"How do you feel when you hear the term ‘Robot'?"

Robotic Surgry: Past, Present, and Future...

-Robotic Surgery in Thoracic Field-

Department of Thraocic and Cardiovascular Surgery
Pusan National University Yangsan Hospital
Bong Soo Son M.D.

PNUH 양산부산대학교병원
Pusan National University Yangsan Hospital

The History of Innovation: Transitioning from Open Surgery to Minimally Invasive Surgery

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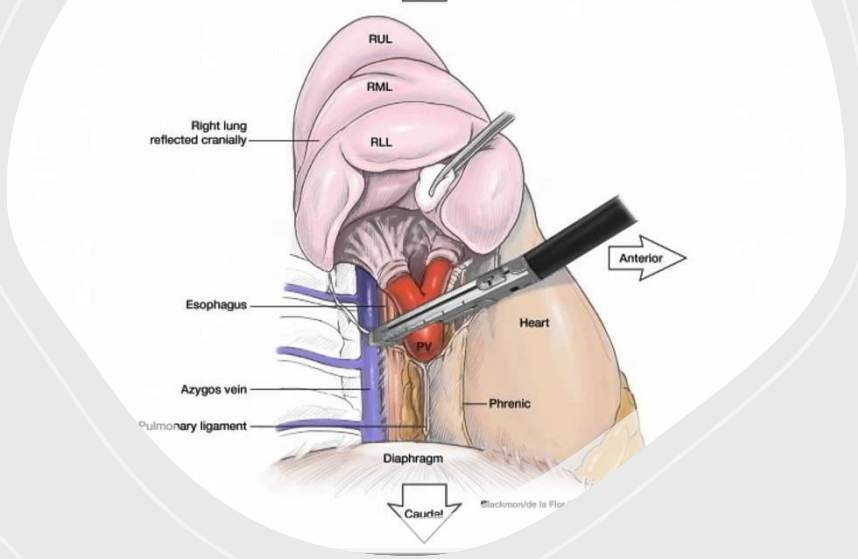
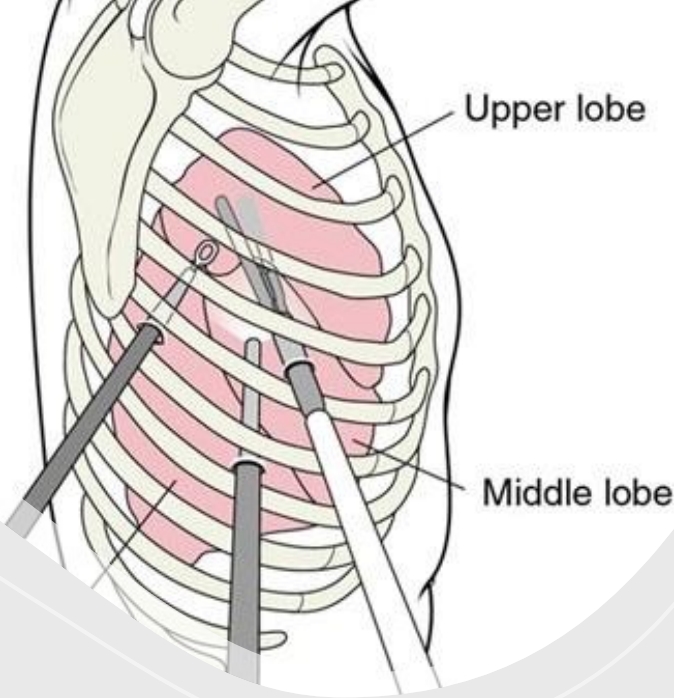
Pusan National University Yangsan Hospital





First VATS Lobectomy in 1991

Prof. Giancarlo Roviaro

University of Milan, Italy

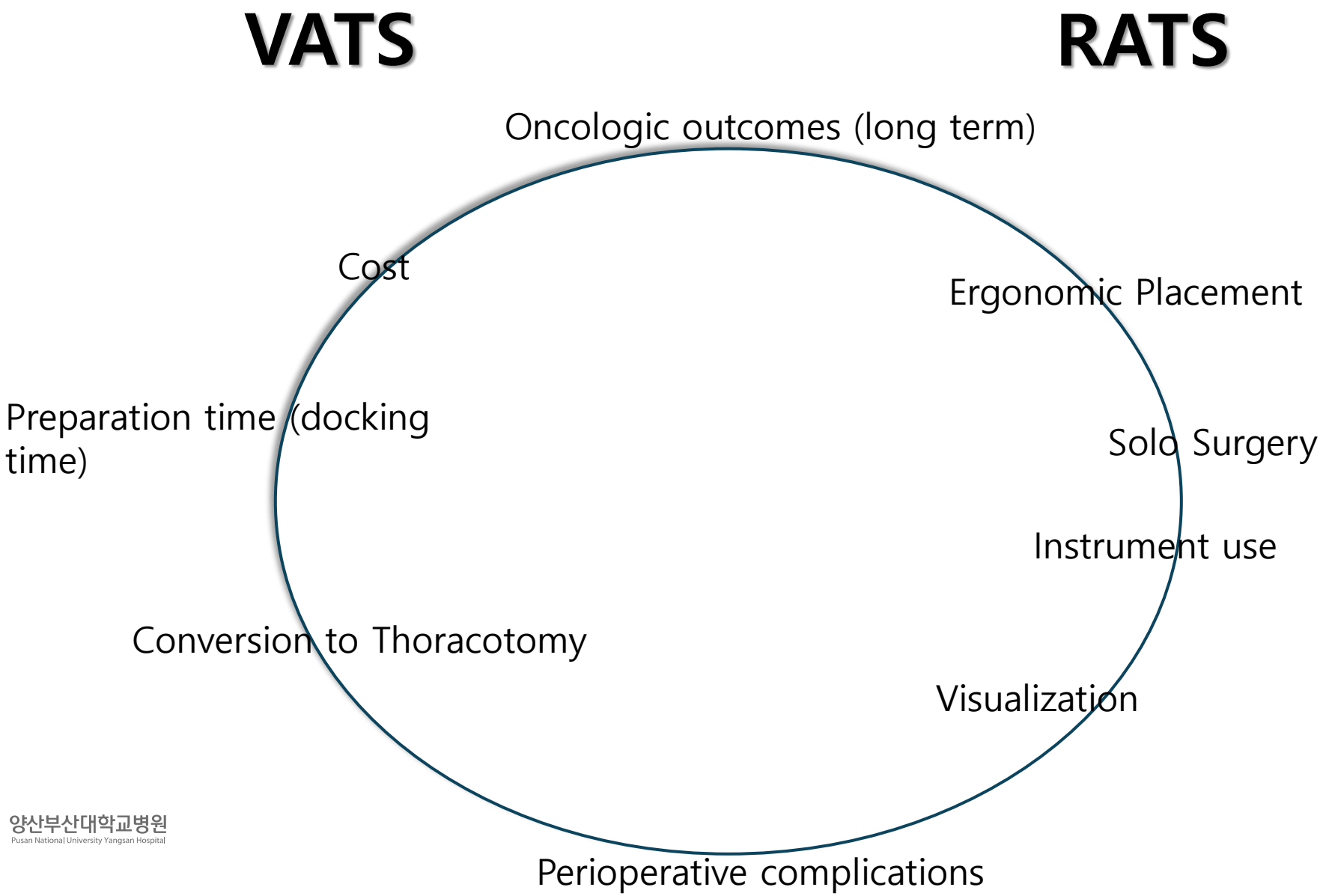
PNU 양산부산대학교병원
Pusan National University Yangsan Hospital

" VATS는 너무 위험해... 왜 쓸데없는 위험을 감수하는 거야?"

"폐암 수술에서 임파선 절제를 완벽하게 할 수 있을까?

"사용할 수 있는 도구와 접근 방향이 제한적인 VATS는 open thoracotomy를 대체할 수 없어!"

VATS Pulmonary Resection VS. RATS Pulmonary Resection



INTUITIVE

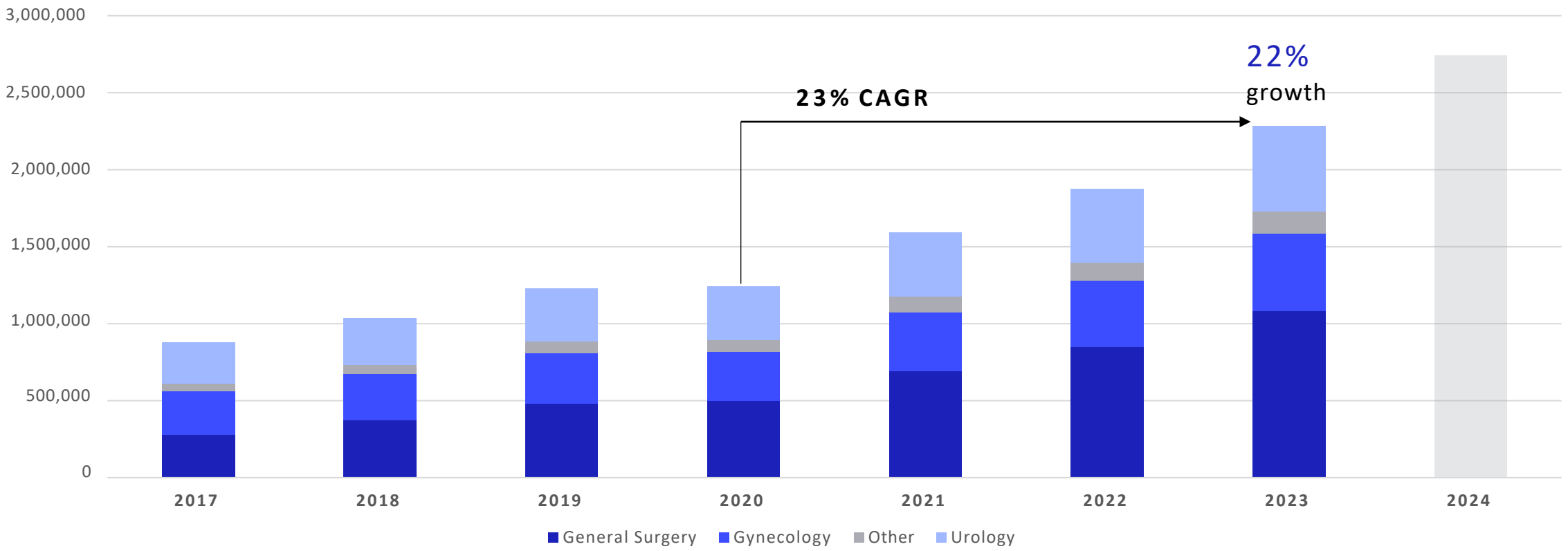
Robotic-assisted Surgery Procedure Trend

Global / Korea / Each Specialty

2000, FDA approvement.

Worldwide

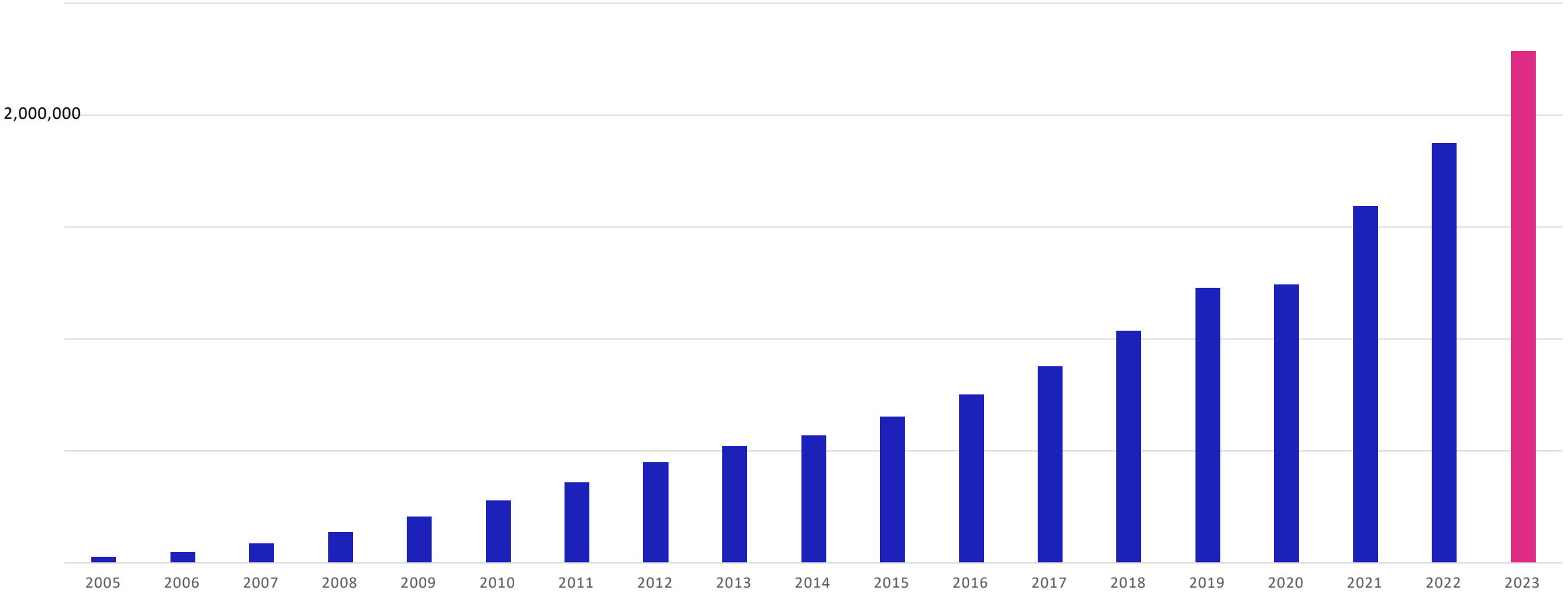
Worldwide procedure trend



Source: 2023 Proxy Statement

Robotic surgery with da Vinci in worldwide

Total Procedure Trend



Intuitive data on file

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Korea General

Installed Base

OS3 Da Vinci Si®

March 2012

OS4 Da Vinci Xi®

December 2014

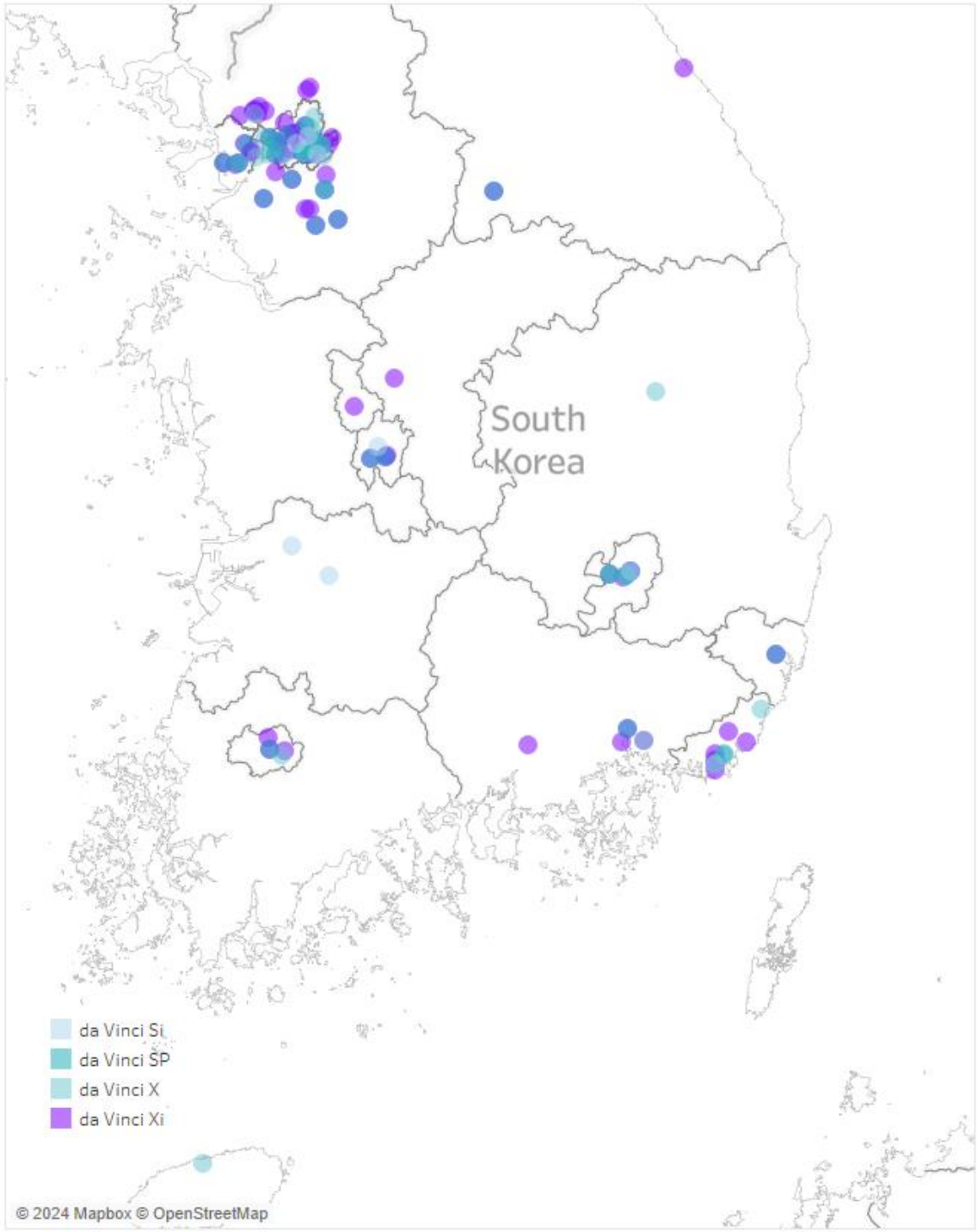
OS4 Da Vinci X®

December 2017

OS4 Da Vinci SP®*

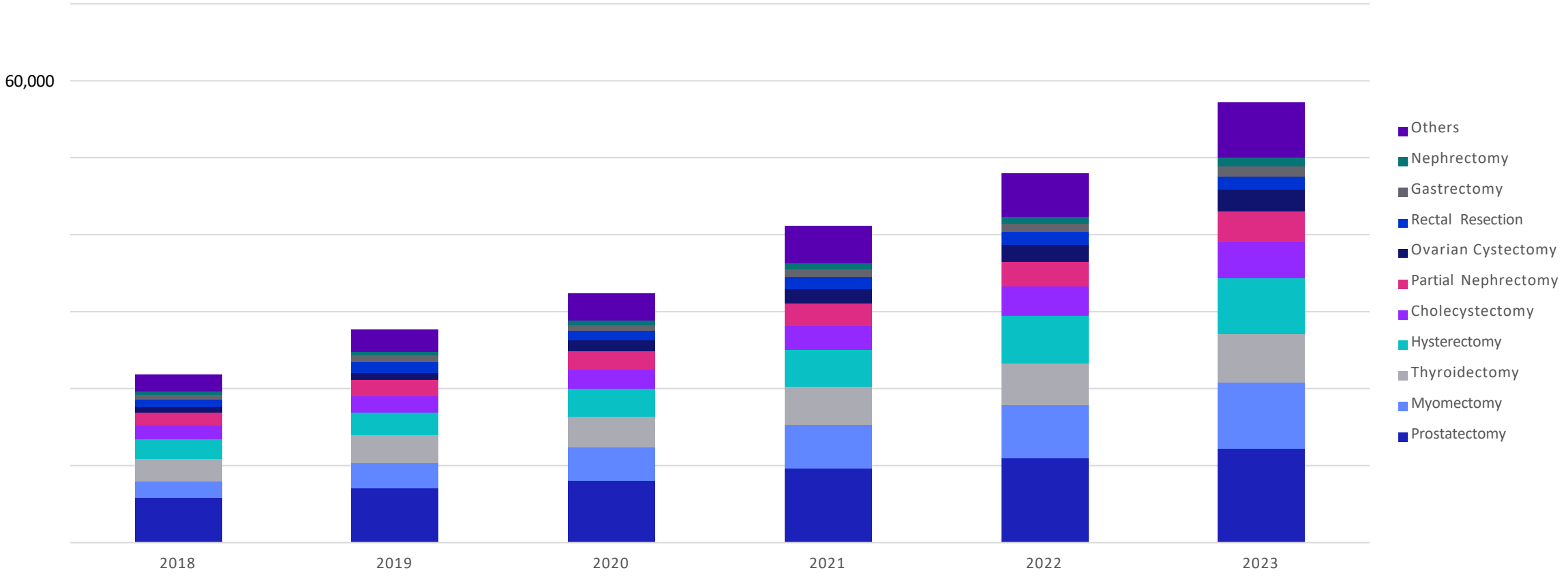
December 2018

	2024-Jan
da Vinci Si	8
da Vinci Xi	106
da Vinci X	25
da Vinci SP	30
Total	**169**



Korea procedure trend

Most often performed procedures



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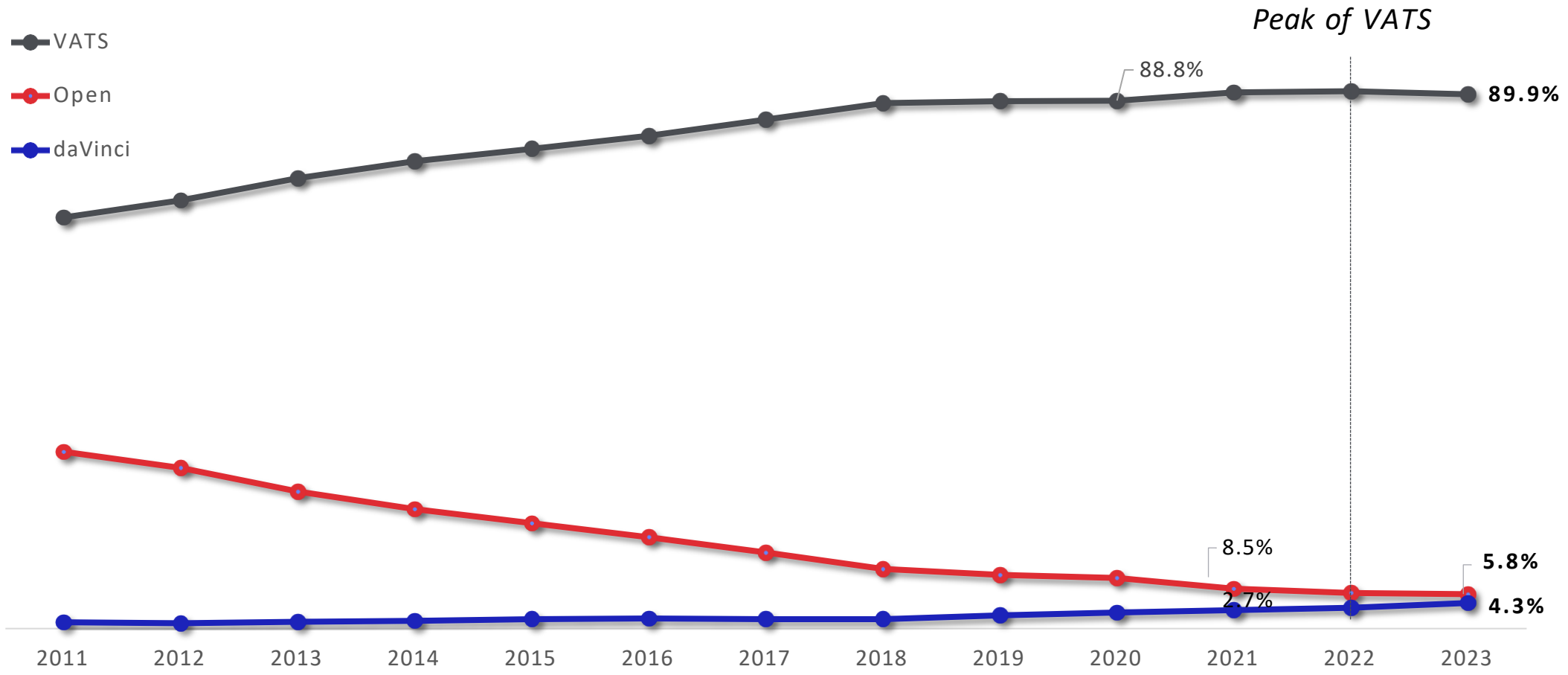
Thoracic

Da Vinci surgery adoption in Korean thoracic



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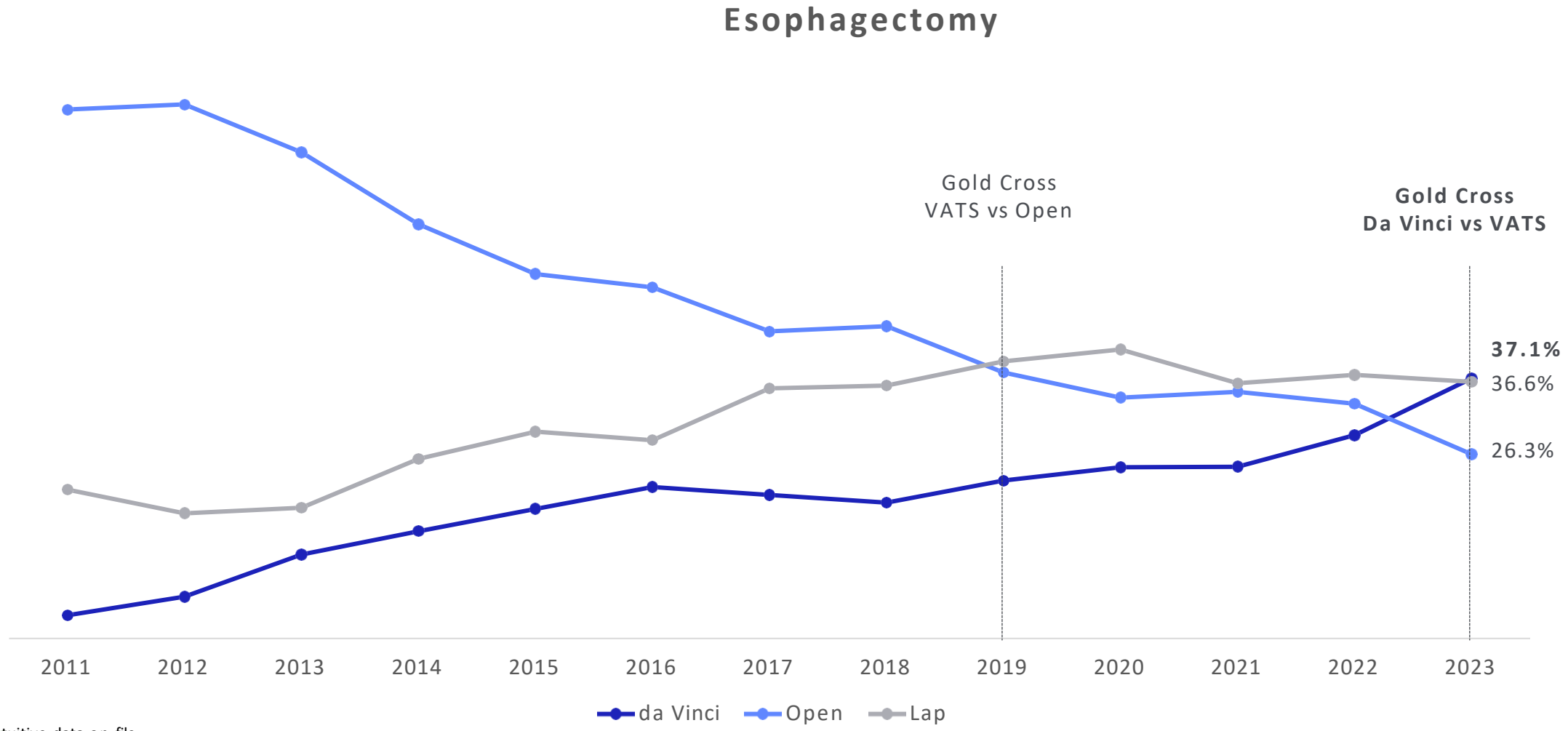
Da Vinci surgery adoption in Esophagectomy



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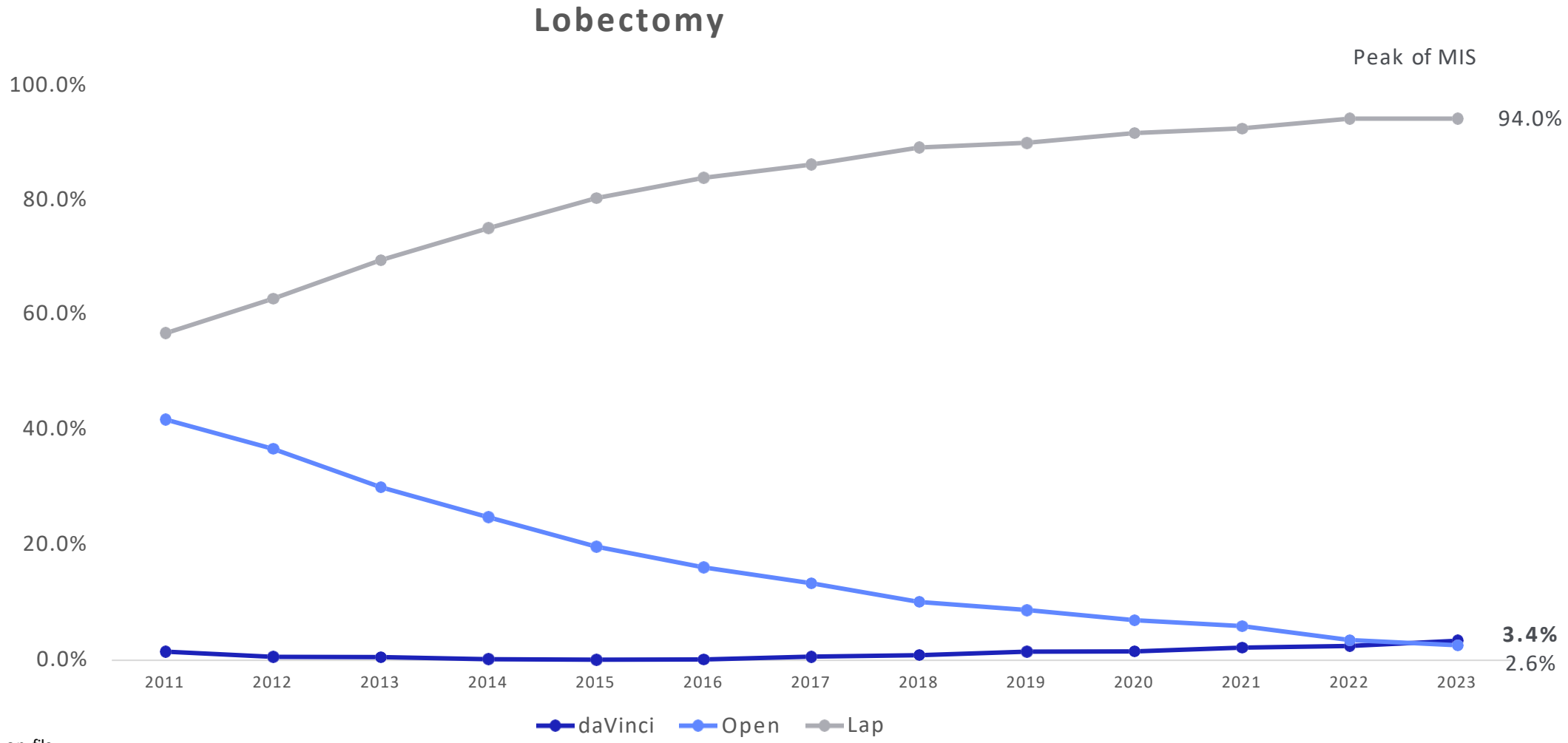
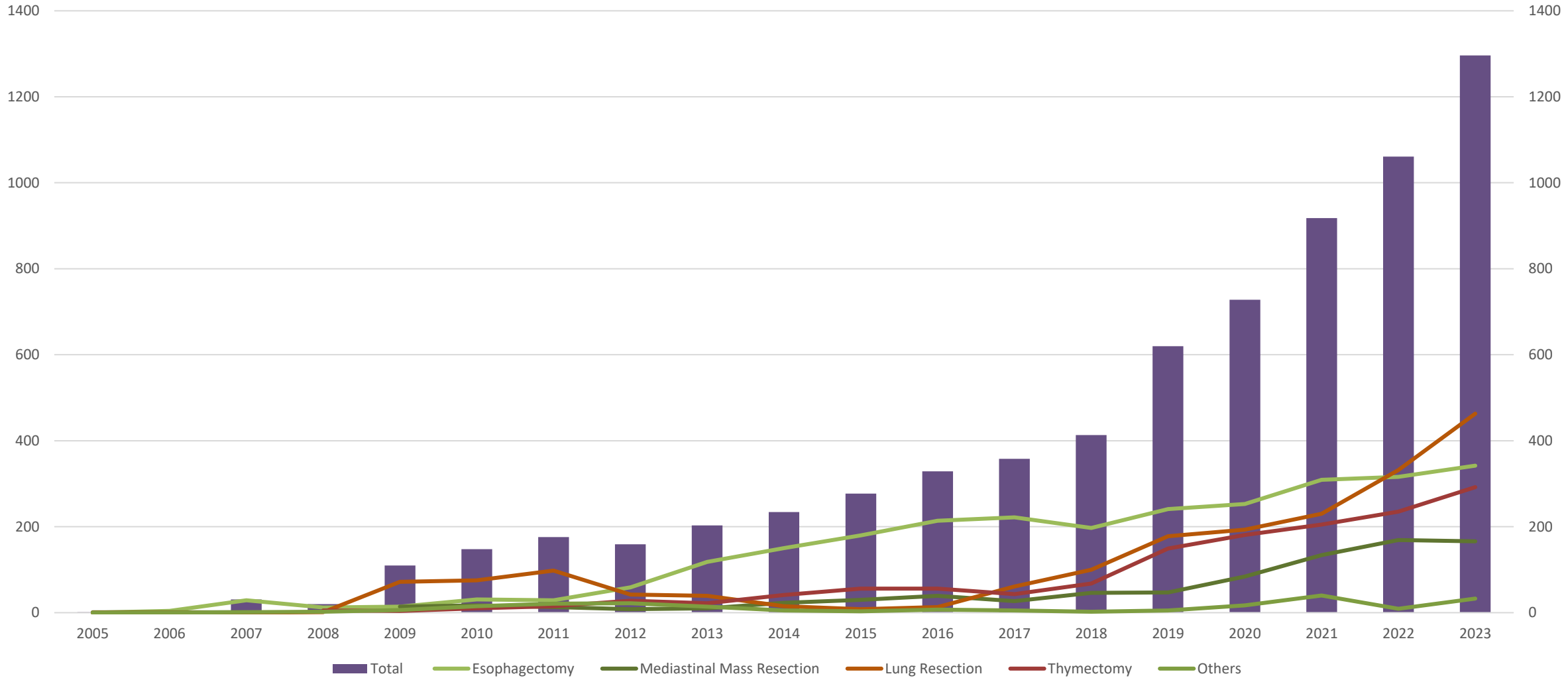
Da Vinci surgery adoption in Lobectomy



Intuitive data on file

국내 흉부외과 로봇수술 변화



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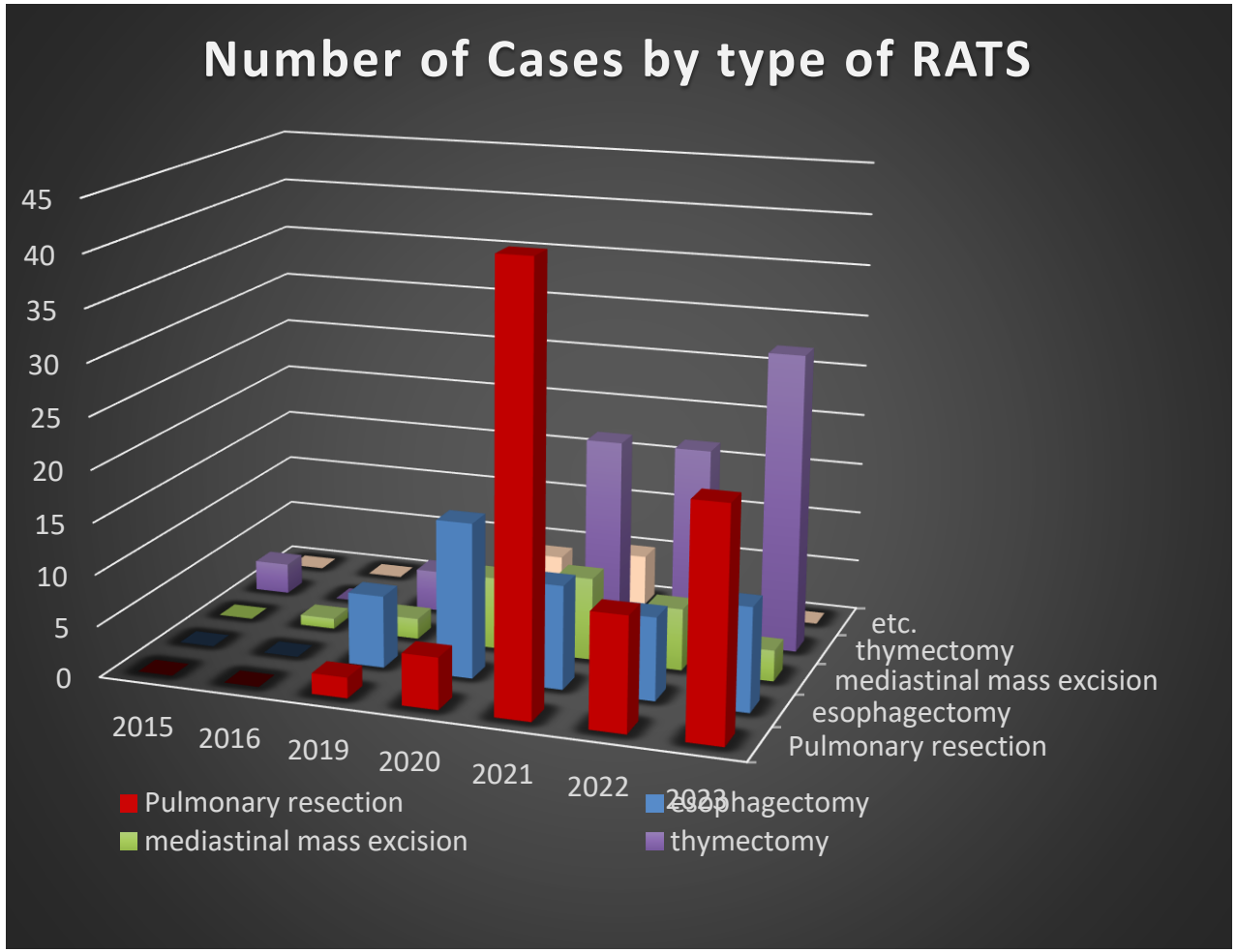
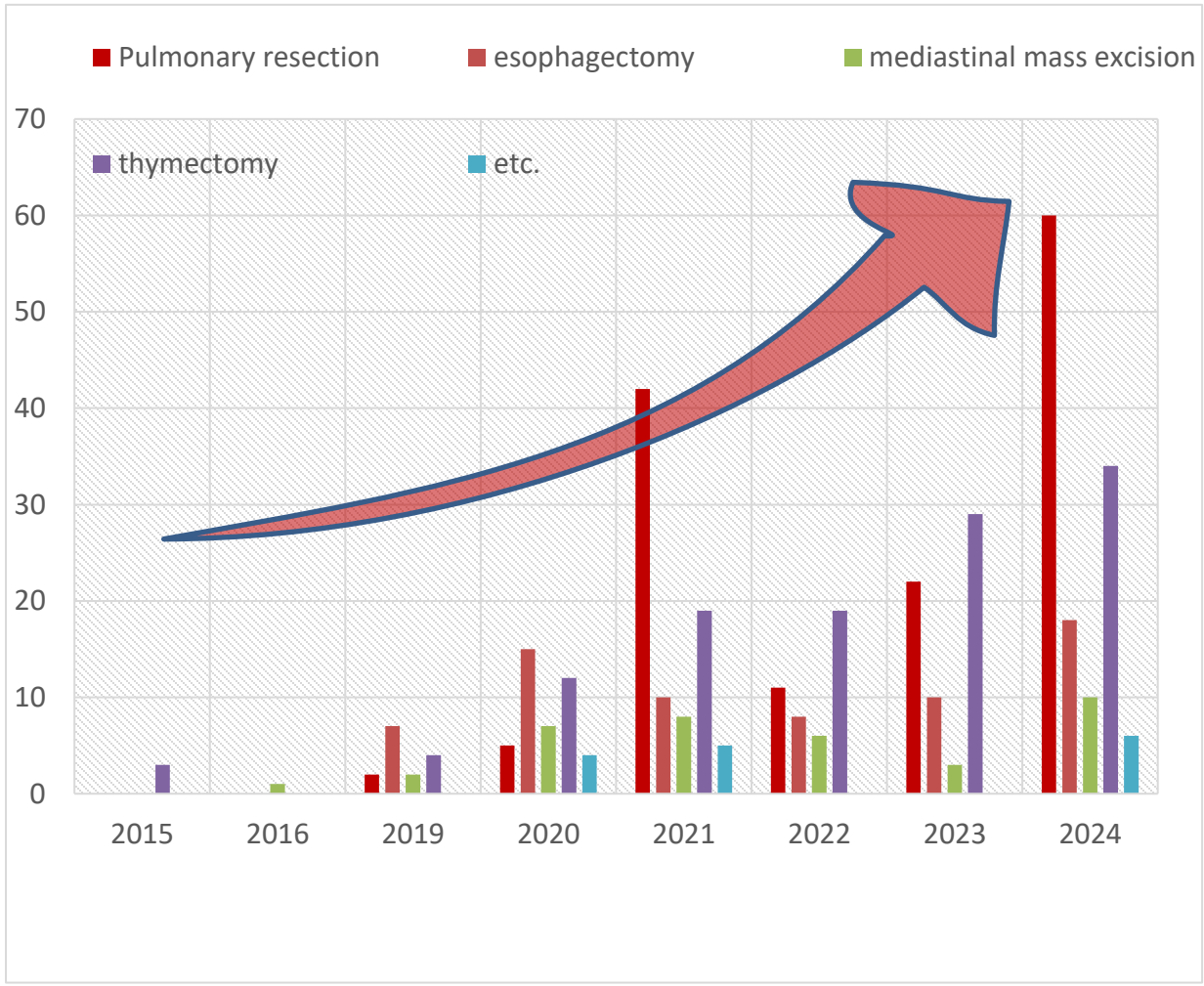
PNUYH Experience of Robot-assisted Pulmonary Resection





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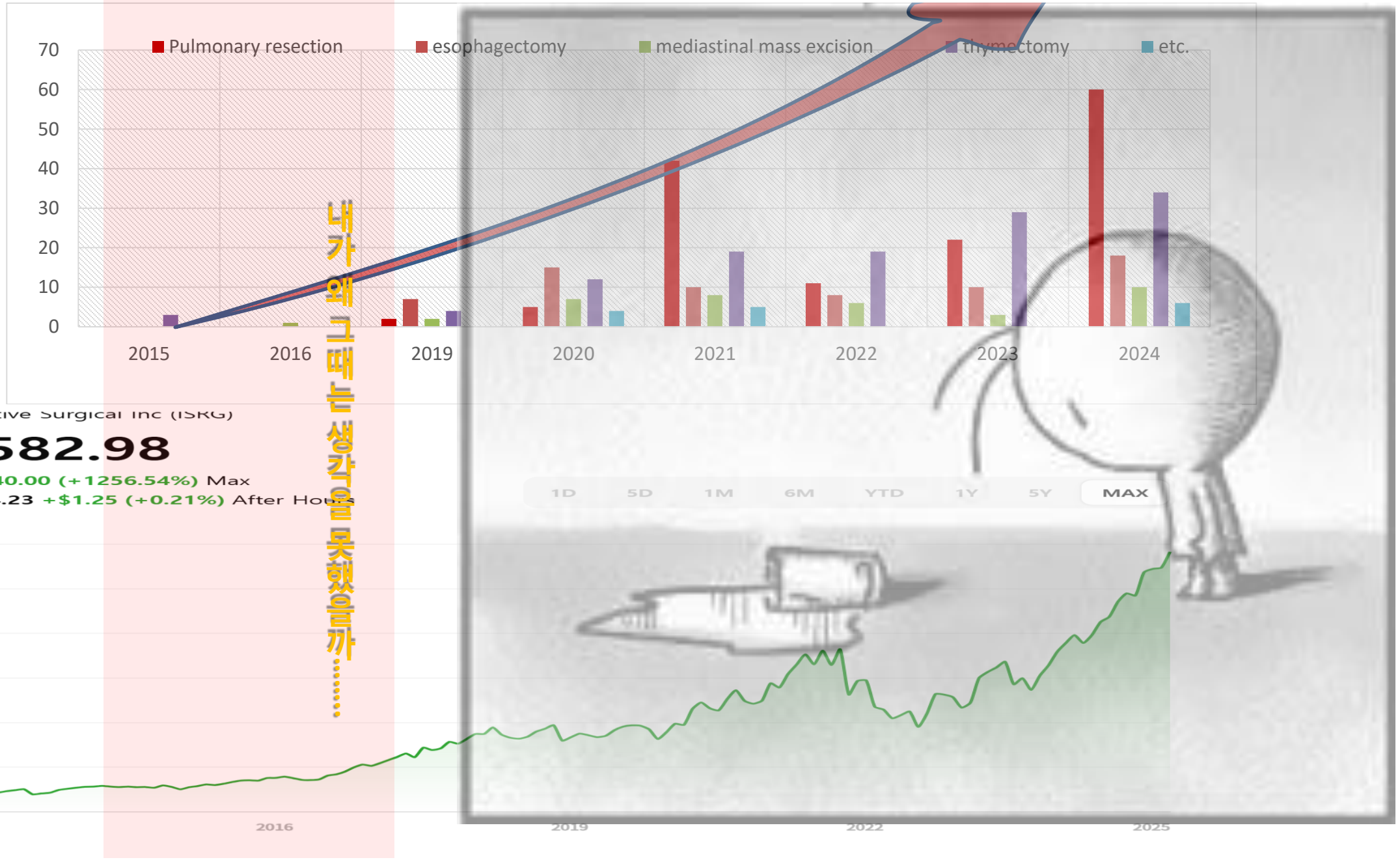
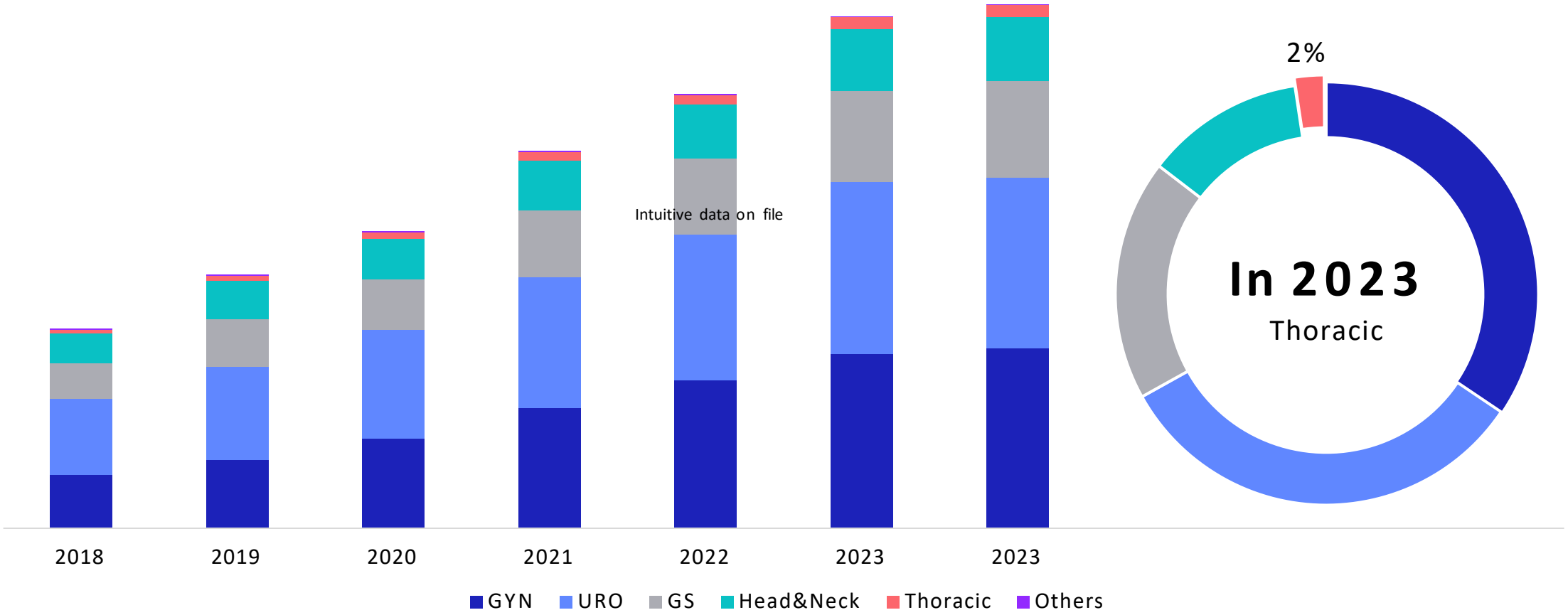

Pulmonary resection
esophagectomy
mediastinal mass excision
thymectomy
etc.
70
60
50
40
30
20
10
0
2015
2016
2019
2020
2021
2022
2023
2024
내가 왜 그때는 생각을 못했을까……
Intuitive Surgical Inc (ISRG)
$582.98
+$540.00 (+1256.54%) Max
$584.23 +$1.25 (+0.21%) After Hours
1D
5D
1M
6M
YTD
1Y
5Y
MAX
600
500
400
300
200
100
0
2016
2019
2022
2025

2023 Procedure overview in thoracic market

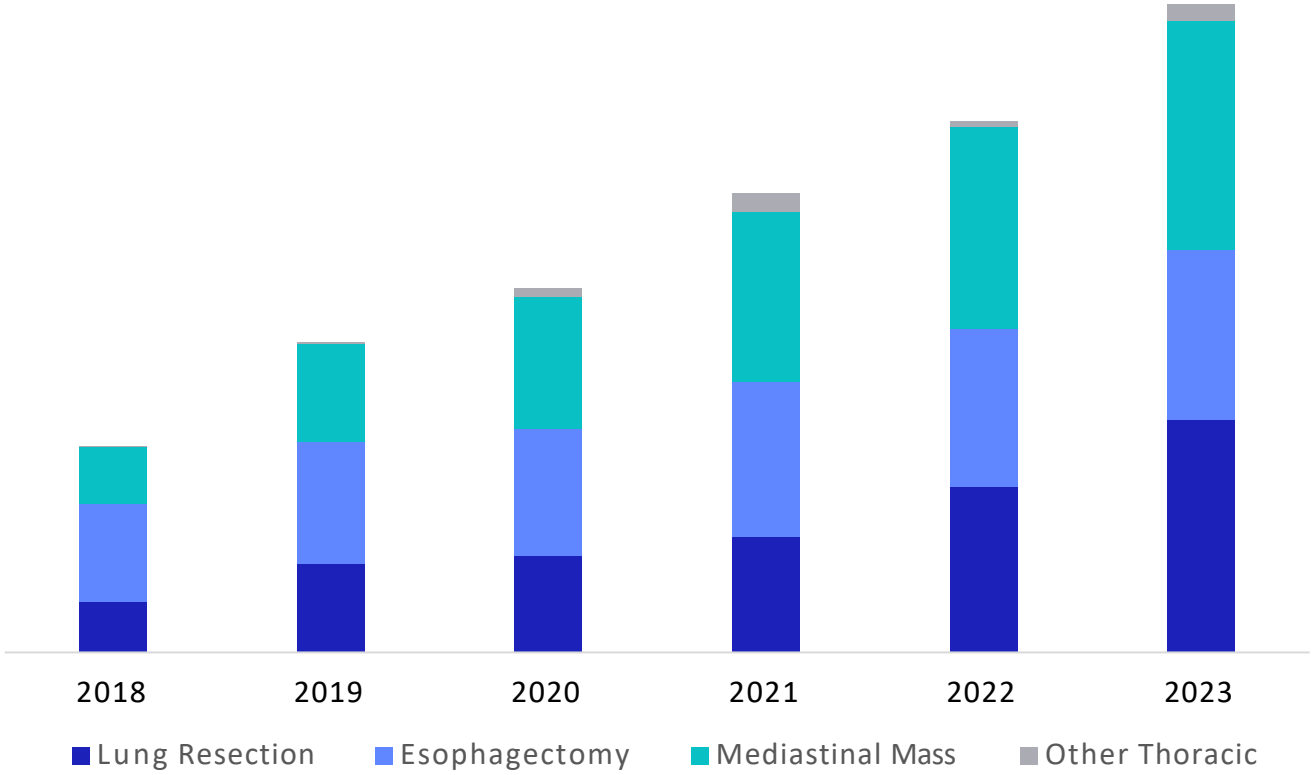
Da Vinci Procedure

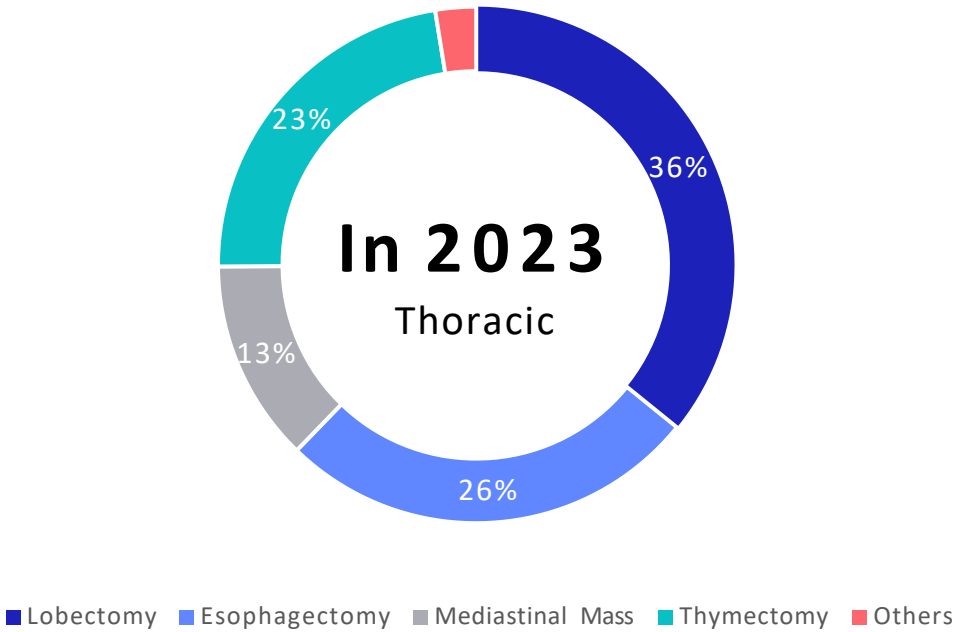


Intuitive data on file

2023 Procedure overview in thoracic market

Thoracic procedure trend





Intuitive data on file

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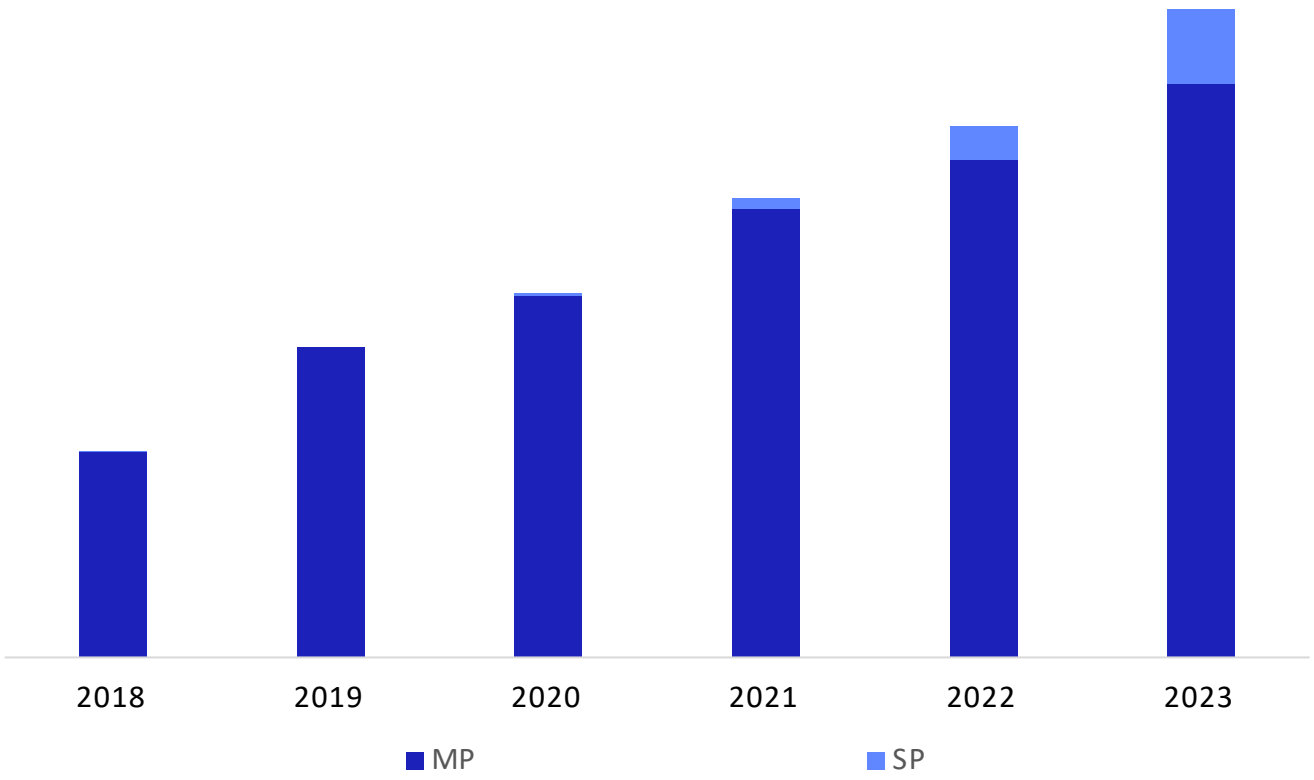
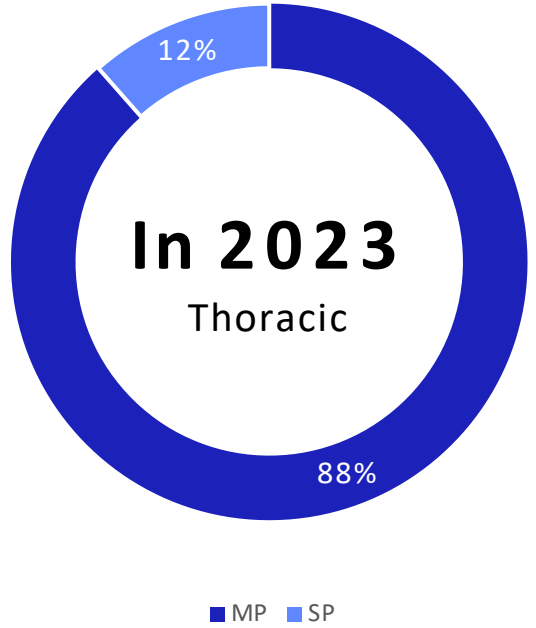
Pusan National University Yangsan Hospital

2023 Procedure overview in thoracic market

Thoracic procedure trend

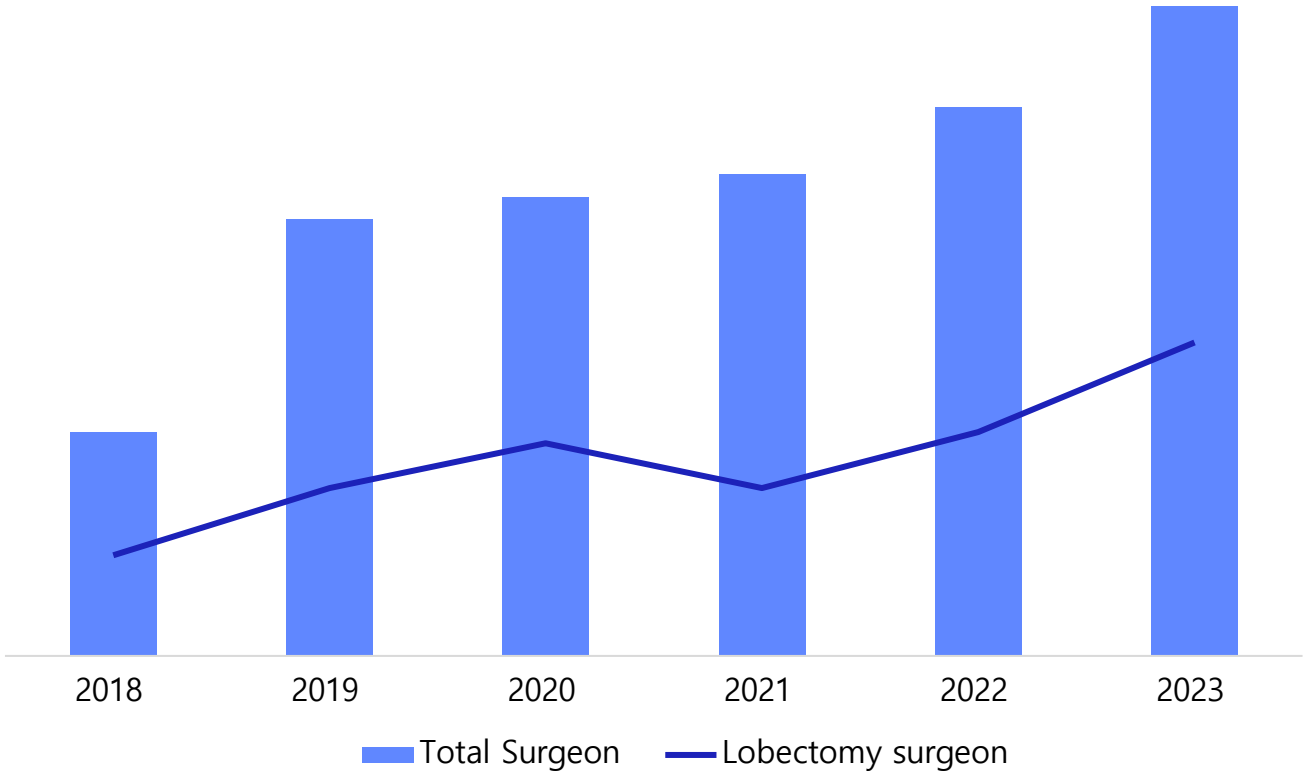


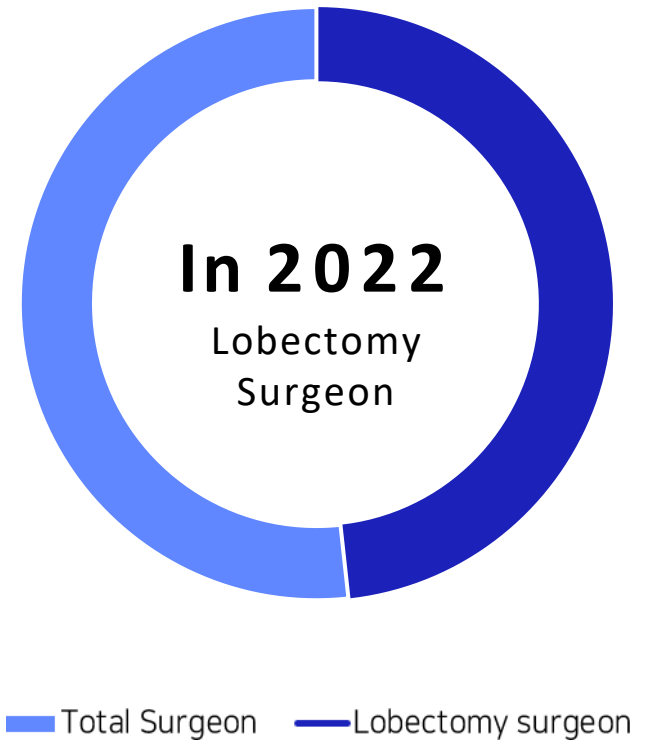


Intuitive data on file

2023 Thoracic surgeon population

Surgeon population trend





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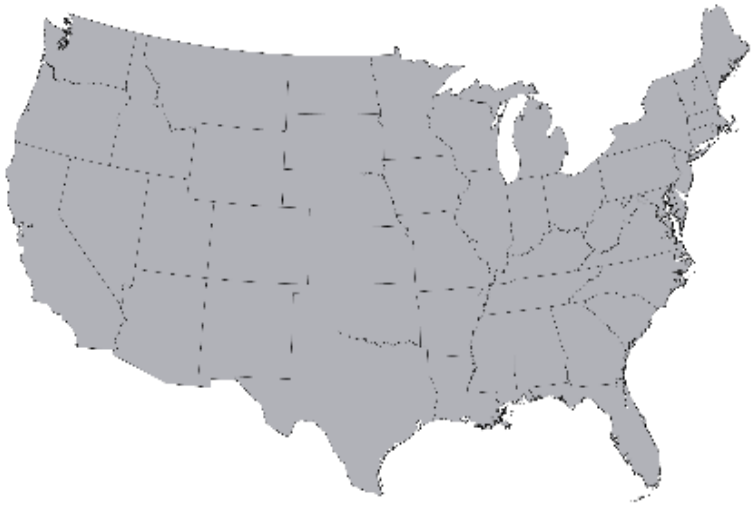
SP System Trend

Global / Korea / Each Specialty

No. of Da Vinci SP Systems Installed Worldwide

177 systems worldwide as of Dec 31, 2023

USA: 140



Korea: 30

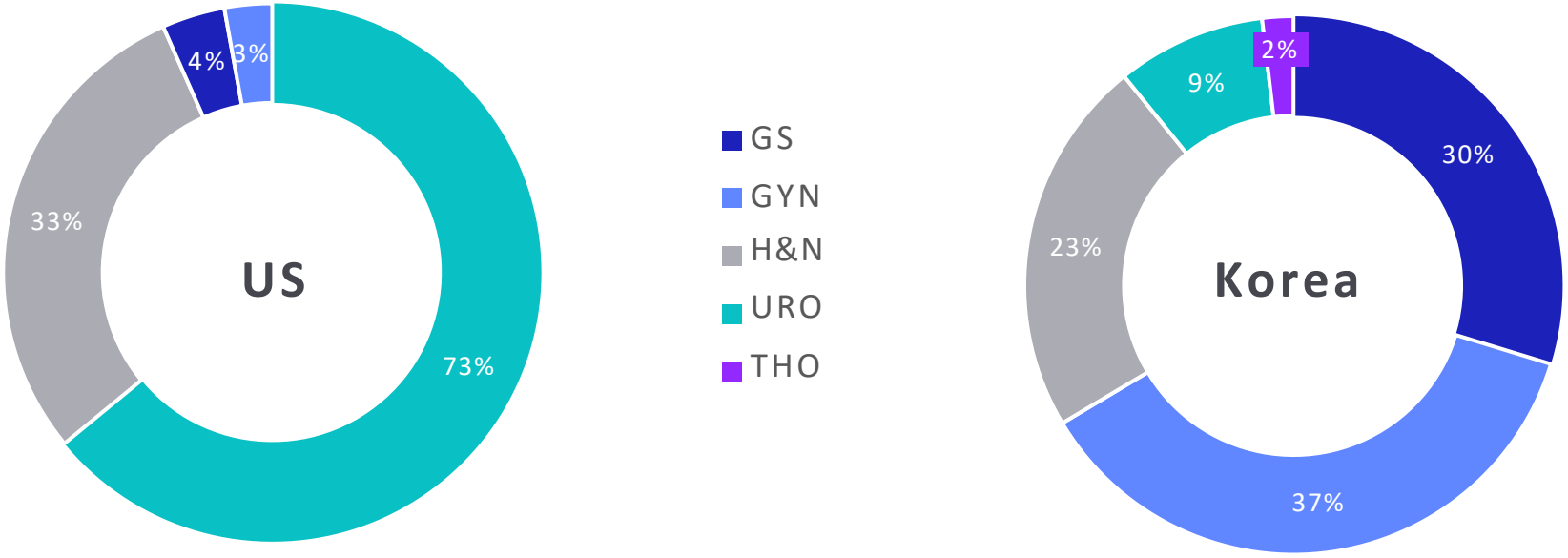
China: 1

Japan: 6

Intuitive data on file

SP procedure trend

US vs Korea



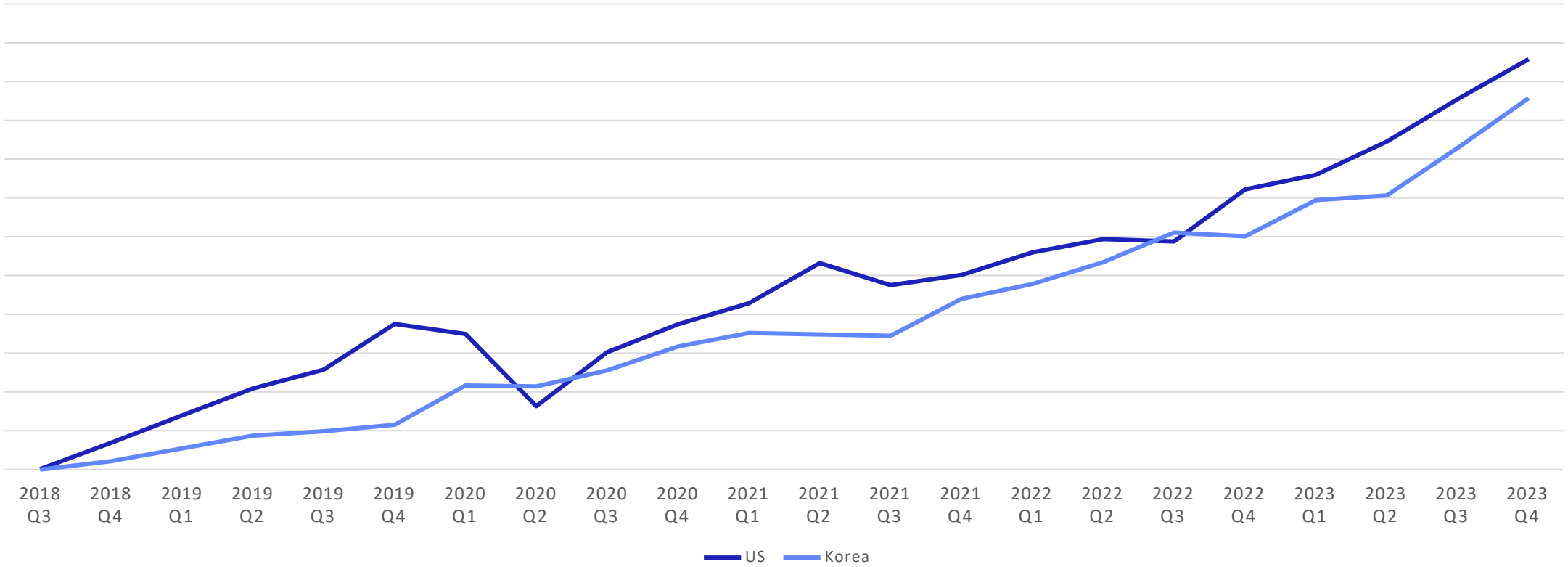
US SP cases
Around 9,000 cases in 2023

Korea SP cases
Around 7,900 cases in 2023

Intuitive data on file

SP procedure trend

US vs Korea



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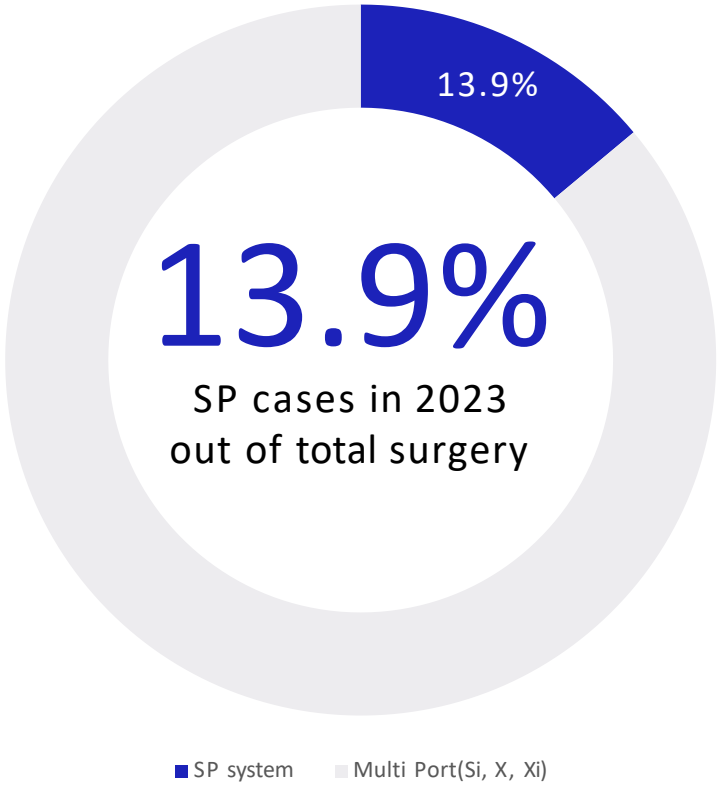
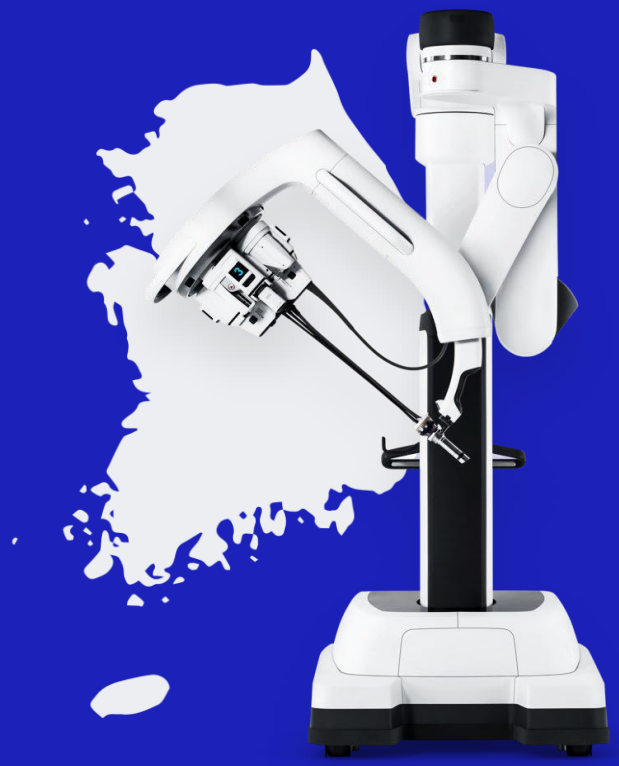
SP system in Korea

30 SP systems installed since 2018



Intuitive data on file



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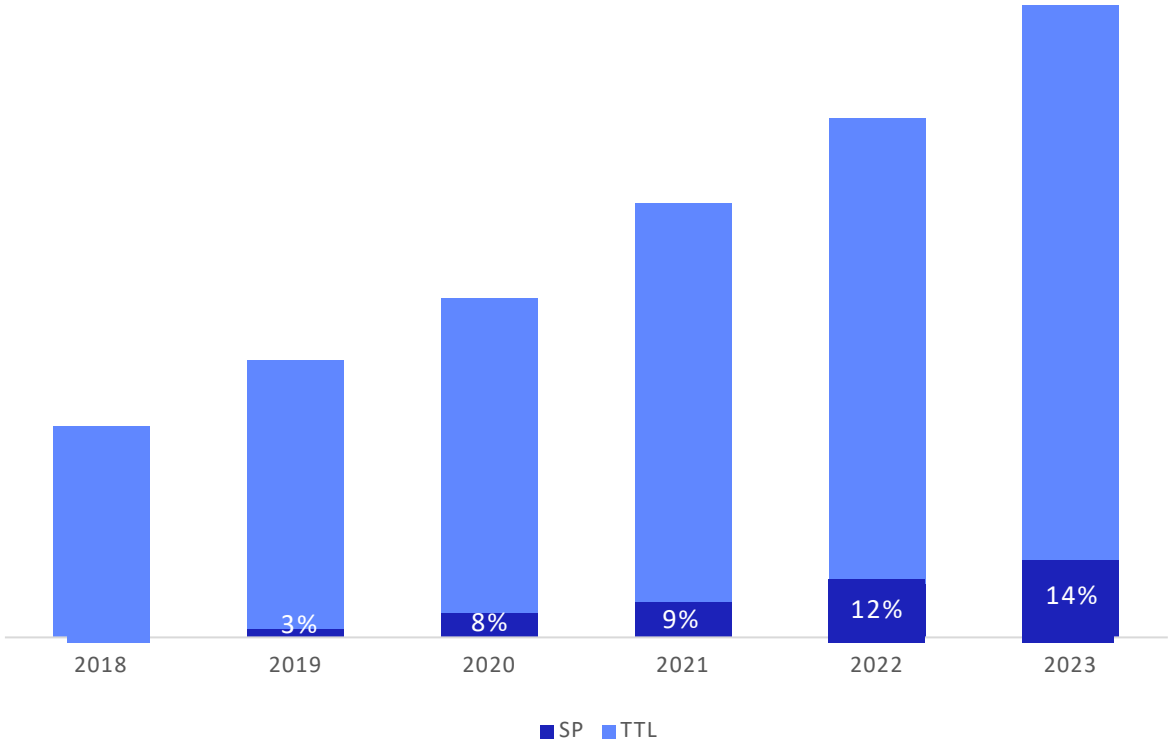
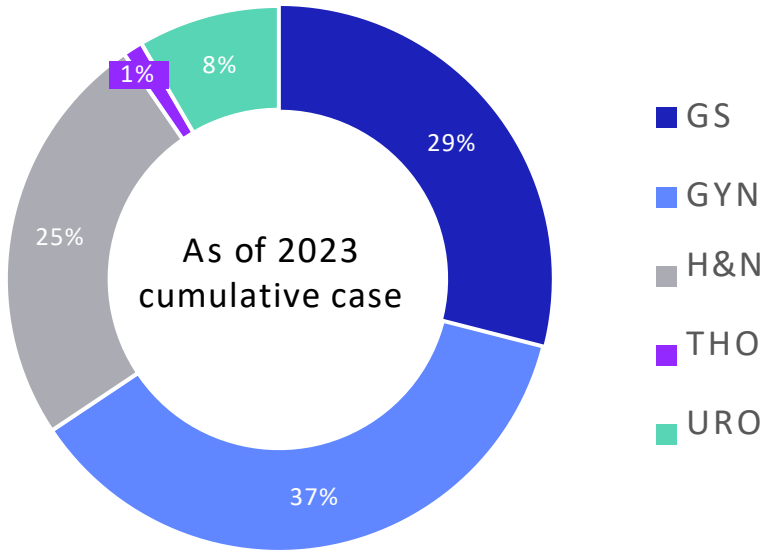
SP procedure trend in Korea

Year over Year

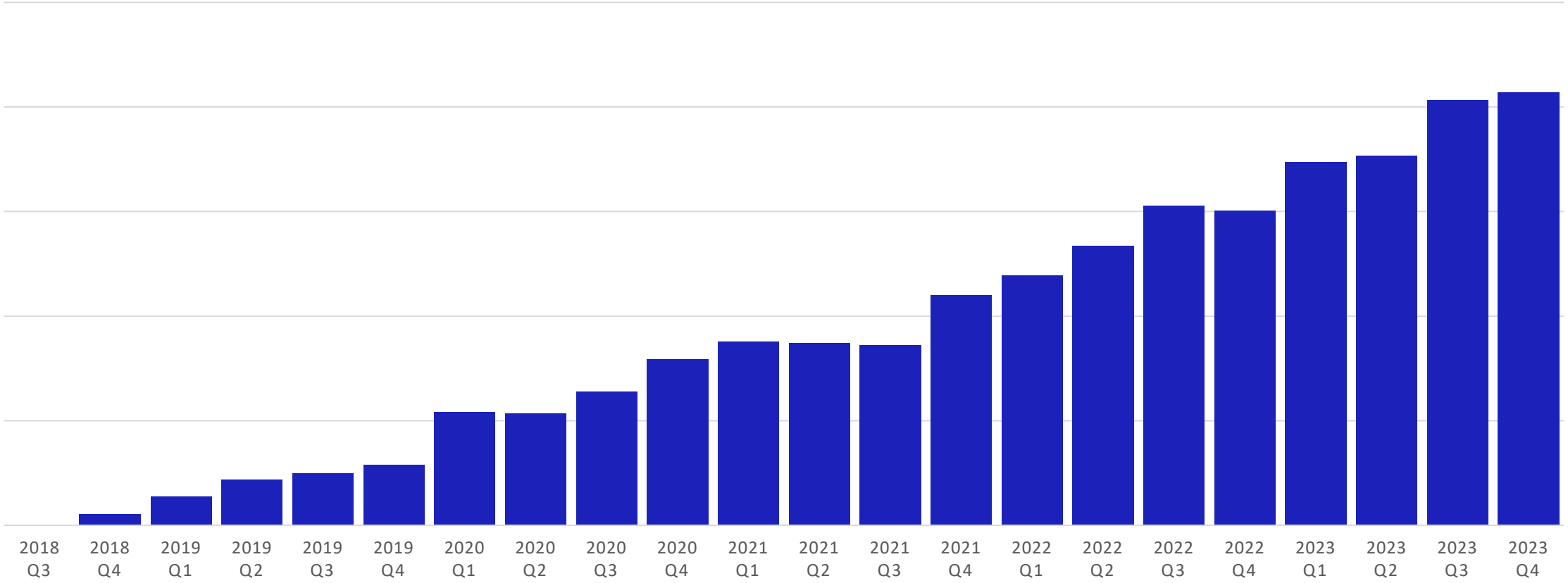




Intuitive data on file

SP procedure trend in Korea

Per quarter



Intuitive data on file

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Why Robotic Surgery??

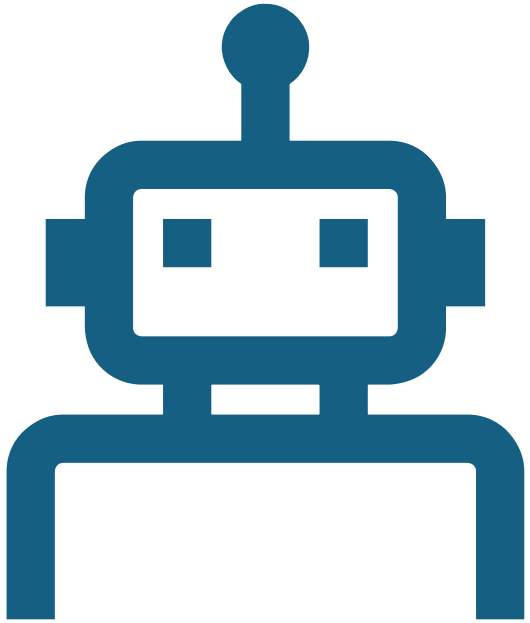
- **High-definition and Three-dimensional Vision**

Offer a stable camera platform, enhancing precise anatomical dissection.

Unlike VATS (Video-Assisted Thoracic Surgery), which requires constant eye adjustments due to screen and table distance, robotic platforms provide stereoscopic vision with optimal depth perception.

Surgeons can control the camera position for better eye-hand-target alignment, enabling operations in narrow spaces like the mediastinum.

Why Robotic Surgery??



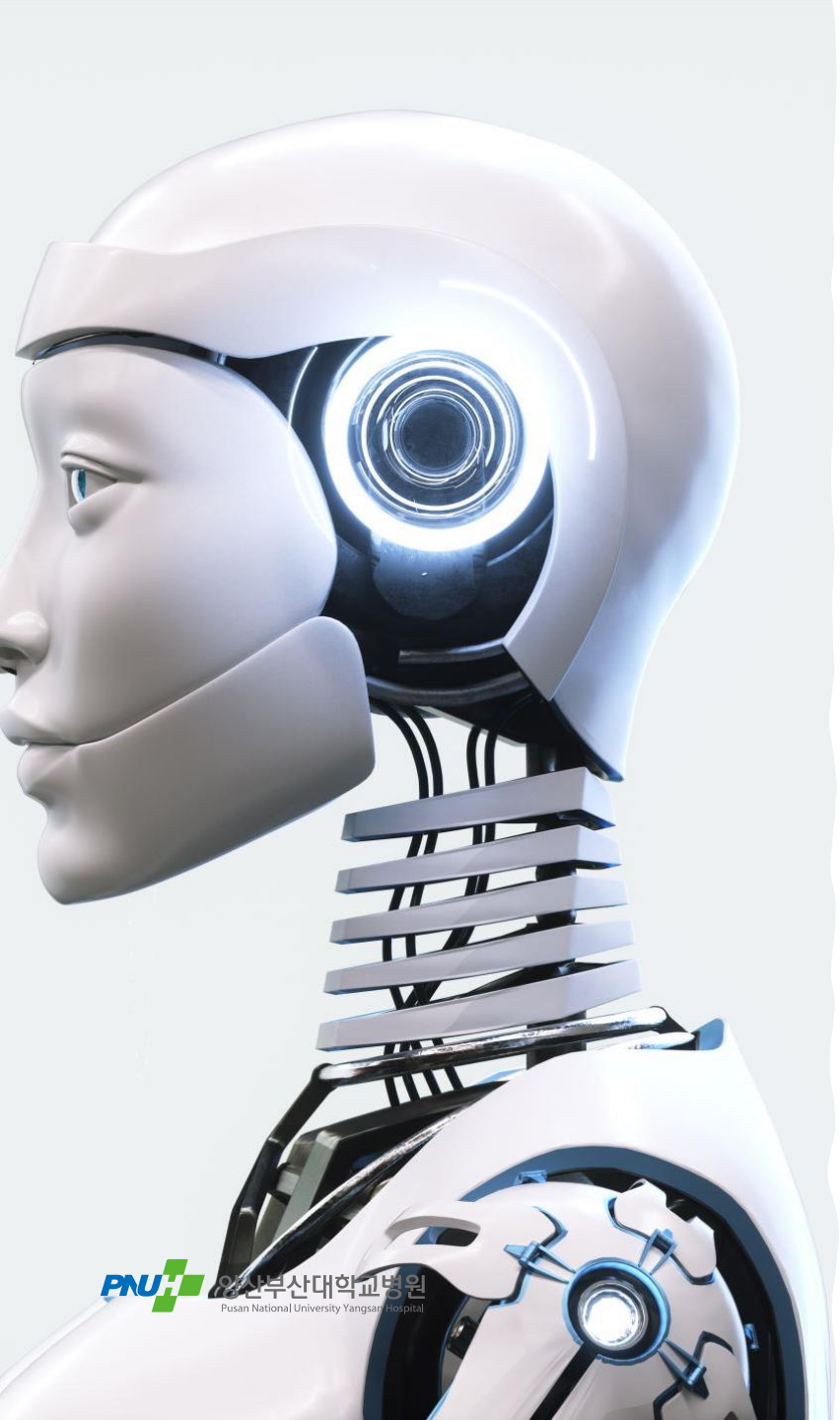
- **Ergonomics**

Robotic surgery reduces fatigue and musculoskeletal strain associated with prolonged standing. Surgeons can operate from a seated, relaxed position, conserving energy for complex operations. This is particularly beneficial for female surgeons, as the tools do not require significant muscular strength.

Why Robotic Surgery??

- **"EndoWrist" System**

Robotic instruments mimic human wrist movements with seven degrees of freedom and 360-degree rotation, allowing access to hidden chest spaces and enabling complex movements like suturing and precise dissections that preserve delicate anatomical structures.



Why Robotic Surgery??

- **"Fulcrum-effect"**

Robotic arms rotate around a fulcrum at the trocar level, reducing pressure on ribs and torque on the chest wall, thereby minimizing intercostal nerve and tissue damage, which results in less pain and reduced need for analgesics.

Why Robotic Surgery??

- **Motion Scaling and Tremor Filtering**

The robotic console translates large surgeon movements into smaller, precise ones while neutralizing physiological tremors. This is in contrast to VATS instruments, which tend to amplify small involuntary hand movements, making robotic tools more suitable for finer dissections with reduced blood loss.

Why Robotic Surgery??

- **Lymph-node Dissection and Upstaging**

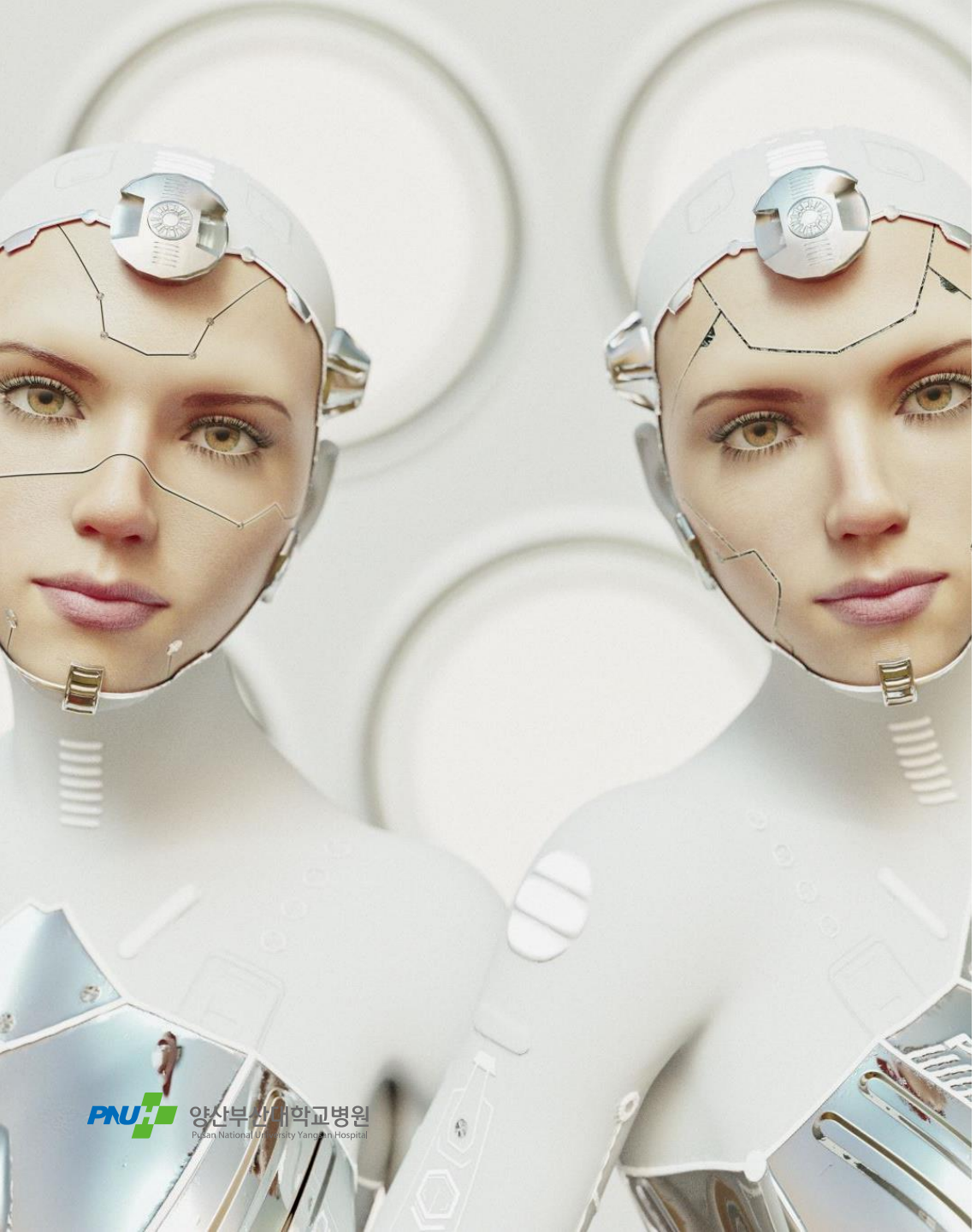
Robotic-assisted thoracic surgeries offer easier and more effective lymph node dissections compared to VATS or open surgery, even in cases with large lymph nodes and adhesions.

Studies indicate that robotic surgery results in a higher number of dissected lymph nodes, potentially leading to better staging and personalized oncologic treatments.

Why Robotic Surgery??

- **Learning Curve**

Robotic surgery appears to be easier to learn than conventional thoracoscopy, with approximately 20 robotic lobectomies needed to achieve competence, compared to 30–60 for VATS lobectomies.



Why Robotic Surgery??

- **Extended Indications**

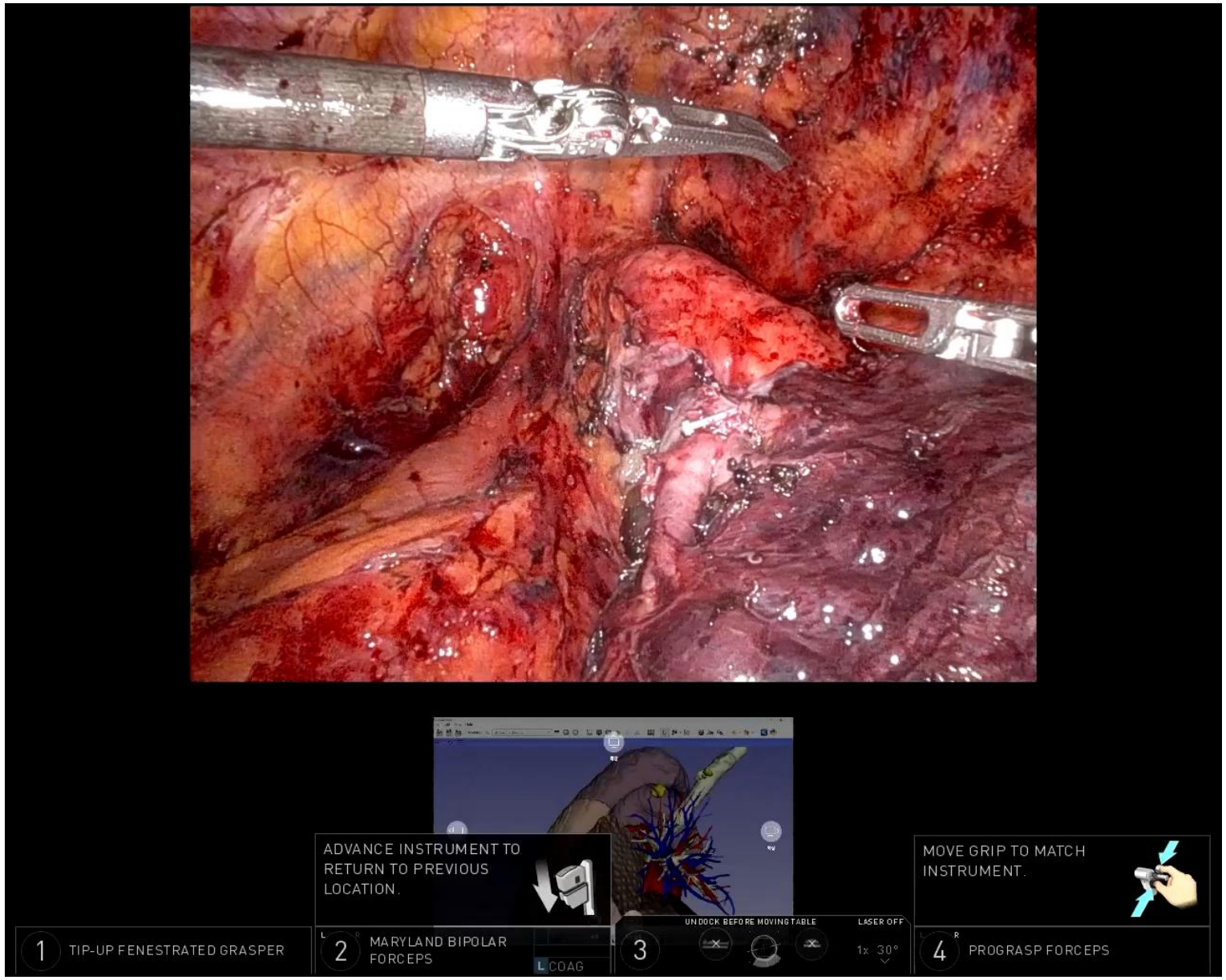
Robotic surgery can handle more complex operations than VATS, including sleeve resections and anatomical segmentectomies, expanding the indications for minimally invasive surgery.

- **Data Integration and Connectivity**

Modern robotic systems offer integrated digital platforms, allowing surgeons to access multiple imaging modes and patient data in real-time, enhancing decision-making and surgical independence.

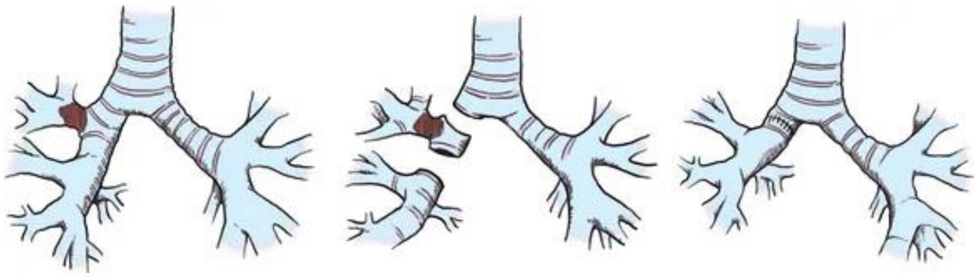
Case Presentation…….

Computer assisted Robotic Surgery (CAS)



Complicated Robotic Lung Resection

Sleeve Lobectomy for
Advanced Lung Cancer



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1st Report Single Port Robotic major Pulmonary Resection

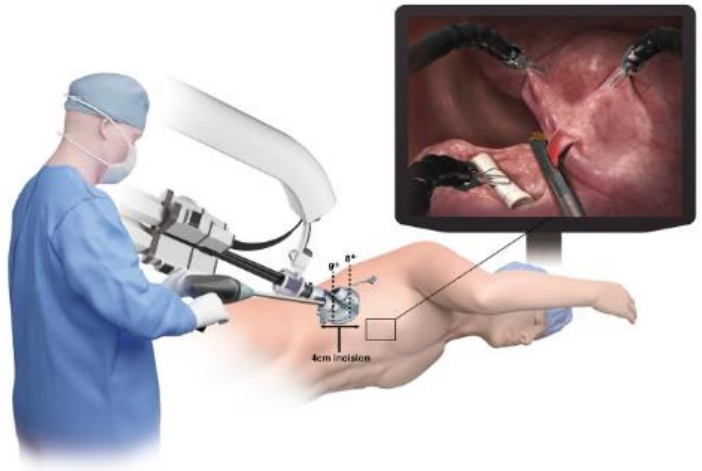


FIGURE 1 Port placement illustration. Illustration of a surgical assistant inserting an endostapler through the assistant port. [Colour figure can be viewed at wileyonlinelibrary.com]

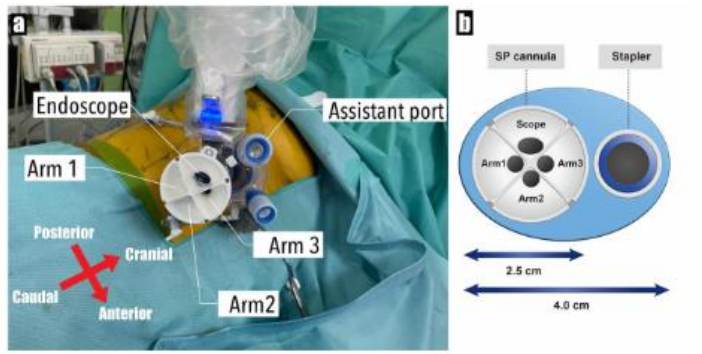


FIGURE 2 Port layout in single-port subcostal major pulmonary resection using the da Vinci single-port surgical system for right-sided procedures. (A) Layout of a multichannel port. (B) Illustration of a multichannel port. A 2.5-cm single port cannula is placed through the cannula port, and the assistant inserts the instrument through the assistant port. [Colour figure can be viewed at wileyonlinelibrary.com]

Received: 8 October 2023 | Accepted: 1 November 2023

DOI: 10.1002/wjs.12051

ORIGINAL SCIENTIFIC REPORT WITH VIDEO

World Journal of Surgery

Single-port robotic subcostal major pulmonary resection using the single-port robotic system

Jun Hee Lee | Jeong In Hong | Hyun Koo Kim

Department of Thoracic and Cardiovascular Surgery, Guro Hospital, Korea University College of Medicine, Seoul, Korea

Correspondence
Hyun Koo Kim, Department of Thoracic and Cardiovascular Surgery, Korea University Guro Hospital, Korea University College of Medicine, 148, Gurodong-ro, Guro-gu, Seoul 08308, Korea.
Email: kimhyunkoo@korea.ac.kr

Funding information
Korea Institute for Advanced Study, Grant/Award Numbers: 2021M3H4A4079630, KMDF_PR_20200901_0094_02; Ministry of Education, Science and Technology, Grant/Award Number: NRF-2018R1D1A1B07048721

Abstract

Background: The da Vinci single-port system (SPS) (Intuitive Surgical, Sunnyvale, CA, USA) was designed for single-port (SP) surgery. Although we have reported our clinical outcomes using the SPS for a simple procedure in general thoracic surgery, major pulmonary resection had been performed only in cadaveric experiments to date. This study evaluated the feasibility of SP subcostal robotic major pulmonary resection using the SPS. Here, we present our initial clinical experience of SP subcostal robotic major pulmonary resection at our institution.

Methods: Twenty-five patients with lung cancer underwent SP major subcostal pulmonary resection using the SPS between March and November 2022. Patient characteristics, intraoperative and perioperative outcomes were assessed. Questionnaires were used to evaluate patient satisfaction with the cosmetic results and quality of life through face-to-face or telephone interviews on postoperative day 30.

Results: All patients underwent major pulmonary resection with complete radical resection (R0). Nineteen patients underwent lobectomy, whereas six patients underwent segmentectomy. The mean docking time and total operative time were 4.16 ± 1.19 min (range, 2.3–7.8 min) and 197.6 ± 55.33 min (range, 130–313 min), respectively. No patients underwent conversion to open thoracotomy. One patient required an additional assistant port due to severe pleural adhesions.

Conclusions: SP subcostal robotic major pulmonary resection using the SPS is feasible and safe. With the continuous development of robotic technology and surgical techniques, we believe that more complex general thoracic surgeries will be performed in the future using SPS.

KEYWORDS
major pulmonary resection, non-small cell lung cancer, robotic-assisted surgery, single-port

Pioneer VS. Guarantee of safety

- Innovation often requires balancing **challenge and safety**.

- My RATS cases…..
- Total over 293 cases….
- Sp system 8 cases….
- Started from August. 2024.

INTUITIVE

Certificate of da Vinci Technology Training as a
Console Surgeon

BongSoo Son
has completed Intuitive's technology training program covering the components and use of the da Vinci® system, instruments, and accessories.

Date:
21-March-2024

Training Center:
Asia Direct: Korea: Intuitive Surgical (Seoul, Korea)

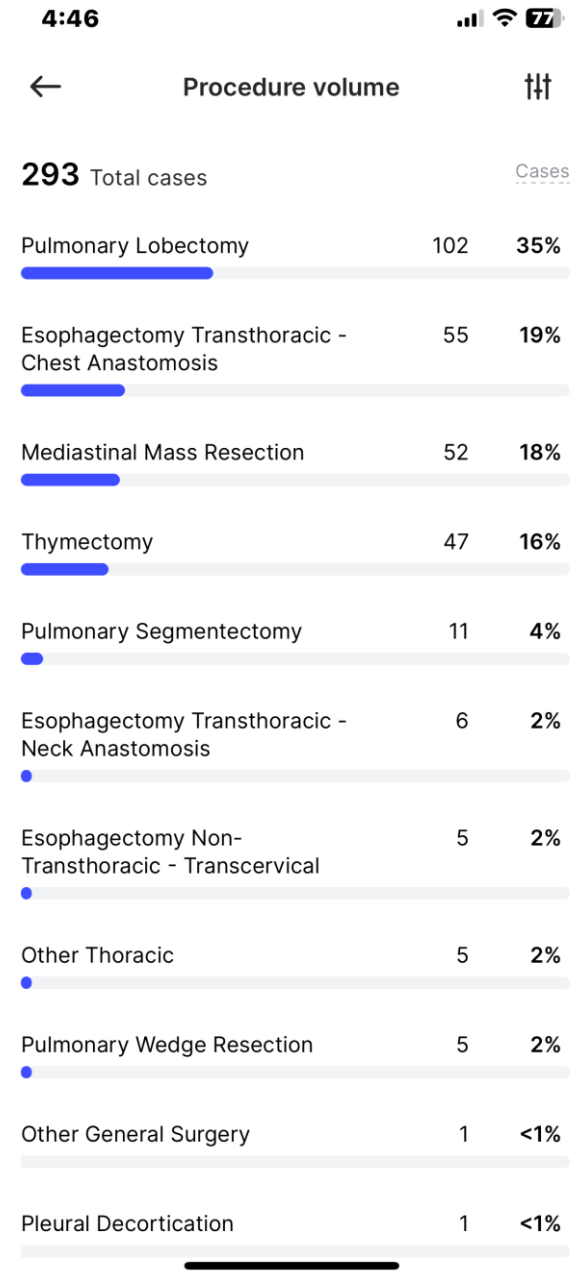
Platform:
Da Vinci SP surgical system

Training conducted by:
Ye Chan Park

Limitations of Intuitive-Provided Instruction:
Training provided by Intuitive is limited to the use of its products and does not replace the necessary medical training and experience required to perform medical interventions. Intuitive's role is to facilitate peer-to-peer clinical teaching. Intuitive does not teach medical intervention, nor does it provide or evaluate medical credentialing. Intuitive's Technology Training Program is solely for the purpose of training on Intuitive products.

PN 1064959 Rev D 04/2021

Myriam J. Curet, M.D.
Executive Vice President
Chief Medical Officer



Monopolar cautery instruments

Product description

Monopolar curved scissors
25 uses

Shown with monopolar curved scissors tip (Sold Separately – Single Use)[1]

Bipolar cautery instruments

Product description

Maryland bipolar forceps
25 uses

Fenestrated bipolar forceps
25 uses

Round tooth retractor
25 uses

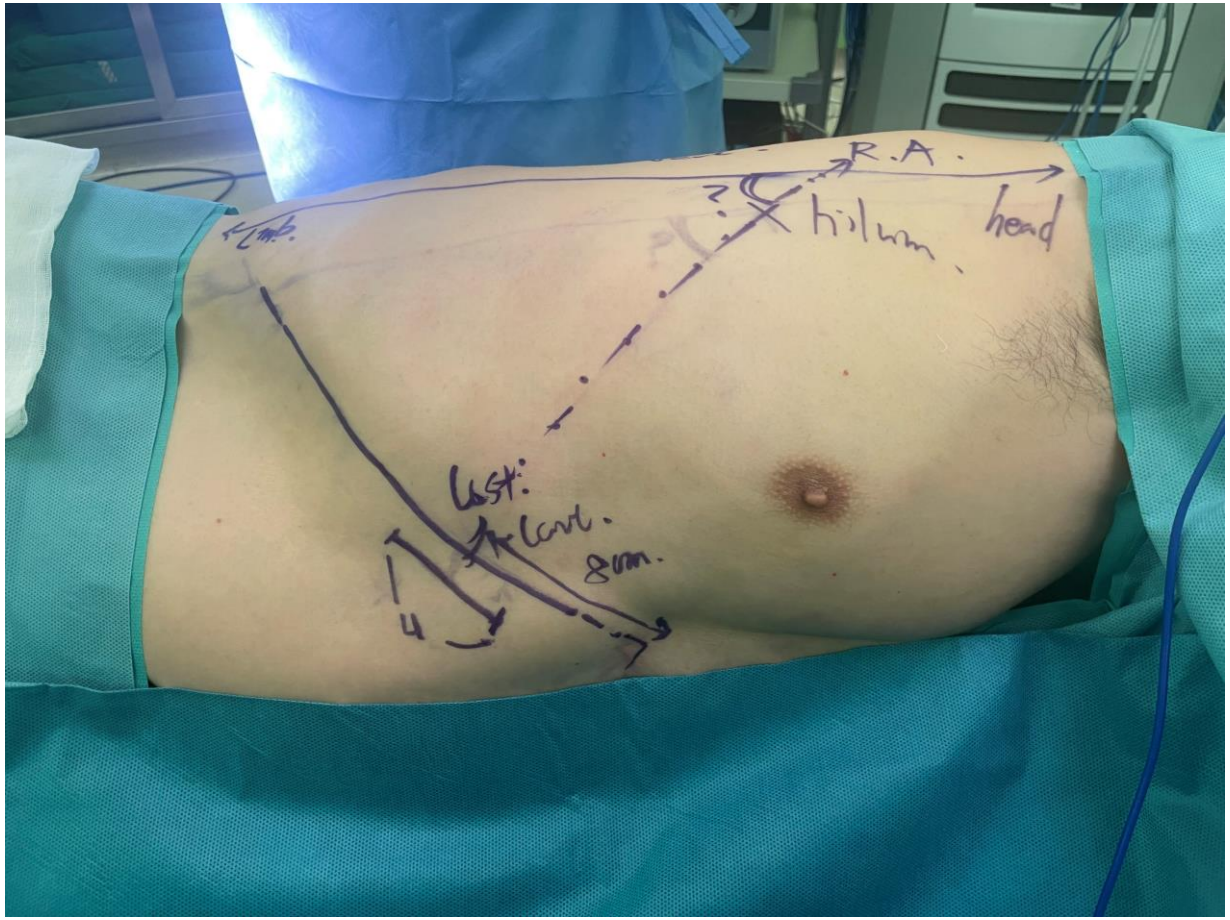
Medium-large clip applier[2]
150 uses

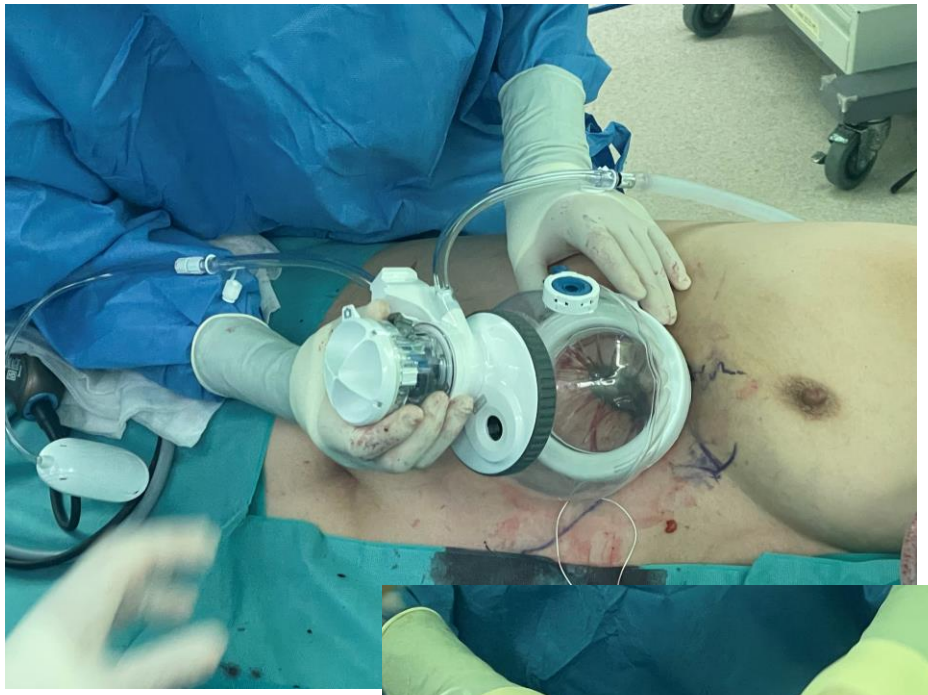
Validated for use only with Weck Hem-o-lok medium-large polymer clip.

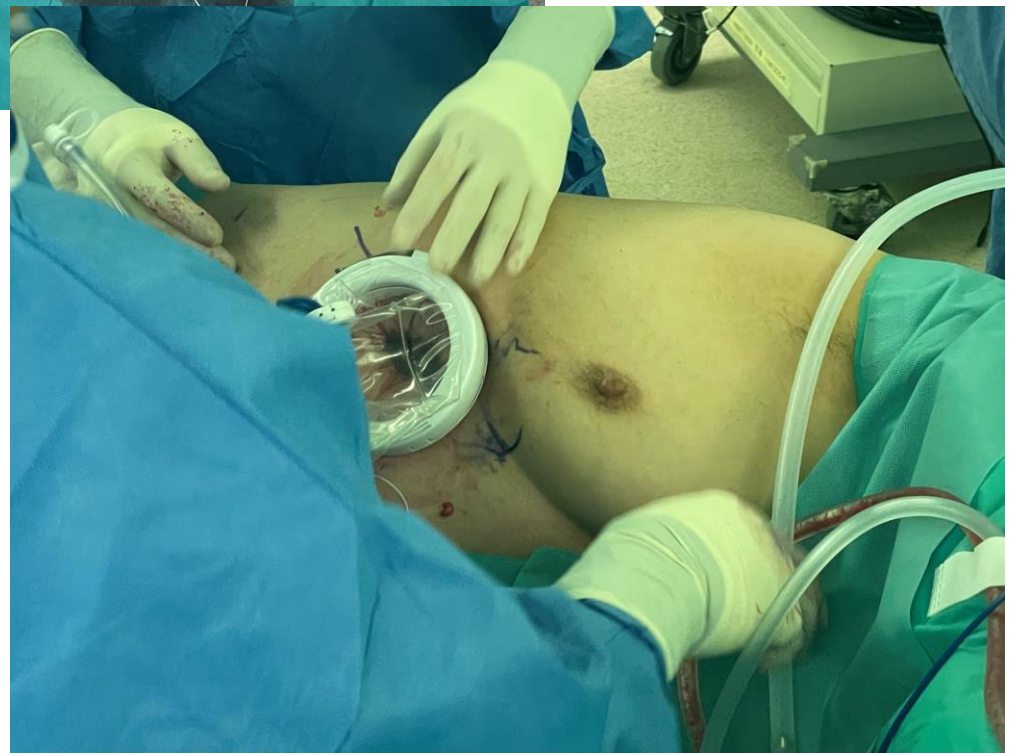
Weck product code #544230[2]

Shown with Weck Hem-o-lok medium-large polymer clip

Patient's Position







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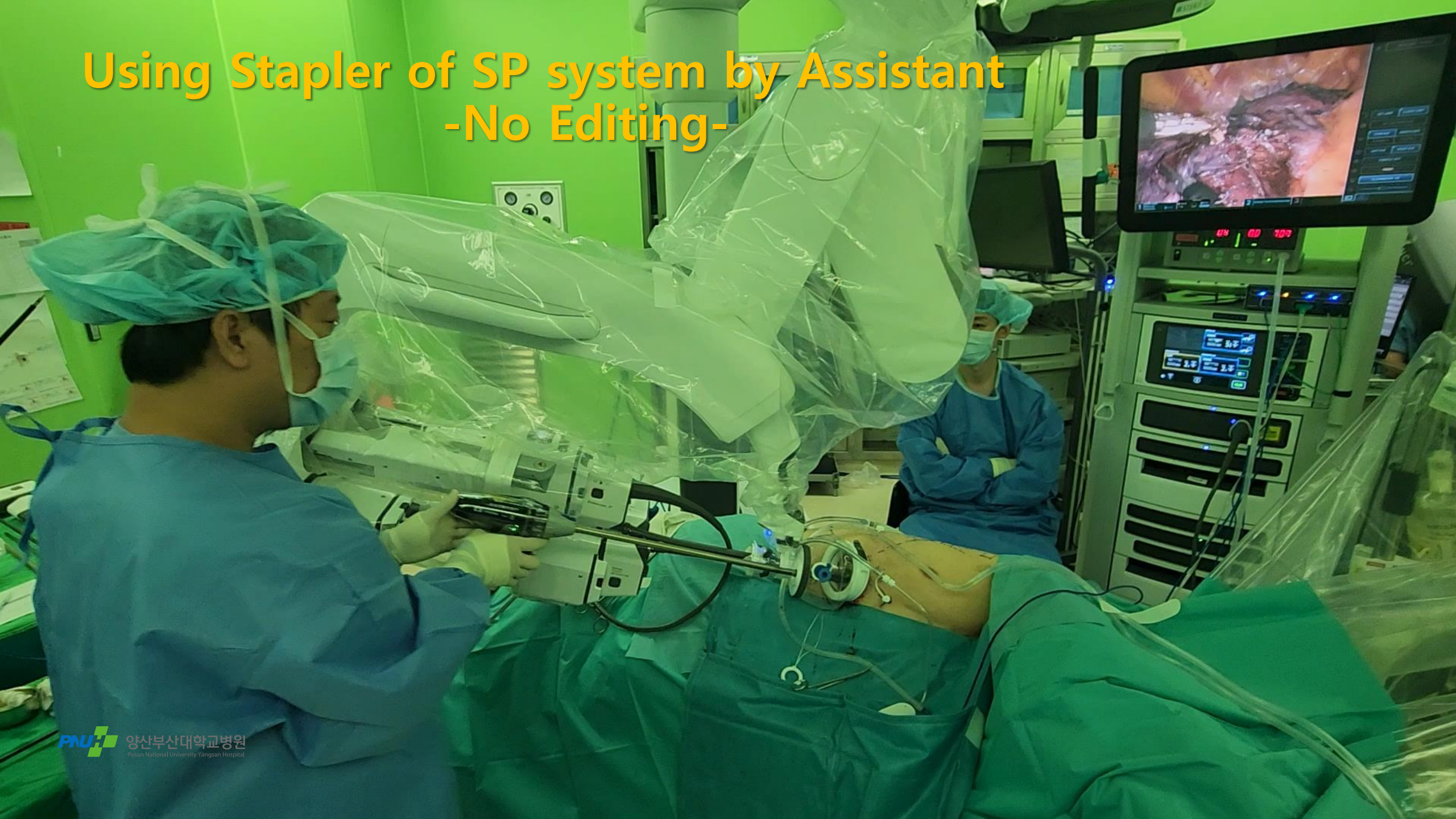
Docking of SP system….

Subcostal incision (Single Port Making)


View Video

Using Stapler of SP system by Assistant
-No Editing-



양산부산대학교병원
Pusan National University Yangsan Hospital

Telehealth or Telemedicine?
And….. TeleSurgery !

Innovations

Collapse of Local Health Care System?

2000명의 증원이 과연 필요한가?

Future of Robotic Surgery

1. Integration of AI and Machine Learning
2. Miniaturization and Micro Robots
3. Integration of Virtual Reality (VR) and Augmented Reality (AR)
4. Telesurgery
5. Cost Reduction and Improved Accessibility
6. Soft Robotics and New Materials

경청해 주셔서 감사합니다.

Thank you for your attention

Pusan National University
Yangsan Hospital

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Pusan National University Yangsan Hospital