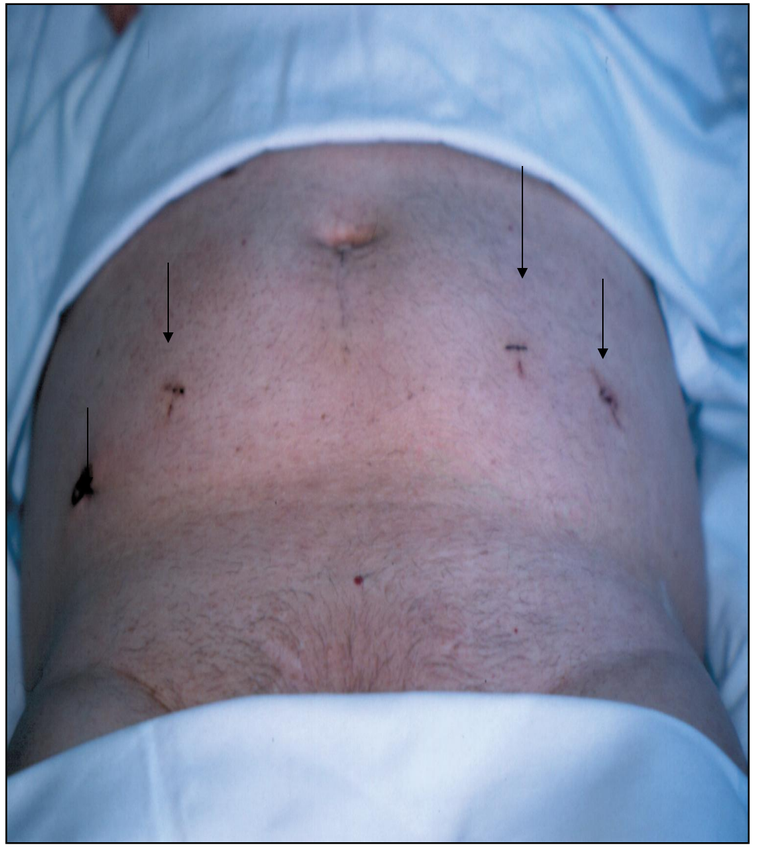


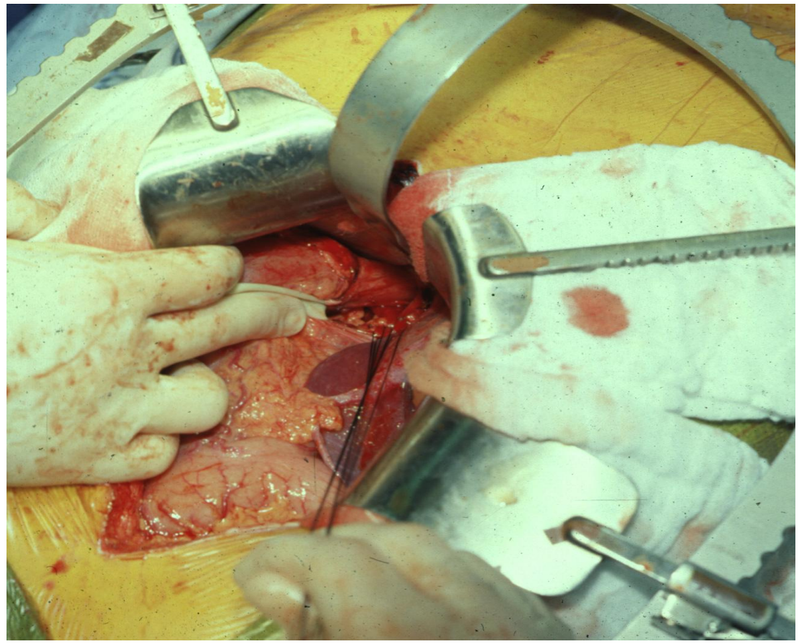
surgery with da Vinci: *1997*

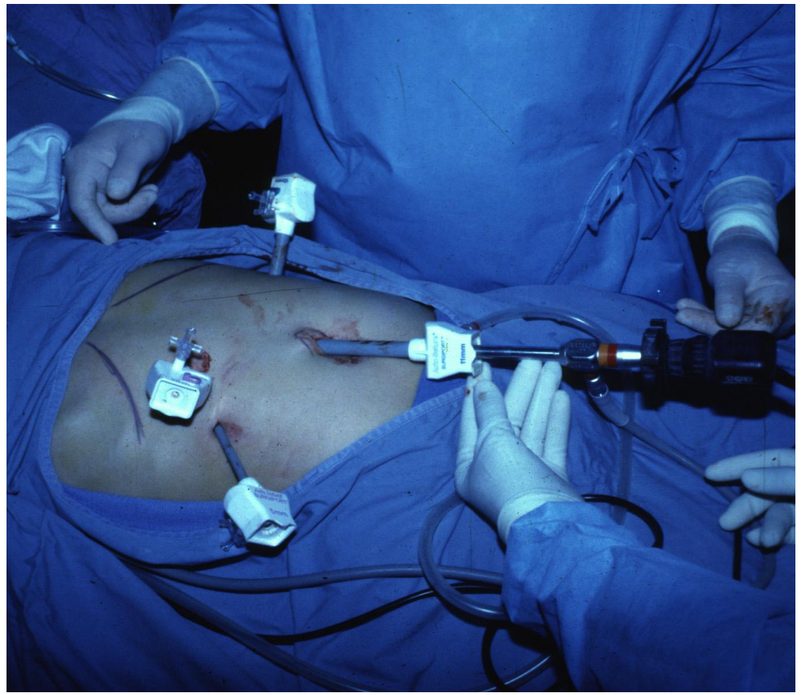


Positive Impact of **MIS**
Surgical wound









Advantages of Minimally Invasive Surgery (MIS)

- **Faster recovery**
- **Shorter hospital stay**
- **Quicker return to work**
- **Less postoperative pain**
- **Recovery of costs**
- **Better cosmesis**
- **Patient Expectation**

But it does have its **drawbacks!**

Laparoscopic Surgery



Unnatural operative field

- 2-D vision, hands and instruments misaligned
- Limited dexterity of instruments inside patient
- Fixed instrument tips, 4 Degrees Of Freedom
- Resting tremors of the surgeon's hands
- Unstable ergonomics; doctor's occupational disease
- Difficult to learn

What is Robotic Surgery?

DEFINITION

A form of **minimally invasive surgery** in which the surgeon operates with robotic robotic arms from a remote console. The 3D-HD vision and wristed instruments instruments deliver unparalleled precision — especially valuable in the confined pelvic anatomy pelvic anatomy of gynecologic surgery.

Evolution of Surgical Approach

STEP 01
Open Surgery

→

STEP 02
Laparoscopy

→

STEP 03
Robotic Surgery

Three Core Components of a Robotic System

01
Surgeon's Console

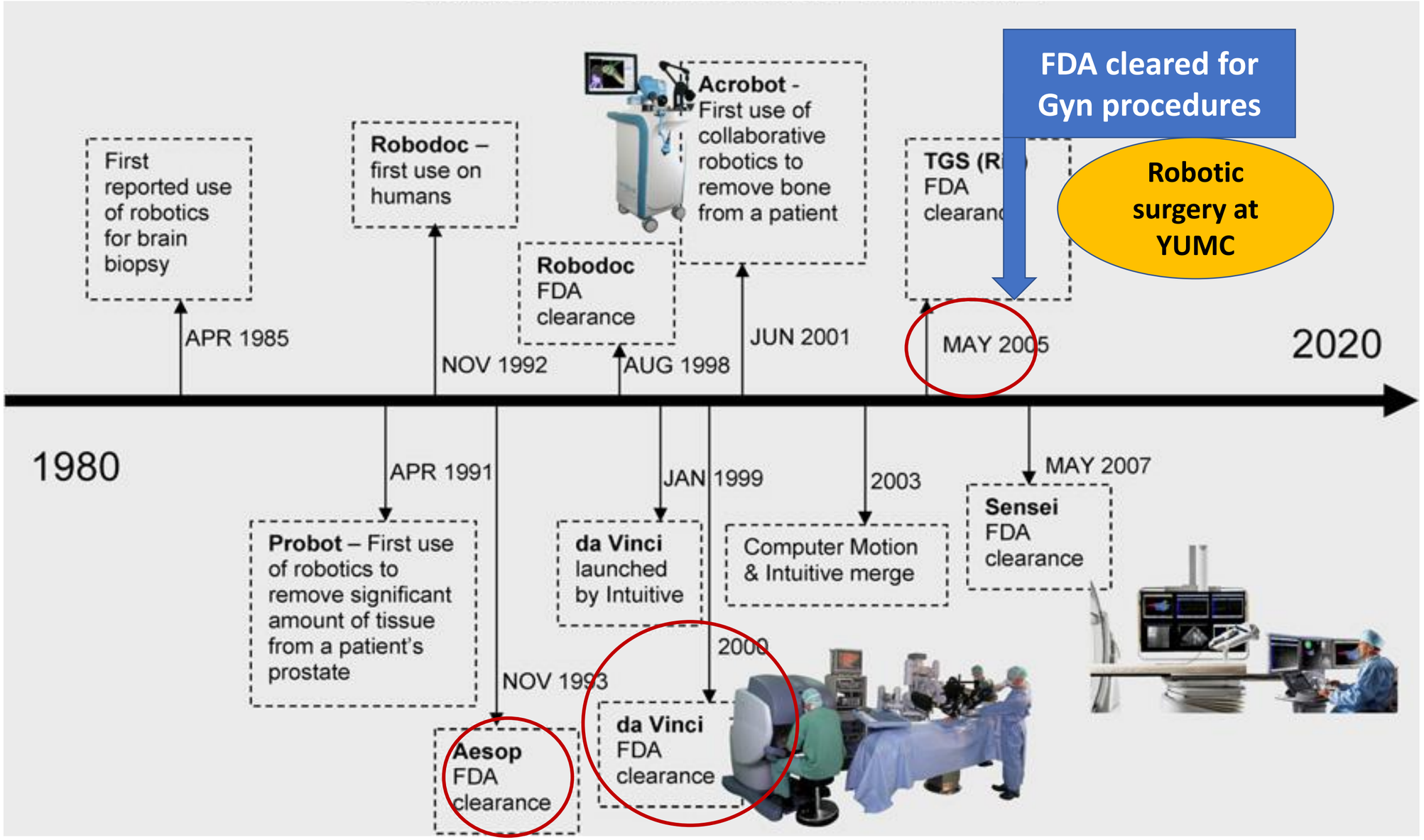
02
Patient-side Cart

03
Vision Cart

Telerobotic surgery; potential solution

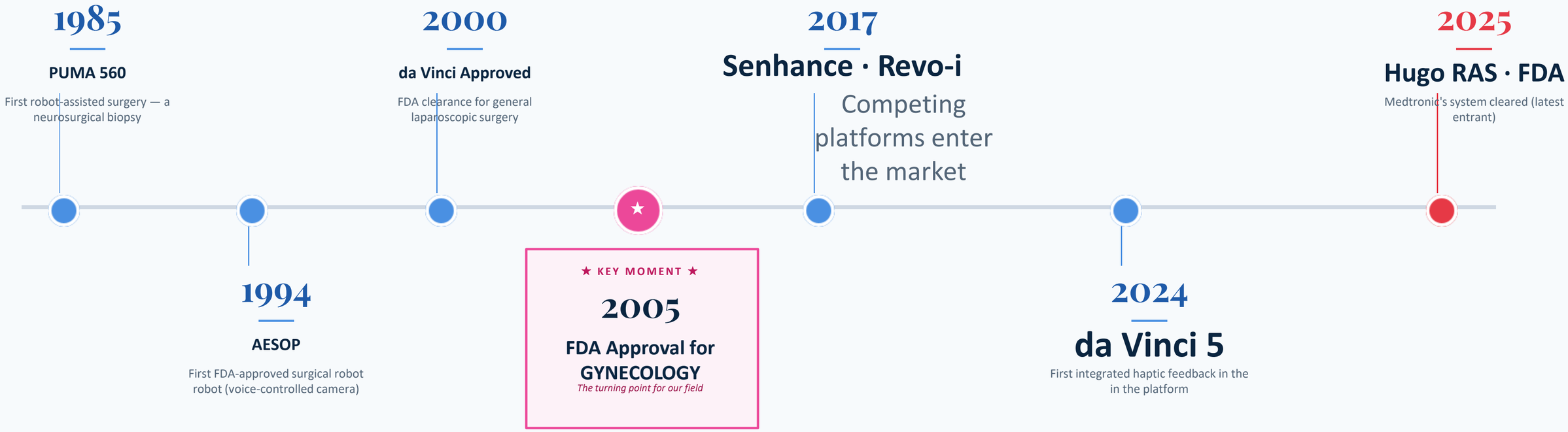


History Timeline – 1



History Timeline – 2

Four decades from experiment to standard of care



KEY INSIGHT FOR GYNECOLOGISTS

The **2005 FDA approval for gynecology** transformed hysterectomy and myomectomy practice worldwide — today, gynecology is the **second-largest specialty** using robotic platforms, and remains the fastest-growing indication.

The first gynecologic procedure

performed with a robot

• Robotically assisted laparoscopic **tubal anastomosis** in a porcine model: a pilot study.
(*J Laparoendosc Adv Surg Tech A. 1998 Apr)*

• Full robotic assistance for laparoscopic **tubal anastomosis**: a case report.

: 1998 with the Zeus robot

(Falcone et al. J Laparoendosc Adv Surg Tech A. 1999 Feb)

• Robotic-assisted laparoscopic **microsurgical tubal anastomosis: a human pilot study.**

: **10 patients** (***1998 with the Zeus robot***)

(Falcone et al. Robot-assisted laparoscopy. Fertil Steril 2000.May)



The Zeus robotic system (Computer Motion Inc.)

Telerobotic surgery; Trans-Atlantic surgery; *2001*

BBC NEWS

You are in: Sci/Tech

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Low Graphics

Wednesday, 19 September, 2001, 14:01 GMT 15:01 UK

Doctors claim world first in telesurgery



The operation was guided by a surgeon thousands of miles from the patient

The first major trans-Atlantic telesurgical operation has been carried out.

Doctors in the United States removed a gall bladder from a patient in eastern France by remotely operating a surgical robot arm.

The procedure could make it possible for a surgeon to perform an operation on a patient anywhere in the world.

Doctors at the European Institute of Telesurgery in Strasbourg say the procedure was successful and there were no complications.

> **It lays the foundations for the globalisation of surgical procedures**
>
> **Professor Jacques Marescaux**

The patient, a 68-year-old woman, was discharged two days after the operation.

To operate on the patient in France, a surgeon

WATCH/LISTEN ON THIS STORY

The BBC's Richard Black "Telesurgery could revolutionise medicine"

See also:

- 05 Jun 01 | Health Inter-continental robot surgery
- 07 Mar 01 | Health Robot injection tested on TV
- 12 Mar 00 | Health Robot reduces spinal surgery risk

Internet links:

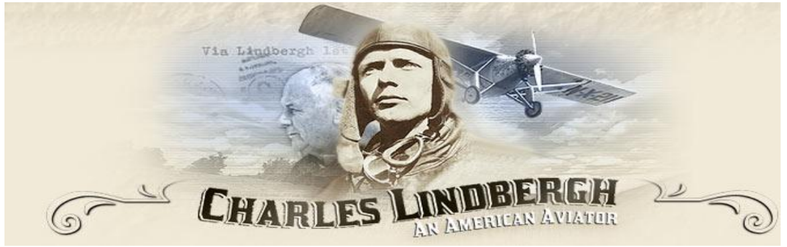
- Nature
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Accident Lindberghs Plane



After Accident



After Accident Lindy On Plane



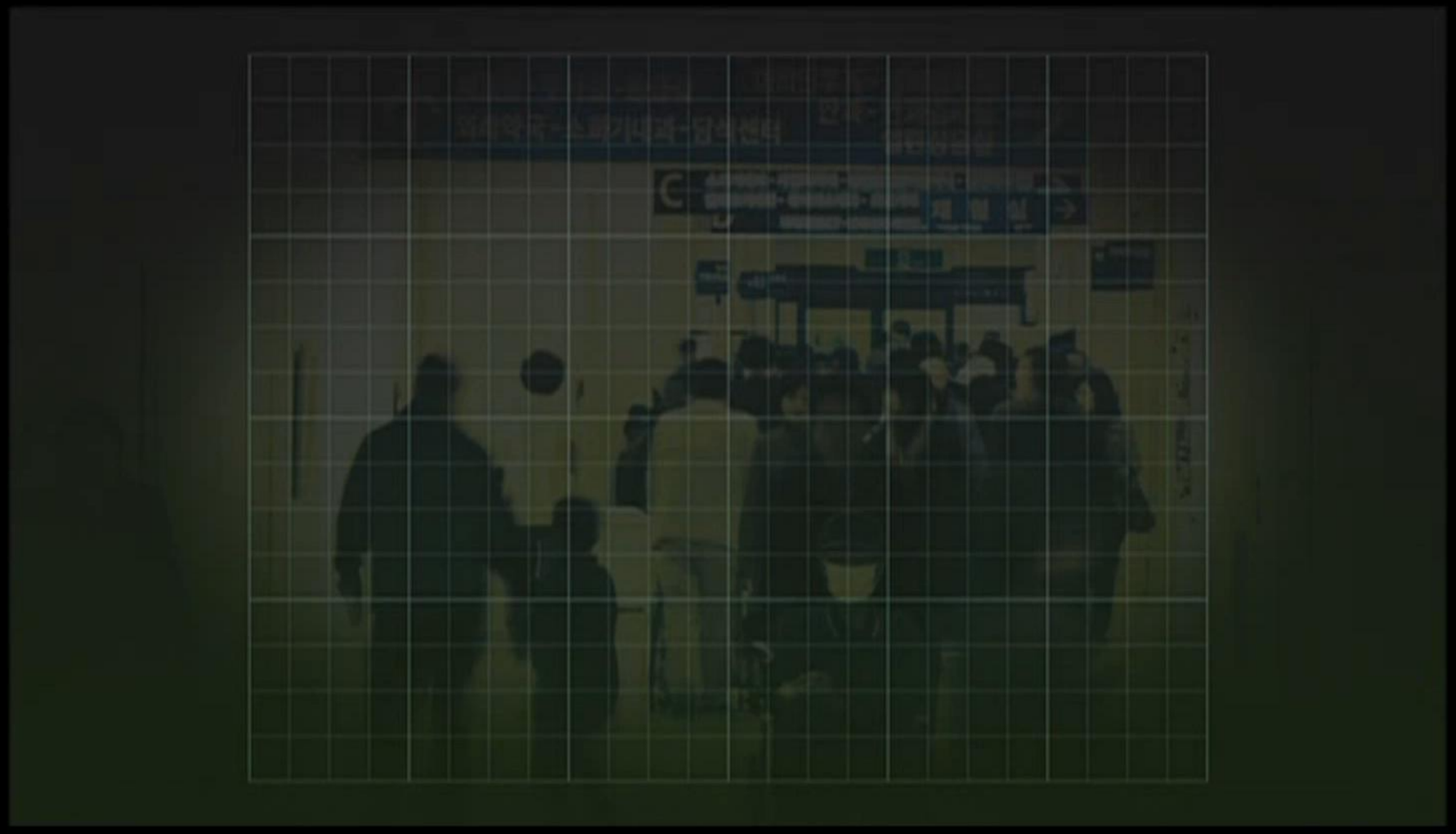
Col & Mrs On Lift Of Hermes



Hoisting Plane After Mishap



Lindberghs Plane



Available online at www.sciencedirect.com
ScienceDirect
Gynecologic Oncology 108 (2008) 312–316
Gynecologic Oncology
www.elsevier.com/locate/ygyno

Robotic radical hysterectomy with pelvic lymphadenectomy for cervical carcinoma: A pilot study

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Received 26 July 2007
Available online 26 November 2007

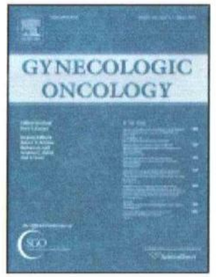
Abstract

Objectives. The purpose of this study was to evaluate the feasibility and surgical outcome of robotic radical hysterectomy with pelvic lymphadenectomy for stage I cervical carcinoma using the da Vinci surgical system.

Methods. A retrospective clinical review was performed of ten patients with FIGO stage IA2–IB1 cervical carcinoma who underwent a total robotic approach for definitive surgical treatment. Patient status was estimated in terms of operative morbidity, length of surgery, docking time, estimated blood loss, yield of pelvic lymph node and hospital stay.

Results. All operations were completed robotically with no conversions to laparotomy. Mean operative time was 207 min (range 120 to 240 min). Mean docking time was 26 min (range 10 to 45 min). Mean estimated blood loss was 355 mL. The average number of pelvic lymph

Gynecologic Oncology



Certificate of Recognition

This certificate is presented to

Y.T. Kim

with thanks and recognition for your article,

Robotic radical hysterectomy with pelvic lymphadenectomy for cervical carcinoma: A pilot study,

one of Elsevier's Top 10 Cited Articles on Scopus™ published 2007-2008

Jennifer Whittaker
Publisher, Elsevier

Dr. Beth Y. Karlan
Editor-in-Chief

Advantages & Limitations

What the evidence says — and what the ACOG guidance emphasizes

✚ ADVANTAGES

Why U.S. Gynecologists Choose Robotics

01 Superior visualization in the pelvis
10× 3D-HD magnification aids ureter, uterine artery & rectovaginal plane ID

02 Wristed instruments for suturing
7-DoF EndoWrist enables intracorporeal knots in deep-pelvic anatomy

03 Better outcomes in obese patients
Lower conversion-to-laparotomy rates in BMI > 40 (per GOG-LAP2 data)

04 Ergonomic benefit for the surgeon
Seated posture — reduces musculoskeletal injury during long cases

EVIDENCE · ROBOTIC vs. OPEN HYSTERECTOMY (meta-analysis, 3.9M cases)

75%↓
Transfusion
Blood loss reduction

44%↓
Complications
Overall morbidity

46%↓
Mortality
In-hospital death

▲ LIMITATIONS

Where Robotic Surgery Falls Short

01 High capital & per-case cost
Platform ~$2M · disposables ~$1,500–$3,500 per case (adds to bundled DRG)

02 No tactile feedback (haptics)
Surgeon cannot "feel" tissue — improving with da Vinci 5 (2024)

03 Setup & docking time
Adds ~15–30 min per case vs. laparoscopy — impacts OR throughput

04 Emergency conversion challenges
Hemorrhage requires rapid undocking & conversion to laparotomy

CLINICAL PEARL · ACOG Committee Opinion #810

"Robotic surgery is not automatically superior to conventional laparoscopy."

ACOG recommends robotic surgery when its unique capabilities offer patient benefit — such as complex disease, high BMI, or hostile pelvis. Trainees must develop **"visual haptics"**: using magnified stereoscopic cues to compensate for the missing sense of touch.

Clinical Applications in Gynecology

★ MOST PERFORMED PROCEDURE IN THE U.S.

Robotic Hysterectomy

The most common robotic-assisted gynecologic surgery worldwide.

Common indications: fibroids, adenomyosis, endometrial cancer, risk-reducing BSO.

U.S. CLINICAL SNAPSHOT

The dominant MIS route

In the United States, robotic-assisted hysterectomy now accounts for a substantial share of all hysterectomies performed each year — surpassing open abdominal hysterectomy in many academic centers. It is a core competency of modern OB/GYN residency training.

02

Myomectomy

Fibroid removal

- Multi-layer uterine closure
- Fertility preservation
- Deep intramural fibroids

Robotic wrist enables secure suturing of the myometrium myometrium

03

Sacrocolpopexy

Pelvic organ prolapse

- Mesh to sacral promontory
- Apical vault support
- Long-term durability

Gold-standard MIS repair — precise deep-pelvis suturing

04

Endometrial Cancer Staging

Gyn-oncology

- Total hysterectomy + BSO
- Sentinel lymph-node mapping
- Pelvic lymphadenectomy

SGO-endorsed preferred approach for early-stage disease

05

Radical Trachelectomy

Fertility-sparing

- Early-stage cervical cancer
- Preserves uterine fundus
- Cerclage placement

⚠ LACC trial (NEJM 2018) — careful patient selection required

06

Deep Endometriosis

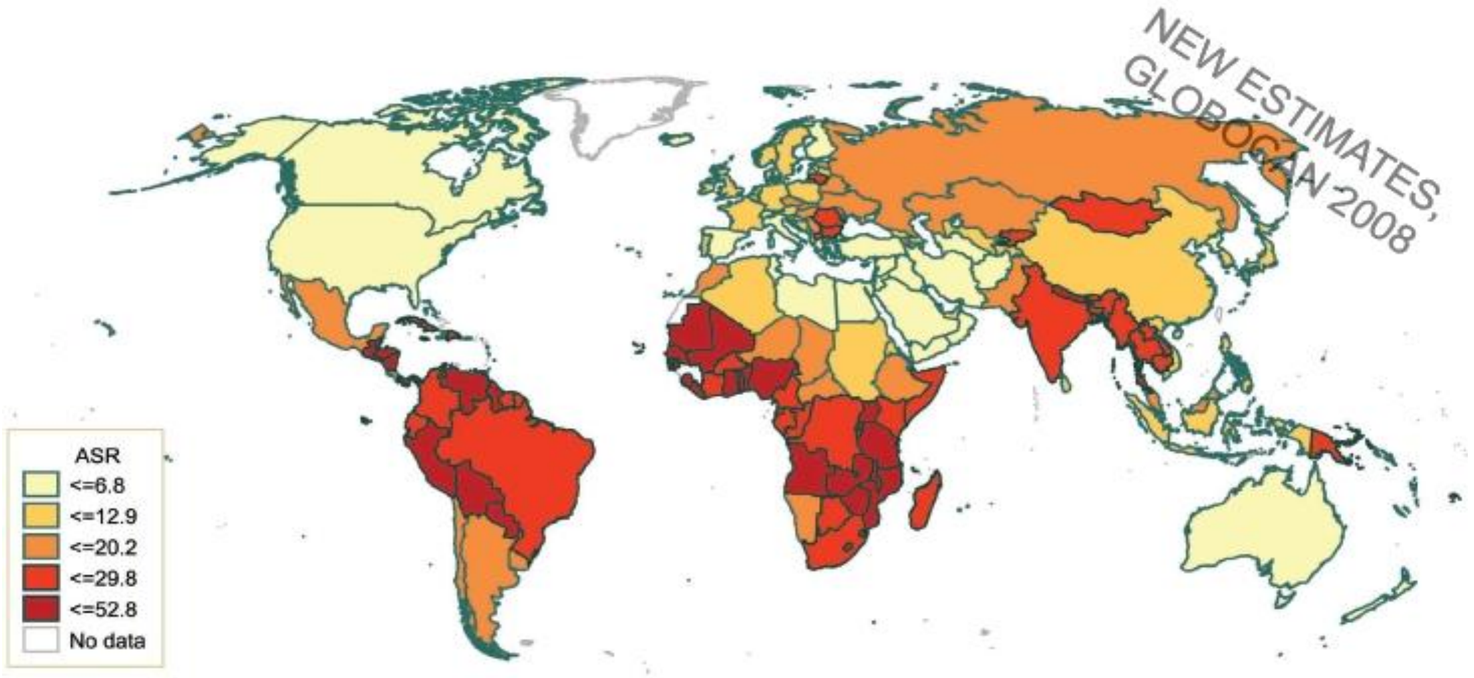
Complex benign disease

- Bowel & bladder involvement
- Ureterolysis
- Rectovaginal dissection

Multidisciplinary approach with colorectal & urology

Every year, *cervical cancer* affects nearly 500,000 women and takes the lives of over a quarter million worldwide.

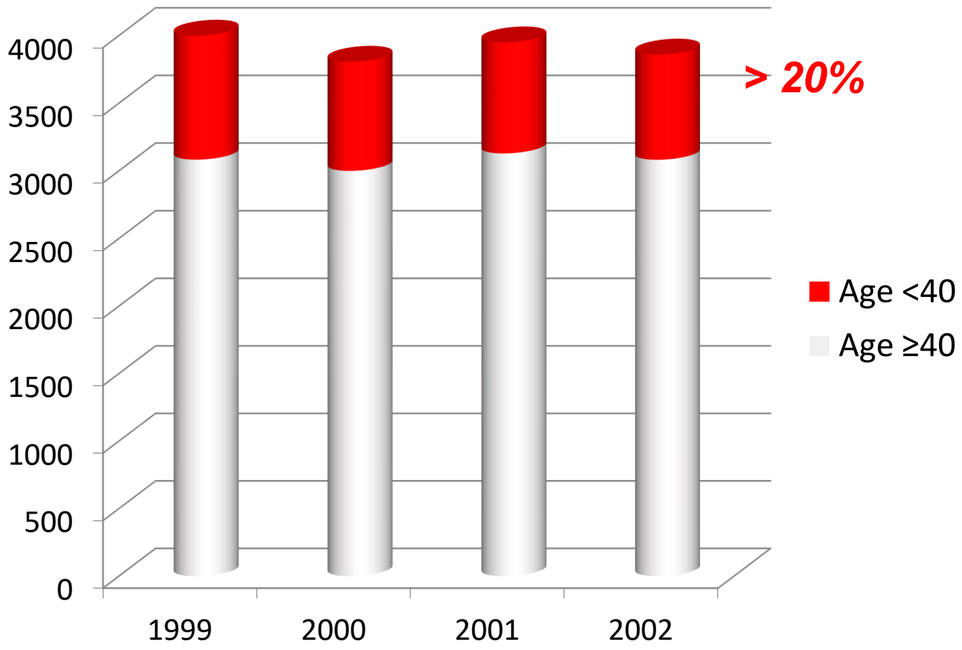
World age-standardized incidence rates of cervical cancer



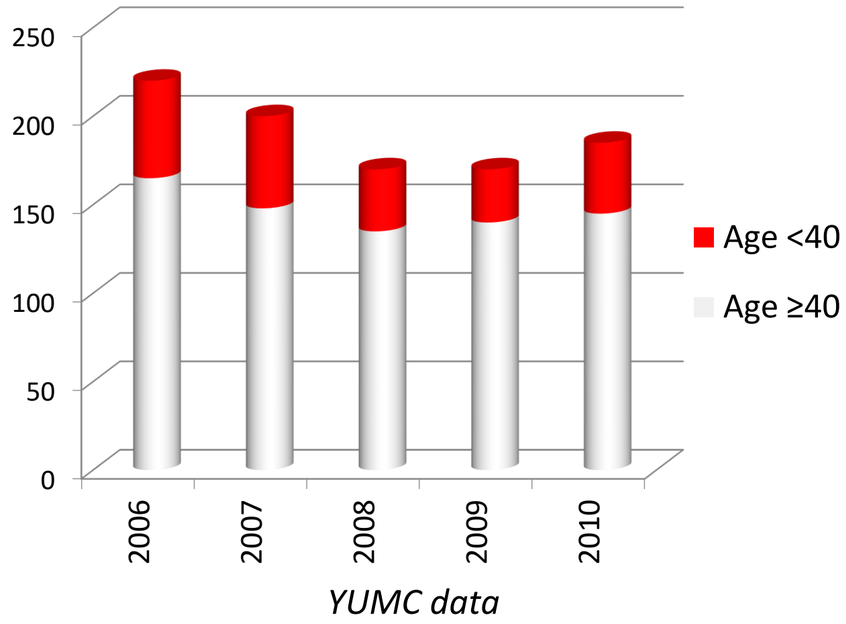
ASR, age-standardized incidence rate; Rates per 100,000 women per year.
Data sources: IARC, Globocan 2008.

❖ SEER data 2010 : 42% of all cervical cancers

☞ diagnosed in women aged 45 yrs or younger



❖ Cervix cancer in Korea



Many young patients have early stage cervical cancer.

☞ ***Radical hysterectomy** has been the key surgical treatment option.*

❖ Cancer-related infertility in young women

☞ depression, grief, stress, and sexual dysfunction

(Carter et al., *Int J Gynecol Cancer* 2010;20:2-8)



❖ Radical trachelectomy for fertility-preservation could be indicated for 40% of patient who had undergone radical hysterectomy.

☞ improve their QOL.

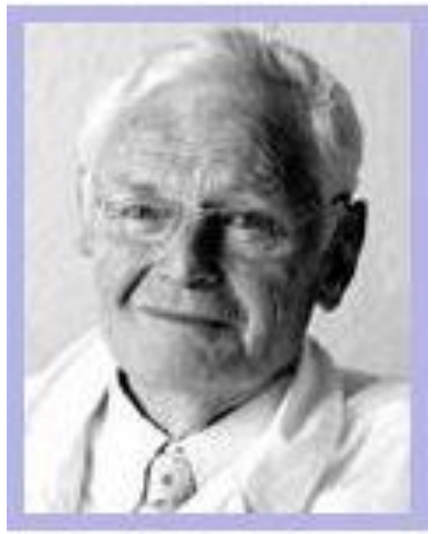
(Sonoda Y, et al. *Gynecol Oncol* 2004;95:534-8)

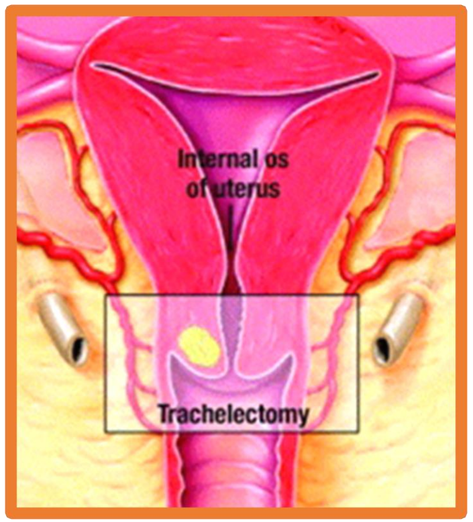
History of trachelectomy

Dr. Daniel Dargent's masterpiece (1994) :

The Radical Vaginal trachelectomy

First fertility-preserving method





- **First reported in 1994, 28 cases**
  - **Radical Vaginal Trachelectomy**
  - **Laparoscopic pelvic lymphadnectomy**

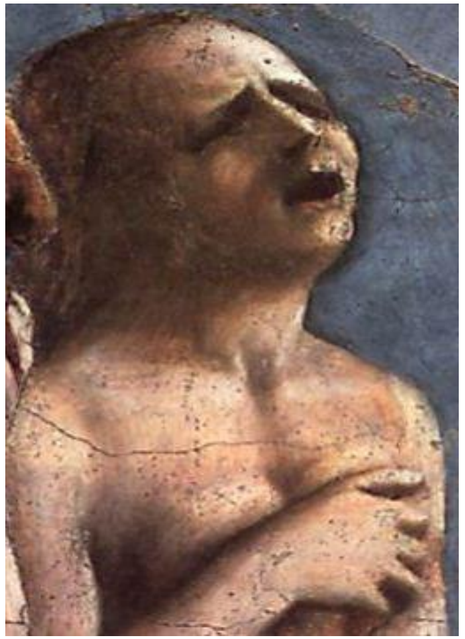
(Gynecol Oncol 1994)

Fertility-sparing surgery
could change their lives

Due to the delay of marriage and childbirth in modern society

☞ **Cervical cancer in young women has become a serious issue.**

Fertility-sparing surgery in young women with cervical cancer could change their QOL.





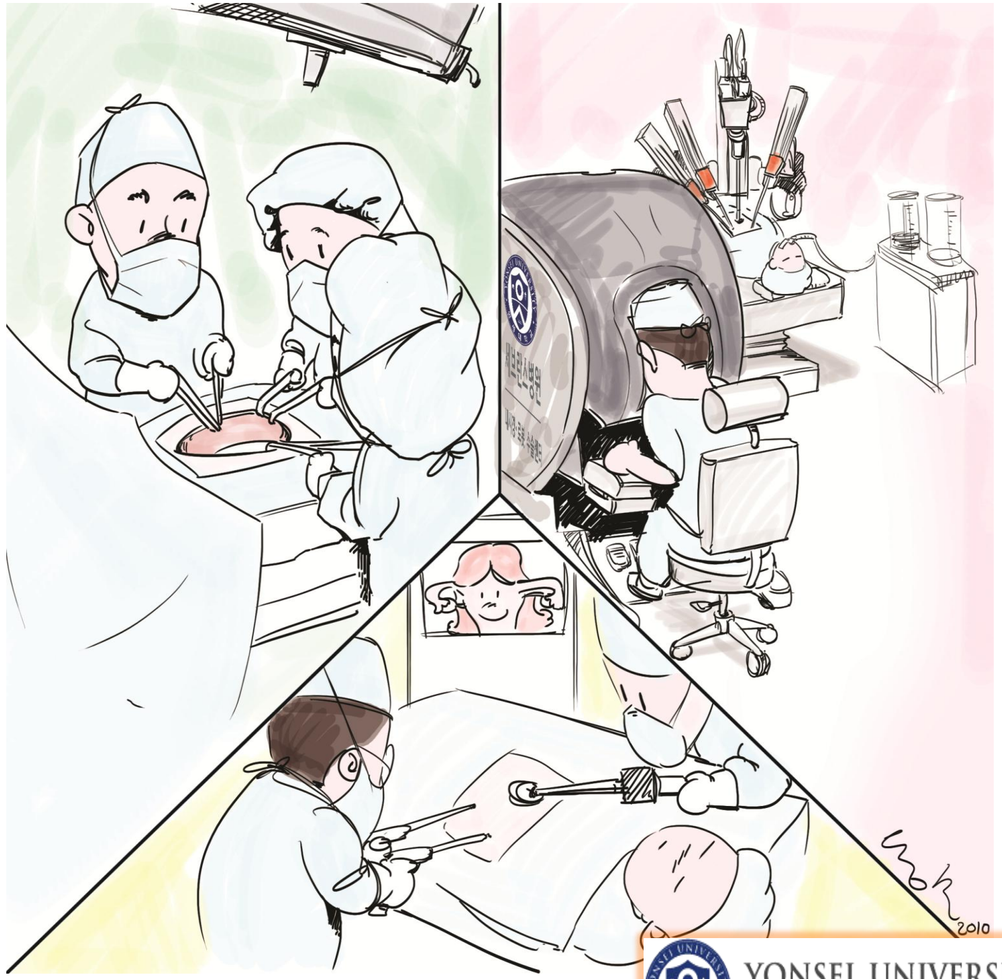
Selection criteria of patients

1. **Very strong desire for future fertility**
2. **Age < 40 years**
3. **Tumor size ≤2 cm**
4. **Exclusion of unfavorable histology (e.g., neuroendocrine type)**
5. **Stage IA1 with LVSI, stage IA2, or stage IB1**
6. **No evidence of pelvic LN metastasis and/or other distant metz**

(Lilian et al. *Gynecol Oncol* 2010)

Fertility-preservation options in early-stage cervical cancer

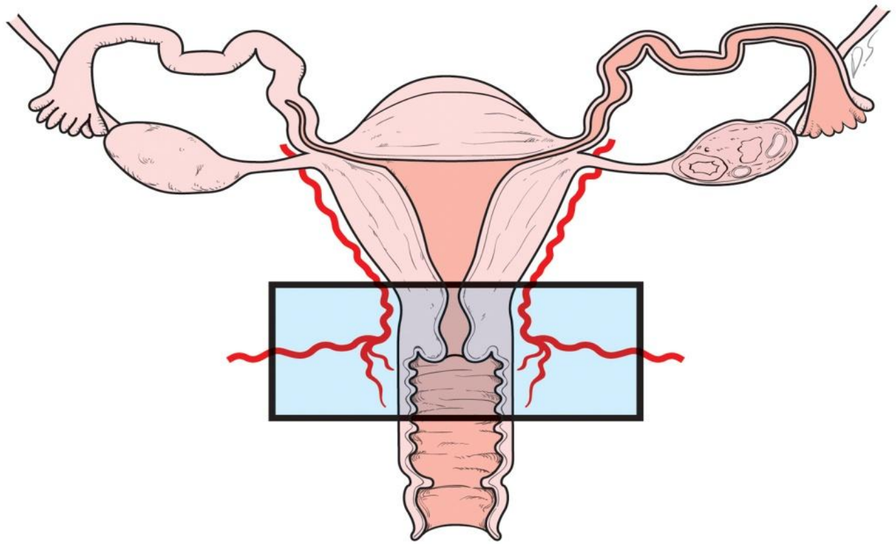
- Radical vaginal trachelectomy with laparoscopic pelvic lymphadenectomy (Dargent's operation)
- Radical abdominal trachelectomy
- Laparoscopic assisted radical trachelectomy
- Total laparoscopic radical trachelectomy
- Robotic radical trachelectomy



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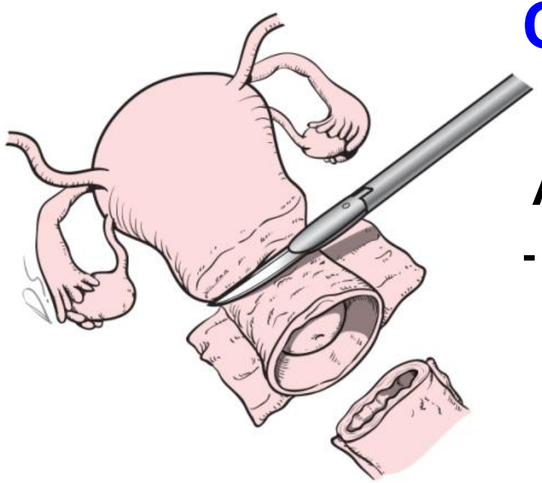
Robotic radical trachelectomy

- Transection of the uterine arteries at their origin
- Unroofing the ureter : Ant. vesicouterine ligaments are divided



- Dividing the cardinal ligaments and uterosacral ligaments

Robotic radical trachelectomy

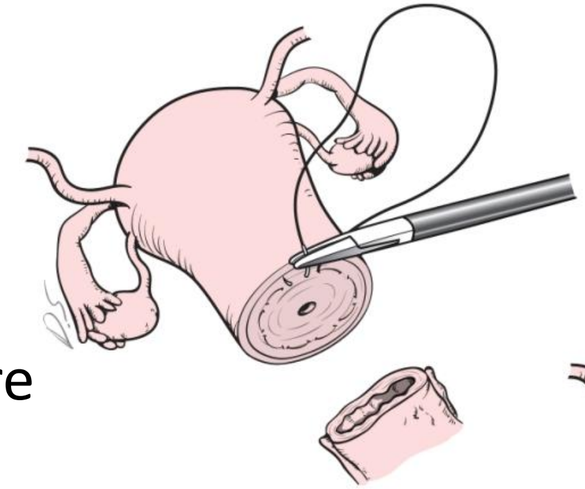


Circumferential incision of vagina :

2cm below the vaginal stump

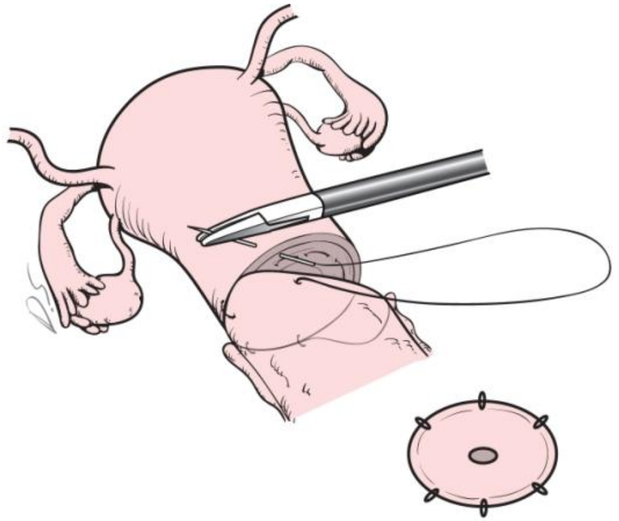
Amputation of the cervix using the Endo-knife™

- Confirm the negative frozen sections of the endocervical margin

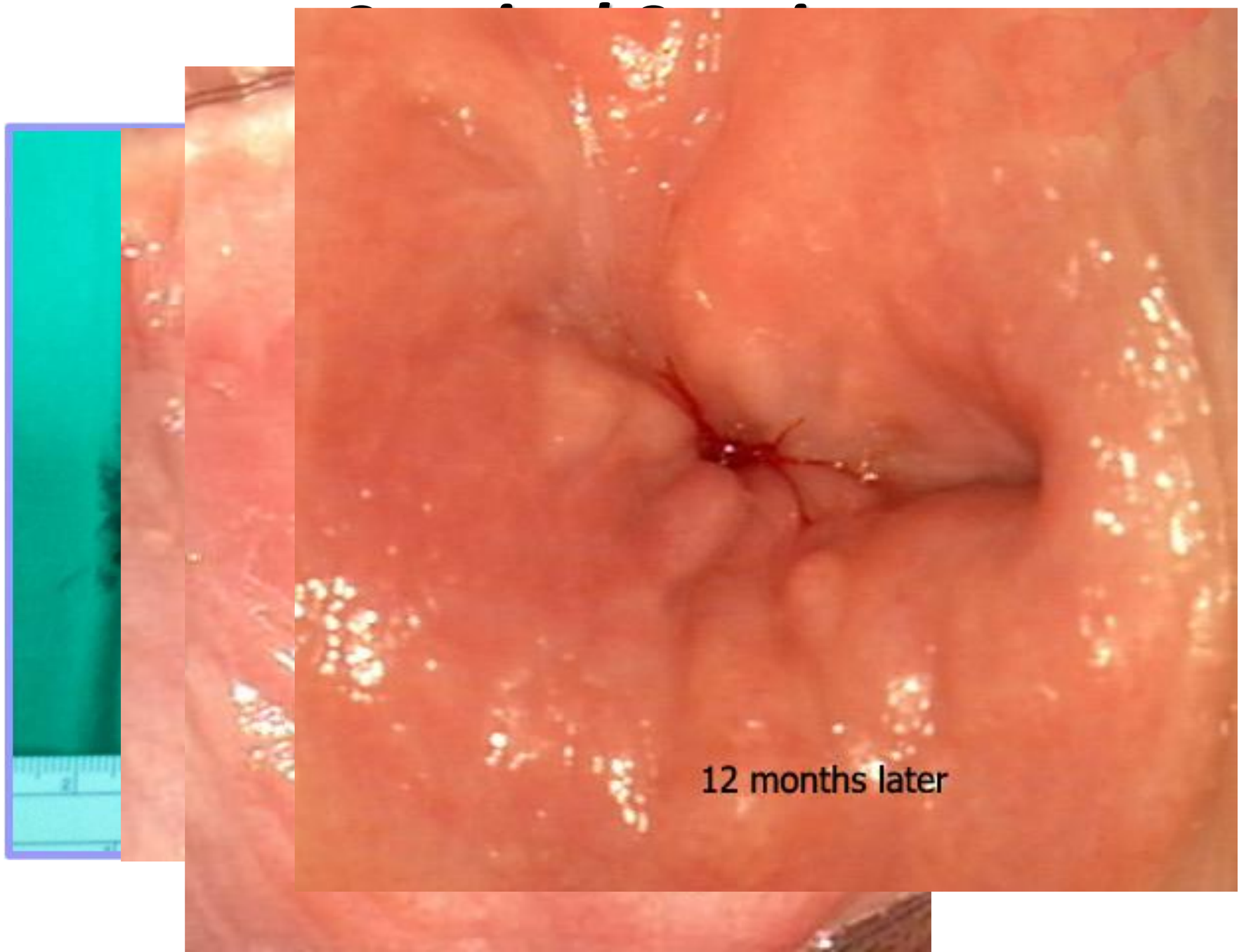


Cerclage

using 1-0 prolene suture



Vaginal-isthmic anastomosis


12 months later

Radical Trachelectomy : *Obstetric Outcomes*

- **40-79% of attempted patients became pregnant.**

- **Overall, 40% of all pregnancies - a term delivery (> 37 wks)**
  Preterm delivery rate (< 37 wks) - approximately 28%

- **Infertility has been described in 25–30% of patients attempting to conceive.**
  - **75% of infertility after trachelectomy is due to a cervical factor.**
    Possible explanations: cervical stenosis, decreased cervical mucus and so on.
  - **15% of patients develop cervical stenosis after radical vaginal trachelectomy.**

(Jennifer A et al. *Amer J Perinatol* 2007Lilian et al. Gynecol Oncol 2010,)

Radical Trachelectomy : Oncologic Outcomes

- Radical trachelectomy case series have demonstrated

  a **recurrence rate of 4.2–5.3%** and a death rate of **2.5–3.2%.**

  (Lilian et al. *Gynecol Oncol* 2010)

- Two studies comparing **radical trachelectomy vs. radical hysterectomy:**

  there was **no statistically significant difference** in 5-yr RFS and OS.

  (Marchiole et al. *Gynecol Oncol* 2007 & Beiner et al. *Gynecol Oncol* 2008)

- **Risk factors for recurrence**

  - ***Tumor size > 2cm***
  - **Positive pelvic lymph node**
  - **Lymphovascular involvement**
  - **Small-cell neuroendocrine type**
  - **Positive resection margin**

  (Lilian et al. *Gynecol Oncol* 2010)

Contents lists available at ScienceDirect

Gynecologic Oncology

journal homepage: www.elsevier.com/locate/ygyno

Long term oncologic and reproductive outcomes after robot-assisted radical trachelectomy for early-stage cervical cancer. An international multicenter study

Linnea Ekdahl [a,f,*], Sarah Paraghamian [b], Kyung Jin Eoh [c], Kavitha Madhuri Thumuluru [d], Simon A. Butler-Manuel [d], Young Tae Kim [c], John F. Boggess [b], Jan Persson [a,f,1], Henrik Falconer [e,1]

[a] Department of Obstetrics and Gynecology, Division of Gynecologic Oncology, Skåne University Hospital, Lund, Sweden
[b] Department of Obstetrics and Gynecology, University of North Carolina at Chapel Hill, NC 27599, USA
[c] Department of Obstetrics and Gynecology, Yonsei University College of Medicine, Yonsei University College of Medicine, CPO Box 8044, Seoul 120-752, Republic of Korea
[d] Department of Gynaecological Oncology, Royal Surrey NHS Foundation Trust, Great Britain, GU2 7XX United Kingdom
[e] Department of Women's and Children's Health, Karolinska Institutet, Department of Pelvic Cancer, Theme Cancer, Karolinska University Hospital, Stockholm, Sweden
[f] Lund University Faculty of Medicine, Clinical Sciences, Obstetrics and Gynecology, 22185 Lund, Sweden

HIGHLIGHTS

- 80% women with an attempt to conceive succeeded.
- The premature delivery rate before gestational week 32 was 14%.
- The intention to treat based recurrence rate was 7.2%.

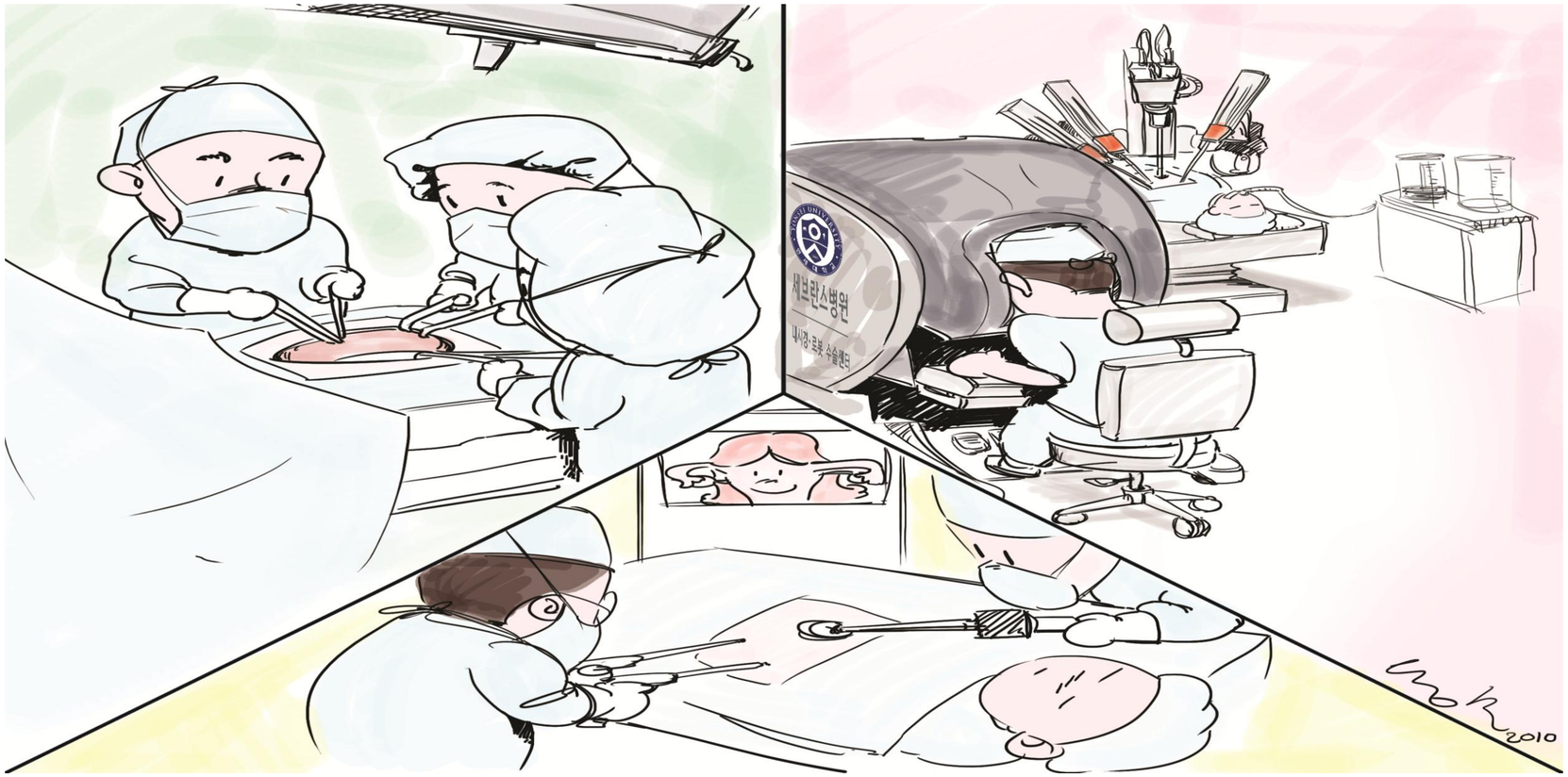
ARTICLE INFO

ABSTRACT





Surgical options in endometrial cancer



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J Clin Oncol. 2009 Nov 10;27(32):5331-6. doi: 10.1200/JCO.2009.22.3248. Epub 2009 Oct 5.

Laparoscopy compared with laparotomy for comprehensive surgical staging of uterine cancer: Gynecologic Oncology Group Study LAP2.

Walker JL[1], Piedmonte MR, Spirtos NM, Eisenkop SM, Schlaerth JB, Mannel RS, Spiegel G, Barakat R, Pearl ML, Sharma SK.

Author information

1 University of Oklahoma, Oklahoma City, OK 73190, USA. joan-walker@ouhsc.edu

Abstract

PURPOSE: The objective was to compare laparoscopy versus laparotomy for comprehensive surgical staging of uterine cancer.

PATIENTS AND METHODS: Patients with clinical stage I to IIA uterine cancer were randomly assigned to laparoscopy (n = 1,696) or open laparotomy (n = 920), including hysterectomy, salpingo-oophorectomy, pelvic cytology, and pelvic and para-aortic lymphadenectomy. The main study end points were 6-week morbidity and mortality, hospital length of stay, conversion from laparoscopy to laparotomy, recurrence-free survival, site of recurrence, and patient-reported quality-of-life outcomes.

Robotic surgery: da Vinci™ XI System





4th generation system; April 2014
da Vinci ™ XI

FIREFLY™ FLUORESCENCE IMAGING

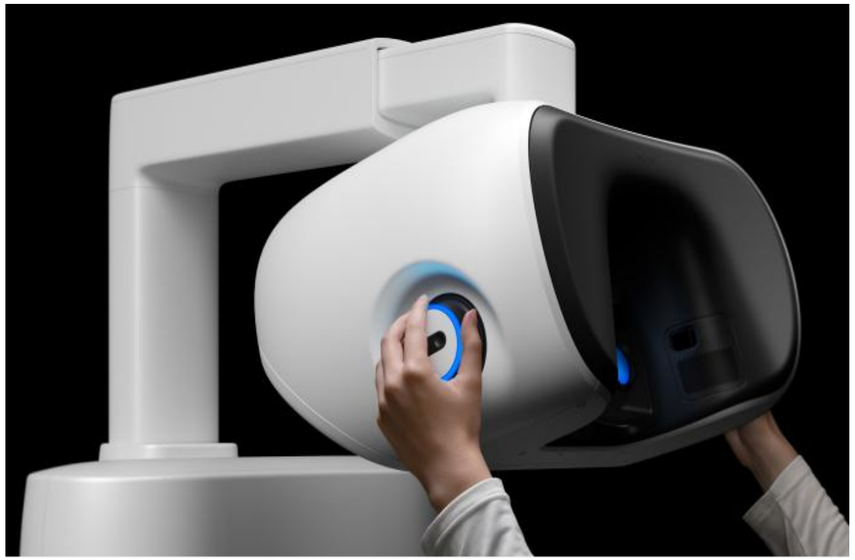
The da Vinci Xi Surgical System is designed to be fluorescence-imaging capable.

Firefly: Fluorescence Imaging provides real-time visualization and assessment of vessels, ducts, and tissue perfusion

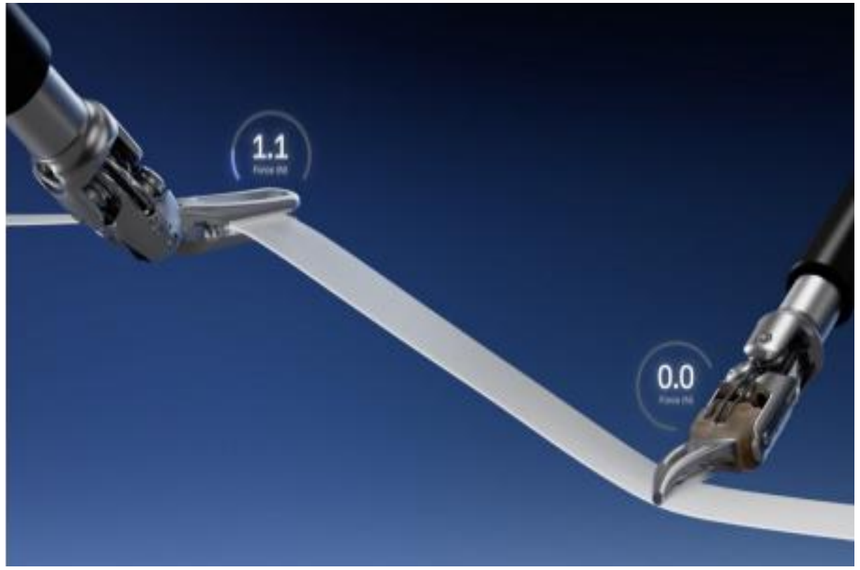
Robotic surgery: da Vinci SP System



Robotic surgery: da Vinci 5



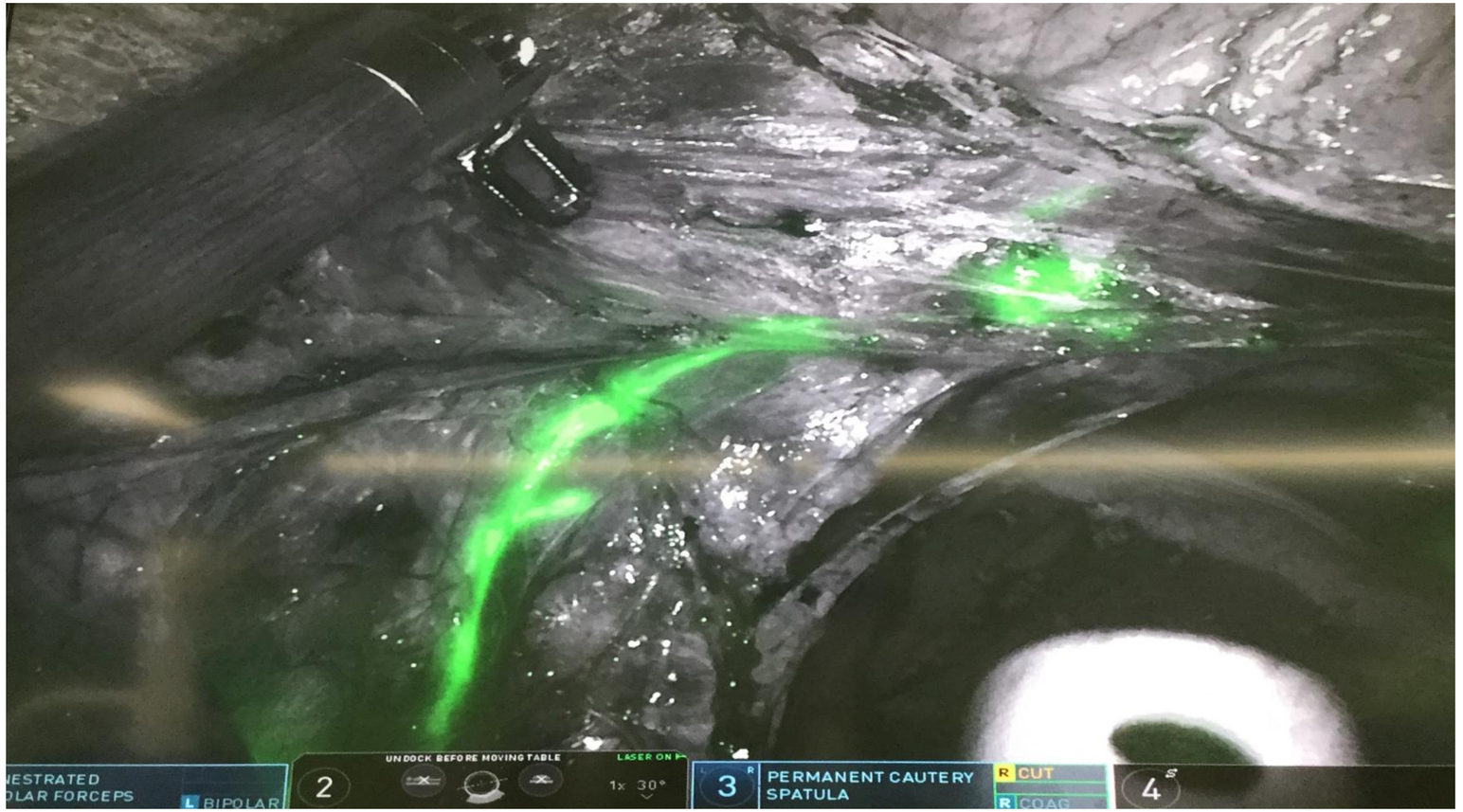
5th generation system; Nov 2024
da Vinci ™



Force Feedback

This new instruments enable surgeons **to sense the push and pull forces exerted on patient tissue.** Force Feedback technology translates forces in three dimensions, **from the instrument tip to the surgeon hand controllers.**

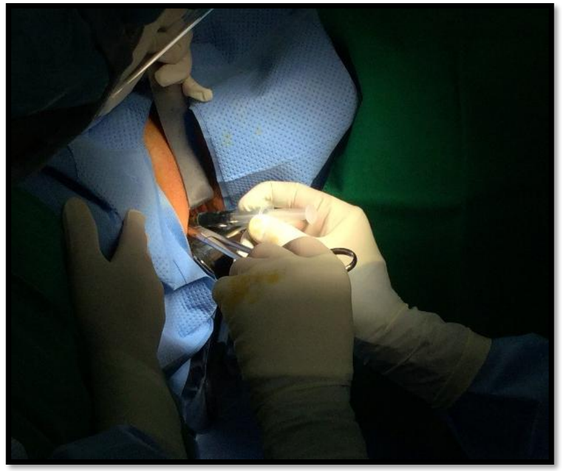
Streamlined FireFly (NIR imaging)



ICG Injection

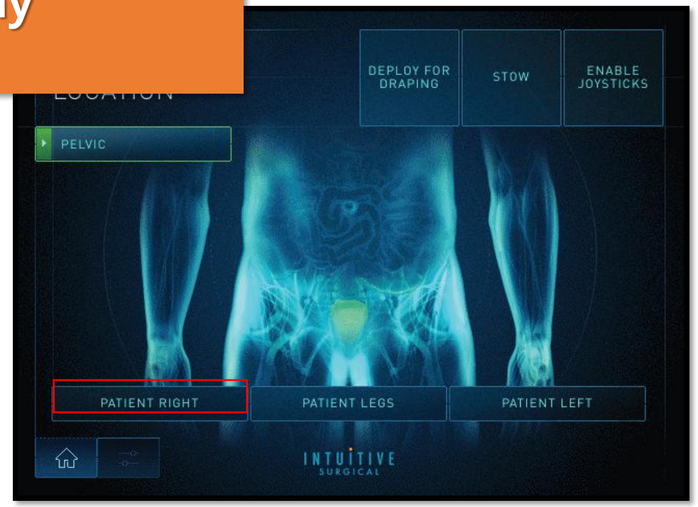






Patient Cart location & Anatomy selection






2
STERIS

Robot-Assisted Staging Using Three Robotic Arms for Endometrial Cancer: Comparison to Laparoscopy and Laparotomy at a Single Institution

YONG WOOK JUNG, MD,[1] DAE WOO LEE, MD,[1] SANG WUN KIM, MD, PHD,[1] EUN JI NAM, MD,[1] JAE HOON KIM, MD, PHD,[1] JAE WOOK KIM, MD, PHD,[2] AND YOUNG TAE KIM, MD, PHD,[1]*

[1]*Division of Gynecologic Oncology, Department of Obstetrics and Gynecology, Women's Cancer Clinic, Yonsei University College of Medicine, Seoul, Korea*

[2]*Department of Obstetrics and Gynecology, Kwandong University College of Medicine, Myongji Hospital, Goyang, Korea*

Purpose: To demonstrate the feasibility of robot-assisted staging surgery using three arms in patients with endometrial cancer.

Methods: One hundred nine patients with clinical stage I endometrial cancer who underwent staging surgery at Yonsei University Health System were enrolled from May 2006 to January 2009. Patient demographics and operative outcomes were prospectively collected.

Results: Robotic surgery using three arms was performed in 28 patients, laparoscopy in 25, and laparotomy in 56. There were no differences among the three groups in terms of patient demographics. The number of harvested pelvic lymph nodes was lower in the laparoscopy group than in the laparotomy group (18.36 ± 7.25 vs. 24.39 ± 10.08, respectively, $P = 0.025$), but there was no difference between the robot and laparotomy groups. The number of resected para-aortic lymph nodes and operative time did not differ among the three groups. The average hospital stay was longer for the laparotomy group than the robot and laparoscopy groups (10.78 days vs. 7.92 days vs. 7.67 days, respectively, $P < 0.001$). Operative complications and transfusions developed more frequently in the laparotomy group than in the robot and laparoscopy groups (25.0% vs. 7.1% vs. 8.0%, respectively, $P = 0.049$; 42.9% vs. 14.3% vs. 16.0%, respectively, $P = 0.006$).

Conclusion: Robot-assisted surgery using three arms is a feasible method for surgical staging in patients with clinical stage I endometrial cancer.

J. Surg. Oncol. 2010;101:116–121. © 2009 Wiley-Liss, Inc.

https://doi.org/10.4143/crt.2020.802

Cancer Res Treat. 2021;53(2):549-557

Original Article

Nationwide Comparison of Surgical and Oncologic Outcomes in Endometrial Cancer Patients Undergoing Robotic, Laparoscopic, and Open Surgery: A Population-Based Cohort Study

Kyung-Jin Eoh[1], **Eun-Ji Nam**[2], **Sang-Wun Kim**[2], **Minkyung Shin**[3], **Stella J-H Kim**[4], **Jung-Ae Kim**[4], **Yong-Tae Kim**[2]

[1]*Department of Obstetrics and Gynecology, Yonsei University College of Medicine, Yongin Severance Hospital, Yongin,* [2]*Department of Obstetrics and Gynecology, Institute of Women's Life Medical Science, Women's Cancer Center, Yonsei Cancer Center, Severance Hospital, Yonsei University College of Medicine, Seoul, Korea,* [3]*Health Economics and Outcomes Research - APAC, Intuitive Surgical, Sunnyvale, CA, USA,* [4]*IQVIA Korea, Seoul, Korea*

Purpose Population-based comparisons between minimally invasive surgery (MIS) (robotic surgery [RS] and laparoscopic surgery [LS]) and open surgery (OS) for managing endometrial cancer are lacking. This study aimed to compare surgical and oncologic outcomes between endometrial cancer patients who underwent surgical staging via MIS or OS.

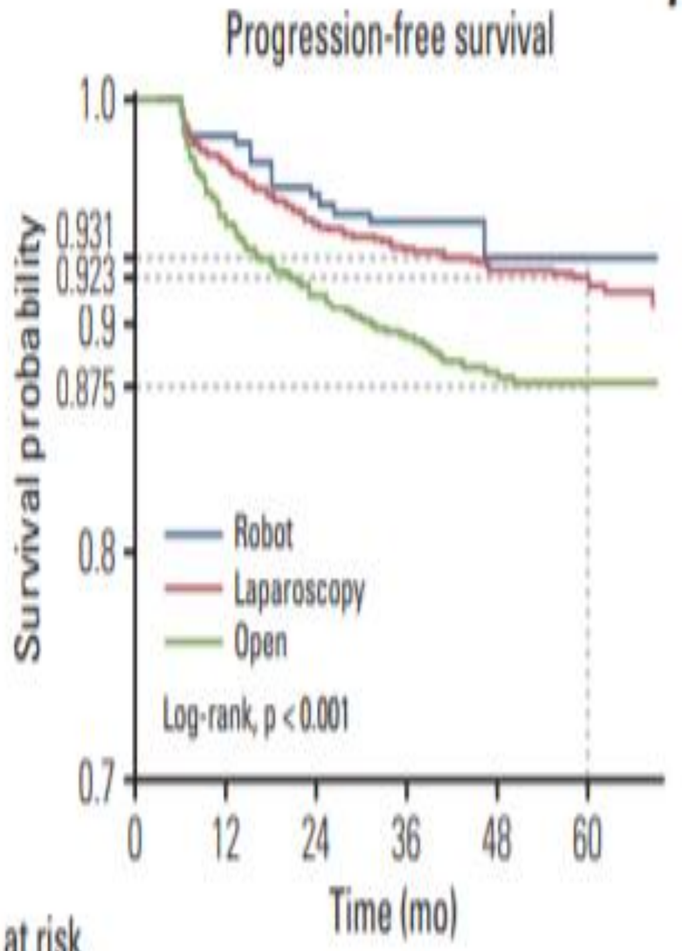
Materials and Methods A population-based retrospective cohort study was performed using claims data from the Korean National Health Insurance database from January 2012 to December 2016. All patients who underwent hysterectomy under diagnosis of endometrial cancer were identified. Patients were classified into RS, LS, and OS groups. Operative and oncologic outcomes were compared among the three groups after adjustments for age group, risk group (adjuvant therapy status), modified Charlson comorbidity index, income level, insurance type, and index year using propensity scores obtained via the inverse probability of treatment weighted method.

Results After adjustment, 5,065 patients (RS, n=315; LS, n=3,248; OS, n=1,503) were analyzed. Patient demographics were comparable. Hospital stay, postoperative complications, and cost were more favorable in the RS and LS groups than in the OS group (all $p < 0.001$). Five-year overall survival was significantly longer in the RS and LS groups than in the OS group (94.8%, 91.9%, and 86.9%, respectively; $p < 0.001$). Moreover, the survival benefit of RS was shown in the subgroup analysis of low-risk endometrial cancer patients.

Conclusion Our study provides further evidence for the RS being a safe surgical alternative to the LS and OS, especially in low-risk endometrial cancer patients, offering surgical and oncologic outcomes equivalent to other surgical approaches.

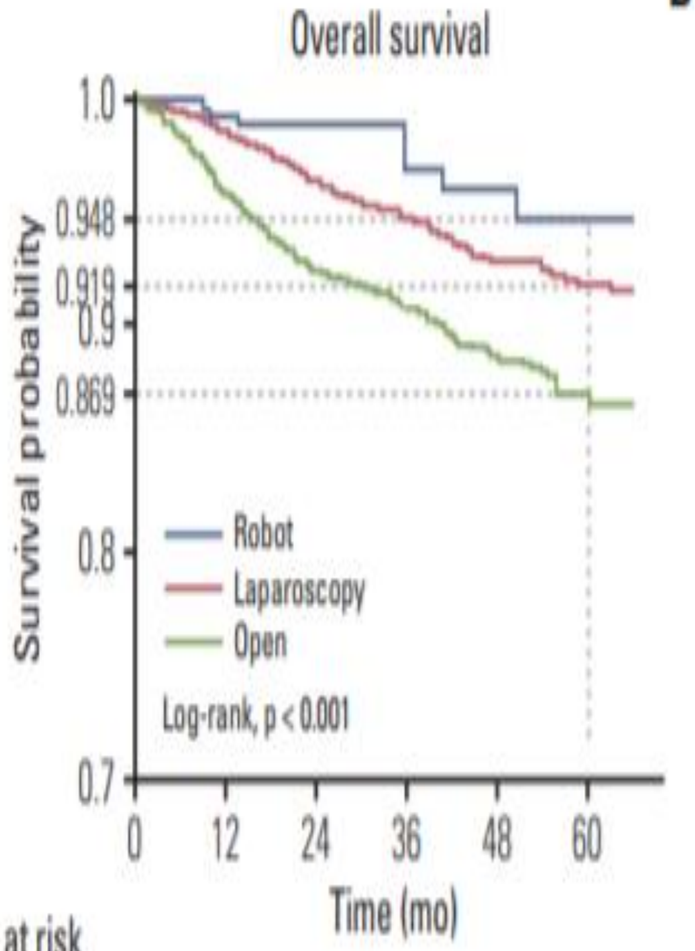
INTUITIVE.

A



No. at risk						
Robot	315	310	227	154	93	47
Laparoscopy	3,248	3,126	2,281	1,619	1,037	486
Open	1,503	1,378	1,000	699	451	209

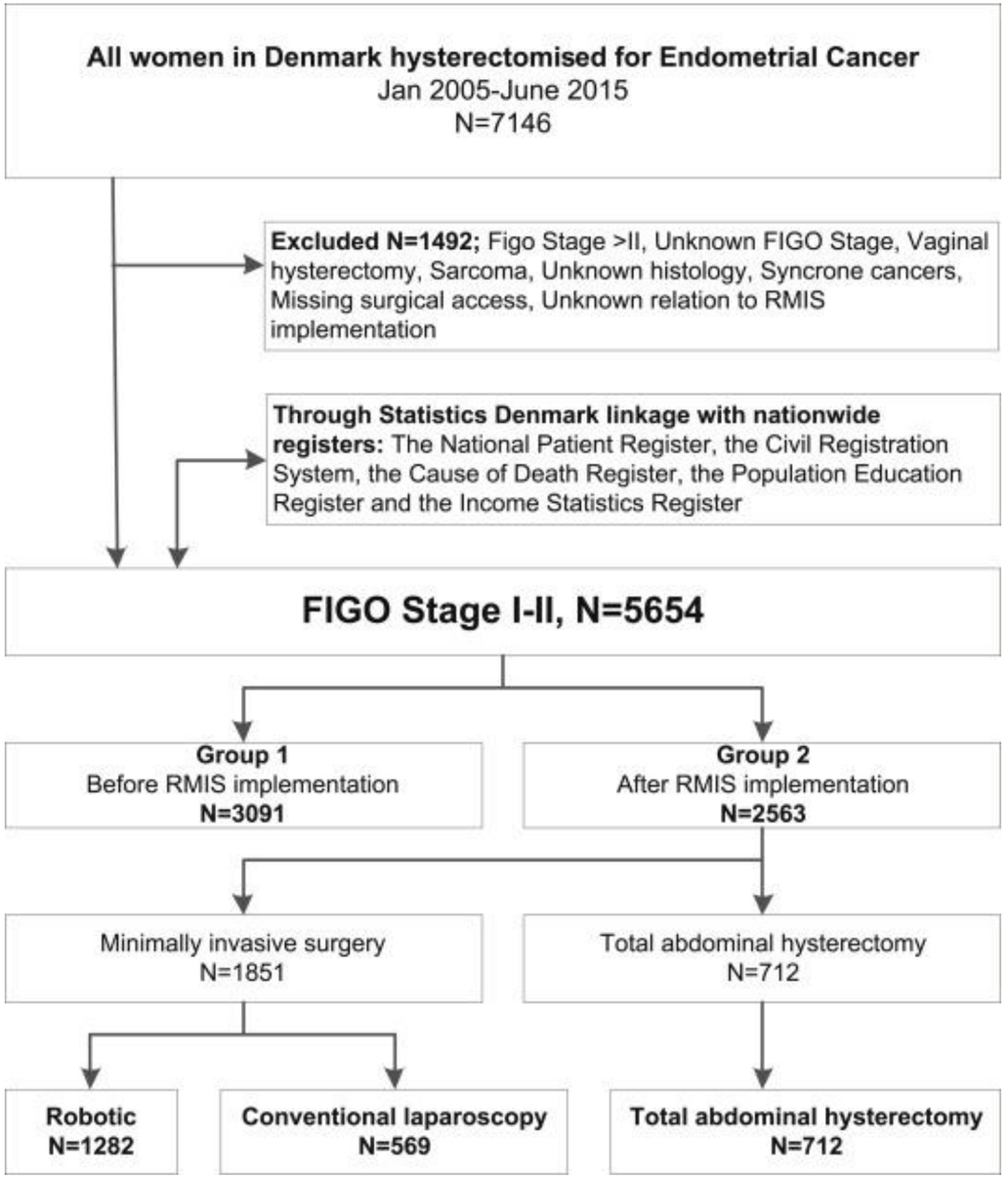
B



No. at risk						
Robot	315	313	233	159	96	47
Laparoscopy	3,248	3,204	2,384	1,695	1,091	509
Open	1,503	1,441	1,061	749	485	227

Conclusion

Our nationwide cohort study provides further evidence for the **RS** being a safe surgical alternative to the LS and the OS in endometrial cancer patients, offering surgical and oncologic outcomes equivalent to other surgical approaches.





Siv L Jorgensen et al. Eur J Cancer 2019

Technical tips to prevent surgical complications



Less invasive, More precise and convenient

Pfannenstiel incsion	Endoscopy	Laparoscopic Hysterectomy	Intrauterine Manipulator	Robotics and Advanced instruments



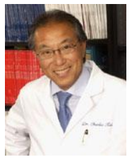
Pfannenstiel, 1900



Yoon's ring, 1968



Reich , 1989



Koh, 1997



Laparotomy

Burnham, 1853

Laparoscopy

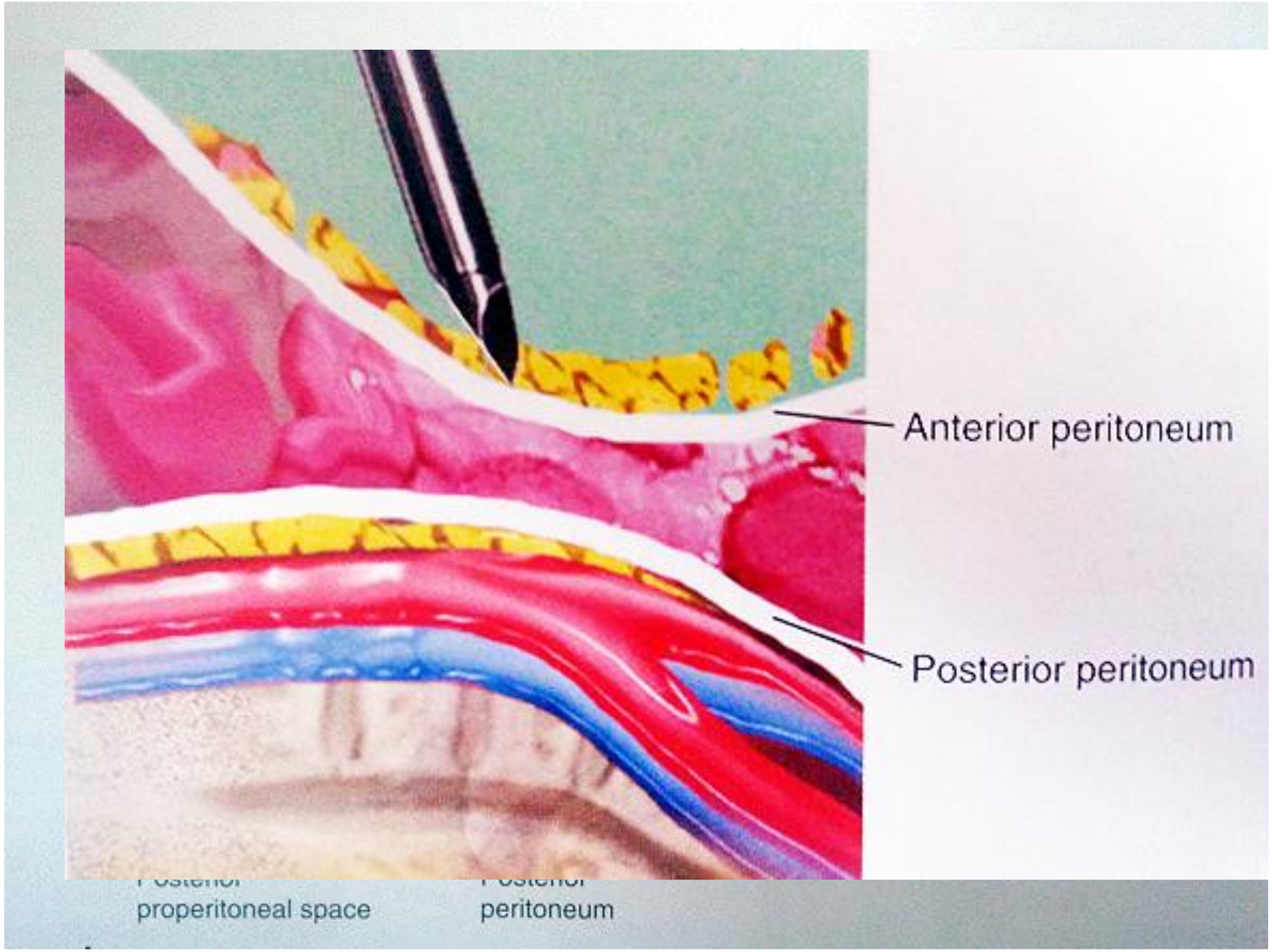
Frangenheim, 1940s

Single port (less invasive)



Robotic surgery (more precise)

Subcutaneous emphysema



Subcutaneous emphysema

- **Mild case of subcutaneous emphysema**:
  - *Expectant management* after evacuation of the pneumoperitoneum

- **Severe case: the extravasation *extends to the neck***
  - Usually preferable to terminate the procedure
  - Pneumomediastinum, pneumothorax, hypercarbia, and cardiovascular collapse risk ↑
  - **chest x-ray** : expectant management unless **tension pneumothorax**

Abdominal wall vessel injury

- The most common site:

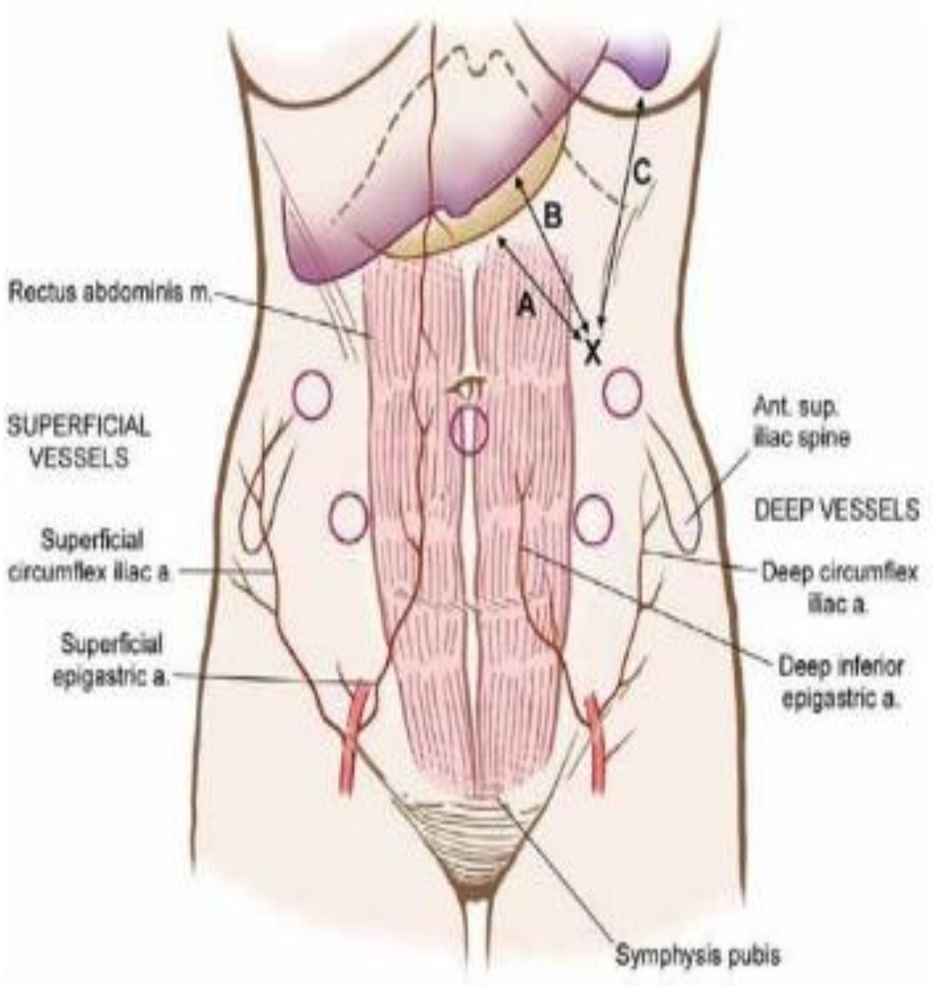
  The superficial inferior epigastric vessels

  - usually stops bleeding spontaneously.
  - expectant management

- More serious injury:

  The deep inferior epigastric vessels

  - A straight ligature carrier
  - Alternatively, a Foley catheter insertion

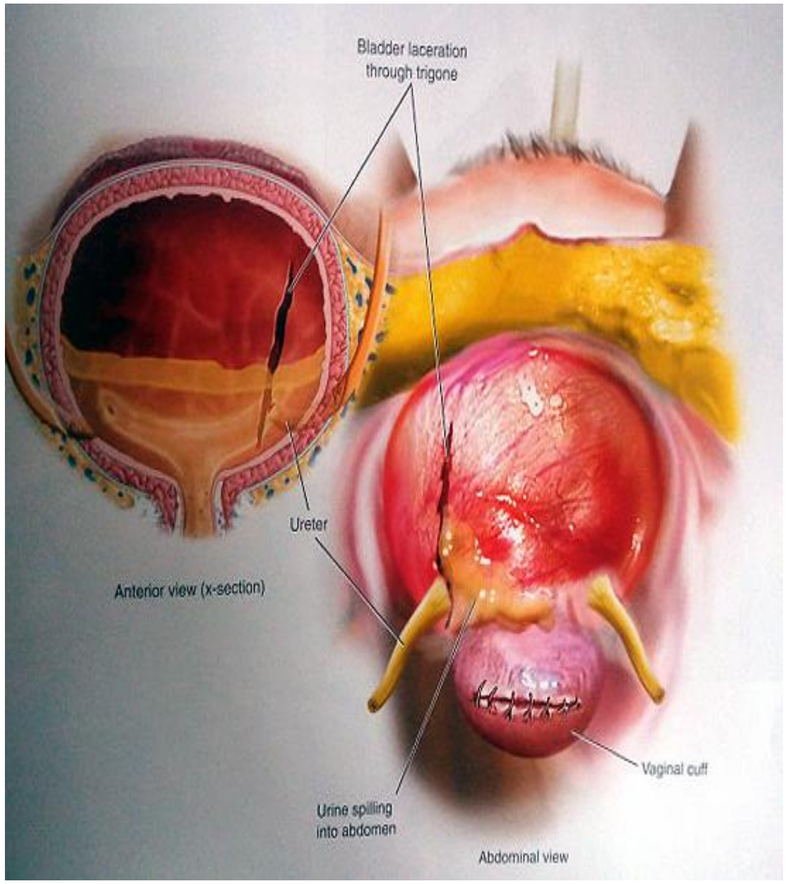


Bladder injury

- From laceration of the undrained bladder by a trocar and robotic arms
- Prevention: **Routine preoperative bladder drainage**
- Management :
  - Repair is undertaken immediately
  - Postoperative catheterization:

    2 to 5 days for small fundal lacerations

    10 to 14 days for injuries to the trigone.



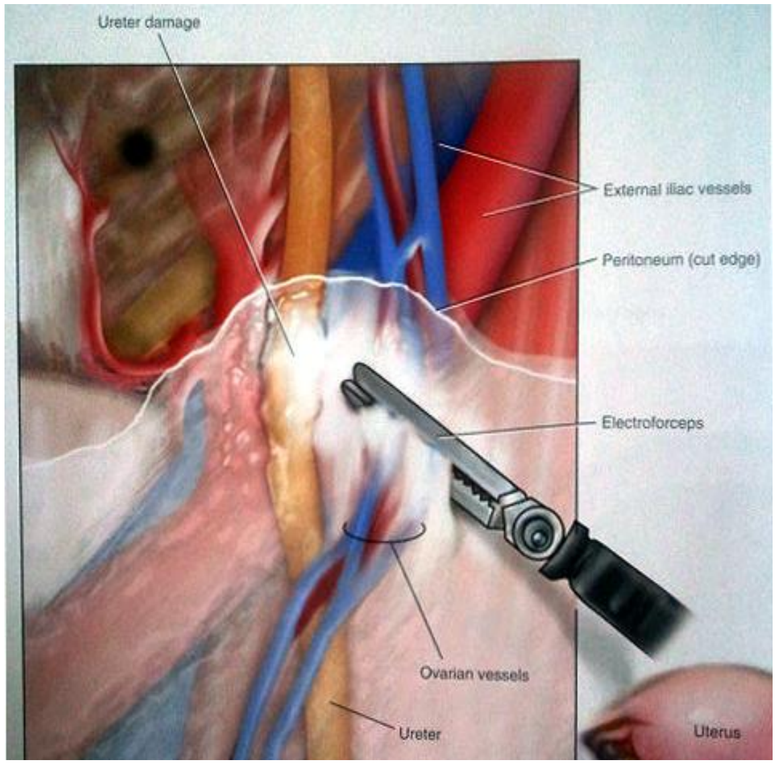


Ureter injury

- The m/c cause: **electrosurgical trauma**
- **Mechanical dissection** including linear cutting and energy devices
  - Thermal injury presents **up to 14 days after surgery**:

    Fever, abdominal or flank pain, peritonitis and leukocytosis
  - Repair of ureteric lacerations and transections in most cases

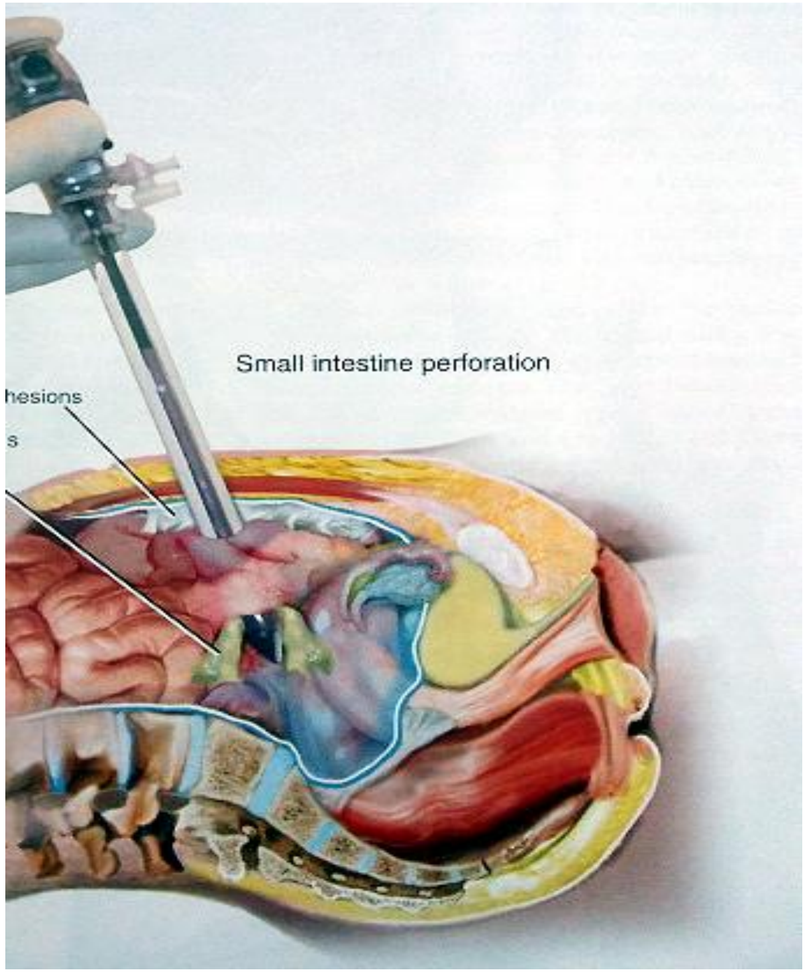
    - a ureteral stent left in place for **10 to 21 days**

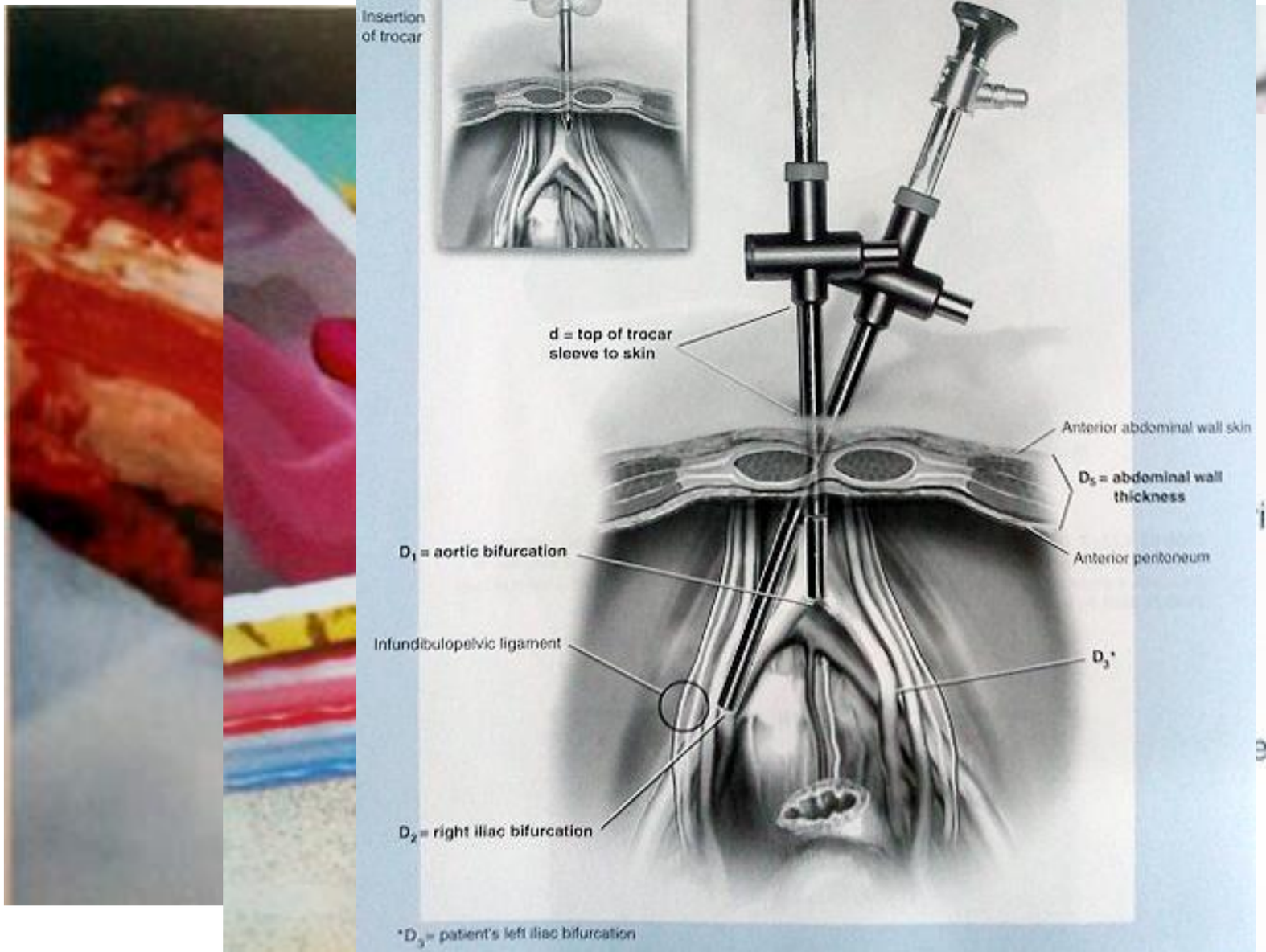


Bowel injury

- The stomach, the small bowel and the colon
- **Previous intraperitoneal inflammation or abdomen surgery**: High risk factor for Bowel injury
- **103 cases of intestinal injury**
  - **77% of small bowel injury :**

Entry related (71% - primary trocar)
(Baggish et al.)




Insertion of trocar
d = top of trocar sleeve to skin
Anterior abdominal wall skin
D_5 = abdominal wall thickness
Anterior peritoneum
D_1 = aortic bifurcation
Infundibulopelvic ligament
D_3*
D_2 = right iliac bifurcation
*D_3 = patient's left iliac bifurcation

Great vessel injury

- **The most dangerous hemorrhagic complications**

- **Management:**
  - **Perform laparotomy (A midline incision)**
  - **Immediate compression below the level of the renal vv.**
  - **Wait a vascular surgeon**


세브란스병원 SEVERANCE HOSPITAL
GLOBAL

Complications unique to robotics

★ **Moving a robotic arm (No tactile feedback);**

The robotic arms can injure any organ **not under visual control**.

→ **Constant visual control.**

★ **Constant pressure** on the patient thighs may result in injury.

→ **Positioning of the trocars and robotic arms.**

Complications unique to robotics

- **A rapid moving of robotic instrument** by the surgeon; hitting the assistant with the robotic arm.

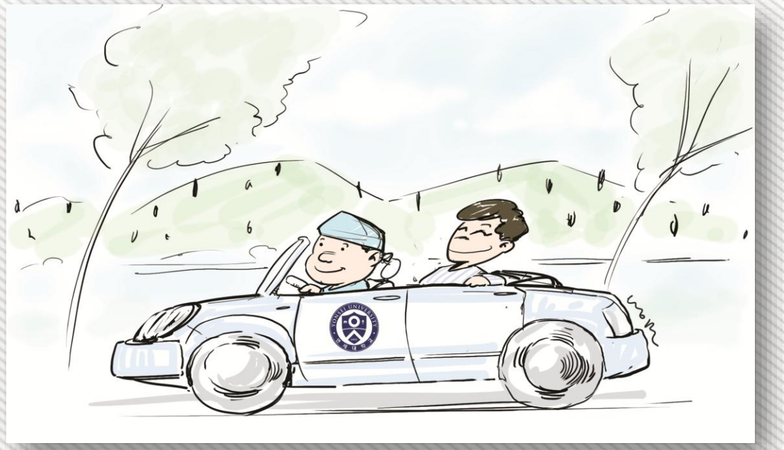


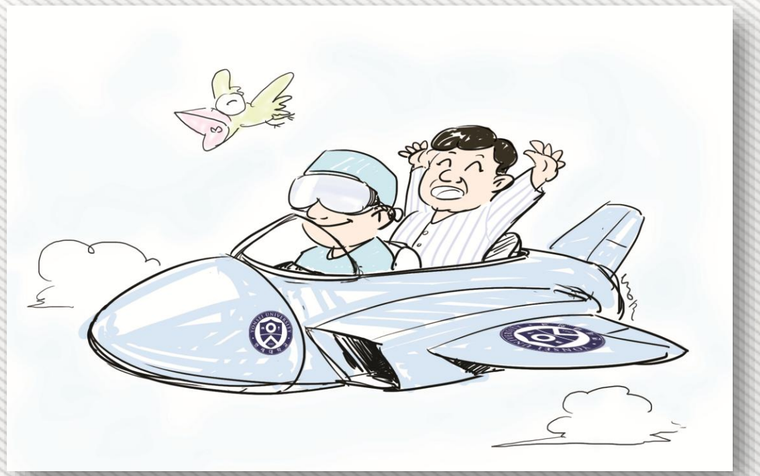
Conclusions

- **Number of surgical cases needed** to achieve proficiency in robotic surgery in GYN oncology **ranges from 10-50 cases.**

- **Learning curves** including **oncologic outcomes are probably longer** and are not yet established.

- **Previous laparoscopic experience** may be related to **learning curve** in robotic surgery.







What is the da Vinci Certificate?

da Vinci Surgical System
Standardized Technology Training Certificate

66,000+
Surgeons trained worldwide

OVERVIEW

The Official Certificate Definition & Issuer

ISSUER

Intuitive Surgical, Inc. (USA)

DEFINITION

An official certificate confirming that the recipient has completed **standardized technology training** to use the da Vinci Surgical System safely and effectively.

IMPORTANT NOTICE

This certificate **does NOT replace hospital credentialing**.
It is proof of completed technology training only.

Source: Intuitive Surgical (intuitive.com) | 2026

The da Vinci Surgical System



Intuitive Surgical's da Vinci — the global standard for robotic surgery

MANUFACTURER

Intuitive Surgical (USA · founded 1995)

Key Technical Features

3D-HD Vision
Stereoscopic view

10× magnified depth perception — critical for pelvic tissue planes

EndoWrist
7 degrees of freedom

Exceeds human wrist range — enables deep-pelvis suturing

Tremor Filter
Motion scaling

Filters natural hand tremor for microsurgical accuracy

Platform Generations

S → Si → Xi → X → SP (single-port) → 5 (2024 · haptics)

WHY IT BECAME THE GLOBAL STANDARD

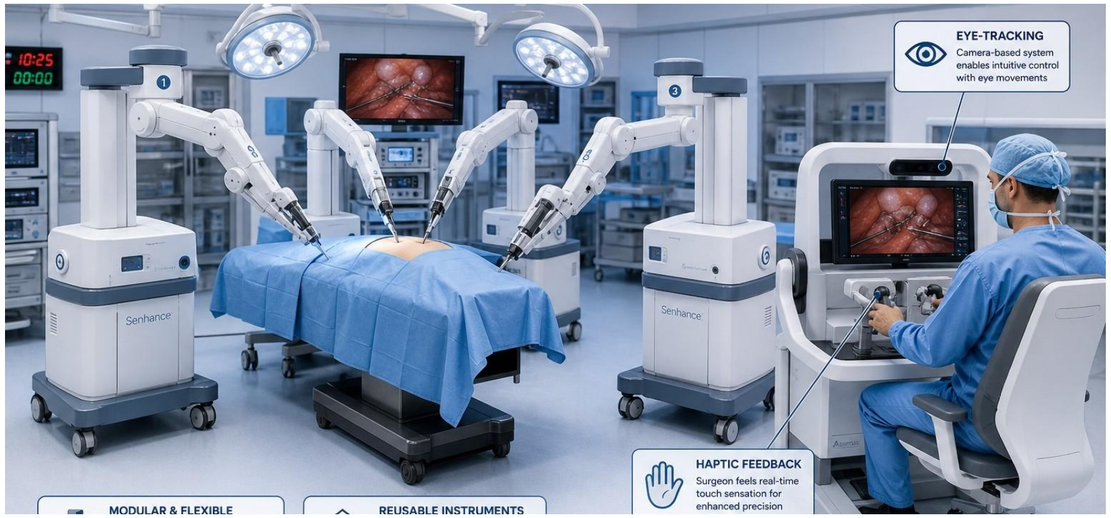
01 25+ years of clinical data · standardized surgical technique

02 Over **9,500 systems installed** across 12+ surgical specialties

03 Continuous platform evolution and robust patent ecosystem

04 Comprehensive surgeon training and credentialing network

Competing *Robotic Systems*



5-1 · UNITED STATES

Senhance

Asensus Surgical · USA · FDA-cleared in 2017

Key Differentiators

- **Haptic Feedback** — tactile force transmitted through handles, useful for identifying uterine tissue planes
- **Eye-Tracking Camera** — gaze-directed field of view, hands-free framing
- **Reusable Instruments** — significantly lower per-case disposables cost



5-2 · REPUBLIC OF KOREA

Revo-i

Meerecompany · South Korea · approved 2017

Key Differentiators

- **First Korean-made** robotic surgery platform — national technology milestone
- **20–30% lower cost** than da Vinci (~USD 1.2M) — lowers hospital adoption barrier
- **First clinical use** in gynecology at Severance Hospital, Seoul

Competing *Robotic Systems*



6-1 · UNITED KINGDOM

Versius

CMR Surgical · UK · launched 2019

Key Differentiators

- **Modular Arms**

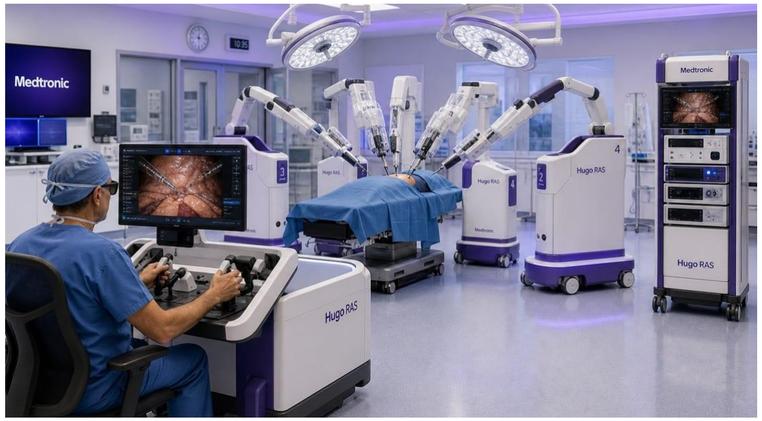
  Deploy only the arms you need

- **Fits Standard OR**

  No dedicated suite required

- **Multi-specialty**

  Portable across OR rooms



6-2 · UNITED STATES

Hugo RAS

Medtronic · USA · FDA-cleared in 2025

Key Differentiators

- **Open Console**

  Better team communication

- **3D-Glasses Vision**

  Polarized 3D · natural posture

- **Newest Platform**

  Freshest generation on market



6-3 · USA · IN TRIALS

OTTAVA

Johnson & Johnson · USA · in development

Key Differentiators

- **Table-integrated**

  Arms mounted on the OR bed

- **Four Robotic Arms**

  Streamlined docking process

- **Next-gen Design**

  J&J's entry into robotic surgery

The U.S. & Global Landscape

Where robotic gynecologic surgery is happening today

U.S. INSTALLED BASE

5,000+

da Vinci systems in the U.S. (2025)

GLOBAL INSTALLED BASE

9,500+

Systems installed worldwide

ANNUAL U.S. PROCEDURES

876K+

Robotic procedures in the U.S. (2020)

Gynecology

One of the top-2 specialties using robotic surgery in the U.S.

U.S. PRACTICE PATTERN

Robotic-assisted hysterectomy has become the most common MIS approach in many U.S. academic centers
academic centers

HISTORIC MILESTONE

2005 FDA Approval transformed U.S. OB/GYN

Turning point for the specialty

Leading U.S. Centers & Global Reach

US LEADING U.S. ROBOTIC GYNECOLOGY PROGRAMS

High-volume academic and community centers

- **Mayo Clinic** — High-volume gynecologic oncology & benign practice
- **Cleveland Clinic** — Robotic training center & complex endometriosis surgery
- **MD Anderson** — Gynecologic oncology & sentinel node mapping
- **Memorial Sloan Kettering** — Cancer-focused robotic surgical trials

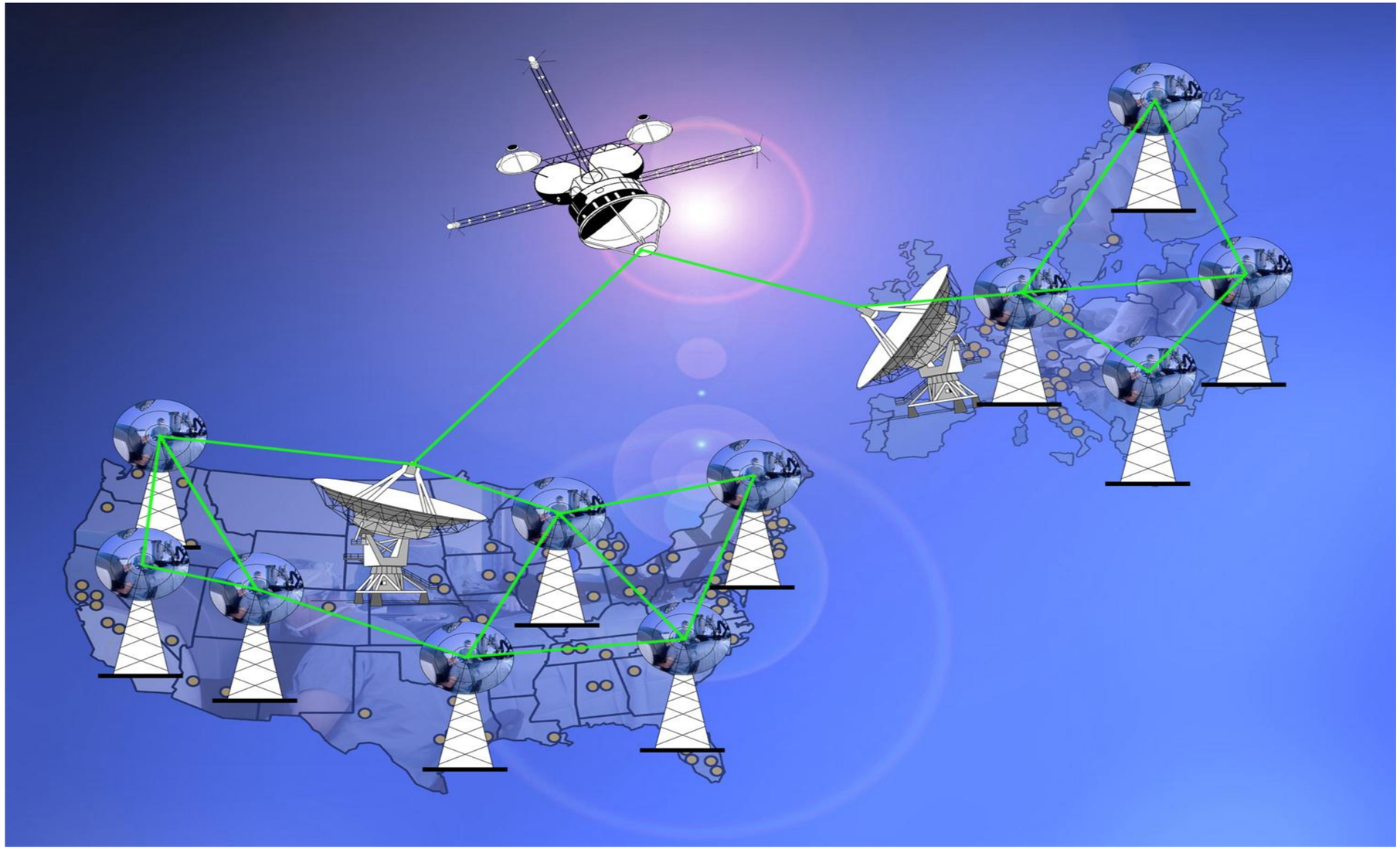
THE GLOBAL PICTURE

Robotic gynecology beyond the U.S.

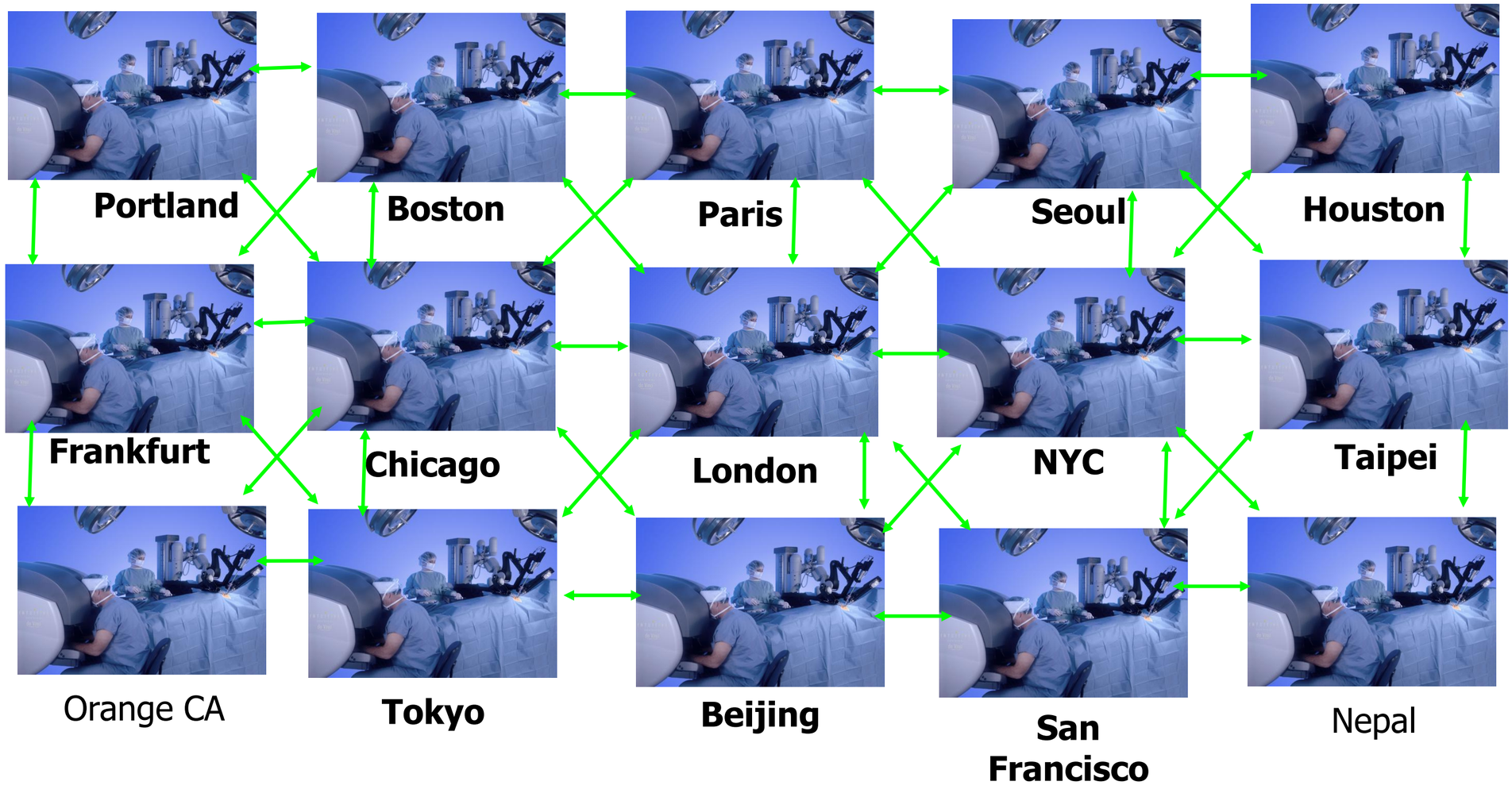
- **Europe** — CMR Surgical's Versius (UK) expanding hospital adoption
- **Asia-Pacific** — **South Korea** leads Asia; Severance Hospital reached 40,000 robotic cases in 2023
- **Emerging markets** — Revo-i (Korea) deployed in **70+ hospitals across 25 countries**, expanding access

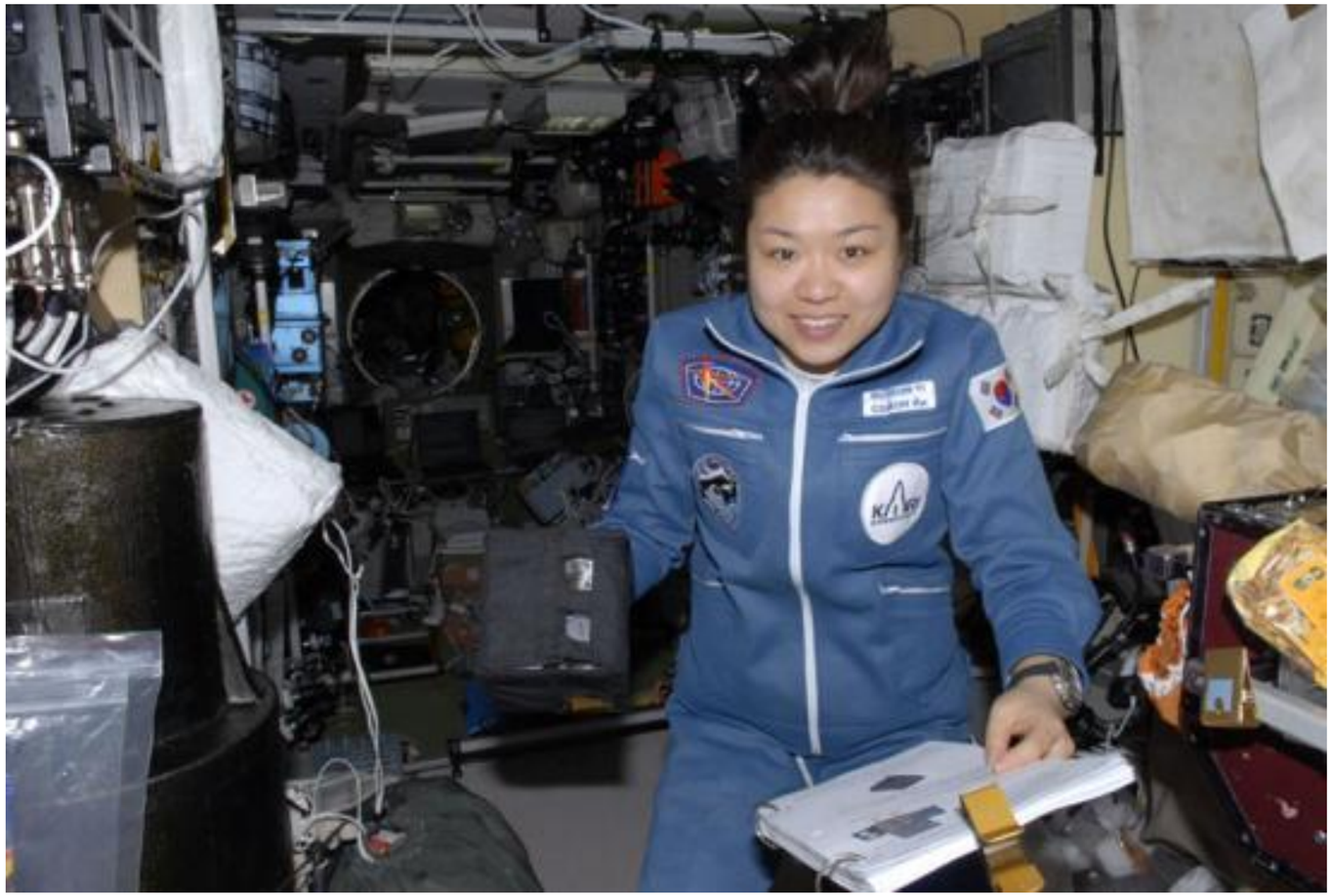
"U.S. residents will increasingly work with a multi-vendor robotic ecosystem."

Robotic Surgical Network



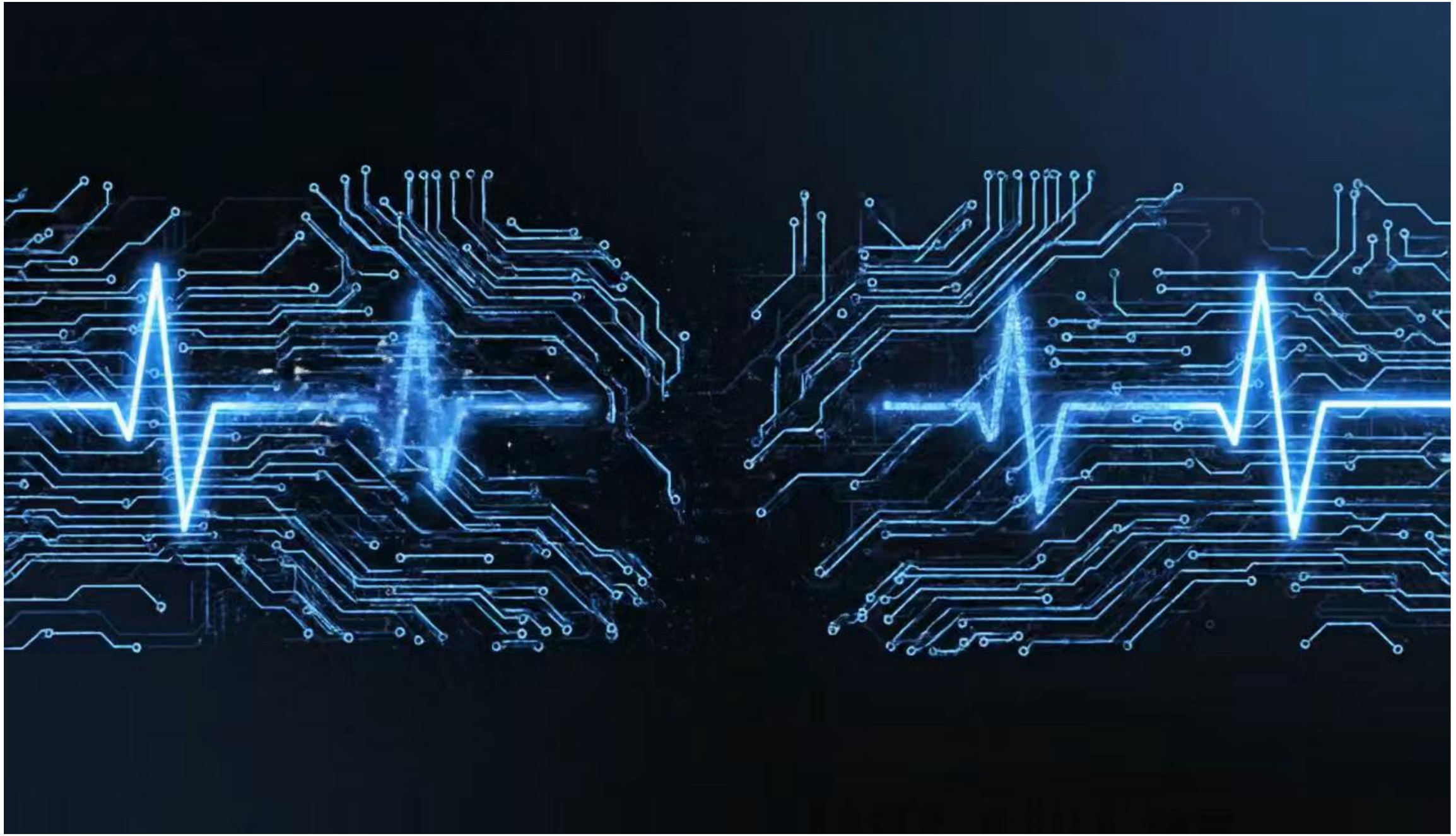
Robotic Surgical Network





이소연 박사
2008년도 국제우주정거장에
11일간 머물며 연구 수행함

Robotic surgery….. **Telerobotic** surgery





Thank you for your attention!